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Notes on Galápagos grenadiers (Pisces, Gadiformes, Macrouridae), with the description of a new species of *Coryphaenoides*

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Abstract: Two unusual specimens of the grenadier genus *Coryphaenoides* were collected by the deep-submersible vehicle *Johnson Sea-Link* off the Galápagos. Unlike any other member of the genus, the snout in these specimens was rounded, non-protruding, naked anteriorly and ventrally, with no tubercular scales marking the terminal and lateral angles. They are herein described as *Coryphaenoides gypsochilus*. Additional specimens of grenadiers were procured by the *Johnson Sea-Link*, including the second and third specimens of *Nezumia ventralis* and the first record of *Caelorinchus canus* from these waters. Three species and one subspecies of Galápagos grenadiers are endemic.

Key words: Grenadier, Macrouridae, *Coryphaenoides*, Galápagos, deep-submersible research vehicle

Two individuals of an unusual undescribed species of grenadier were captured in the Galápagos during recent California Academy of Sciences expeditions using the Harbor Branch Oceanographic Institution's *Johnson Sea-Link* deep-submersible manned research vehicle. The presence of six branchiostegal rays, serrations along the leading edge of the spinous second ray of the first dorsal fin, anus located immediately in front of the anal fin with no enlarged periproct region and no sign of a ventral light organ, and a fairly typical squamation, mouth, and head structure suggest a relationship closest to the genus *Coryphaenoides*. The peculiar snout of the fish—low, rounded, and naked at its anterior end, lacking spinous tubercles at tip and lateral angles, and scarcely protruding beyond the mouth—is, however, unlike that of any other member of *Coryphaenoides* and is somewhat suggestive of the snout shape in *Haplomacrourus* and *Kuronezumia*, grenadiers possessing seven branchiostegal rays. The new species may be endemic to the Galápagos, where it was observed and captured along steep, rocky slopes at depths of 630-900 m.

MATERIALAND METHODS

All specimens are deposited in the ichthyological collections of the California Academy of Sciences.

Methods for making measurements and counts follow general procedures described in Iwamoto (1970) and Iwamoto & Sazonov (1988). All measurements are point-to-point. The internasal, interorbital, and suborbital

measurements are least bony widths. A small, splint-like ray closely adhered to the base of the uppermost developed ray in the pectoral fin is noted in the fin ray count with a small "i." Transverse scale row counts are to, but do not include, the lateral line scale. Lateral-line scales are counted from the anterior origin over a distance that is equal to that from the snout tip to the origin of the first dorsal fin.

Coryphaenoides gypsochilus new species
Figs. 1-3

Type specimens.

Holotype: CAS 86530 (77.2 mm HL, 390 mm TL); Galápagos, Isla Fernandina (=Narborough), Bolivar Channel, 00°14.64'S, 91°6.54'W, 732 m; *Johnson Sea-Link* dive 3958; collector J.E. McCosker et al., 17 Nov. 1995. Paratype: CAS 209223 (91.5 mm HL, 437 mm TL); Galápagos, Is. Fernandina, off Cabo Douglas, 00°17.4'S, 91°38.8'W, 631 m; *Johnson Sea-Link* dive 3088; collectors J.E. McCosker & C.C. Baldwin, 23 June 1998.

Diagnosis. Branchiostegal rays six. Anus immediately before anal fin origin, small periproct lacking light organ. Head laterally compressed; snout rounded, without prominent tubercular scale at tip or lateral angles, scarcely protruding beyond large mouth, naked over anterior end and ventrally below suborbital ridge to about vertical through posterior nostril. Opercular opening wide, extending ventrally forward to below angle of lower jaw. Suborbital region almost vertical, lacking prominent angular ridge and coarsely modified scale rows. Base of pectoral fin broad, i22-i24 rays; pelvic rays 10 or 11.

Description of holotype (paratype characters in parentheses). Fresh specimens have a thick mucous coating over entire fish, including fins, but that coating is easily sloughed off with handling. Head and body compressed laterally, width of head across opercles about 1.7 times into greatest body depth; head about five times in total length. Profile of body relatively flat ventrally, but rising from mouth in a steep, rounded curve over snout, then straightening from snout to front of nape; from there the profile ascends over nape in a high arch before descending gently posteriorly to end of trunk, then gradually leveling off to end of long, tapered tail. Snout rounded, essentially non-protruding beyond mouth, naked anterior to lateral tips of nasal bones and below suborbital shelf posteriorly about to area below nostrils; this pattern of naked areas somewhat reminiscent of that seen in species of *Kumba*. Anterior portion of lower jaw also naked. Sensory pores of head fairly prominent along dorsal and ventral margins of occipital region and over preopercle, but not along snout, suborbital, or lower jaw. Lips thick and papillaceous. Chin barbel short, stout near base, gradually tapering to fine distal tip. Opercular opening broad, extending from upper end of opercle to level of posterior angle of lower jaw; a narrow free fold of gill membrane across isthmus. Gular and branchiostegal membranes naked. Gill rakers finely spinulated, mostly tubercular but somewhat plate-like on ventralmost part of arch and on epibranchial arm. Twelve pre-caudal vertebrae were counted in the holotype (and paratype); there were seven anal pterygiophores before the first haemal spine.

Holotype a male with a pair of well-developed testes and 13 long, slender pyloric caeca. (Paratype a male with 16 pyloric caeca, each about 20 mm long. Swimbladder large, with two drumming muscles along anterolateral wall, and four small gas glands. Intestines multiply looped, in a pattern similar to that of *C. anguliceps* in figure 8a of Iwamoto & Sazonov (1988), except for an additional short loop at oral end.)

Teeth short, conical, in broad bands in both jaws, with outer premaxillary series spaced and slightly enlarged.

Spinulation on body and head scales essentially all similar, consisting of 1-5 short rows of small, tightly imbricate, greatly reclined, conical spinules aligned in parallel or slightly divergent rows. Height of spinule rows on each scale increasing posteriorly on

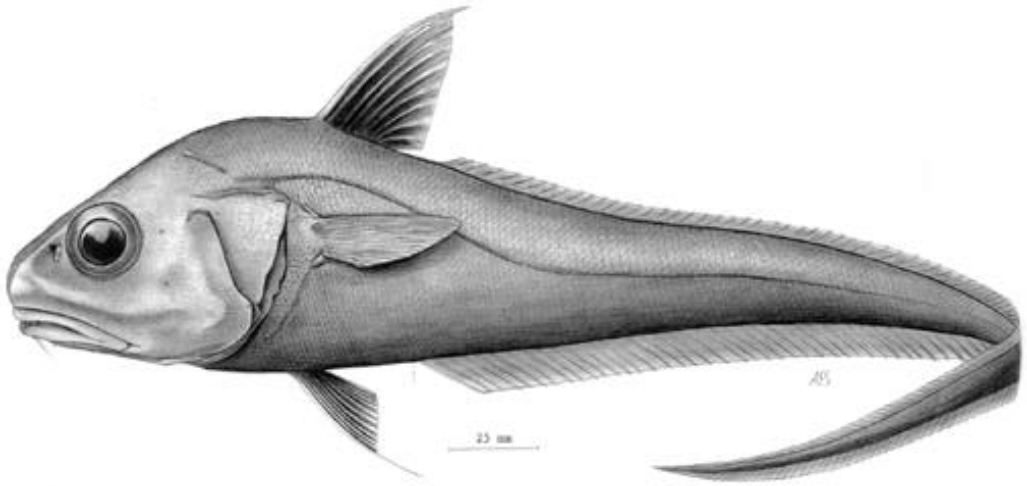

Fig. 1. *Coryphaenoides gypsochilus* new species, holotype, CAS 86530 (390 mm TL), Galápagos, Isla Fernandina, 732 m. Scale bar equals 25 mm. Drawn by Alison E. Schroeer.

exposed field, the last spinule in each row extending beyond scale margin. Spinules much reduced posteriorly on tail; spinules absent on scales posteriorly from about two head lengths (about 2.4 head lengths in paratype) behind opercular margin. All scales on head except those on gill cover small; those over suborbital region somewhat similar to those in species of *Mesobius*, viz., short, conical, closely adjacent spinules aligned in a single row, but some scales having two or three divergent rows. Alignment of spinule rows give a somewhat striated pattern to surface.

Fins well developed and typical of macrourines. First spinous ray of first dorsal fin minute, scarcely noticeable; second spinous ray long, well-developed, the leading edge beset with numerous short, weak, non-overlapping serrations. Pectoral fin broad-based, its origin slightly above midlateral axis of trunk, its length about equal to postorbital length of head. Pelvic fin relatively broad-based, short, outer ray slightly prolonged into a filamentous distal tip extending to base of 4th to 7th anal ray; most of fin extending to or beyond anus. (In paratype most of rays fall short of anus.)

Color. Soon after its capture, McCosker photographed and made color notes of the paratype. He noted: “body gray. Dorsal-most pectoral, first pelvic, and first dorsal rays chalky-white. All other rays gray/black. Anal and tail (fins) black. Opercular and subopercular membranous margins black. Pectoral base black. Lips and chin barbel white.” Color of holotype preserved in 70% ethyl alcohol: ground color brown; lips pale; narrow black eye ring; chin barbel pale; mouth dark; gill cavity black, gill filaments, arches and rakers pale; outer margin of branchiostegal rays black. Fins mostly black, although distal membranes (but not rays) of first dorsal, pectoral, and pelvic fins clear, and spinous ray of first dorsal, uppermost ray of pectoral, and outer ray of pelvic fins pale. (Paratype much darker, more swarthy overall.)

Counts and measurements: Holotype first (paratype between parentheses if different). First dorsal fin rays II,10; pectoral fin rays [left/right] i23/i22 (i24/i23); pelvic fin rays 11/11 (10/11); gill rakers first arch [outer/inner] 8/2+11 (7/3+10), second arch 1+11/2+11 (1+10/2+11); scales below first

Fig 2. *Coryphaenoides gypsochilus* new species, paratype, CAS 209233 (437 mm TL), Galápagos, Isla Fernandina, 631 m.

dorsal fin 11(10), below second dorsal fin 7 (7.5), below mid-base of first dorsal fin 6.5, lateral line scales 47 (46). Measurements in mm: total length 390 (437); head length 77.2 (91.5); snout length 19.2 (26.9); internasal width 13.8 (15.9); interorbital width 15.0 (18.5); orbital diameter 19.8 (24.6); suborbital width 12.3 (14.0); postorbital length 40.1 (46.0); distance from posterior margin of orbit to angle of preopercle 35.4 (39.5); upper jaw length 32.9 (38.4); barbel length 11.8 (14.5); first gill-slit length 11.3 (16.5); preanal length 111 (129); isthmus to anal-fin origin 59 (74); origin of outer pelvic ray to origin of anal fin 27 (40); greatest body depth 66 (79), depth over anal fin origin 53 (65); height first dorsal fin 52 (52); length pectoral fin 43 (48); length outer pelvic fin 49 (58).

Comparisons. *Coryphaenoides gypsochilus* is not likely to be confused with any other *Coryphaenoides* owing to its distinctly rounded, narrow, essentially non-protruding snout that is naked anteriorly and ventrally, and lacks tubercular scales at the median tip and lateral angles. The high pectoral fin ray count, the 10 or 11 pelvic fin rays, the smoothly rounded, almost vertical suborbital space, the wide opercular opening, and the thick lips, in combination, further distinguish the species. In the eastern Pacific, *C. delsolari* Chirichigno & Iwamoto, 1977 is sympatric with the new species and is somewhat similar in overall appearance. However, the snout is almost completely scaled in *C. delsolari* and tubercular scales are present at the tip and lateral angles. The tridentate spinules in that species are also highly distinctive and found in no other grenadier. *Coryphaenoides oreinos* Iwamoto & Sazonov, 1988 has a rounded snout that scarcely protrudes beyond the mouth, but that species differs, among other characters, in having a broader naked area on snout, a tubercular scale at the lateral snout angles, black lips, body scales with reduced spinules arrayed in 8-12 subparallel ridges, and several different proportional measurements of the head.

Etymology. From the Greek, *gypso*, chalky like gypsum, and *cheilus*, lip, in reference to the chalk-colored lips, which stand out so prominently in life.

Ecological notes. The specimens of the new species were collected at opposite ends of Isla Fernandina. The western edge of the

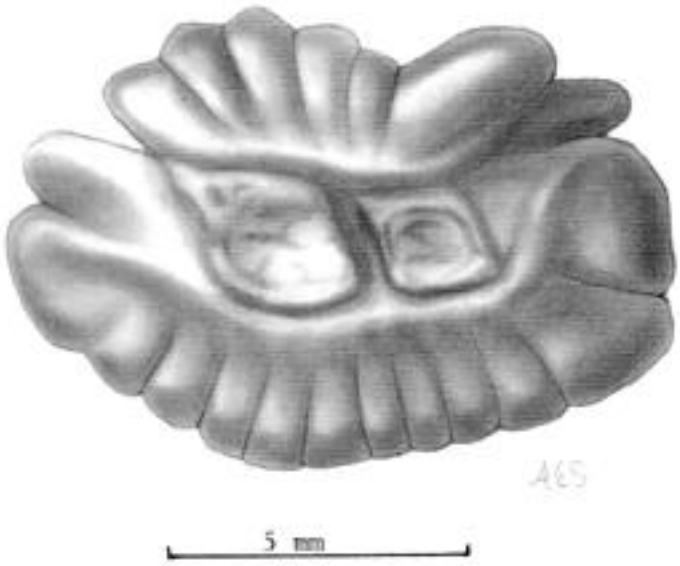

Fig. 3. Mesial view of right sagitta otolith of *Coryphaenoides gypsochilus*, CAS 86530. Scale bar equals 5 mm. Drawn by Alison E. Schroeer.

Galápagos Archipelago differs dramatically from the central platform and the eastern edge in that the surface waters are as much as 10°C colder in the west, particularly along the central western edge of Isla Isabela (=Albemarle) and the waters surrounding Isla Fernandina (McCosker & Rosenblatt 1984). Much of the ichthyofauna observed along the western edge of the archipelago during submersible dives differed considerably from other Galápagos areas at similar depths. Cabo Douglas, located along the NW corner of Isla Fernandina, drops steeply into deep water (more than 1000 m deep at a distance less than 2.0 km from shore). The collection of the paratype was made along a 60°-70° volcanic slope with large ~0.5 m diameter lava boulders overlaying a fine gray sediment bottom. Occasional larger lava reefs were present. Water temperature at the capture site was 10°C. Also collected and seen during that dive were several pelagic holothurians (*Pelagothuria nanatrix* Ludwig), catsharks (*Apristurus* spp.), combtooth dogfish (*Centroscyllium nigrum* Garman), chimaeras (*Hydrolagus* spp.), witch-eels (*Facciolella equatorialis* (Gilbert)), viperfish (*Chauliodus sloani* Bloch & Schneider), grenadier (*Nezumia l. loricata* (Garman)), cardinalfish (*Epigonus merleni* McCosker & Long), batfishes (*Dibranchus erinaceus* (Garman)), roughies (*Hoplostethus pacificus* (Garman)), bythitids (*Diplacanthopoma jordani* Garman), hagfish (*Eptatretus wisneri* McMillan), and an undescribed scorpionfish (*Phenacoscorpius* sp.). Tissue samples of the paratype were taken, preserved in 95% EtOH, and are deposited at the USNM.

The holotype was collected in the Bolivar Channel between Fernandina and Isabela islands. The submersible dive was along the edge of a very steep offshore pinnacle, similar in profile to the site of the collection of the paratype. The wall was also overlain with gray sediment with irregular lava outcroppings. The water temperature was colder (6.8° C at 730 m) and an ~0.5 kt current ran along the bottom. The fauna was very similar to that of the Cabo Douglas station, with more numerous large individuals of

Hoplostethus pacificus as well as several adult and juvenile goosefish (*Lophioides spil - urus* (Garman)). Specimens of the macrourid *Trachyrincus helolepis* Gilbert, 1892 were observed and photographed during the dive but were not collected; the individuals were alone and hovering above the bottom at 628 m and 716 m.

Additional individuals of *C. gypsochilus* were seen from the submersible but not collected at three other Galápagos localities. The habitats and associated faunas were similar to those from which the type specimens were collected. On 26 November 1995, McCosker observed and videographed an adult at 897 m over a mildly (~30°) sloping bottom that intersected with a steep slope. The dive location was off James Bay, Isla Santiago (=James) (JSL 3977, 00°15.12'S, 90°53.78'W). On 13 July 1998, Carole Baldwin (USNM) observed and videographed an adult at ~900 m along a steep (65°-70°) volcanic slope NE of Isla Santa Cruz (=Indefatigable) (JSL dive 3098, 00°30.4'S, 90°08.8'W). On 25 July 1998, McCosker observed three adult *C. gypsochilus* in close proximity to each other at 640 m along a steep (60°-70°) volcanic slope offshore from North Seymour Island (=Seymour Island) (JSL dive 3113, 00°21.7'S, 90°15.0'W).

Remarks. The collection of many new species of fishes from the Galápagos using the submersible *Johnson Sea-Link* (McCosker 1997, McCosker et al. 1997) illustrates the value and effectiveness of deep submersible research vehicles in sampling steep, rough-bottom slope areas beyond normal scuba depths. These collections also suggest a large gap in our knowledge of fishes from such areas, particularly in tropical reef regions the world over.

The capture of a new species of grenadier is not in itself surprising, but what is surprising is that the species is so peculiar. The overall physiognomy of the head, which is unlike that of any other species of *Coryphaenoides*, with which it obviously belongs, raises the possibility of it representing a new genus. A more comprehensive comparative study of its osteology and other internal characters with additional specimens may reveal differences that would support a separate recognition.

Other grenadiers captured during the two expeditions of the *Johnson Sea-Link* include two specimens of *Nezumia ventralis* Hubbs & Iwamoto, 1979 (CAS 86505, 26.1 mm HL, 145 mm TL; Darwin Island, 515 m, dive 3967, 21 Nov. 1995, and CAS 201869, 64.7 mm HL, 328 mm TL, Isla Santa Cruz, 878 m, dive 3098, 13 July 1998). That species was previously known only from the holotype and one paratype taken by the *Alba - tross* during expeditions to the Galápagos Islands in 1888 and 1904. Also, two fine specimens of *Nezumia loricata* subspecies *loricata* were captured (CAS 201866, 46.2-48.4 mm HL, 257-244+ mm TL, Is. Fernandina, 625 m, dive 3088, 23 June 1998). These two species along with *Coryphaenoides myersi* Iwamoto & Sazonov, 1988 and *C. gypsochilus* represent species endemic (so far as known) to the Galápagos. Five specimens of *Caelorinchus canus* (Garman, 1899) were collected (CAS 201897, 1 spec., 34.0 mm HL, 126 mm TL, I. Marchena, 309-336 m, 19 July 1998; CAS 201856, 1 spec., 61.8 mm HL, 218 mm TL, I. Española, 335 m, 7 July 1998; CAS 86525, 3 spec., 72-80 mm HL, 236-275 mm TL, I. Genovesa, 462 m, 24 Nov. 1995). The last three specimens are considerably larger than any previously known. *C. canus* is known from the tropical eastern Pacific from Costa Rica south to northern Peru and out to the Cocos Islands. Its presence off the Galápagos should not be surprising. Two polka-dotted, phalacromacrurus-stage juveniles of *Mataeocephalus tenuicaudus* (Garman, 1899) were collected during dive 3977 (CAS 86531, 2 spec., 25.3-26.8 mm HL, 155-156 mm TL; I. San Salvador, 914 m; 26 Nov. 1995). Phalacromacrurus-stage juveniles of this species were not previously known. Adults have been recorded from Panama, Ecuador, Galápagos, and south of Cocos. Observations of *Tra -*

chyrincus helolepis were made and photographs taken several times during the first (1995) expedition, but no specimens were secured during that or the subsequent expedition. The species was originally described from the Galápagos but has been subsequently taken off the coasts of Peru and northern Chile.

A list of the grenadier species reported from the Galápagos region is here provided with the endemic taxa preceded by an asterisk.

Caelorinchus canus (Garman, 1899)
Coryphaenoides anguliceps (Garman, 1899)
Coryphaenoides armatus (Hector, 1875)
Coryphaenoides boops (Garman, 1899)
Coryphaenoides bucephalus (Garman, 1899)
Coryphaenoides bulbiceps (Garman, 1899)
Coryphaenoides delsolari Chirichigno & Iwamoto, 1977
**Coryphaenoides myersi* Iwamoto & Sazonov, 1988
**Coryphaenoides gypsochilus* Iwamoto & McCosker, new species
Mataeocephalus tenuicaudus (Garman, 1899)
Nezumia convergens (Garman, 1899)
**Nezumia loricata loricata* (Garman, 1899)
Nezumia stelgidolepis (Gilbert, 1890)
**Nezumia ventralis* Hubbs & Iwamoto, 1979
Trachyrincus helolepis Gilbert, 1892

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RESUMEN

Se describe una nueva especie, *Coryphaenoides gypsochilus*, de aguas profundas de Galápagos. Tres especies y una subespecie de “granaderos” son endémicos de Galápagos.

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