

Review of genus *Halieutaea* (Teleostei: Lophiiformes: Ogcocephalidae), with a new species from northern south China sea, named *Halieutaea liui*

Ming BA

Beijing Huiwen Middle School, 6 Peixin Street, Dongcheng, Beijing, PRC, 100061

631607010331@mails.cqjtu.edu.cn

Abstract. In the offshore waters of Shantou, Guangdong Province, in the northern part of the South China Sea, a specimen belonging to the genus *Halieutaea* was collected at a depth of about 100 meters. It is similar to the known *Halieutaea fitzsimonsi* but also has some differences. Hence, this specimen is considered a neotype named *Halieutaea liui* sp. nov. The neotype can be distinguished from *Halieutaea fitzsimonsi* by the following external features: a prominent snout, a shorter peduncle, and unevenly distributed bony spines on the dorsal side of the disc. In addition, methods of distinguishing 13 known species of *Halieutaea* (including *Halieutaea liui* sp. nov.) by their appearance characteristics are cldwarified.

Keywords: *Halieutaea*, fin, spine, snout, distinguish.

1. Introduction

This treatise is about *Halieutaea* Cuvier *et* Valenciennes, 1837.

Genus *Halieutaea* belongs to Order Lophiiformes and Family Ogcocephalidae. Only found in seawater. All the species are famous for their flat and round discs. They have a wide horizontal distribution range, widely distributed in the Indian and Pacific oceans, from the temperate to the tropics. The vertical distribution range is also wide, mostly distributed at the edge of the continental shelf, and the habitat depth is mostly 50-500m below the sea surface.

They have a different standard length (SL), up to about 30 cm. Mouth produced as anterior or sub-anterior position, can freely open, with teeth on both the maxilla and mandible. They all have lateral lines. The gills are large, but the openings are small, located on the dorsal side of the disc, the inner side of the base of the pectoral fin. The skin around them is loose. No pseudobranches. The pectoral fin is long, and the arm is developed. The pelvic fins are under the larynx, with long soft rays and arms. There are two dorsal fins, which are very far separated. The first dorsal fin has only one spine, specialized as an illicium with a lure at the end; the second dorsal fin, which is located behind the disc, is nearly opposite to the anal fin but slightly misaligned and has soft rays only. The front part of the frontal bone is specialized into a depression, forming an illicial trough (IC). The illicium hidden in it can partly freely move and can extend out of the IC, but it can't extend further. Two pairs of nostrils. The body is completely scaleless, just with spines. Slight spinules are all embedded in the skin and can move with the skin. The bony spines are mostly embedded in the skin and can also move with the skin; some are fixed to the bone and cannot move at all [1-3].

All the species of *Halieutaea* live a planktonic life at the early stage of development and actively prey on plankton. Adults are not good at swimming but can walk on the sea floor using their pectoral and pelvic fins. But usually, they like to be an angler. The lure can lure the small animals, and the anglers wait to suck them into the mouth. The feeding habits of different species are almost the same, and the adults are carnivorous, preferring to eat brittle stars, starfish, small fish, small crustaceans, and polychaetes [3].

According to the research, there are 13 species of *Halieutaea* [1-10]:

Halieutaea retifera

Halieutaea fumosa

Halieutaea fitzsimonsi

Halieutaea dromedaria

Halieutaea xenoderma

Halieutaea hancocki

Halieutaea stellata

Halieutaea coccinea

Halieutaea sinica

Halieutaea nigra

Halieutaea indica

Halieutaea brevicauda

and a new species: *Halieutaea liui* sp. nov.

Among them, *H. sinica* is considered to be a synonym of *H. indica* due to the lack of specimens. However, there is enough morphological evidence to prove that they are not the same species. For that sake, the author tentatively defines them as two different species. These 13 species can be easily distinguished by the structure of the epidermis, the length of each fin, and the form of the snout.

2. New species

2.1. Description

Holotype: *Halieutaea liui* sp. nov.

Type locality: PRC, Guangdong, Shantou, Nan'ao, 117.184°E, 23.201°N, deep tropical water, 100m under the surface, 1 January 2023.

Original label: "Holotype, frozen, 117.184°E, 23.201°N, 100m deep, 1 Jan. 2023 / 3 Jan. 2023, Ming Ba" "PRVT-Fr 00104"

The body is flat and not extended. The head is slightly higher, the snout is slightly protruding from the mouth, and the IC is inclined forward from bottom to top. The snout is mildly longer than the eye diameter. The body is like a round disc. The length of the disc is slightly more significant than the width when fully tightened, and the width is slightly more significant than the length when fully expanded; the widest part is at the same horizon as the base of the pelvic fin, the highest part is horizontally far in front of the base of pelvic fin. The eyes are nearly oval, and the orbital bone is thick and large. Mouth large, sub-anterior position, with a concave on the middle of the inside of the maxilla and a bulge on the corresponding outside. Fine teeth, which are slightly blunt and banded, are produced on the maxilla and mandible. The vomer bone has teeth and is divided into multiple subgroups; The tongue is large, wide and free, and its upper surface is also toothed, which is distributed near the edge of the tongue and slightly near the inner side, as a "U" Shaped belt, similar to the shape and trend of the tongue edge. The gill is significant, without pseudobranches, the openings are small, located on the dorsal side of the inner side of the base of the pectoral fin, and the skin around them is very loose. There is an inconspicuous horizontal lateral line in front of the anal fin after the anus; the starting point of the lateral line is at about the same level as the anal fin. This lateral line is bent to the anus, while the part directly in front of the anus is straight. Two pairs of nostrils are located on both the left and right sides of the IC. The anterior naris is nearer to the IC, at the front and lower part of the posterior naris. The diameter of the anterior naris is about isometric to the semidiameter of the posterior naris.



Figure 1. The external appearance of the neotype. A: the vertical view of the neotype; B: the ventral view of the neotype; C: the side view of the neotype; D: the snout of the neotype.

Pectoral fin: 14; pelvic fin : 5; dorsal fin: I, 5; anal fin: 4; caudal fin: 9.

The pectoral fin is long, and the arm is developed; the former ray is always longer than the latter one, and all of them are not branched. The pelvic fins are under the larynx, also with long soft rays and arms. The former ray is always shorter than the latter one, and all the rays are not branched. Two dorsal fins are very far separated. The first dorsal fin is specialized as an illicium, the fin spine is not bifurcated, covered by membrane, with a lure at the end. The lure has three parts, the upper part and the lower two parts, the upper part is small, the lower two parts are large and equal in size, and are connected with the fin membrane. The third ray of the second dorsal fin is the longest, slightly as long as the length of the caudal peduncle. All the rays are not branched, located behind the body disc. The anal fin also ends with fin membrane, and the last fin membrane starts from the lower middle part of the last ray and connects to the skin of the caudal peduncle, the second ray is the longest, and all the rays are not branched. The end of the anal fin could reach the base of the caudal fin. The anal fin and the second dorsal fin are nearly opposite, but the anal fin is slightly backward. The caudal fin is truncated, and each ray is nearly

isometric. The first, eighth and ninth soft rays are not branched, the other six only have two branches in the lower middle part, which do not branch again after branching. In contrast, the membrane of the odd fins is 'tight, thin and diaphanous than the even fins. The caudal peduncle is short, the pectoral fin is long, and the end of the pectoral fin can reach the base of the caudal fin or be further behind when the body disc is normally tightened.

The front part of the frontal bone is specially shaped into a depression, forming an IC, with the snout protruding, the IC leans forward slightly from the bottom to the top, and the illicium is hidden in it, which can move freely, and can partially extend out of the IC, but can't extend further.

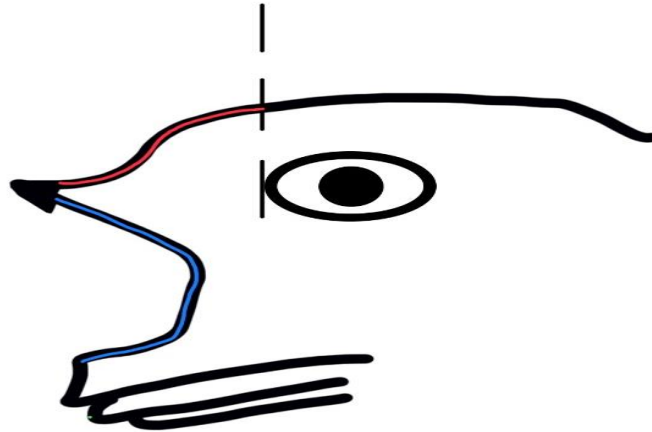


Figure 2. The longitudinal section of the head of the neotype. Red line: dorsal side of snout; blue line: IC; green dot: front edge of the mouth.

The body is entirely scale-free, the dorsal side and the edge of the ventral side are covered with bony spines, and there are no slight spinules. Except for bony spines, the skin on the body surface is loose and smooth. Bony spines can be embedded in the skin and can move with the skin, these bony spines, but are usually bifurcated, are mostly distributed in the middle of the dorsal side of the disc and the rear part near the edge of the disc; they can also combine with bone, fixed but can't move, these bony spines which are usually bifurcated are mostly distributed at the edge or near the edge of the head and body. There is one fixed spine at the upper edge, left edge and right edge of the IC, and no spine at the lower edge. The spine on the left and right edges are bifurcated, the spine on the upper edge is not bifurcated. There are also two small bifurcated spines under the fixed spines on the left and right edges of the IC, which are distributed along the edge of the IC and can move with the skin. There are two spines on the orbit, one spine behind the orbit, and three spines in front of the orbit, which are neither bifurcated nor movable. Below the eyes, a small spine with no bifurcation is embedded in the skin. The thick bone makes the dorsal part of the body have many arrises, either long or short. The density of bony spines on the arrises is high, and the density of bony spines in the non-arris area is low; they are mostly movable. The bony spines are almost entirely covered with skin, and there is often skin whisker extension at the distal end.

Table 1. Each proportion of the neotype (unit: mm).

Standard length	120.1
Total length	153.2
Body depth	29.9
Body width	93.4
Length of base of pectoral fin	15.0
Length of base of pelvic fin	7.6

Table 1. (continued).

Length of base of dorsal fin	5.7
Length of base of anal fin	7.1
Length of base of caudal fin	8.0
Length of pectoral fin	43.9
Length of pelvic fin	24.5
Length of dorsal fin	18.7
Length of anal fin	24.1
Length of caudal fin	34.1
Eye diameter	11.2
Snout length	13.4
Caudal peduncle depth	10.5
Caudal peduncle length	16.6
Ocular distance	13.0
Head length	64.9
Trunk length	83.2
Caudal length	70.0

Its cover change colour quickly.

2.2. Methods

First, the author observed the physical characteristics on the surface of this specimen with the naked eye only. According to the description, it was the most similar to *H. fitzsimonsi*, but there were still differences, and then the author determined it was an undetermined species. Comparing the solid specimens, more undetermined characteristics significantly different from those of *H. fitzsimonsi* were found. However, given that all the specimens of *H. fitzsimonsi* the author has got are larger than the specimen with different characteristics, it is reasonable to suspect that there are significant differences in different ages or sizes. To falsify this suspicion, the author used incomplete induction: due to the low yield of *H. fitzsimonsi*. The author collected some more common specimens: 32 specimens of *H. stellata*, with a TL of 6 cm-19 cm; 9 specimens of *H. indica*, with a TL of 3 cm-8 cm. Then observed their body in detail. Finally, it was found that the appearance characteristics used to distinguish the undetermined species from *H. fitzsimonsi* almost do not change with age and size. Hence, it can be inferred that although the undetermined specimen is smaller than all the specimens of *H. fitzsimonsi*, this undetermined specimen is still likely to become a neotype. Because the author has only one neotype, it is difficult to observe its internal structure. Only a rough comparison can be made under X-ray, but it can still be seen that its otolith morphology is also different from *H. fitzsimonsi*, which further confirms that it is a new species. The author named it *Halieutaea liui* sp. nov..

2.3. Results

How to distinguish *Halieutaea liui* sp. nov. from *H. fitzsimonsi*.

2.3.1. Snout. The snout is more prominent:

The dorsal side of the snout protrudes from the front edge of the mouth (vs: doesn't protrudes from the front edge of the mouth); the IC inclines forward from bottom to top (vs: the IC inclines forward from top to bottom)

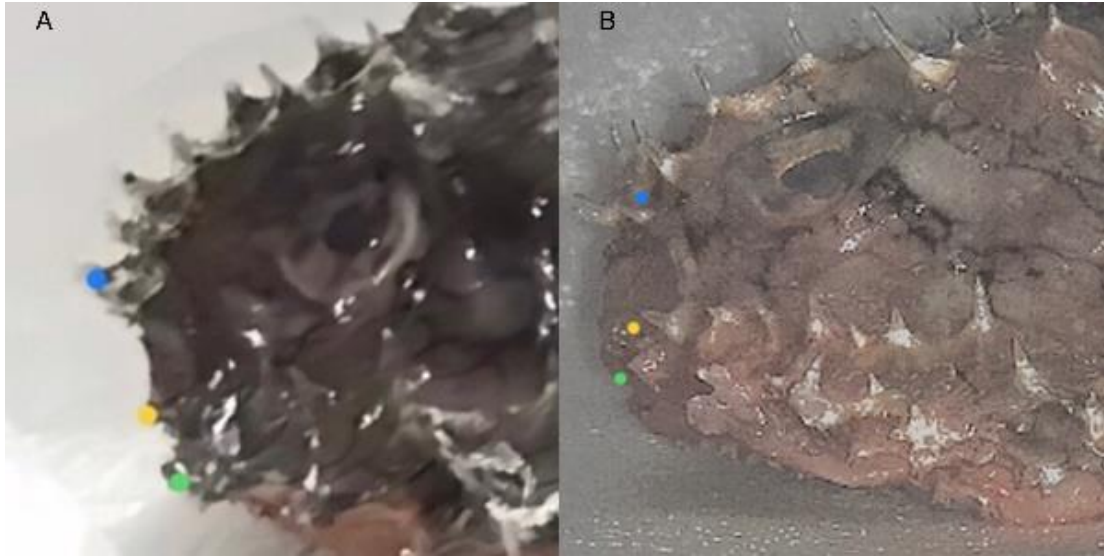


Figure 3. Side view of head structure. A: neotype; B: *H. fitzsimonsi*. There are three points in each picture, which are blue, yellow and green from top to bottom. Blue point: the front edge of the dorsal side of the snout (simplified as the top of IC); yellow point: the bottom of the IC; green point: the front edge of the mouth.

2.3.2. *Caudal peduncle.* The caudal peduncle is shorter:

When the body plate is naturally tightened, the pectoral fins reach the caudal fin (vs: the pectoral fins do not reach the caudal fin).

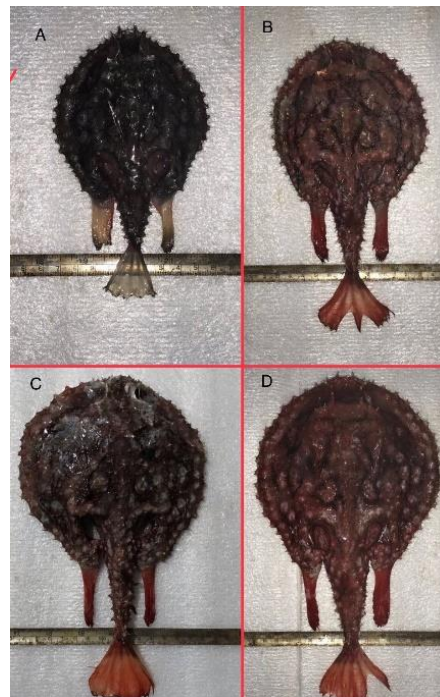


Figure 4. A, B, C: *H. fitzsimonsi*; D: neotype. The scale under the tail can be used to compare the position of the end of the pectoral fin.

2.3.3. *Bony spines.* The distribution of bony spines on the dorsal side of the disc is uneven:

The bony spines on the bulge of the dorsal side of the disc are obviously dense, and the bony spines at the non-bulge area of the dorsal side of the disc are obviously sparse (vs: The bony spines on the dorsal side of the are uniformly dense).

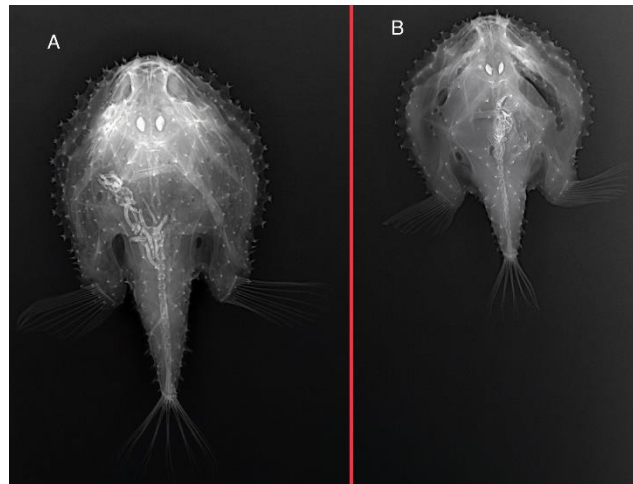


Figure 5. Dorsal views under X-ray. A: *H. fitzsimonsi*; B: neotype. It reflects the distribution of superficial bony spines.

2.3.4. *Otolith*. e ends of the otolith are more pointed:

The front and back ends of the otolith are pointed (vs: The front and back ends of the otolith are circularly blunt).

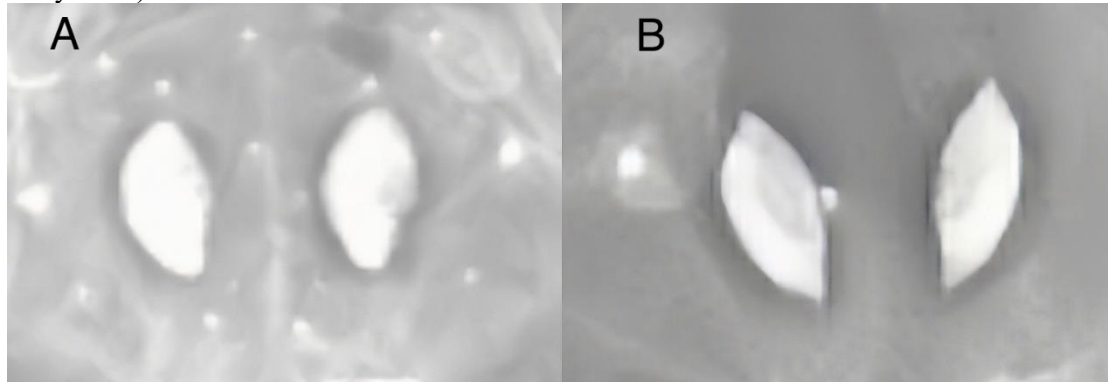


Figure 6. A: The otoliths of *H. fitzsimonsi*; B: The otoliths of the neotype. Reflects the differences between otoliths.

3. Keys in distinguishing each species

They are usually distinguished by using DNA before developing into adults.

The key methods to distinguish adults by appearance [1-10]:

- 1 (8) Ventral surface of disc wholly smooth
- 2 (5) Small spinules distributed between bony spines on dorsal surface of disc
- 3 (4) Dorsal side of disc covered with dark solid reticular.....*Halieutaea retifera*
- 4 (3) Dorsal side of disc covered with dark dotted lines.....*Halieutaea fumosa*
- 5 (2) Between bony spines on dorsal surface of disc wholly smooth
- 6 (7) Dorsal side of snout not protrudes from front edge of mouth.....*Halieutaea fitzsimonsi*
- 7 (6) Dorsal side of the snout protrudes from front edge of mouth.....*Halieutaea liui*
- 8 (1) Ventral surface of disc not smooth
- 9 (16) Ventral surface of disc not covered by small bucklers

- 10 (11) Base of villiform spinules on ventral surface of disc having tubercles.....*Halieutaea dromedaria*
11 (10) Base of villiform spinules on ventral surface of disc having no tubercles
12 (13) Length of caudal fin more than half of caudal length.....*Halieutaea xenoderma*
13 (12) Length of caudal fin less than half of caudal length
14 (15) Bony spines on the dorsal surface of the disc only distributed at edge...*Halieutaea hancocki*
15 (14) Bony spines on dorsal surface of disc distributed everywhere.....*Halieutaea stellata*
16 (9) Ventral surface of disc covered by small bucklers
17 (18) All caudal fin rays unbranched.....*Halieutaea coccinea*
18 (17) Some of rays of caudal fin branched
19 (20) Ventral surface of disc bearing no villiform spinules.....*Halieutaea sinica*
20 (19) Ventral surface of disc bearing villiform spinules
21 (22) Dorsal side of disc covered with solid dark veins.....*Halieutaea nigra*
22 (21) Dorsal side of disc not covered with solid dark veins
23 (24) Dorsal side of snout protrudes from front edge of mouth.....*Halieutaea indica*
24 (23) Dorsal side of snout not protrudes from front edge of mouth.....*Halieutaea brevicauda*

4. Prospect

As for the new species, *Halieutaea liui* sp. nov., there is only one neotype. It can be identified as a new species just based on morphology. Hence, it also needs molecular evidence, such as DNA, to support it. More specimens are also needed to summarize more accurate characteristics. It may form a complex with the *H. fitzsimonsi*. The Distribution range of *Halieutaea liui* sp. nov. may also be wider than we thought. Dr. Prokofiev once collected a specimen in the Coral Sea with the characteristics of both *H. brevicauda* and *H. nigra*, which is still under study and is likely to be a new species [5]. In addition, many new species are still waiting to be discovered. The interspecific differentiation of the *Halieutaea* is relatively high, but it is like that of other families of anglerfish, its distinguishing method is different from other fishes, so they are usually ignored. Regarding the new species discovery sites of the same family, new species under the genus *Halieutaea* may still be found near the central and eastern Pacific Ocean islands [1,5,7]. Their distribution range should also continue expanding with the record.

References

- [1] Bradbury, M.G., Ogocephalidae. p. 370-373. In M.M. Smith and P.C. Heemstra (eds.) Smiths' sea fishes. Springer-Verlag, Berlin, 1986.
[2] Chang, C. and Chang, Y., Research of *Halieutaea* (Ogocephalidae) of China. ACTA ZOOLOGIA SINICA (1), 158-163,1964.
[3] Su, J. and Li, C., FAUNA SINICA OSTICHTHYS TETRAODONTIFORMES PEGASIFORMES GOBIESOCIFORMES LOPHIIFORMES [M]. Science Press, 2002.
[4] Gilchrist, J. D. F. and W. W. Thompson, Description of four new S. African fishes. Marine Biological Report South Africa 1914-1918, 1916.
[5] Prokofiev, A. M., A new species of *Halieutaea* (Teleostei: Lophiiformes: Ogocephalidae) with a revised identification key for the genus. Munis Entomology & Zoology. 2020, 15 (2): 331-335.
[6] Bradbury M G., JSTOR: Copeia, Vol. 1967, No. 2 (Jun. 5, 1967), pp. 399-422 [J]. Copeia.
[7] Prokofiev, A. M. New Species of Batfish from the Genus *Halieutaea* (Ogocephalidae) from Vietnam. *Journal of Ichthyology*. 2019, 59(6): 827-833.
[8] Chen D. and Chang M., MARINE FISHES OF CHINA [M]. China Ocean University Press, 2015.
[9] Cheng, T., Systematic retrieval of fish in China [M]. Science Press, 1987.
[10] Wu, H. and Zhong, J., Key to Marine and Estuarial Fishes of China [M]. Science Press, 2021.