Summary

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Title	Systematics of the waspfish genus *Neocentropogon* Matsubara, 1943 and related genera (Teleostei: Tetrarogidae)

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Introduction

The family Tetrarogidae was regarded as comprising 18 valid genera with 43 valid species overall. The genus *Neocentropogon* Matsubara 1943, one of the most poorly known genera in the family, comprises 6 species, viz., *Neocentropogon aeglefinus*, *Neocentropogon affinis* (Lloyd 1909a), *Neocentropogon japonicus* Matsubara 1943, *Neocentropogon mesedai* Klausewitz 1985, *Neocentropogon profundus* (Smith 1958), and *Neocentropogon trimaculatus* Chan 1966. Apart from original descriptions and numerous brief treatments in general classifications and regional faunal studies, *Neocentropogon* has at no time been reviewed on the basis of type and non-type materials; thus, some taxonomic confusion has resulted. Accordingly, the present review of the genus has been made on an Indo-West Pacific basis. Examination of all available type specimens and a large number of non-type specimens of *Neocentropogon* representing wide distributional ranges in this study resulted in six species being regarded as valid. They are redescribed here in detail, including key to species of the genus *Neocentriopogon*.

Similarly, taxonomic reviews and a key to all genera of Tetrarogidae on the basis of examination of all valid species have never been published, although some authors (e.g., Poss and Rama-Rao 1984; Poss 1999) provided a regional key to some genera. This study aims to provide a taxonomic revision and a complete key to the genera of the family, based on examination of numerous specimens.

Material and methods

Counts and proportional measurements followed Motomura (2004a) and Motomura et al. (2008), except scale counts followed Chungthanawong and Motomura (2018). Standard and head lengths are expressed as SL and HL respectively. Head spine terminology follows Randall and Eschmeyer (2002: fig. 1) and Motomura (2004b: fig. 1). Osteological characters, including vertebral counts, were observed on radiographs of *Neoc. aeglefinus* (8 specimens: CSIRO H 4032-01, MNHN 2006-0256, 2014-0992, QM I. 21498, 32707, 34291, 38959, 38964), *Neoc. affinis* Lloyd 1909 (3: KAUM–I. 33280, SAIAB 65706, 2 specimens), *Neoc. japonicus* Matsubara 1943 (11: FAKU S511, 103972, KAUM–I. 20392, 20393, 30815, MNHN 1984-0635, 2005-0624, 2005-0709, 2005-1006, 2005-1298, NSMT-P 119710), *Neoc. profundus* Smith 1958 (1: MNHN 2006-0008), and *Neoc. trimaculatus* Chan 1966 (11: BMNH 1965.11.6.3, FAKU 75091, KAUM–I. 40487, 77115, 88804, MNHN 2003-1850, 2005-2624, 2014-1040, NSMT-P 112288, QM I. 22111, 38768). The formula for configuration of the supraneural bones, anterior neural spines and anterior dorsal-fin pterygiophores follows Ahlstrom et al. (1976). Swimbladder

absence was confirmed by dissection of the abdomen on the right side of the body in *Neoc. aeglefinus* (2: QM I. 21498, 2), *Neoc. affinis* (KAUM–I. 33280), *Neoc. japonicus* (8: FAKU S511, S512, 103972, KAUM–I. 20393, 30815, 81861, 114281, 114289), *Neoc. trimaculatus* (5: KAUM–I. 77115, 77117, 88804, 97509, 97510). Color descriptions are based on preserved specimens. The key to genera was based on specimens representing 39 species in 17 genera examined during this study and the original descriptions of four species (Bleeker 1848; Weber 1913; Poss and Eschmeyer 1975; Fricke 2017). Institutional codes follow Sabaj (2019).

Chapter 1 Revision of the genus *Neocentropogon*

The examination of type and non-type specimens of the genus *Neocentropogon* collected from Indo-West Pacific resulted in six species being regarded as valid viz., *Neoc. aeglefinus* (distributed in Philippines to Australia), *Neoc. affinis* (eastern Indian Ocean), *Neoc. japonicus* (Japan west to South China Sea), *Neoc. mesedai* (Red Sea), *Neoc. profundus* (southwestern Indian Ocean), and *Neoc. trimaculatus* (East Asia and Australia). Although *Neoc. trimaculatus* (Fig. 7) resembled *Neoc. aeglefinus* (Fig. 1) and *Neoc. affinis* (Fig. 3) in sharing 13–15 (mode 14) dorsal-fin spines and a dark blotch behind the opercular margin above the pectoral fin, it could be easily distinguished from the latter two species by the two blotches on the dorsal-fin base extending up to the fin (vs. absent), head with brownish stripes radiating from the pupil (vs. absent), lowermost four pectoral-fin rays elongated (vs. not elongated), postocular spine present (vs. absent), 6–8 (mode 7) anal-fin soft rays [vs. 5 or 6 (6)], and symphyseal knob unremarkable (vs. pronounced). *Neoc. affinis* is clearly separated from *Neoc. aeglefinus*, the former having rows of dark spots on the dorsal body surface, dorsal fin, pectoral fin, and caudal fin (vs. spots absent), 79–96 scale rows in the longitudinal series (vs. 94–137), and 0–8 scale rows above the lateral line (vs. 8–17). *Neoc. mesedai* (Fig. 5) is similar to *Neoc. profundus* (Fig. 6) and *Neoc. japonicus* (Fig. 4) in lacking a dark blotch behind the opercular margin. However, it differs from the latter two species in having the four lowermost pectoral-fin rays elongated (vs. not elongated), 13 dorsal-fin spines (vs. 14–16), and 18 lateral-line pores (vs. 19–24). *Neoc. profundus* can be distinguished from *Neoc. japonicus* by the unremarkable symphyseal knob (vs. pronounced), postocular spine absent (vs. present), 5 anal-fin soft rays (vs. 6–7), 71–76 scale rows in the longitudinal series (vs. 97–139), 5–8 scale rows above the lateral line (vs. 10–21), greater orbit diameter [15.4–17.0% (mean 15.9%) of SL vs. 11.4–14.1% (12.7%)], and irregular dark spots present on the dorsal body surface (vs. absent).

Analyses of 35 measurements taken from 77 specimens (29.6–116.4 mm SL) of *Neoc. aeglefinus* showed that several morphometric proportions (% of SL) changed with growth. Whereas relative post lacrimal spine length increased with growth (Fig. 2a), the relative length of pectoral fin, first dorsal-fin spine, second dorsal-fin spine, third dorsal-fin spine, fourth dorsal-fin spine, all anal-fin spines, pelvic-fin spine, and longest pelvic-fin soft ray decreases (Figs. 2b–k). These proportional changes indicated that small specimens of *Neoc. aeglefinus* have a relatively short lacrimal spine, longer dorsal-, anal-, and pelvic-fin spines, and longer pectoral fin (Fig. 1). As well as analyses of 38 specimens (24.5–145.6 mm SL) of *Neoc. trimaculatus* showed that relative suborbital width and posterior lacrimal spine length increased with growth (Figs. 9a–b), while the relative length of pectoral fin, all dorsal-fin rays, all anal-fin spines, longest anal-fin soft ray, pelvic-fin spine, and longest pelvic-fin soft ray decreases (Figs. 9c–n). These proportional changes indicated that small specimens of *Neoc. trimaculatus* have a

relatively short lacrimal spine, narrow suborbital space, longer dorsal-, anal-, and pelvic-fin spines, and longer pectoral fin (Fig. 8).

Key to the species of *Neocentropogon*

1a. Body with single large dark blotch behind opercle ……..……...……..……2

1b. Body without large dark blotch behind opercle ……..……4

2a. Two dark blotches basally on dorsal fin; head with brownish stripes radiating from pupil; symphyseal knob unremarkable; postocular spine present; four lowermost pectoral-fin rays elongated; anal-fin soft rays 6–8 (usually 7) …..…….. *Neoc. trimaculatus*

2b. No dark blotches basally on dorsal fin; head without brownish stripes; symphyseal knob pronounced; postocular spine absent; four lowermost pectoral-fin rays not elongated; anal-fin soft rays 5 or 6 (usually 6) ……..... 3

3a. Rows of dark spots on dorsal half of trunk, and dorsal, pectoral, and caudal fins; scale rows in longitudinal series 79–96; scale rows above lateral line 0–8 ..... *Neoc. affinis*

3b. Dark spots absent from trunk and fins; scale rows in longitudinal series 94–137; scale rows above lateral line 8–17 ……..…….. *Neoc. aeglefinus*

4a. Dorsal-fin spines XIII; four lowermost pectoral-fin rays elongated; lateral-line pores 18 ……..……... *Neoc. mesedai*

4b. Dorsal-fin spines XIV–XVI; four lowermost pectoral-fin rays not elongated; lateral-line pores 19–24 ……..……..……..……..……. 5

5a. Symphyseal knob unremarkable; irregular dark spots on dorsal body surface; dorsal-fin spines XIV; anal-fin soft rays 5; scale rows in longitudinal series 71–76; scale rows above lateral line 5–8; postocular spine absent; orbit diameter 15.4–17.0 % of SL ..... *Neoc. profundus*

5b. Symphyseal knob pronounced; no dark spots on dorsal body; dorsal fin spines XIV–XVI (usually XV); anal-fin soft rays 6 or 7 (usually 7); scale rows in longitudinal series 97–139; scale rows above lateral line 10–21; postocular spine present; orbit diameter 11.4–14.1% of SL .....…… *Neoc. japonicus*

Chapter 2 Reviews of related genera of the family Tetrarogidae

The taxonomic study of related genera of the family Tetrarogidae, key to the genera, and key to species will be provided. The study of the family Tetrarogidae resulted in the recognition of 17 valid genera with 45 valid species, viz., *Ablabys* (5 valid species: *A. binotatus*, *A. gymnothorax*, *A. macracanthus*, *A. pauciporus*, and *A. taenianotus*), *Centropogon* (3: *Ce. australis*, *Ce. latifrons*, and *Ce. marmoratus*), *Coccotropsis* (1: *Coc. gymnoderma*), *Cottapistus* (1: *Cot. cottoides*), *Glyptauchen* (1: *Gl. panduratus*), *Gymnapistes* (1: *Gy. marmoratus*), *Liocranium* (2: *L. pleurostigma*, and *L. praepositum*), *Neocentropogon* (6: *Neoc. aeglefinus*, *Neoc. affinis*, *Neoc. japonicus*, *Neoc. mesedai*, *Neoc. profundus*, and *Neoc. trimaculatus*), *Neovespicula* (1: *Neov. depressifrons*), *Notesthes* (1: *Note. robusta*), *Ocosia* (9: *O. apia*, *O. fasciata*, *O. possi*, *O. ramaraoi*, *O. sphex*, *O. spinosa*, *O. vespa*, *O. zaspilota*, and *Ocosia* sp.), *Paracentropogon* (4: *Pa. longispinis*, *Pa. rubripinnis*, *Pa. vespa*, and *Pa. zonatus*), *Pseudovespicula* (3: *Ps. cypho*, *Ps. dracaena*, and *Ps. zollingeri*), *Richardsonichthys* (1: *R. leucogaster*), *Snyderina* (3: *S. guentheri*, *S. yamanokami*, and *Snyderina* sp.), *Tetraroge* (2: *Te. barbata*, and *Te. nigra*), and *Trichosomus* (1: *Tr. trachinoides*).

Review of the genus *Vespicula* resulted in the genus *Vespicula* is regarded here as a junior synonym of the genus *Trichosomus* because *Prosopodasys gogorzae*, the type species of *Vespicula*, has been regarded as a junior synonym of *Tr. trachinoides*. *Vespicula cypho* and *Vespicula zollingeri* is regarded here as species of the genus *Pseudovespicula* on the basis of having dorsal-fin membrane between third and fourth spines deeply incised, forming a nearly separate fin; dorsal-fin origin directly above posterior margin of orbit; 5 pelvic-fin soft rays; pectoral-fin rays not detached; body with small cycloid scales, without cirri or papillae; lateral line well separated from dorsal-fin base; teeth on palatine; head profile oblique, straight; and nape flattened.

Key to the genera of Tetrarogidae

1a. Body covered with small scales ……..……...…….…….. 2

1b. Body not covered with scales ……...……..……...…. 13

2a. Pelvic-fin rays I, 4 ..……..…..…….…… 3

2b. Pelvic-fin rays I, 5 ……..……..…….....…… 6

3a. Three anteriormost dorsal-fin spines forming separate fin; cirri, papillae, or tentacles on head and dorsal surface of body; lateral line running along dorsal-fin base; first dorsal-fin spine origin posterior to posterior margin of orbit ……..…..…… *Trichosomus*

3b. Three anteriormost dorsal-fin spines not forming separate fin; cirri, papillae, or tentacles absent from body; lateral line not close to dorsal-fin base; first dorsal-fin spine origin anterior to posterior margin of orbit ……..…….....…… 4

4a. Dorsal-fin origin distinctly anterior to anterior margin of orbit ……..…..*Cottapistus*

4b. Dorsal-fin origin distinctly posterior to anterior margin of orbit …….. 5

5a. Dorsal-fin spines XIII or XIV (usually XIII); pectoral-fin rays 13–15; palatine teeth absent ……..……..…….. *Liocranium*

5b. Dorsal-fin spines XIV or XV, pectoral-fin rays 10 or 11; palatine teeth present … *Paracentropogon*

6a. Dorsal-fin origin distinctly anterior to posterior margin of orbit …….……..…… 7

6b. Dorsal-fin origin distinctly posterior to posterior margin of orbit ……..……. 9

7a. Head profile almost vertical, slightly concave; dorsal-fin spines XV–XVIII; membrane of last dorsal-fin soft ray posteriorly connected to caudal peduncle and upper base of caudal fin ..... *Ablabys*

7b. Head profile oblique, straight; dorsal-fin spines XII–XVI; membrane of last dorsal-fin soft ray posteriorly connected to dorsal caudal peduncle but not extending onto upper base of caudal fin ……. 8

8a. Palatine teeth present; dorsal-fin spines XIII–XVI; four lowermost pectoral-fin rays detached, basal half connected by low membrane ..……..…….. *Neocentropogon*

8b. Palatine teeth absent; dorsal-fin spines XII–XIII; lowermost four pectoral-fin rays not detached ……..……..……. *Snyderina*

9a. Head profile vertical, squarish; mouth small, 22.7–29.2% of HL; nape deeply and broadly concave ……..……...…… *Glyptauchen*

9b. Head profile oblique; mouth large, greater than 30.0% of HL; nape flattened 10

10a. Dorsal fin continuous, without deeply incised membrane between third and fourth dorsal-fin spines; cleithral spine present ……..……..…….. 11

10b. Dorsal fin continuous with deeply incised membrane between third and fourth dorsal-fin spines

(almost to dorsal-fin base); cleithral spine absent …….……... 12

11a. Pectoral-fin rays 13 or 14; dorsal-fin origin vertical through preopercular margin; orbit diameter 11.1–16.0% of SL ……..……..……...…. *Centropogon*

11b. Pectoral-fin rays 11 or 12; dorsal-fin origin distinctly posterior to preopercular margin; orbit diameter 7.7–11.6% of SL ……..……..….. *Notesthes*

12a. Dorsal-fin origin vertical through preopercular margin ……..……..……..…. *Neovespicula*

12b. Dorsal-fin origin distinctly anterior to preopercular margin ……..…….…..… *Pseudovespicula*

13a. Pelvic-fin rays I, 3; palatine teeth absent ……..…… *Coccotropsis*

13b. Pelvic-fin rays I, 5; palatine teeth present ……..……..……. 14

14a. Dorsal-fin origin distinctly posterior to posterior margin of orbit ……..… *Gymnapistes*

14b. Dorsal-fin origin distinctly anterior to posterior margin of orbit ..…….……...……. 15

15a. Head profile oblique, convex; dorsal tentacles on eye; lateral line running just below dorsal-fin base; tip of opercle curved dorsally, almost reaching to dorsal-fin base ……..….. *Richardsonichthys*

15b. Head profile oblique, straight; tentacles absent on eyes; lateral line well separated from dorsal-fin base; tip of opercle not reaching to dorsal-fin base ……..…..……...….. 16

16a. Small papillae on eyes, head, and body; dorsal-fin spines XIII or XIV ……. *Tetraroge*

16b. No small papillae on eyes, head, and body; dorsal-fin spines XIV–XVII …..…… *Ocosia*