

COMMENTS ON THE SKATES OF THE TROPICAL
EASTERN PACIFIC: ONE NEW SPECIES
AND THREE NEW RECORDS
(ELASMOBRANCHII: RAJIFORMES)

John D. McEachran and Tsutomu Miyake

Abstract.—Recent collections of benthic fishes off the coasts of Ecuador, Peru, and the Galapagos Islands yielded a new species and three new records of skates from the eastern central Pacific. *Bathyraja peruana*, n. sp. is described from eight specimens, including the paratype of *B. aguja* Kendall and Radcliffe. This species is distinguished from other *Bathyraja* species of the eastern Pacific in morphometrics, meristics, spination, and pigmentation. A specimen resembling *B. richardsoni* but differing from it in a number of proportional measurements is discussed. *Bathyraja longicauda* and *Breviraja nigerrima* (= *Malacoraja nigerrima*) are recorded from Peru for the first time. A neotype for *M. nigerrima* is designated and described.

As presently known, the skate fauna of the eastern central Pacific, southern Baja California to northern Peru, is species poor, consisting of *Psammobatis aguja*, (Kendall and Radcliffe), (= *Bathyraja aguja*), *B. spinosissima* (Beebe and Tee-Van), *Raja badia* Garman, *R. ecuadoriensis* Beebe and Tee-Van, *R. equatorialis* Jordan and Bollman, *R. velezi* Chirichigno, and *Sympterygia brevicaudata* (Cope). In the eastern central Atlantic, zoogeographically similar to the eastern central Pacific (Briggs 1974), there are 32 species of skates (Stehmann 1981).

Beebe and Tee-Van (1941) and Hildebrand (1946) suggested that the paratype of *B. aguja* represents an undescribed species of skate and recent collections mainly by the R/V *Anton Bruun* (cruises 16, 18A, and 18B) support their suggestion and indicate that the paucity of skates in the eastern central Pacific may, in part, be due to sampling error. Herein we describe the eight species of skate from this area and discuss three other species which are either new records for the area or new species.

Materials and Methods

Specimens examined were obtained from the Museum of Comparative Zoology, Harvard University (MCZ), the Smithsonian Oceanographic Sorting Center (SOSC), and the National Museum of Natural History, Smithsonian Institution (USNM). The SOSC specimens were deposited at the Museum of Comparative Zoology (MCZ), the Texas Cooperative Wildlife Collection (TCWC) and the USNM. One specimen of the new species was dissected to reveal the structure of the neurocranium, scapulocoracoids and claspers. Most specimens, including the holotype and paratype of *B. aguja*, were radiographed to verify anatomical observations based on dissections and to count vertebrae and pectoral radials. Methods for making measurements and counts follow McEachran and Compagno (1979, 1982).

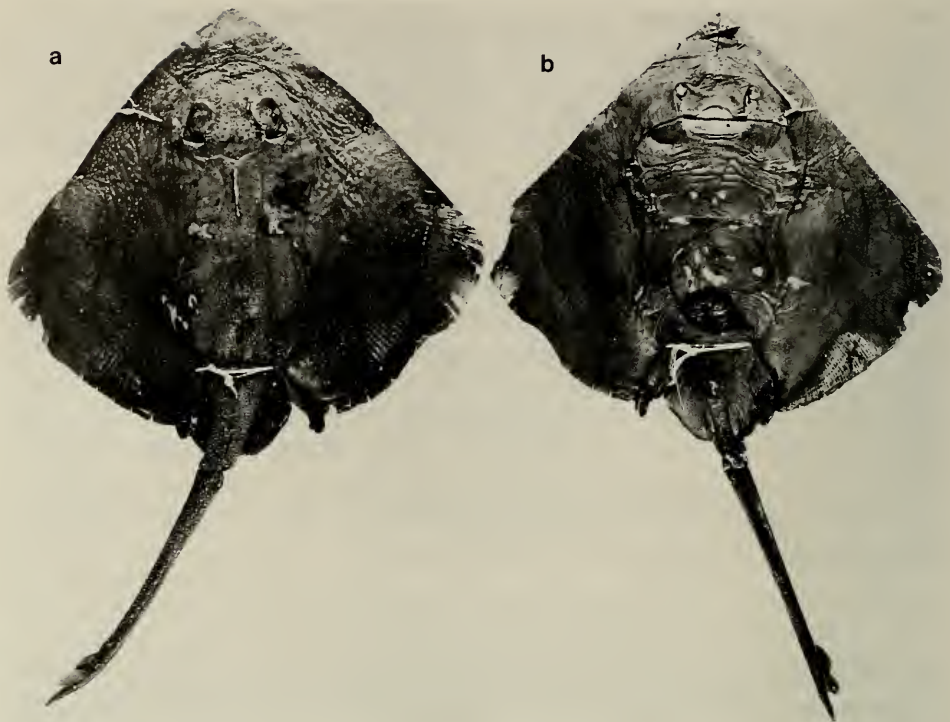


Fig. 1. *Bathyraja peruana* MCZ 1364 (Holotype, 283 mm TL, immature male), a, Dorsal view; b, Ventral view.

Bathyraja peruana, new species

Figs. 1–4; Tables 1, 2

Raja aguja Kendall and Radcliffe, 1912:78–79 (in part), Fig. 2.

Holotype.—MCZ 1364, 283 mm TL, juvenile male (paratype of *Raja aguja*, collected off Point Aguja, Peru, 5°47'S, 81°24'W, 980 m, 12 Nov 1904, R/V *Albatross*, Station 4653.

Paratypes.—MCZ 61113, 173 mm TL, juvenile male, 70°49'S, 80°38'W, 605–735 m, 5 Jan 1966, R/V *Anton Bruun*, Cruise 18B, Station 754.—TCWC 3515.1, 970 mm TL, 980 mm TL, mature females, 15°11.5'S, 75°43'W, 1010 m, 25–26 Aug 1966, R/V *Anton Bruun*, Cruise 18A, Station 739A.—TCWC 3516.1, 1053 mm TL, mature female, 15°11'S, 75°44'W, 1060 m, 25–26 Aug 1966, R/V *Anton Bruun*, Cruise 18A, Station 739.—USNM 267045, 203 mm TL, 469 mm TL, juvenile males, 610 mm TL, juvenile female, 3°15'S, 80°55'W, 945–960 m, 10 Sep 1966, R/V *Anton Bruun*, Cruise 18B, Station 770.

Diagnosis.—Disc lozenge-shaped, anterior margin more or less straight; preorbital length 2.41 to 3.40 times orbital length and 0.10 to 0.14 times total length; disc lacking thorns; tail with 18 to 26 midrow thorns, lacking thorns between dorsal fins; ventral surface of disc without dermal denticles.

Description.—Disc 1.15 times as broad as long (1.22 to 1.36 in paratypes);

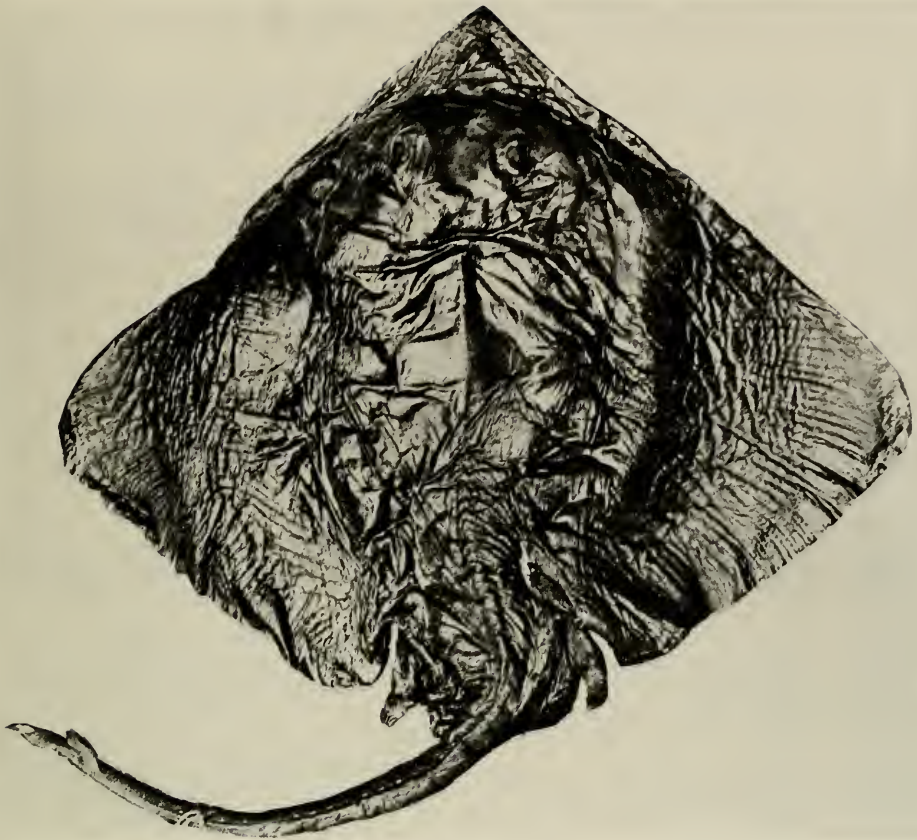


Fig. 2. *Bathyraja peruana* TCWC 3516.1 (Paratype, 1053 mm TL, mature female).

maximum angle in front of spiracles 105° (100° to 125°); margin of disc nearly straight from tip of snout to level of nares, slightly convex to level of first gill slits, nearly straight to outer corners which are abruptly rounded, posterior margin slightly convex. Axis of greatest width 0.80 (0.70 to 0.82) times distance from tip of snout to axil of pectoral fins. Pelvic fins deeply incised; anterior lobe narrow, tapering distally, length 0.88 times posterior lobe (0.64 to 0.95, with ratio greater in larger specimens). Tail slender, little depressed, with narrow lateral fold along ventrolateral surface originating at axil of pelvic fins, widening distally and extending to near tip. Length of tail from center of cloaca to tip 1.07 times distance from tip of snout to center of cloaca (0.88 to 1.40, with ratio smaller in larger specimens). Post dorsal fin tail length less than one-half length of base of second dorsal fin.

Preorbital length 3.13 (2.41 to 3.40) times orbit length; preoral length 1.69 times internarial distance (1.23 to 1.72, with ratio smaller in larger specimens). Interorbital distance 1.04 times orbit length (1.02 to 1.17); orbit length 1.62 times spiracle length (1.16 to 1.78, with ratio smaller in larger specimens). Anterior nasal flap (nasal curtain) coarsely fringed along distal margin; posterior nasal flap

Table 1.—Proportional measurements and meristic values of *Bathyraja peruana*. Proportions are expressed in percent total length.

| Sex | MCZ | MCZ | USNM | USNM | TCWC | TCWC | TCWC | ♂ |
|--------------------------------------|-------------------|--------------------|---------------------|---------------------|---------------------|---------------------|---------------------|------|
| | 1364 ¹ | 61113 ² | 267045 ² | 267045 ² | 3515.1 ² | 3515.1 ² | 3515.1 ² | |
| Total length (mm) | 283 | 173 | 203 | 469 | 970 | 980 | 1053 | |
| Disc width | 64 | 63 | 63 | 70 | 71 | 70 | 70 | 69 |
| Disc length | 55 | 49 | 51 | 53 | 59 | 51 | 54 | 54 |
| Snout length (preorbital) | 13.3 | 9.8 | 12.5 | 13.3 | 10.9 | 10.9 | 10.5 | 11.4 |
| Snout length (preoral) | 14.1 | 10.8 | 13.2 | 14.5 | 11.1 | 10.9 | 10.1 | 11.6 |
| Snout to maximum width | 36 | 32 | 32 | 36 | 30 | 33 | 32 | 32 |
| Prenasal length | 11.0 | 8.9 | 10.8 | 11.2 | 8.7 | 9.3 | 8.9 | 9.5 |
| Orbit diameter | 4.2 | 3.8 | 4.3 | 3.9 | 4.3 | 4.0 | 4.3 | 4.1 |
| Distance between orbits | 4.4 | 4.3 | 4.4 | 4.1 | 4.8 | 4.4 | 5.1 | 4.7 |
| Orbit and spiracle length | 5.3 | 5.0 | 4.8 | 5.1 | 5.2 | 4.9 | 6.0 | 5.2 |
| Spiracle length | 2.6 | 2.3 | 2.4 | 2.2 | 3.7 | 3.3 | 3.5 | 3.1 |
| Distance between spiracles | 7.1 | 6.5 | 6.8 | 6.1 | 7.6 | 7.1 | 7.7 | 7.1 |
| Mouth width | 8.2 | 6.6 | 8.1 | 8.1 | 9.4 | 9.0 | 9.2 | 8.7 |
| Nare to mouth | 3.7 | 2.6 | 3.3 | 4.1 | 3.3 | 2.8 | 2.4 | 3.1 |
| Distance between nostrils | 8.3 | 6.9 | 7.9 | 8.4 | 8.3 | 8.8 | 8.0 | 8.2 |
| Width of first gill openings | 1.7 | 1.1 | 1.5 | 1.9 | 2.0 | 2.1 | 2.7 | 2.1 |
| Width of third gill openings | 2.0 | 1.1 | 1.7 | 1.9 | 2.6 | 2.4 | 3.1 | 2.5 |
| Width of fifth gill openings | 1.2 | 0.9 | 1.1 | 1.4 | 1.9 | 1.8 | 2.4 | 1.8 |
| Distance between first gill openings | 19.3 | 16.1 | 19.1 | 17.4 | 20.9 | 20.0 | 21.2 | 19.5 |
| Distance between fifth gill openings | 11.7 | 11.3 | 12.4 | 10.5 | 14.9 | 13.4 | 15.1 | 13.3 |
| Length of anterior pelvic lobe | 11.1 | 11.9 | 11.3 | 11.7 | 10.9 | 10.0 | 12.8 | 11.4 |
| Length of posterior pelvic lobe | 12.6 | 12.8 | 12.0 | 14.8 | 15.2 | 15.8 | 16.4 | 15.5 |
| Distance—snout to cloaca | 48 | 42 | 46 | 49 | 51 | 53 | 50 | 50 |
| Distance—cloaca to 1st dorsal fin | 40 | 40 | 43 | 42 | 40 | 37 | 44 | 40 |
| Distance—cloaca to caudal origin | 46 | 47 | 48 | 50 | 46 | 43 | 49 | 47 |
| Distance—cloaca to caudal tip | 52 | 58 | 53 | 51 | 47 | 47 | 50 | 50 |
| Number of tooth rows (upper jaw) | 33 | 35 | 34 | 35 | 34 | 36 | 35 | 34.8 |
| Number of trunk vertebrae | 34 | 33 | 35 | 32 | 34 | 35 | 34 | 33.8 |
| Number of predorsal caudal vertebrae | 69 | 69 | 69 | 64 | 69 | 68 | 71 | 68.0 |
| Number of pectoral radials | 77 | | 72 | 72 | 70 | | | 73.0 |

¹ Holotype.² Paratype.

Table 2.—Neurocranial and scapulocoracoid measurements of *Bathyraja peruana* USNM 267045, 469 mm TL juvenile male. Measurements are expressed as percentage of nasobasal length or scapulocoracoid length.

| | |
|--------------------------------------|------|
| Nasobasal length (mm) | 51.7 |
| Cranial length | 187 |
| Rostral cartilage length | 87 |
| Prefontanelle length | 77 |
| Cranial width | 115 |
| Interorbital width | 34 |
| Rostral base | 30 |
| Anterior fontanelle length | 36 |
| Anterior fontanelle width | 19 |
| Posterior fontanelle length | 42 |
| Posterior fontanelle width | 4 |
| Rostral appendix length | 31 |
| Rostral appendix width | 16 |
| Rostral cleft length | 19 |
| Cranial height | 23 |
| Width across otic capsules | 49 |
| Least width of basal plate | 27 |
| Greatest width of nasal capsule | 42 |
| Internasal width | 21 |
| Scapulocoracoid length (mm) | 33.2 |
| Scapulocoracoid height | 69 |
| Premesocondyle | 29 |
| Postmesocondyle | 71 |
| Postdorsal fenestra (largest) length | 15 |
| Postdorsal fenestra (largest) height | 10 |
| Predorsal fenestra length | 10 |
| Predorsal fenestra height | 10 |
| Rear corner | 49 |

poorly developed and weakly fringed (smooth to weakly fringed). Upper and lower jaws slightly arched (moderately arched in larger specimens). Teeth with short pointed cusps (larger specimens with longer cusps) and quincunx arrangement.

Distance between first gill slits 2.32 (2.08 to 2.64) times internarial distance; distance between fifth gill slits 1.41 (1.25 to 1.89) times internarial distance; length of first gill slits 1.48 times length of fifth gill slits (1.05 to 1.32 with ratio smaller in larger specimens). First dorsal fin about equal in size and shape to second; distance between dorsal fins equal to about one-half of base of first; second dorsal fin separated by short distance from poorly developed epichordal caudal fin lobe.

Upper surface of disc and tail covered with dermal denticles, dense along anterolateral margin, over cranium and along midline to tip of tail but sparse over branchial region and on base of pectoral fins; denticles with four-pointed, star-shaped bases and posteriorly directed spine. Disc devoid of thorns (some specimens with several midrow thorns just anterior to axil of pectoral fins). Tail with 25 small midrow thorns (18 to 26) with oval bases.

Color.—After storage in alcohol, holotype is uniform brownish gray; paratypes are similarly colored, except areas around nares, mouth, base of pelvic fins and base of tail are lighter, ranging from brown to yellow.

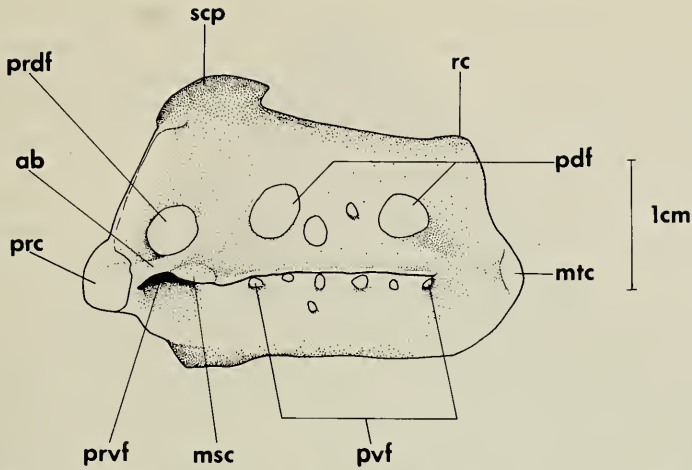


Fig. 4. Lateral view of left scapulocoracoid of *Bathyraja peruana* USNM 267045 (Paratype, 469 mm TL, juvenile male). ab—anterior bridge, msc—mesocondyle, mtc—metacondyle, pdf—postdorsal foramina, prc—procondyle, prdf—predorsal fenestra, prvf—preventral fenestra, pvf—postventral foramina, rc—rear corner, scp—scapular process.

Neurocranium.—Rostral shaft relatively long, slender and unsegmented (Fig. 3a, Table 2); rostral appendices relatively long, about one-third of rostral shaft, broadly joining rostral node posterior to rostral foramen, plate-like anteriorly but conical in cross-section posteriorly; rostral base moderately narrow; propterygia of pectoral girdle extending to lateral extreme of rostral appendices; nasal capsules rather small, rhomboid-shaped, with straight anterior margins, set at about 16° angle to transverse axis of neurocranium; foramen for profundus nerve on leading edge of nasal capsule; preorbital processes only moderately developed, continuous with incised supraorbital crests; anterior fontanelle teardrop-shaped, moderately broad, extending slightly anterior to leading edge of nasal capsules; posterior fontanelle narrow, with irregular lateral margins; foramen for anterior cerebral vein on a vertical with dorsal rim of optic nerve foramen, just posterior to line connecting foramina of preorbital and orbitonasal canals (Fig. 3b); foramen for trochlear nerve double, dorsal to optic nerve foramen, foramen for oculomotor nerve dorsal to optic stalk; foramen for intercerebral vein anterior to orbital fissure and posterior to efferent spiracular artery foramen; jugal arches moderately slender (Fig. 3c); basal and internasal plates relatively narrow (Fig. 3d).

Scapulocoracoids.—Lateral aspect low and greatly expanded between mesocondyle and metacondyle (Fig. 4, Table 2); four postdorsal foramina, first and fourth largest, third minute; seven postventral foramina; anterior corner slightly elevated.

Etymology.—Named after Peru, the type-locality. The name was proposed by Carl L. Hubbs and R. Ishiyama.

Comments.—*Bathyraja peruana* and *B. aguja* are transferred from *Psammobatis* to *Bathyraja* because they share the following synapomorphies with the latter genus: 1) scapulocoracoid greatly expanded between meso- and metacondyle and 2) scapulocoracoid with multiple postdorsal foramina (McEachran, unpublished

data). Also they lack the following synapomorphies possessed by *Psammobatis* (McEachran 1983): 1) tip of snout with small, slender, conical integumental process; 2) nasal flaps forming tube-like structures around nares; 3) rostral shaft of neurocranium very slender and separated from remainder of neurocranium; 4) rostral base lacking; 5) nasal capsules with basal fenestra; and 6) interorbital region moderately narrow to narrow (McEachran 1983).

Bathyraja peruana is distinguished from *B. aguja* by its nearly straight anterior disc margin (in *B. aguja* it is distinctly undulated) (Kendall and Radcliffe 1912); preorbital length 2.41 to 3.40 times orbital length (3.70 times); preoral snout length 1.23 to 1.72 times internarial distance (2.12); dorsal surface of disc covered with dermal denticles (dorsal surface sparsely covered with denticles); disc without thorns (several midrow thorns anterior to axil of pectoral fins); tail with 18 to 26 midrow thorns (33 midrow thorns); no thorns between dorsal fins (one thorn); nasal capsules set at about 16° angle to transverse axis of neurocranium (33° angle); pelvic girdle with rather short prepelvic processes (extremely long and slender prepelvic processes); dorsal surface of disc uniformly colored (with two large, light colored spots on base of pectoral fins and small, light colored spots along margin of disc and pelvic fins) (Kendall and Radcliffe 1912).

Bathyraja peruana is distinguished from the other eastern Pacific *Bathyraja* species as follows: *B. abyssicola* (Gilbert), *B. cf. richardsoni* (Garrick) and *B. spinosissima* (Beebe and Tee-Van) possess denticles on the ventral aspect of the disc (Miller and Lea 1972); *B. abyssicola*, *B. aleutica* (Gilbert), *B. kincaidi* (Garman), *B. interrupta* (Gill and Townsend), *B. parmifera* (Bean) and *B. rosispinis* (Gill and Townsend) possess thorns on the dorsal surface of the disc (Eschmeyer and Herald 1983); *B. abyssicola* and *B. aleutica* have preorbital snout lengths exceeding 15% of total length (McEachran, unpublished data); in *B. cf. richardsoni* the anterior pelvic lobe is only one-half the length of the posterior lobe, and the upper jaw possesses 44 tooth rows; *B. spinosissima* has a short preorbital length, about equal to interspiracular distance (McEachran, unpublished data); in *B. trachura* (Gilbert) the anterior margin of disc is distinctly undulated, denticles on disc are coarser and more sparsely distributed, and the postdorsal tail nearly equals length of second dorsal fin (McEachran, unpublished data); *B. longicauda* (de Buen) lacks dermal denticles over most of disc and possesses thorns on disc from level of maximum width to origin of pelvic lobes.

New or Rarely Encountered Skates

Three species of skates were captured in the eastern tropical Pacific which are new records for that area or, in two cases, may represent undescribed species.

Bathyraja cf. richardsoni (Garrick)

Fig. 5, Table 3

TCWC 3514.1, ca. 1860 mm TL, mature female, collected off Galapagos Islands, $0^\circ 11.3'S$, $97^\circ 27.2'W$, 1710 m, 25 May 66, *Anton Bruun*, Cruise 16, Station 618 A.

Description.—Disc 1.16 times as broad as long; maximum angle in front of spiracles 91° , margin of disc lozenge-shaped, slightly concave from level of spiracles to level of first gill slits, outer corners abruptly rounded, posterior margin

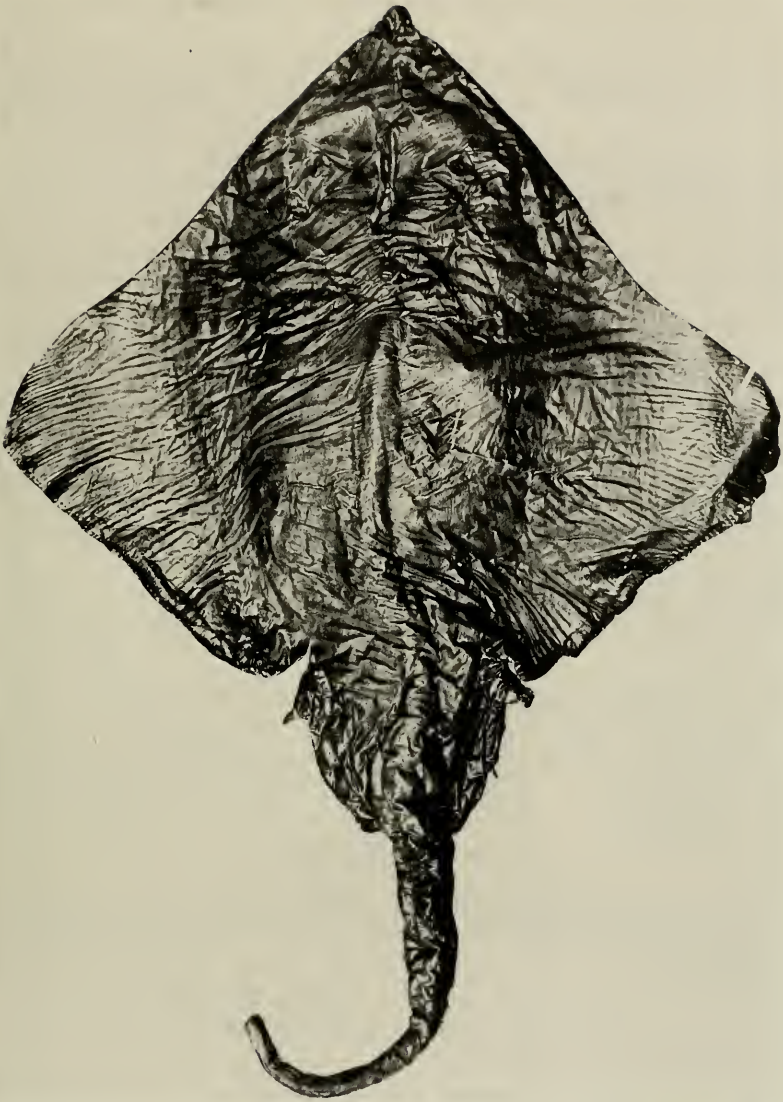


Fig. 5. *Bathyraja cf. richardsoni* TCWC 3514.1 (ca. 1860 mm TL, mature female), dorsal view.

more or less straight. Axis of greatest width 0.67 times distance from tip of snout to axil of pectoral fins. Pelvic fins with narrow anterior lobes, length 0.47 times posterior lobes, posterior lobes with convex lateral margins. Tail broad, slightly depressed, poorly developed lateral fold originating as ridge near axil of pelvic fins, and extending to tip of tail; tail damaged, extending only to posterior margin of first dorsal fin.

Preorbital length 3.69 times orbit length; preoral length 1.14 times internarial distance. Interorbital distance 1.82 times orbit length; orbit length 1.49 times spiracle length. Anterior nasal flap with triangular process posterior to nare, coarsely fringed along distal margin; posterior nasal flap poorly developed. Upper and

Table 3.—Proportional measurements and meristic values of *B. aguja*, *B. cf. richardsoni* (compared with *B. richardsoni*), *B. longicauda* and *Malacoraja nigerrima*. Proportions are expressed in percent total length.

| | <i>B. aguja</i> | | | <i>B. richardsoni</i> | | | <i>B. longicauda</i> | | | <i>Malacoraja nigerrima</i> | | |
|--------------------------------------|----------------------------|-------------------------------|----------------------|--------------------------|----------------|-----------|----------------------|----------------|-----------|-----------------------------|-----------|-----------|
| | USNM 65641 ¹ | TCWC ^{2,3} 3514.1 | Range ^{3,4} | \bar{x} ^{3,4} | TCWC 3597.1 | \bar{x} | TCWC 3597.1 | TCWC 3597.1 | \bar{x} | USNM 267046 ⁵ | Range | \bar{x} |
| Sex | ♀ | ♀ | ♂ | ♂ | ♀ | ♂ | ♂ | ♂ | ♂ | ♂ | | |
| Total length (mm) | 481 | 1860 | 950-1722 | | 110 | 156 | 167 | 167 | 65 | 374 | 139-374 | |
| Disc width | 69 | 65 | 74-82 | 77 | 65 | 67 | 64 | 64 | 65 | 53 | 51-53 | 52 |
| Disc length | 57 | 56 | 60-65 | 62 | 45 | 51 | 46 | 46 | 48 | 49 | 46-49 | 48 |
| Snout length (preorbital) | 12.1 | 12.0 | 12.3-15.4 | 13.7 | 7.8 | 9.6 | 8.3 | 8.3 | 8.7 | 12.1 | 10.2-12.8 | 11.6 |
| Snout length (preoral) | 12.8 | 11.6 | 13.3-15.8 | 14.5 | 9.0 | 10.8 | 9.5 | 9.5 | 9.8 | 14.5 | 12.6-14.5 | 13.9 |
| Snout to maximum width | 36 | 35 | | | 33 | 35 | 31 | 31 | 33 | 35 | 31-35 | 32 |
| Prenasal length | 9.6 | 9.3 | | | 5.9 | 8.0 | 6.9 | 6.9 | 7.0 | 11.5 | 9.6-11.5 | 11.0 |
| Orbit diameter | 3.3 | 3.2 | | | 3.9 | 3.6 | 3.4 | 3.4 | 3.6 | 4.6 | 3.7-4.8 | 4.3 |
| Distance between orbits | 4.3 | 5.9 | 7.1-8.8 | 8.0 | 5.3 | 3.7 | 3.6 | 3.6 | 4.0 | 3.5 | 3.3-3.6 | 3.5 |
| Orbit and spiracle length | 4.9 | 4.8 | | | 5.5 | 4.7 | 4.7 | 4.7 | 4.9 | 4.8 | 3.4-5.2 | 4.6 |
| Spiracle length | 2.0 | 2.2 | | | 1.5 | 1.8 | 1.7 | 1.7 | 1.7 | 1.8 | 1.5-2.3 | 1.8 |
| Distance between spiracles | 6.0 | 11.3 | 11.8-13.6 | 12.7 | 8.1 | 7.1 | 6.4 | 6.4 | 7.1 | 6.1 | 6.1-6.8 | 6.3 |
| Mouth width | 7.7 | 10.9 | 11.4-13.2 | 12.5 | 7.6 | 6.7 | 6.5 | 6.5 | 6.8 | 7.2 | 6.2-7.2 | 6.9 |
| Nare to mouth | | 2.1 | | | 2.3 | 3.0 | 2.8 | 2.8 | 2.7 | 3.5 | 2.6-3.5 | 3.1 |
| Distance between nostrils | 6.2 | 10.1 | 10.6-12.4 | 11.6 | 6.7 | 6.4 | 6.2 | 6.2 | 6.4 | 7.1 | 6.5-7.1 | 7.0 |
| Width of first gill openings | 2.0 | 2.2 | 1.6-1.9 | 1.7 | 0.9 | 1.1 | 1.2 | 1.2 | 1.1 | 1.3 | 1.0-1.5 | 1.2 |
| Width of third gill openings | 2.2 | 2.4 | 1.8-2.2 | 2.0 | 1.0 | 1.2 | 1.3 | 1.3 | 1.2 | 1.3 | 1.0-1.5 | 1.2 |
| Width of fifth gill openings | 1.1 | 1.6 | 1.3-1.9 | 1.6 | 0.7 | 0.6 | 0.7 | 0.7 | 0.6 | 1.1 | 0.6-1.1 | 0.8 |
| Distance between first gill openings | 16.1 | 20.2 | 21.0-22.9 | 22.3 | 19.1 | 16.7 | 16.3 | 16.3 | 17.2 | 13.9 | 13.0-14.5 | 13.8 |
| Distance between fifth gill openings | 12.0 | 15.9 | 17.0-18.9 | 17.9 | 12.2 | 10.1 | 10.5 | 10.5 | 10.8 | 8.8 | 8.1-8.8 | 8.5 |
| Length of anterior pelvic lobe | 10.5 | 7.4 | | | 9.9 | 10.1 | 9.4 | 9.4 | 9.8 | 12.5 | 10.4-14.7 | 12.9 |
| Length of posterior pelvic lobe | 14.0 | 15.6 | | | 9.4 | 9.9 | 9.7 | 9.7 | 9.7 | 15.7 | 11.8-16.0 | 14.9 |
| Distance—snout to cloaca | 49 | 58 | 64-68 | 66 | 43 | 44 | 43 | 43 | 43 | 44 | 40-44 | 43 |
| Distance—cloaca to 1st dorsal fin | 40 | 43 | 32-37 | 34 | 43 | 43 | 45 | 45 | 44 | 41 | 41-44 | 42 |
| Distance—cloaca to caudal origin | 48 | | | | 52 | 53 | 54 | 54 | 53 | 47 | 47-57 | 54 |
| Distance—cloaca to caudal tip | 51 | | | | 57 | 56 | 57 | 57 | 57 | 56 | 56-60 | 57 |
| Number of tooth rows (upper jaw) | 30 | 44 | 43-48 | 45 | 34 | 32 | 33 | 33 | 33 | 33 | 36-46 | 42.4 |
| Number of trunk vertebrae | 35 | 38 | 24-40 | 29.6 | 31 | 31 | 31 | 31 | 31 | 29 | 27-30 | 28.6 |
| Number of predorsal caudal vertebrae | 66 | 70 | | | 62 | 62 | 62 | 62 | 62 | 65 | 59-65 | 62.6 |
| Number of pectoral radials | 81 | | | | 72 | 72 | 72 | 72 | 72 | 65 | 61-65 | 63.0 |

¹ Holotype.² *B. cf. richardsoni*.³ Proportional measurements based on distance from tip of snout to origin of first dorsal fin.⁴ Data from Templeman (1973), females.⁵ Neotype.

lower jaws moderately arched. Teeth with sharp pointed cusps and arranged in rows.

Distance between first gill slits 1.99 times internarial distance; distance between fifth gill slits 1.57 times internarial distance; length of first gill slits 1.40 times length of fifth gill slits.

Upper and lower surfaces of disc and tail uniformly covered with denticles, dorsal surface of anterior pelvic lobes naked, remainder of fins with denticles. Disc devoid of thorns. Tail with 18 moderate sized thorns.

Color.—After storage in alcohol specimen is uniform chocolate-brown on both surfaces.

Comments.—This specimen agrees with *B. richardsoni* in disc shape, interorbital distance, denticle pattern and coloration. Most of its morphometric and meristic values, however, do not fall within the ranges given by Templeman (1973) for *B. richardsoni* (Table 3). Although this specimen most likely represents a new species, it is not named at this time because of its poor condition and the lack of other specimens. The tail posterior to the first dorsal fin is missing and the neurocranium is crushed. Proportional measurements of skates are usually based on total length, tip of the snout to tip of the tail, and this measurement can only be approximated for this specimen. Templeman (1973) based his proportional measurements on the distance from tip of the snout to origin of the first dorsal fin, and thus it was possible to compare the specimens of his study with the one from Galapagos Islands.

Bathyraja richardsoni was described from New Zealand and has since been reported from off southeastern England (Forester 1965), and from the northwestern Atlantic off Labrador to Georges Bank (Templeman 1973) and off the Virginia Capes (Musick, personal communication).

Bathyraja longicauda (de Buen)

Fig. 6, Table 3

TCWC 3597.1, 167 mm TL, 110 mm TL, juvenile males, 156 mm TL, juvenile female collected off Peru, 7°49'S, 80°38'W, 605 to 735 m, 5 Sep 1966 aboard R/V *Anton Bruun*, Cruise 18B, Station 754.

Description.—Disc 1.30 to 1.42 times as broad as long; maximum angle in front of spiracles 118° to 128°; anterior margin of disc convex except straight to slightly concave from level of orbits to level of second gill slits; outer corners sharply rounded; posterior margins convex. Axis of greatest width 0.84 to 0.88 times distance from tip to snout to axil of pectoral fins. Pelvic fins deeply incised, anterior lobes narrow and acutely tipped, length 0.97 to 1.06 times posterior lobes. Tail slender, with a narrow lateral fold extending to origin of hypochordal caudal lobe. Length of tail from center of cloaca to tip 1.26 to 1.34 times distance from tip of snout to center of cloaca.

Preorbital length 2.00 to 2.68 times orbital length; preoral length 1.30 to 1.69 times internarial distance. Interorbital distance 1.02 to 1.30 times orbit length; orbit length 2.00 to 2.53 times spiracle length. Anterior nasal flaps fringed along posterior margin; posterior nasal flaps poorly developed and weakly fringed. Upper and lower jaws more or less straight; teeth with short pointed cusps in quincunx arrangement.

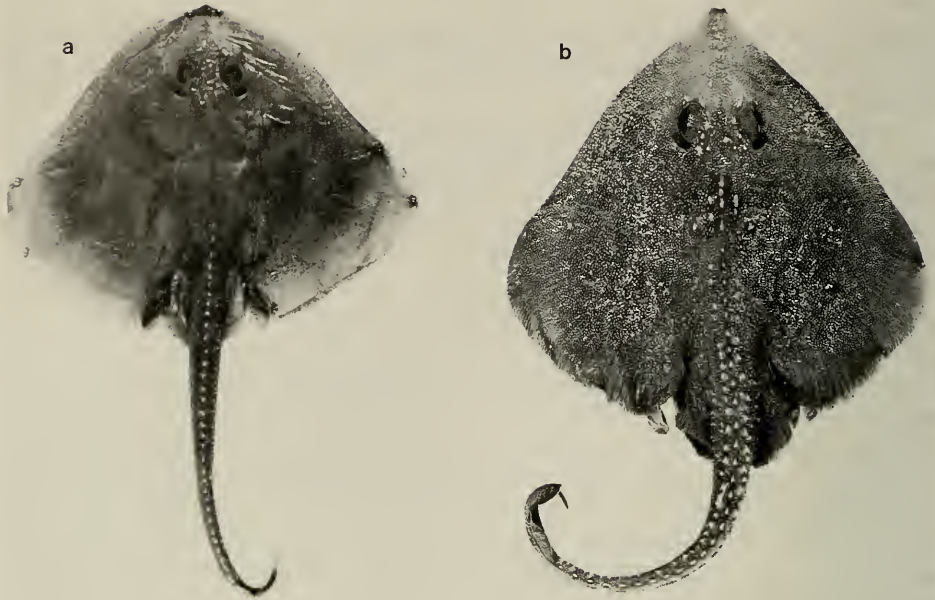


Fig. 6. a, *Bathyraja longicauda* TCWC 3597.1 (156 mm TL, juvenile female), dorsal view; b, *Malacoraja nigerrima* USNM 267046 (Neotype, 374 mm TL, juvenile male), dorsal view.

Distance between first gill slits 2.61 to 2.84 times internarial distance; distance between fifth gill slits 1.58 to 1.81 times internarial distance; length of first gill slits 1.25 to 1.89 times length of fifth gill slits. First dorsal fin slightly larger than second; interspace between dorsal fins about equal to one-half base of first dorsal fin; second dorsal fin separated by short distance from poorly developed epichordal caudal lobe formed by confluence of lateral folds; hypochordal lobe very short.

Dorsal surface of disc with denticles or thornlets along anterior margin to level of second gill slits, on snout and between orbits. Mid-row thorns number from 26 to 30 and run from just posterior to maximum width of disc to origin of first dorsal fin; one or two thorns between dorsal fins. Ventral surface naked. Tail with lateral row of denticles or thorns on each side.

Color.—Dorsal surface uniform tannish-brown, except tip of snout dark brown. Ampular pores on dorsal surface dark brown. Ventral surface of disc brown (slightly darker than dorsal surface) except for dark brown tip of snout and light tan blotches around mouth, on center of abdomen, on anterior pelvic lobes and on entire surface of tail.

Comments.—*Bathyraja longicauda* was previously known from a single specimen from off Valparaiso, Chile, ca. 33°S, which has subsequently been lost (R. I. Lavenberg, personal communication). The above three specimens agree with the description (de Buen 1959) and the figure (de Buen 1960) of *B. longicauda*, except that they have more mid-row thorns (26 to 30 vs. 19), and the thorns originate slightly anterior to the origin of the pelvic girdle rather than at the level

of the pelvic girdle as in the holotype. Also the tail length of these specimens is slightly shorter than that of the holotype (1.26 to 1.34 vs. 1.42 times the distance from the tip of the snout to the cloaca). Because of the small size of the specimens it was decided to wait for additional material to become available before selecting a neotype.

The range of *B. longicauda* is extended from Valparaiso, Chile to Peru (7°49'S, 80°38'W).

Malacoraja nigerrima (de Buen)

Fig. 6, Table 3

Neotype.—USNM 267046, 374 mm TL, juvenile male, collected off Chile, 34°53.5'S, 72°44'W, 780 to 925 m, 9–10 Aug 1966, R/V *Anton Bruun*, Cruise 18A, Station 40.

Other material.—TCWC 3881.1, 273 mm TL, juvenile female, same data as neotype.—TCWC 3882.1, 139 mm TL, 144 mm TL, 162 mm TL, 292 mm TL, juvenile males, 273 mm TL, 277 mm TL, juvenile females, collected off Chile, 34°06.5'S, 72°18.5'W, 750 m, 5 Aug 1966, R/V *Anton Bruun*, Cruise 18A, Station 25.—TCWC 3883.1, 114 mm TL, 135 mm TL, juvenile females, collected off Chile, 32°08.5'S, 71°43'W, 960 m, 12 Aug 1966, R/V *Anton Bruun*, Cruise 18A, Station 47.—TCWC 3884.1, 365 mm TL, juvenile female, collected off Chile, 24°29.5'S, 70°40'W, 950 m, 16 Dec 1966, R/V *Anton Bruun*, Cruise 18A, Station 60.—TCWC 3885.1, 239 mm TL, juvenile female, collected off Peru, 3°15'S, 80°55'W, 945–960 m, 10 Sep 1966, R/V *Anton Bruun*, Cruise 18A, Station 120.

Description.—Disc 1.07 times as broad as long in neotype (1.06 to 1.13 in other specimens); maximum angle in front of spiracles 101° (98° to 108°); anterior margin of disc slightly concave from tip to anterior extension of pectoral radials, slightly convex to level of mouth, slightly concave to level of second gill slits, outer corners broadly rounded, posterior margins convex. Axis of greatest width 0.89 (0.78 to 0.89) times distance from tip of snout to axil of pectoral fins. Pelvic fins deeply incised; anterior lobe narrow, tapering distally, length 0.80 (0.83 to 0.93) times posterior lobe. Tail moderately slender, depressed, with lateral folds originating just anterior to origin of first dorsal fin and extending to tip of tail. Length of tail from center of cloaca to tip 1.29 (1.28 to 1.48) times distance from tip of snout to center of cloaca.

Preorbital length 2.64 (2.38 to 2.99) times orbit length; preoral length 2.05 (1.92 to 2.10) times internarial distance. Interorbital distance 0.76 (0.72 to 0.92) times orbit length; orbit length 2.55 (1.70 to 2.90) times spiracle length. Anterior nasal flap laterally expanded but indented at mid-length; posterior margin coarsely fringed; posterior nasal flap with well developed, finely fringed lateral lobe. Upper and lower jaws slightly arched. Teeth with very short pointed cusps (rounded to slightly pointed) in quincunx arrangement.

Distance between first gill slits 1.96 (1.91 to 2.16) times distance between nares; distance between fifth gill slits 1.25 (1.15 to 1.32) times distance between nares; length of first gill slits 1.18 (1.38 to 1.89) times length of fifth gill slits. Dorsal fins similarly shaped and confluent at bases, first slightly larger than second; second dorsal confluent with poorly developed epichordal caudal lobe.

Dorsal surface of disc and tail densely covered with dermal denticles; anterior

lobe of pelvic fin naked; posterior lobe sparsely covered with denticles. Denticles with slender cusps and oval bases. Several thorns on rostral shaft, four along inner margin of orbits, one medial to each spiracle, triangular patch of 11 over nuchal and scapular regions, three rows on midline of disc posterior to suprascapula, and five rows on dorsal and lateral aspects of tail extending to origin of first dorsal fin. Thorns on oval bases and with posteriorly directed, claw-like cusps. Ventral surface naked except for tail which is densely covered with denticles, except for narrow midline which is naked.

Color.—After storage in alcohol dorsal surface is uniformly dark brown, except dorsal fins are blackish brown. Ventral surface is yellowish brown anteriorly grading to dark brown posteriorly.

Comments.—The 11 specimens described herein agree with de Buen's (1960) description and figure of *Breviraja nigerrima* in possessing a relatively long tail, narrow disc, long anterior pelvic lobes, confluent dorsal fins, and dense covering of dermal denticles on dorsal and ventral surface of tail.

The species is transferred from *Breviraja* to *Malacoraja* because it possesses the synapomorphy of the latter genus, i.e., dermal denticles along all but the narrow midline of the ventral surface of the tail, and lacks the synapomorphies of *Breviraja*, i.e., oronasal pits, rostral shaft distally very slender and shaft distally segmented.

The range of *M. nigerrima* is extended from its type-locality off Chile, 33°20'29"S, 71°59'0"W, to off Peru, 3°15"S, 80°55'W.

Acknowledgments

We express our appreciation to L. W. Knapp (SOSC) for furnishing specimens for this study, to William L. Fink and Karsten Hartel (MCZ) for furnishing a radiograph of the holotype of *Bathyraja peruana*, to Susan Jewett (USNM) for providing measurements and a radiograph of the holotype of *B. aguja*, and to Vicky McCall, Texas A&M University, for radiographing the remainder of the specimens used in the study. The late Carl L. Hubbs generously gave of his time, knowledge and data concerning eastern Pacific skates at the inception of the study. Steven G. Branstetter and Richard E. Matheson read drafts of the manuscript and offered improvements. The study was supported in part by the National Science Foundation, Grant Nos. DEB 78-11217 and DEB 81-04661.

Literature Cited

- Beebe, W., and J. Tee-Van. 1941. Eastern Pacific expeditions of the New York Zoological Society. XXVIII. Fishes from the tropical eastern Pacific. Part 3. Rays, mantas and chimaeras.
- Briggs, J. C. 1974. Marine zoogeography.—McGraw-Hill, Inc., New York, 475 pp.
- de Buen, F. 1959. Notas preliminares sobre la fauna marina preabismal de Chile, con descripción de una familia de rayas, dos géneros y siete especies nuevos.—Boletín del Museo Nacional de Historia Natural, Santiago 27:173–201.
- . 1960. Tiburones, rayas y quimeras en la Estación de Biología Marina de Montemar, Chile.—Revista Biología Marina, Valparaíso 10:3–50.
- Eschmeyer, W. N., and E. S. Herald. 1983. A field guide to Pacific coast fishes of North America: from the Gulf of California to Baja California.—Houghton Mifflin, Boston, 336 pp.
- Forester, G. R. 1965. *Raja richardsoni* from the continental slope off south-west England.—Journal Marine Biological Association of the United Kingdom 45:773–777.

- Hildebrand, S. F. 1946. A descriptive catalog of the shore fishes of Peru.—Bulletin of the United States National Museum 189:1–531.
- Kendall, W. C., and L. Radcliffe. 1912. Reports on the scientific results of the expedition to the eastern Tropical Pacific in charge of Alexander Agassiz, by the U.S. Fish Commission Steamer “Albatross” from Oct. 1904 to March 1905, Lieut. Comm. L. M. Garrett, U.S.N., Commanding. 25. The shore fishes.—Memoirs of the Museum of Comparative Zoology, Harvard 5:77–171, 8 pls.
- McEachran, J. D. 1983. Results of the research cruises of FRV “Walther Herwig” to South America. LXI. Revision of the South American skate genus *Psammobatis* Gunther, 1870 (Elasmobranchii: Rajiformes, Rajidae).—Archiv für Fischereiwissenschaft, Berlin 34:23–80.
- , and L. J. V. Compagno. 1979. A further description of *Gurgesiella furvescens* with comments on the interrelationships of Gurgesiellidae and Pseudorajidae (Pisces, Rajoidei).—Bulletin of Marine Science 29(4):530–553.
- , and ———. 1982. Interrelationships of and within *Breviraja* based on anatomical structures (Pisces: Rajoidei).—Bulletin of Marine Science 32:399–425.
- Miller, D. J., and R. N. Lea. 1972. Guide to the coastal marine fishes of California.—California Fish & Game, Fish Bulletin 157:1–235.
- Stehmann, M. 1981. Batoid fishes. In: W. Fischer, G. Bianchi, and W. B. Scott (eds.) FAO species identification sheets for fishery purposes. Eastern Central Atlantic; fishing areas 34, 47 (in part), vol. 7.
- Templeman, W. 1973. First records, description, distribution, and notes on the biology of *Bathyraja richardsoni* (Garrick) from the northwest Atlantic.—Journal of the Fishery Research Board of Canada 30:1831–1840.

(JDM) Department of Wildlife and Fisheries Sciences, and Department of Oceanography, (TM) Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, Texas 77843.