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Caribbean species of *Eiconaxius* (Decapoda: Axiidea: Axiidae)

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Abstract

The type status of specimens of three species of the axiid genus *Eiconaxius* Bate, 1888 from the Caribbean Sea is clarified. *Eiconaxius agassizi* Bouvier, 1905, *E. borradailei* Bouvier, 1905 and *E. caribbaeus* (Faxon, 1896) are diagnosed and illustrated. *Axius* (*Eiconaxius*) *communis* Bouvier, 1905, *Axius* (*Eiconaxius*) *rotundifrons* Bouvier, 1905, and *Axius* (*Eiconaxius*) *caribbaeus carinatus* Bouvier, 1925, hitherto treated as valid species, are synonymised with *E. caribbaeus*. Lectotypes are selected for *Eiconaxius agassizi* Bouvier, 1905 and *Eiconaxius borradailei* Bouvier, 1905.

Key words: Axiidae, *Eiconaxius*, taxonomy, type status

Introduction

The axiid genus *Eiconaxius* Bate, 1888 comprises more than 30 species confined to deep water that are, as far as is known, associates of sponges (Komai & Tsuchida 2012).

The US Coast Survey Steamer *Blake* surveyed the Gulf of Mexico and the Caribbean Sea between 1877 and 1880. Faxon (1896) described the first species of *Eiconaxius* from this collection but the bulk of the reptant decapod collection was studied by the French zoologist Eugène Louis Bouvier (1856–1944) at the Muséum nationale d'Histoire naturelle, Paris (MNHN). Bouvier (1905) described four species of *Eiconaxius* and one subspecies by means of a dichotomous key but listed no material. In 1917 he completed his study and listed stations from which his specimens came. This work was published eight years later, like his first, in French (Bouvier 1925). Bouvier apparently returned most of the *Blake* collection to the Harvard Museum of Comparative Zoology, Cambridge (MCZ) but representatives were retained at the MNHN.

Among the many species of decapods found during the KARUBENTHOS 2015 expedition to Guadeloupe Poupin & Corbari (2016) tentatively identified only *E. antillensis* Bouvier, 1905. This record has been confirmed by Poore & Dworschak (2018). Other specimens of this genus proved more difficult to identify using Bouvier's works. His descriptions and illustrations are sometimes difficult to interpret, features described for one species are not described for another and many of the supposed differences appear very subtle. In fact, Bouvier (1925) himself was rather tentative in differentiating his taxa. He synonymised one of the species he had described in 1905 with *E. caribbaeus*, reconsidered another as a variety and added a second variety to *E. caribbaeus.* Further, he noted that one specimen listed in the material of *E. caribbaeus* "… est le passage à la variété *rotundifrons*." Nevertheless, Bouvier's taxa have been recently listed as full species (Kensley 1996; Komai & Tsuchida 2012; Sakai 2011).

In this contribution, only three species are recognised in addition to *E. antillensis.* The three are partially reillustrated and the type status of all known material is established. The distribution of all four species is mapped.

Material and methods

Size is expressed as carapace length, including rostrum, in mm. As part of this study and continuing discovery of new species in the Indo-West Pacific diagnoses have been prepared for all species of *Eiconaxius* and coded into a

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DELTA database (Dallwitz 2010). This database was used to generate the diagnoses presented here; character states in italics diagnose each species in at least two respects from every other species.

In the absence of specific designation of type specimens by Bouvier (1905) ICZN Article 72.4.1.1 is invoked to treat Bouvier's (1925) publication as "evidence … to determine what specimens constitute the type series".

The MCZ catalogue (https://mczbase.mcz.harvard.edu/) was used as a source for material held but these specimens were not examined. The list of *Blake* stations (Smith 1888) was consulted for problematic localities. The MNHN material was examined in detail and listed with both its original registration numbers (Th prefixes) and current catalogue numbers (IU-) prefixes. The on-line catalogue of the National Museum of Natural History, Smithsonian Institution, (https://collections.nmnh.si.edu/search/iz/) was searched and records incorporated into distributions and depth ranges. Representative specimens of one species are retained in Museums Victoria, Melbourne (NMV). Photographs of the types are available at https://science.mnhn.fr/institution/mnhn/collection/iu/item/search. Bouvier (1925) provided general localities and *Blake* station numbers for all his material; depths were given in "brasses", translated from fathoms in Smith's (1888) lists, and converted to metres here.

The map was prepared from all available records but reflects, at best, collecting effort.

Taxonomic account

Eiconaxius agassizi Bouvier, 1905

(Figs 1, 4)

Eiconaxius agassizi Bouvier, 1905: 803.
Iconaxius agassizi.—Balss 1925: 209 (list).
Axius (*Eiconaxius*) *agassizi*.—Bouvier 1925: 458–461, fig. 22, pl. 7 fig. 5, pl. 9, fig. 2.—De Man 1925: 4 (list), 17.
Eiconaxius agassizi.—Sakai & de Saint Laurent 1989: 20–21.—Kensley 1996: 475 (list).—Felder et al. 2009: 1063 (records).—Sakai 2011: 272.—Komai & Tsuchida 2012: 37 (list).

Type material. Lectotype. Cuba, 4 miles off Morro Light, N of Havana, 23.2°N, 82.4°W, 1473 m (805 fm) (*Blake* stn 2), MCZ CRU-11966 (male).

Paralectotypes. Gulf of Mexico, Cuba, NW of Havana, 23.7°N, 83.2°W, 1574 m (*Blake* stn 41), MCZ CRU-11948 (1). Martinique, 919 m (502 fm) (*Blake* stn 95), MNHN IU-2014-12079 (Th173) (male). Dominica, 15.3°N, 61.4°W, 992 m (*Blake* stn 190), MCZ CRU-11949 (ovigerous female). Grenada, 12.1°N, 61.8°W, 533 m (*Blake* stn 260), MCZ CRU-11965 (male). Grenada, 12.1°N, 61.8°W, 844 m (*Blake* stn 266), MCZ CRU-11964 (ovigerous female). Barbados, 13.2°N, 59.8°W, 730 m (*Blake* stn 288), MCZ CRU-11950 (3), MNHN IU-12078 (Th174) (2 remain of 3 males, 2 females).

Diagnosis. Rostrum twice as long as wide. *Major cheliped merus lower margin with prominent tooth at midpoint*, fixed finger about half as long as upper margin of palm, cutting edge *with proximal blade ending in prominent sharp tooth*; dactylus cutting edge with basal molar, notch at midpoint, and straight beyond. Minor cheliped palm upper margin significantly shorter than greatest width; distolateral margin with prominent triangular toothed lobe at base of dactylus.

Distribution. USA, Cuba, Mexico, Jamaica, Martinique, Dominica, Grenada, Barbados; Caribbean Sea; Straits of Florida; 183–1574 m depth.

Remarks. Most of Bouvier's (1925) syntypic material can be accounted for in the MCZ; two lots were retained in the MNHN. Bouvier referred to two "exemplaires types" from *Blake* stn 2 on page 460 and to the "Type mâle" in the legend for plate 9. His account does not meet the conditions of ICZN Article 74.5 for lectotype designation. The illustrated male (MCZ CRU-11966) is here designated as the lectotype and is assumed to be the one remaining from this station in the MCZ.

Eiconaxius agassizi is notable for the narrow acute rostrum, median carina simply bifurcating on the gastric region, a strong notch on the dactylus of the major cheliped opposing a prominent tooth on the fixed finger, and a bifid distolateral tooth on the propodus of the minor cheliped. The species is distributed along the margins of the Caribbean Sea and into the Straits of Florida.

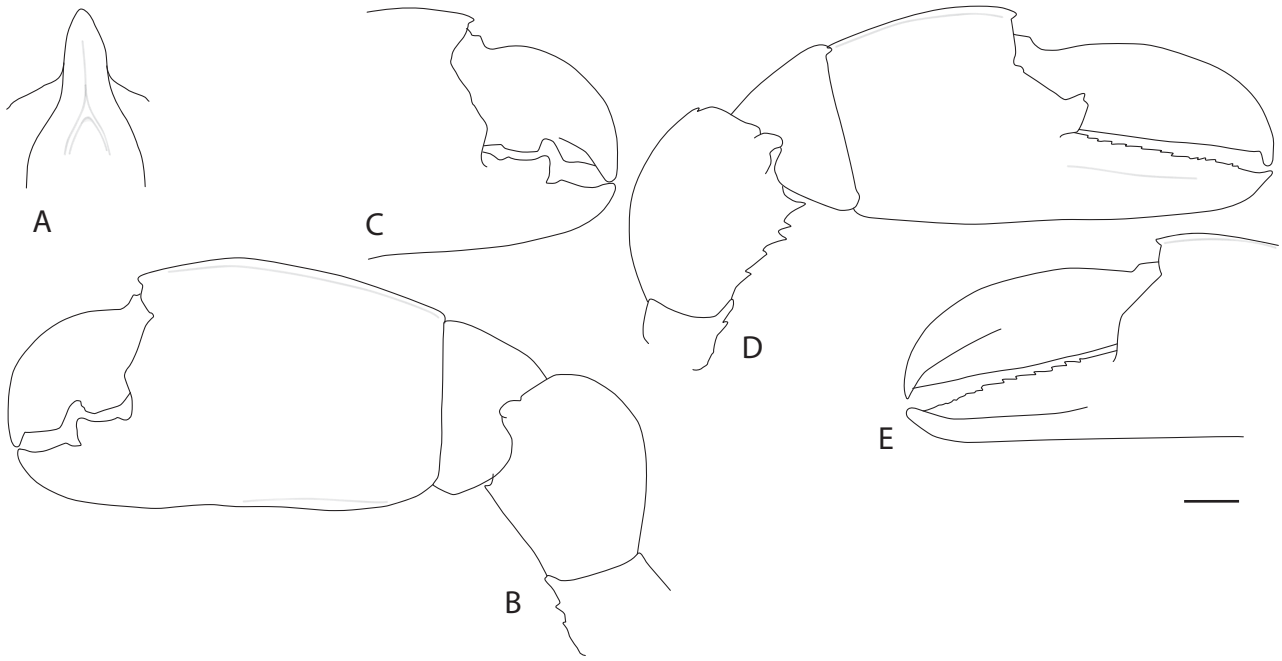

FIGURE 1. *Eiconaxius agassizi* Bouvier, 1905, paralectotype, IU-2014-12079. A, rostrum, anterior gastric region, dorsal view. B, major cheliped, lateral view. C, major cheliped, fingers, mesial view. D, minor cheliped, lateral view. E, minor cheliped, fingers, mesial view. Scale bar = 1 mm.

Eiconaxius borradailei Bouvier, 1905

(Figs 2, 4)

Eiconaxius borradailei Bouvier, 1905: 803.
Iconaxius borradailei.—Balss 1925: 209 (list).
Axius (*Eiconaxius*) *borradailei.*—Bouvier 1925: 465–466, pl. 7 figs 7, 8, pl. 9 fig. 4.—De Man 1925: 4 (list), 17.
Eiconaxius borradailei.—Sakai & de Saint Laurent 1989: 21.—Kensley 1996: 475 (list).—Felder et al. 2009: 1063 (records).—Sakai 2011: 275.—Komai & Tsuchida 2012: 37 (list).

Type material. Lectotype. Cuba, off Havana, 23.2°N, 82.3°W, 324 m (*Blake* stn ?57), MCZ CRU-11959 (female).

Paralectotypes. Barbados, 15.9°N, 61.6°W, 275 m (*Blake* stn 166), MNHN IU-2014-12076 (Th176) (1 male, 1 female – not 2 females). Barbados, 13.1°N, 59.6°W, 194 m (*Blake* stn 277), MCZ CRU-11960 (female), IU-2014-12077 (Th175) (male). Barbados, 13.0°N, 59.6°W, 225 m (*Blake* stn 297), MCZ CRU-11969 (female).

Non-type material. Guadeloupe. KARUBENTHOS 2015 stations. N of Grande-Terre, 16°42'N, 61°36'W, 618–627 m (stn DW4540), IU-2016-2470 (1 male, 4.3 mm). W of Marie-Galante, 15°48'N, 61°26'W, 304–310 m (stn DW4634), IU-2016-2570 (7 females, 3.4–4.2), IU-2016-2892 (2 males, 2.9, 4.3 mm; 6 females, 3.3–4.5 mm; 2 ovigerous females, 4.5 mm), (NMV J71656 (1 male, 1 female, 4.3 mm). 15°51'N, 61°26'W, 262 m (stn CP4636), IU-2016-2622 (1 male, 4.2 mm).

Diagnosis. Rostrum tapering more over distal third than proximal, with rounded apex in adult (acute in juvenile), 1.2–1.3 times as long as wide. Sublateral gastric carinae present, diverging widely from base of median carina. Major cheliped merus lower margin with single denticle. *Major cheliped palm upper margin distally bicarinate, ending in 2 blunt teeth*; fixed finger about half as long as upper margin of palm, cutting edge with 2 blunt teeth (overlapping); dactylus cutting edge with basal molar, notch proximal to midpoint, and concave beyond. Minor cheliped palm distolateral margin with sharp spine at base of dactylus (small); fixed finger cutting edge *with sharp tooth near base*. Pereopods 3 and 4 dactyli ovate, with row of marginal plus up to 3 facial rows of spiniform setae. Male pleopod 1 present, simple.

Distribution. Cuba, Guadeloupe, Barbados; Caribbean Sea; 194–627 m depth.

Remarks. Bouvier referred to a "femelle Type" in the legend for plate 9, almost certainly the female remaining in the MCZ from what is probably *Blake* stn 57 (the first listed but not numbered in Bouvier's list of material. Again, his account does not meet the conditions of ICZN Article 74.5 for lectotype designation. The illustrated female (MCZ CRU-11959) is here designated the lectotype. The incomplete female from *Blake* stn 259 (227 m, Milligan's Key) is lost.

Eiconaxius borradailei is notable for the upper margin of the propodus of the large cheliped uniquely ending in two short ridges and blunt teeth. This was vaguely shown in Bouvier's (1925) figure 4 but he made no mention of it. Nor did he mention the sharp tooth at the base of the dactylus of the minor cheliped. Most records of this species are on the eastern margin of the Caribbean Sea but the type locality is isolated at the northwestern limit.

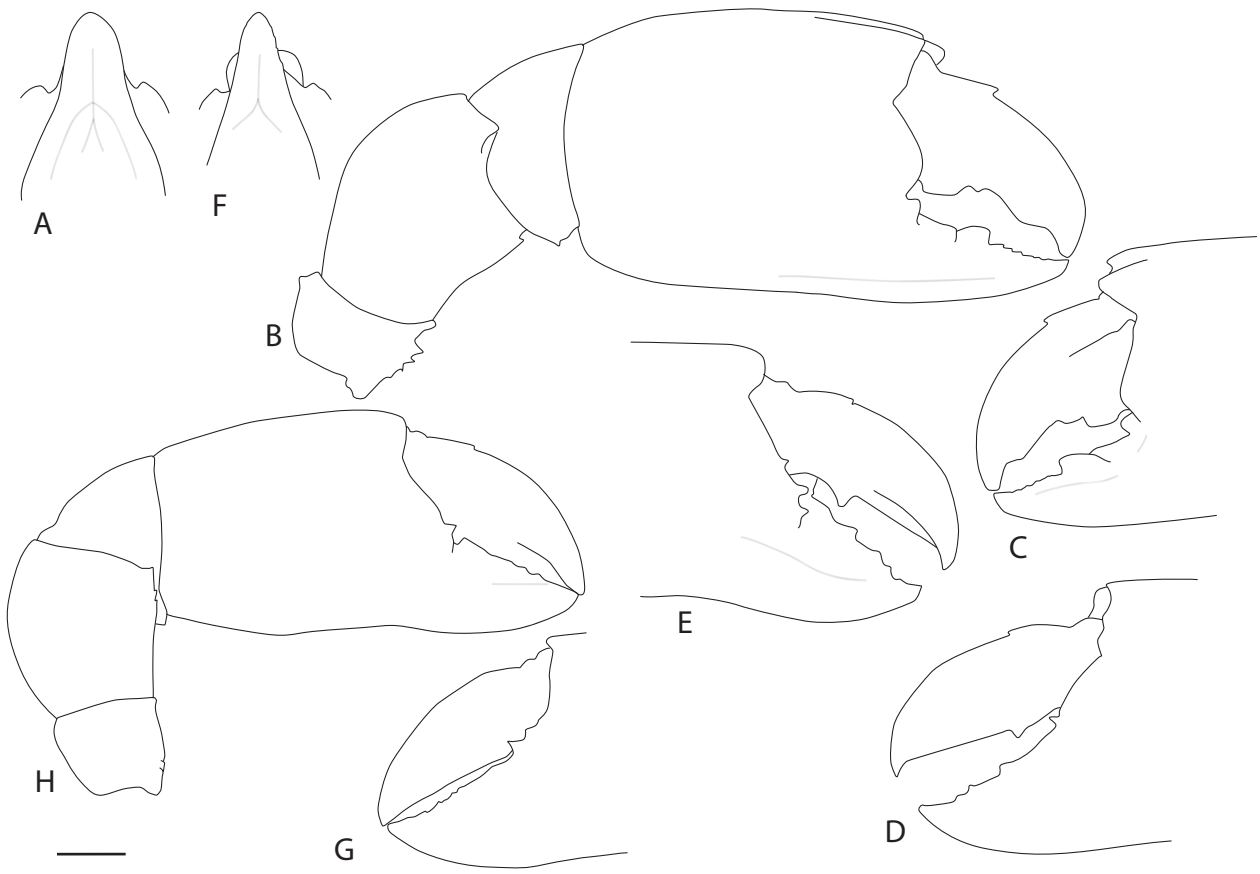

FIGURE 2. *Eiconaxius borradailei* Bouvier, 1905, paralectotype, IU-2014-12076. A, rostrum, anterior gastric region, dorsal view. B, major cheliped, lateral view. C, major cheliped, fingers, mesial view. D, minor cheliped fingers, lateral view. E, minor cheliped fingers, mesial view. Paralectotype, IU-2014-12077, F, rostrum, anterior gastric region, dorsal view. G, minor cheliped fingers, lateral view. H, minor cheliped, mesial view. Scale bar = 1 mm.

Eiconaxius caribbaeus (Faxon, 1896)

(Figs 3, 4)

Iconaxius caribbaeus Faxon, 1896: 155, pl. 1 figs 1–4.—Balss 1925: 209 (list).
Eiconaxius communis Bouvier, 1905: 803.
Axius (*Eiconaxius*) *communis* De Man, 1925: 4 (list), 17 (key).
Eiconaxius rotundifrons Bouvier, 1905: 803. **Syn. nov.**
Axius (*Eiconaxius*) *caribbaeus carinatus* Bouvier, 1925: 465, pl. 9 fig. 3.—Schmitt 1935: 191–192, fig. 52. **Syn. nov.**
Axius (*Eiconaxius*) *caribbaeus.*—Bouvier 1925: 461–463, pl. 7 fig. 6.—De Man 1925: 4 (list), 16 (key).
Axius (*Eiconaxius*) *caribbaeus rotundifrons.*—Bouvier 1925: 463–464, figs 23–25, pl. 10 figs 3, 4.
Iconaxius communis.—Balss 1925: 210.
Axius (*Eiconaxius*) *rotundifrons.*—De Man 1925: 4 (list), 17 (key).—Sakai 2011: 285

Iconaxius rotundifrons.—Balss 1925: 210.
Eiconaxius carribaeus.—Sakai & de Saint Laurent 1989: 19 (misspelling).
Eiconaxius carinatus.—Sakai & de Saint Laurent 1989: 23.—Sakai 2011: 276.—Komai & Tsuchida 2012: 37 (list).
Eiconaxius rotundifrons.—Sakai & de Saint Laurent 1989: 21–22, fig. 6.—Felder et al. 2009: 1963 (records).—Sakai 2011: 276.—Komai & Tsuchida 2012: 37 (list).
Eiconaxius caribbaeus.—Kensley,1996: 475 (list).—Felder et al. 2009: 1963 (records).—Sakai 2011: 275.—Komai & Tsuchida 2012: 37 (list).

Type material. *Eiconaxius communis* Bouvier, 1905. Syntypes. Guadeloupe, 15.9°N, 61.6°W, 275 m (*Blake* stn 166), MCZ CRU-11954 (7), MNHN IU-2014-7157 (Th178) (1), MNHN IU-2014-7159 (Th180) (2). Grenada, Milligan Key, 12.1°N, 61.8°W, 227 m (*Blake* stn 259), MNHN IU-2014-7160 (Th181) (2). Grenada, St Vincent, off Milligan Key, 13.1°N, 61.1°W, 227 m (*Blake* stn 269), MCZ CRU-11955 (3 males, 1 female). Barbados, 13.0°N, 59.6°W, 225 m (*Blake* stn 297), MCZ CRU-11956 (1 male, 2 females), MNHN IU-2014-7158 (Th179) (ovigerous female). Barbados, 13.1°N, 59.6°W, 256 m (*Blake* stn 299), MCZ CRU-11957 (1), MNHN IU-2014-7156 (Th177) (1).

Eiconaxius rotundifrons Bouvier, 1905. Syntypes. Martinique, 14.4°N, 60.9°W, 346 m (*Blake* stn 209), MCZ CRU-11951 (ovigerous female). St Lucia, 13.8°N, 61.1°W, 300 m (*Blake* stn 218), MCZ CRU-11952 (male). Barbados, 12.9°N, 59.6°W, 527 m (*Blake* stn 281), MCZ CRU-11953 (female, male lost). Barbados, 13.1°N, 59.7°W, 432 m (*Blake* stn 283), MCZ CRU-11967 (2 ovigerous females). Saint Lucia, 281 m (*Blake* stn 216), MNHN IU-2014-5069 (4 males, 4 ovigerous females)

Axius (*Eiconaxius*) *caribbaeus carinatus* Bouvier, 1925. Syntypes. St Croix, off Mount Eagle, 17.8°N, 64.8°W, 399 m (*Blake* stn 139), MCZ CRU-11968 (1). Montana, Montserrat, 16.7°N, 62.2°W, 545 m (*Blake* stn 154), MNHN IU-2014-7161 (Th182) (female). Grenada, Milligan Key, 12.1°N, 61.8°W, 291 m (*Blake* stn 259), MCZ CRU-11958 (female).

Non-type material. *From* Blake *stations*. *Eiconaxius caribbaeus* (Faxon, 1896). Guadeloupe, 15.9°N, 61.6°W, 275 m (*Blake* stn 166), MCZ CRU-74395 (1), MCZ CRU-19408 (male). St. Lucia, 13.8°N, 61.1°W, 300 m (*Blake* stn 218), MCZ CRU-126745 (1). Barbados, 13.2°N, 51.9°W, 384 m (*Blake* stn 291), MCZ CRU-19409 (1).

Other material. Cuba, off Matanzas, 420 m (Harvard-Havana Expedition 1938 stn 2999) (MNHN IU-2017-1738, MCZ donation (female non-type).

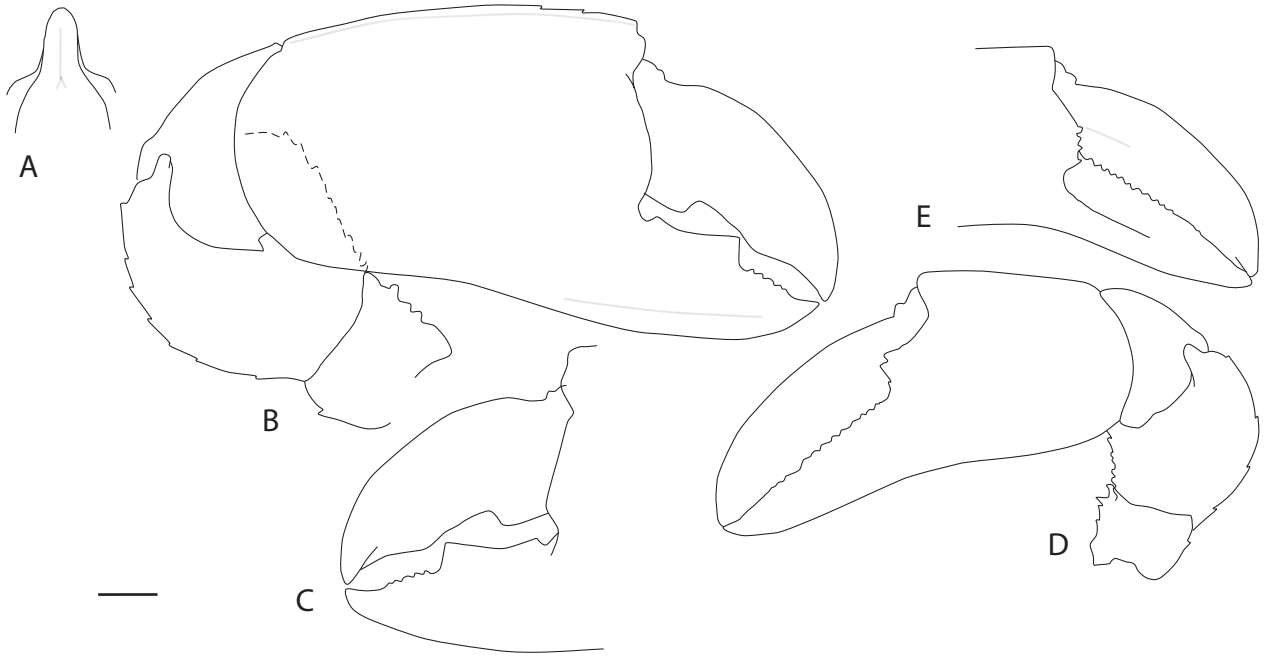

FIGURE 3. *Eiconaxius caribbaeus* (Faxon, 1896). Syntype of *Axius* (*Eiconaxius*) *caribbaeus carinatus* Bouvier, 1925, IU-2014-7161. A, rostrum, anterior gastric region, dorsal view. B, major cheliped, lateral view. C, major cheliped, fingers, mesial view. Syntype of *Eiconaxius rotundifrons* Bouvier, 1905, IU-2014-5069. D, minor cheliped, lateral view. E, minor cheliped fingers, mesial view. Scale bar = 1 mm.

Guadeloupe. KARUBENTHOS 2015 stations. N of Grande-Terre, 16°34'N, 61°37'W, 426–441 m (stn DW4518), IU-2013-18871 (male, 5.6 mm). 16°38'N, 61°31'W, 320–338 m (stn DW4538), IU-2016-2319 (ovigerous female, 5.6 mm). 16°37'N, 61°31'W, 432–482 m (stn DW4550), IU-2016-2411 (3 males, 3.6–3.8 mm; 7 females, 4.5–4.8 mm; ovigerous female, 5.8 mm), (NMV J71645) (male, 5.1 mm; female, 5.7 mm; 2 ovigerous females, 5.7–6.0 mm). W of Marie-Galante, 15°48'N, 61°28'W, 378–432 m (stn DW4633), IU-2016-2642 (female, 5.4 mm). S of Marie-Galante, 15°48'N, 61°20'W, 485–496 m (stn DW4639), IU-2016-2903 (2 males, 4.2, 6.5 mm). E of La Désirade, 16°20'N, 60°55'W, 389–413 m (stn DW4573), IU-2016-8309 (male, 3.6 mm; female, 4.5 mm; 4 ovigerous females, 4.3–6.3 mm). 16°22'N, 60°54'W, 140–340 m (stn DW4574), IU-2016-8353 (female, 4.0 mm). 16°21'N, 60°56'W, 370 m (stn DW4554), IU-2016-8361 (4 males, 4.5–6.4 mm; female, 5.7 mm; 5 ovigerous females, 4.4–6.1 mm).

Diagnosis. *Rostrum tapering more over distal third than proximal, with rounded apex in adult (acute in juvenile)*, *1.5–2.0 times as long as wide*; lateral margins smooth or denticulate. Major cheliped fingers about half as long as upper margin of palm; fixed finger cutting edge with broad blade over proximal half, irregular beyond; dactylus cutting edge with basal molar, notch and straight beyond. Minor cheliped palm upper margin as long as greatest width; distolateral margin *with prominent triangular toothed lobe at base of dactylus*; fingers almost as long to longer than upper margin of palm. Uropod endopod anterolateral apex acute, with 1 or few small teeth.

Distribution. USA, Cuba, Mexico, Virgin Islands, Monserrat, Martinique, Dominica, Grenada, Guadeloupe, Saint Lucia, Barbados; Caribbean Sea; Straits of Florida; Gulf of Mexico; 140–545 m depth.

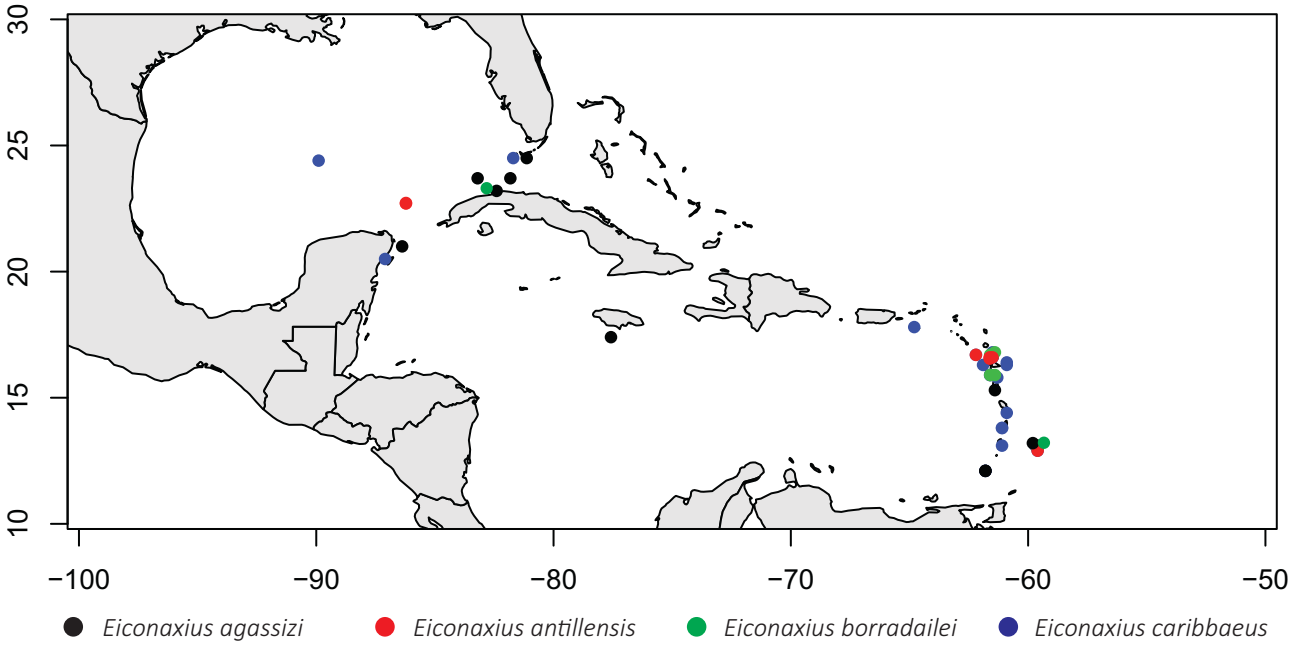

FIGURE 4. Distribution of four species of *Eiconaxius* throughout the Gulf of Mexico and Caribbean Sea. *E. agassizi* (10 records); *E. antillensis* (7 records); *E. borradailei* (7 records); *E. caribbaeus* (25 records).

Remarks. Faxon (1896) designated the specimen from *Blake* stn 283 as the "type" (holotype) of *Iconaxius caribbaeus* but this is lost. He also listed one each from *Blake* stns 166 and 232 plus three from *Blake* stn 241. One specimen from *Blake* stn 166 remains in the MCZ (CRU-74395), possibly the "femelle qui a servi de type pour la description précédente" by Bouvier (1925). Bouvier listed other material from *Blake* stn 166 (3 males, 5 females, plus several), stn 218 (2), stn 259 (1 male, 2 females), stn 269 (1 ovigerous female, 3 males), stn 291 (1), stn 290 (2 males, 1 female), stn 297 (2 ovigerous females) and stn 299 (2 males, 1 female) but only two of these remain in the MCZ. Bouvier (1925) treated *Eiconaxius communis* Bouvier, 1905 as a junior synonym of *Axius* (*Eiconaxius*) *caribbaeus* without specifying its types or type localities. Five lots bearing this name, presumably in Bouvier's hand, from some of the stations listed under *A*. (*E*.) *caribbaeus* by Bouvier (1925) remain in the MNHN and are treated as syntypes of *E. communis*. The male of *Eiconaxius rotundifrons* from *Blake* stn 241 listed by Bouvier (1925) is lost. Bouvier (1925) listed syntypes of *Axius* (*Eiconaxius*) *caribbaeus carinatus* from four *Blake* stations:

stn 139 (1 female) and stn 259 (1 female), now at MCZ, stn 154 (1 female), now at MNHN, and stn 232 (1 male) now lost.

Bouvier (1905, 1925) distinguished his species and varieties relying on the prominence of the denticulation of the rostral margin and the cheliped merus margin, and the degree of carination of the major cheliped. These are subtle differences and in this large sample intermediate states were common. None of Bouvier's species or varieties are recognised here. The fixed finger of the major cheliped of *Eiconaxius caribbaeus* consistently has a broad concave blade, slightly more elevated distally, over its proximal half. A blunt proximal tooth opposes it on the dactylus. These can be seen in Faxon's (1896) figure 3 and in Bouvier's (1925) figure 3 of *E. caribbaeus rotundifrons*. The median carina bifurcates and disappears quickly on the gastric region.

The species is the mostly commonly occurring species of the genus in the Caribbean and that with the shallowest depth range. There is a single record from the Gulf of Mexico as *E. rotundifrons* (see Felder et al. 2009).

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