Western Indian Ocean
JOURNAL OF
Marine Science

Volume 18 | Issue 1 | Jan – Jun 2019 | ISSN: 0856-860X

Chief Editor José Paula

Western Indian Ocean
JOURNAL OF
Marine Science

Published biannually

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ISSN 0856-860X

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The cavernicolous swimming crab *Atoportunus dolichopus* Takeda, 2003 (Crustacea, Decapoda, Portunidae) reported for the first time in the Western Indian Ocean during technical dives in the mesophotic zone

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Abstract

The rare cavernicolous crab *Atoportunus dolichopus* Takeda, 2003, described from Kume-Jima Island, Ryukyu archipelago, is recorded for the first time since its description. Two specimens were observed in a marine cave off Mayotte Island, Western Indian Ocean, during technical dives in the mesophotic zone. The crabs were observed in total darkness at a depth of 75m, 120m from the entrance of the cave. No specimens were collected but morphological traits recognized on close-up photographs agree with those of *A. dolichopus*. This rare species is illustrated with comments on its remarkable disjunct geographical distribution and ecology.

Keywords: Cavernicolous crab, *Atoportunus*, Mayotte Island, Mesophotic zone

The marine mesophotic, or twilight zone, situated at depths of approximately 50-150m in the tropics, is still poorly known because it is beyond the usual depths of recreational dives. Exploring these depths necessitates technical dives with re-breather and trimix gas; techniques that are still mastered by only a few divers. The first two authors of this note are experienced technical divers. In 2018 they initiated a collaborative research programme to study the mesophotic zone around Mayotte (Barathieu, 2019). This programme brings together several experts on the marine fauna and flora around Mayotte and adds to another mesophotic research programme currently being conducted around Mayotte (MesoMay, funded by DEAL Mayotte).

During a dive by the first two authors the entrance of a cave was discovered at a depth of 50m southwest of Mayotte Island near 'Passe Bateau'. The entrance of the cave was very large, approximately 3-4m high by 15m long, opening into two separate galleries sinking gently into the basement of the island (Fig. 1). At the end of the longest gallery, about 120m from the entrance at a depth of 75m, in total darkness, a remarkable crab was observed during three successive dives with photographs taken on 28/11/2018 and 23/02/2019 showing two distinct specimens. A photograph of the first specimen was transmitted for determination to JP by Professor Bernard Thomassin of the collaborative research programme. Additional photographs of the second specimen, including close-up frontal views, were later examined (Fig. 2).

Based on these photographs the genus *Atoportunus* Ng and Takeda (2003) is recognized for the first time around Mayotte. This genus was established to accommodate two unusual swimming crabs living in marine caves, respectively *A. gustavi* Ng and Takeda, 2003 and *A. pluto* Ng and Takeda, 2003. These two species are superficially similar but differ in a series of subtle morphological characters. *Atoportunus pluto* is still unrecorded outside Hawaii where it is probably endemic. *Atoportunus gustavi* has a much wider distribution being present in the western Pacific (Guam, Marianas; and

http://dx.doi.org/10.4314/wiojms.v18i1.10

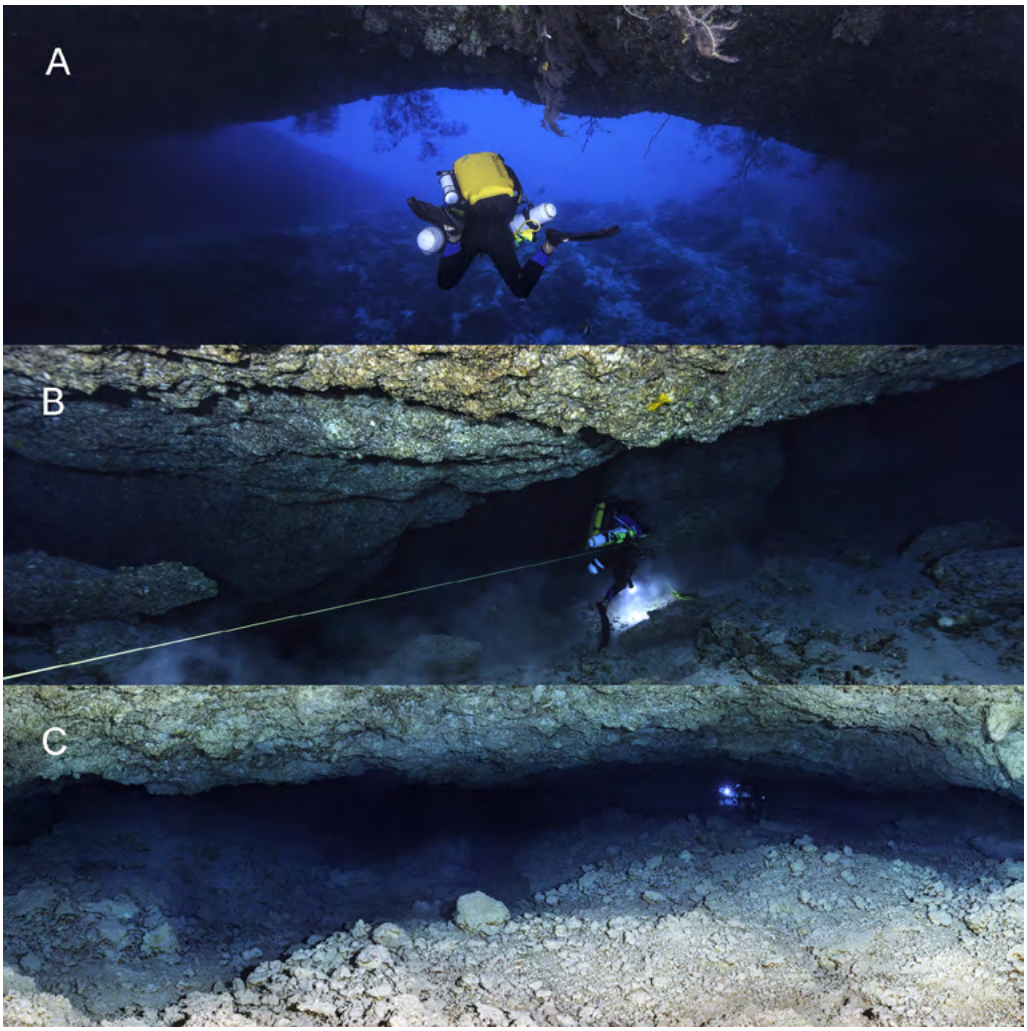

Figure 1. The *Atoportunus dolichopus* cave in Mayotte. A) Diver at the entrance of the cave, 50m deep; B) Exploring the 120m long tunnel with security line to avoid getting lost in the cave; C) End of the tunnel where the crab was observed with aspect of the bottom made up of rubble and calcareous muddy sand. Photographs G. Barathieu.

Yonaguni Island, Ryukyus) and in the eastern Indian Ocean (Christmas Island). It is probably common in marine caves as suggested by at least three more reports in the Ryukyus since its description in Shimojijima Island (Fujita *et al*., 2013) and in Okinawa-jima Island and Ie-jima Island (Fujita and Mizuyama, 2016). *Atoportunus gustavi* and *A. pluto* have been reported in depths of 2-30m in coral rubble near or in caves, normally in dark places, hence the qualification of 'chalicophilous and cavernicolous' crabs by Ng and Takeda (2003). These authors have also indicated that *Atoportunus* is classified in the Portunidae Rafinesque, 1815, despite an unusual morphology and without appropriate comparison with other portunid genera. More recently Mantelatto *et al*. (2018, Fig. 1, Table 1) have sequenced a specimen of *Atoportunus gustavi*. It groups to *Carupa tenuipes* Dana, 1852, suggesting a potential affinity of *Atoportunus* with the Carupinae Paulson, 1875.

A third species of the genus, *Atoportunus dolichopus* Takeda, 2003, has been recognized in Japan based on two specimens collected off Kume-jima Island, Ryukyus. They were found in a cave in total darkness at a depth of 38m, approximately 60m from the entrance. The new species differed from the two previous *Atoportunus* species by at least six morphological characters: a) hemispheric carapace (vs. more flattened carapace); b) narrower carapace, carapace breadth CB (including lateral spine) on carapace length CL being 1.22-1.44 (vs. 1.67-1.83); c) last anterolateral tooth directed obliquely forward (vs. more laterally); d) longer legs and chelipeds, the cheliped being ca. 3 times CB (vs. 1.80-2.00); e) armature of the merus of cheliped with mesial margin having more than 10 spines on proximal half and 3 equidistant spines on distal half (vs. 6 spines distributed over the entire length); f) cutting edges of movable and immovable

fingers of chela with respectively, 2 and 3 long spines of similar size directed obliquely (vs. 2 and 5 spines, of various sizes on immovable finger).

Morphological characters recognized on the photographs of the two *Atoportunus* specimens from Mayotte agree broadly with those of *A. dolichopus*: a) carapace hemispherical (Figs. 2B-C); b) last anterolateral spine directed obliquely forward (Figs. 2A, 3A); c) CB/CL ca. 1.45-1.55 (Fig. 3A); d) long legs with chelipeds more than 3 times CB (Fig. 2A); e) cutting edges of movable and immovable fingers of chela with respectively, 2 and 3 long spines of equal sizes directed obliquely (Figs. 2B, 3D). The armature of the mesial margin of the merus of the cheliped is intermediate between *A. dolichopus* and *A. gustavi/pluto* having 6-8 spines on the proximal half and 3-4 spines on the distal half disposed as illustrated in Fig. 3C. It seems, however, that this armature may display variation in *A. dolichopus* as illustrated in Takeda (2003) between the male holotype (Fig. 1A, 2E) and the female allotype (Fig. 1B-C). Despite this minor difference it seems reasonable, for the time being, to attribute the specimens from Mayotte to *A. dolichopus*. A new species closely affiliated to *A. dolichopus* cannot be totally excluded at this stage for Mayotte but more specimens and observations are necessary to confirm that hypothesis.

With this discovery, the geographical distribution of *A. dolichopus* appears remarkably disjunct with ca. 10 000km between Kume-jima and Mayotte Islands. Such a disjunct distribution has, however, already been observed for *A. gustavi* occurring in the Ryukyus, Marianas and Christmas Island, the latter being ca. 5 000km from the two former archipelagoes. *Atoportunus dolichopus* is probably widespread in the Indo-west Pacific (IWP) though rarely seen due to living in deep caves necessitating technical dives with complex and risky navigation in cave networks.

The eyes of *Atoportunus* crabs are reduced which is indicative of obligate cavernicolous species (Guinot, 1988; Ng and Takeda, 2003). In some cavernicolous crabs of the Potamidae, the reduction is so pronounced that the cornea is no longer visible (Guinot, 1988, Figs. 7-8). In the crabs examined from Mayotte, the cornea is still present but it is distinctly narrower than the ocular peduncle (Fig. 2C). Such a reduction is common in cavernicolous crabs. It has been documented recently by Wowor and Ng (2018) for three cavernicolous sesarmid of the genus *Karstarma*.

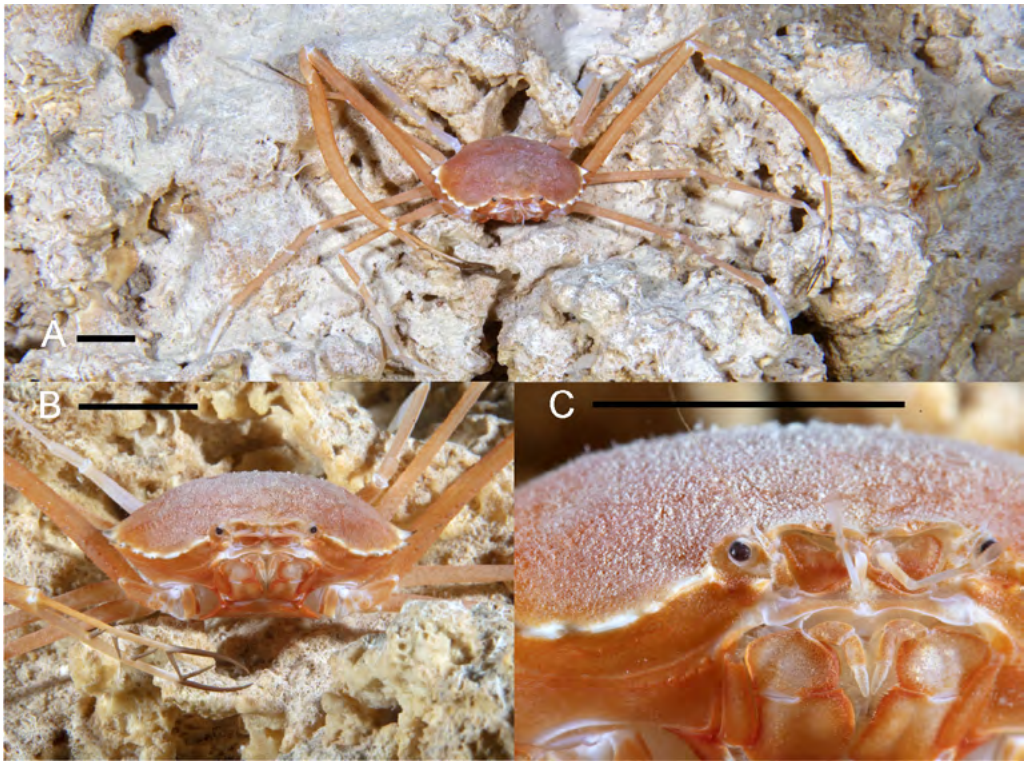

Figure 2. *Atoportunus dolichopus* in the cave at 75m depth at Mayotte Island, 23/02/2019. A) Defensive posture on hard substrate; B) Frontal view of carapace and aspect of right chela; C) Close-up frontal view showing orbits, epistome and buccal cavity. Estimated CB - 28mm. Scales bars - 10mm. Photographs G. Barathieu.

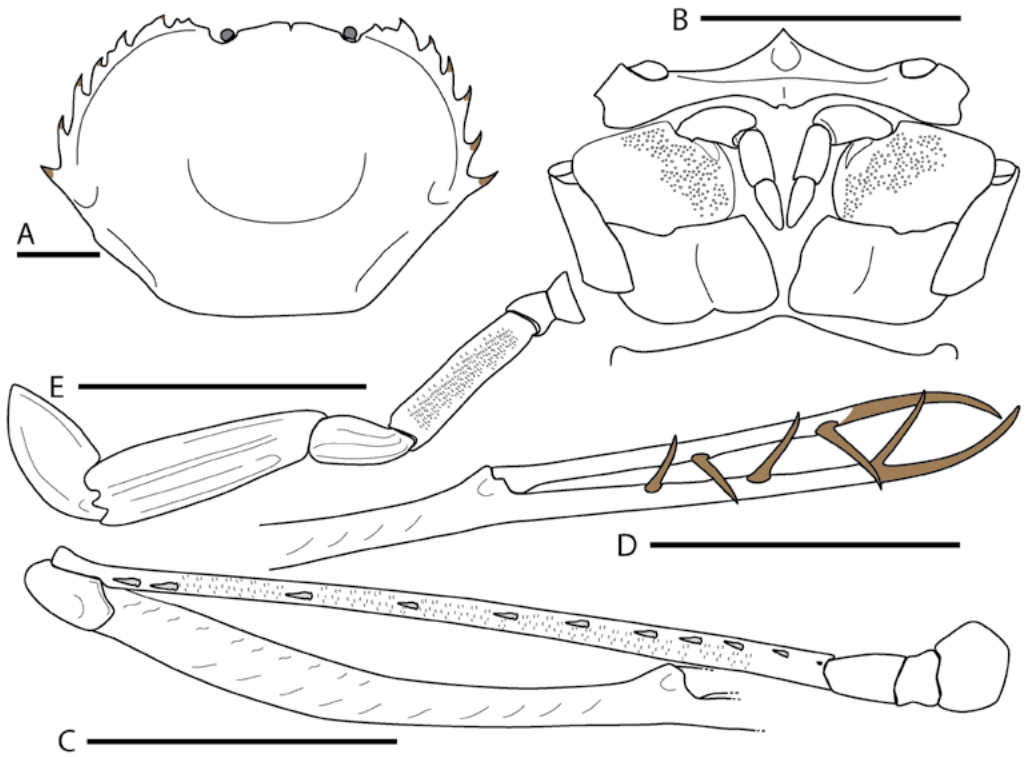

Figure 3. *Atoportunus dolichopus*, line drawings made from photographs. A, E, specimen photographed 28/11/2018; B, C-D, specimen photographed 23/02/2019; estimated CB 28mm for both specimens. A) Carapace, dorsal view with aspect of anterolateral armature; B) buccal cavity with MxP3 (setae omitted) and epistome (length of ischium is reduced because of oblique view); C) right cheliped showing mesial armature of merus; D) right chela, lateral view; E) right P5, dorsal view. Scale bars A-B, 5mm, C-E, 10mm.

Because of its hemispherical body (Fig. 2B-C), long legs (Fig. 2A) and reduced natatory P5 (Fig. 3E) this crab is probably not a good swimmer (Ng and Takeda, 2003; Takeda, 2003). The movement of the crabs in the cave was very slow and it could have been picked easily by hand which confirms Takeda's (2003) similar observation for Japanese specimens. The defensive posture of the crab (Fig. 2A) suggests that it probably hunts from a hide in total darkness. It must be able to quickly project its long chelipeds forward when it feels a prey within reach and harpoon it with the spear-like spines of its claws (Fig. 3D). No potential prey were observed during the dives in the immediate surroundings of crab but small shrimps and fishes were seen in the first tens of meters from the entrance where the crabs could possibly move for hunting. Three other macro-decapods were observed in the cave during the dives: a swimming crab, probably *Gonioinfradens paucidentatus* (A Milne-Edwards, 1861) hidden in a hole near the entrance; the hermit crab *Aniculus maximus* Edmonson, 1952 observed in total darkness, 60m from the entrance; and the shrimp *Parhippolyte misticia* (J Clark, 1989) with solitary individuals observed in several places in the tunnel - one in total darkness 100m from the entrance. *Parhippolyte misticia* is also a true cavernicolous shrimp originally described from a cave in Palau (Clark, 1989) and now reported from several IWP localities (Debelius, 2001). The two other species, *G. paucidentatus*, and *A. maximus*, are not cavernicolous but occasionally visit the caves.

Acknowledgements

Professor Bernard Thomassin is warmly thanked for bringing to JP's attention this remarkable crab and for his useful comments and constant help for the study of the mesophotic zone in Mayotte.

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