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INLAND FISHES FROM THE ANAMBAS AND NATUNA ISLANDS, SOUTH CHINA SEA, WITH DESCRIPTION OF A NEW SPECIES OF *BETTA* (TELEOSTEI: OSPHRONEMIDAE)

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***ABSTRACT.* –** Eighty-two species of fish are recorded from inland localities on the Anambas and Natuna Islands. Among these are two species from earlier museum records not obtained on the recent two surveys in 2002. Forty-seven species (10 restricted to freshwater) are reported from the Anambas islands; and 55 species (21 restricted to freshwater, among which two are endemic) are reported from the Natuna islands. Of the two endemic species, *Betta aurigans*, new species, is described from the lowland swamp forest streams of Pulau Natuna Besar (formerly Pulau Bunguran). It differs from congeners of the *B. akarensis* group in having a greenish-gold opercle, gold scales on the belly, a distinct hump behind head of large males, 29-30 anal fin-rays and 33-33½ lateral scales.

***KEY WORDS.* –** Biodiversity, inland, new species, *Betta*, Anambas, Natuna, islands.

INTRODUCTION

Expedition Anambas was organised by the Raffles Museum of Biodiversity Research of the National University of Singapore and the Lembaga Ilmu Pengatahuan Indonesia (Indonesian Institute of Sciences) to document the biodiversity of the South China Sea around the Anambas and Natuna islands (Fig. 1). The ten-day expedition was carried out from the 11th to the 22nd of March, 2002. Another trip was made to sample the inland localities on Pulau Natuna Besar (also known as Bunguran Island or Pulau Bunguran) from the 29th of October to the 6th November 2002 which contributed additional specimens and taxa. The present report is an inventory of the fish fauna found in inland localities on the Anambas and Natuna islands.

The definition of 'inland fish' in this report is based on the localities where the fishes were collected and/or observed. These 'inland' sites (see Appendix 1) include all mangrove patches, tidal drainages and river mouths. Many of the species reported here are characteristic of saline habitats, and some are also found in marine environments. Therefore, a few species are also present in the report on marine fishes of the same area (Adrim et al., 2004, in the present volume).

The fish fauna of inland drainages on the Anambas Islands has apparently never been reported on. It is also the first time an inventory is made on the inland fish fauna of the Natuna Islands. Only three species of freshwater fish have been reported previously from Pulau Natuna Besar. These are the cyprinids *Rasbora bunguranensis* and *Puntius everetti*, and the syngnathid *Doryichthys heterosoma* (see Brittan, 1951; Dawson, 1981; Kottelat et al., 1993). The latter two were not collected nor observed in the recent surveys.

In the short periods of the two present surveys, few sites were covered, and the sampling was far from thorough. Nonetheless, 80 species were recorded of which one is recognised as undescribed. A total of 82 species are now known from inland localities on the Anambas and Natuna islands. Seventy species are represented by collections, while two were recorded only by visual census. Of the species recorded here, at least 24 species spend their entire lives in freshwater beyond tidal influence. These freshwater fishes are indicated with a '!'. The remaining species live wholly, or spend certain stages of their lives in saline water. Many of these are well distributed around the coasts. They should be expected from the other island group even if they are recorded only from one island group. Forty-seven species, of which ten are confined to freshwater, and one is a feral species, are recorded from the Anambas Islands. 21 species of freshwater fish out of 55 species are recorded from inland sites on the Natuna Islands. From the Natunas' total, two species are known only from past collections, and two others were recorded based on observations. See Appendix 3 for distribution of fish species restricted to freshwater on the islands.

Our preliminary records seem to indicate a slight difference in the composition of fishes that are restricted to freshwater

on the Anambas islands and the Natuna islands. Those on the Anambas islands appear to have closer affinity to the Malay Peninsula as evidenced by the presence of *Neolissochilus* cf *soroides*, *Rasbora elegans* and *Betta pugnax*, and their apparent absence on the Natuna islands and on Borneo. Similarly, the Natuna group seems to have closer faunal links to Borneo since *Puntius everetti*, *Nemacheilus spiniferus* and *Silurichthys marmoratus* are not found on the Anambas, nor on the Malay Peninsula. Such differences are expected since the Anambas is geographically nearer the Malay Peninsula, and the Natuna islands are closer in proximity to Borneo. The presence of *Rasbora gracilis*, *R. pauciperforata* and *Luciocephalus pulcher*, fishes characteristic of lowland peat swamps on Natuna Besar, and their apparent absence in the Anambas could be due to the hilly terrain of the Anambas islands, and thus absence of their preferred habitat there. All three species occur on the Malay Peninsula and Borneo. *Rasbora bunguranensis* and *Betta aurigans* appear to be endemic to Pulau Natuna Besar of the Natuna Archipelago.

MATERIALS AND METHODS

Specimens were collected mainly by hand-nets, rectangle-frame push nets and cast nets. They were fixed in 10% formalin solution for about one week before being transferred to 75% ethanol for long-term preservation. 'Material examined' refer to specimens collected, and the total number is indicated within brackets alongside the site number. Where the species is recorded by visual census, the respective sites are listed under 'Observed at'. See Appendix 1 for the list of inland survey localities on the Anambas and Natuna Islands visited during Expedition Anambas, 2002.

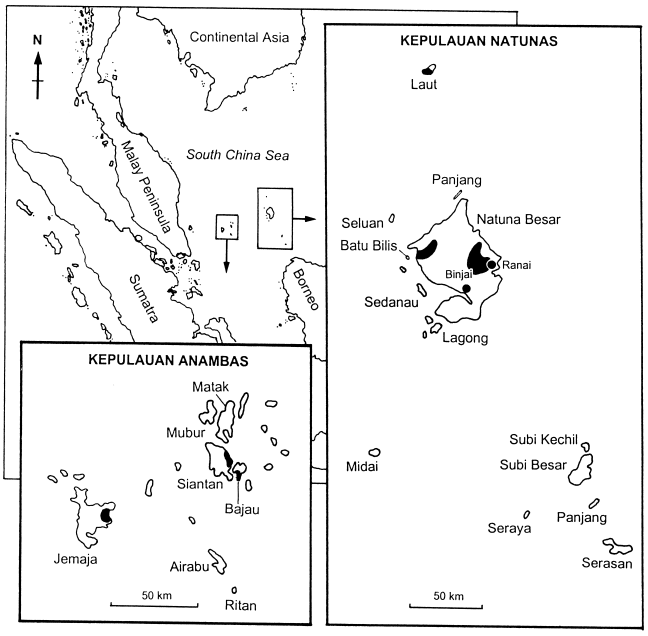

Fig. 1. Map of the Anambas and Natuna Islands with approximate areas (in black patches) where collections were made in 2002.

Material examined is deposited at The Research and Development Centre for Biology, The Indonesian Institute of Sciences, Cibinong, Indonesia (MZB); and the Raffles Museum of Biodiversity Research, Department of Biological Sciences, National University of Singapore, Singapore (ZRC). Additional specimens examined are from the Natural History Museum, London (BMNH); and The California Academy of Sciences, San Francisco (CAS-SU).

Classification and nomenclature follow that of Tan & Kottelat (1998), Kottelat et al. (1993), and Randall & Lim (2000). Abbreviations used in the text are SL: standard length, TL: total length, HL: head length. All measurements are taken from the left side of body with a pair of dial calipers (0.05 mm).

LIST OF FISHES

CLASS ACTINOPTERYGII

Order **Elopiformes**

Family **Megalopidae** (tarpons)

Megalops cyprinoides (Broussonet)

Material examined. – Natuna – P. Laut (W9: 5 ex.).

Order **Gonorhynchiformes**

Family **Chanidae** (milkfishes)

Chanos chanos (Forsskål)

Material examined. – Natuna – P. Laut (W9: 1 ex.).

Order **Cypriniformes**

Family **Cyprinidae** (carps and relatives)

Cyclocheilichthys apogon (Valenciennes) !

Material examined. – Anambas – P. Jemaja (W1: 3 ex.); Natuna – P. Natuna Besar (W11: 2 ex., DW0209: 1 ex.).

Neolissochilus cf. *soroides* (Duncker) !

Material examined. – Anambas – P. Jemaja (W1: 14 ex. [form 1]), P. Siantan (W6: 11 ex. [form 1], 26 ex. [form 2]; W7: 11 ex. [form 1], 6 ex. [form 2]).

Remarks. – Rainboth (1985) described the genus *Neolissochilus*, and listed the nominal species, but did not revise the genus. Our

Fig. 2. *Neolissochilus soroides* (form 1), ca. 120 mm SL, freshly preserved specimen from Pulau Jemaja.

Fig. 3. *Neolissochilus soroides* (form 2), 108.5 mm SL, freshly preserved specimen from Pulau Siantan.

identification of the Anambas *Neolissochilus* is tentative, for the genus is fairly confusing at the present for us to be certain if this population actually represents two, or perhaps only one, possibly undescribed taxon. We are treating the present materials as one species with two distinct morphotypes that are syntopic on Pulau Siantan. Form 1 has a rounded snout, smaller eyes and gently rising predorsum (Fig. 2). Form 2 has a distinctly pointed and protruding snout, down-turned lower lip, larger eyes and a humped predorsum (Fig. 3). *Neolissochilus* spp. inhabit boulder-strewn streams with cool, clear fast-flowing water throughout South and Southeast Asia. The species inhabiting the Malay Peninsula is generally believed to represent *N. soroides* (Duncker). A smaller, less slender species, *N. hendersoni* (Herre) is found on Penang island, and perhaps Langkawi island. Several others are known from the Indochinese mainland, India, Sumatra and Java.

Puntius banksi Herre !

Material examined. – Anambas – P. Jemaja (W1: 15 ex.); Natuna – P. Natuna Besar (DW0201: 1 ex., DW0203: 3 ex., DW0204: 3 ex., DW0208: 1 ex.).

Puntius everetti Boulenger !

Material examined. – None.

Remarks. – This species has been recorded on Pulau Natuna Besar (= Bunguran Island) (see Paepke, 1989: 404, as *Barbus everetti*; Kottelat et al., 1993: 58), but is not represented in recent collections.

Puntius hexazona Weber & de Beaufort !

Material examined. – Natuna - P. Natuna Besar (W11: 3 ex.; W12: 1 ex.).

Puntius lateristriga (Valenciennes) !

Material examined. – Anambas - P. Jemaja (W1: 6 ex.); Natuna - P. Natuna Besar (DW0201: 2 ex.).

Remarks. – The population on the Anambas and Natuna islands has a bold black lateral band on the tail, but lacks black markings between the two vertical black bars on the trunk.

Rasbora bunguranensis Brittan !

Rasbora elegans bunguranensis Brittan, 1951: 3, fig. 2; 1954: 73, fig. 12.

Material examined. – Natuna - P. Natuna Besar (CAS-SU 15328: 2 paratypes, W11: 12 ex., DW0201: 50 ex., DW0203: 7 ex., DW0204: 2 ex., DW0209: 11 ex.).

Remarks. – An example of this species is illustrated in Fig. 4. Along with the recent specimens, we have also examined two paratypes (42.0-68.5 mm SL) collected in 1893 by A. Hart Everett. Related to *Rasbora elegans*, the species is apparently endemic to Pulau Natuna Besar. It closely resembles the populations of *R. elegans* from the northeastern part of Peninsular Malaysia in Terengganu and Kelantan. As in *R. bunguranensis*, this form has the black blotch in the middle of the body connected to the black blotch on the caudal base by a black lateral stripe. However, the triangular blotch at the tail base of the Malaysian specimens are consistently and distinctly broader. The largest specimen in the present collection is 78.1 mm SL (from DW0201).

Fig. 4. *Rasbora bunguranensis*, 59.8 mm SL, live (above) and freshly-preserved specimen.

Rasbora einthovenii (Bleeker) !

Material examined. – Natuna - P. Natuna Besar (W11: 10 ex., W12: 5 ex., W13: 10 ex., DW0204: 1 ex., DW0208: 23 ex.).

Rasbora elegans Volz !

Material examined. – Anambas - P. Jemaja (W1: 10 ex., W3: 2 ex., W4: 10 ex.).

Remarks. – The Anambas population of *R. elegans* has a large squarish black blotch under the dorsal fin, a separate black blotch on the caudal base, and a black streak along the anal fin base. This colour pattern seems consistent with that of *R. elegans* from the southern Malay Peninsula.

Rasbora gracilis Kottelat !

Material examined. – Natuna - P. Natuna Besar (W11: 35 ex., W12: 45 ex., DW0204: 11 ex., DW0209: 7 ex.).

Remarks. – This species and *Rasbora pauciperforata* are characteristic of lowland peat swamps, and are often syntopic. Their apparent absence in the Anambas archipelago could be explained by the rugged hilly topography of the islands, and hence the lack of suitable habitat.

Rasbora pauciperforata Weber & de Beaufort !

Material examined. – Natuna - P. Natuna Besar (W11: 5 ex.).

Tor tambra (Valenciennes) !

Material examined. – Anambas - P. Siantan (W7: 1 ex.).

Remarks. – The single specimen obtained is a juvenile (56.2 mm SL). The presence of a short fleshy mental lobe under its lower lip distinguishes it from the syntopic and similar-looking *Neolissochilus*. Pending the availability of additional material, we are unable to distinguish the present specimen from *Tor tambra* of the surrounding large Sunda land masses.

Family **Balitoridae** (sucker loaches and relatives)

Homaloptera nebulosa Alfred !

Material examined. – Natuna - P. Natuna Besar (W11: 2 ex.).

Nemacheilus spiniferus Kottelat !

Material examined. – Natuna - P. Natuna Besar (DW0204: 1 ex.).

Order **Siluriformes**

Family **Siluridae** (sheat catfishes)

Silurichthys marmoratus Ng & Ng !

Material examined. – Natuna - P. Natuna Besar (W13: 1 ex., DW0209: 1 ex.).

Family **Clariidae** (walking catfishes)

Clarias leiacanthus (Bleeker) !

Material examined. – Anambas - P. Jemaja (W1: 2 ex.), P. Siantan (W6: 4 ex.); Natuna - P. Natuna Besar (W12: 1 ex., W13: 3 ex., DW0207: 2 ex.).

Family **Plotosidae** (eeltail catfishes)

Plotosus lineatus (Thunberg)

Material examined. – Anambas - P. Jemaja (W4: 1 ex.).

Order **Beloniformes**

Family **Hemiramphidae** (halfbeaks)

Dermogenys collettei Meisner

Material examined. – Anambas – P. Jemaja (W1: 6 ex., W2: 1 ex., W3: 2 ex., W4: 1 ex.), P. Siantan (J5: 1 ex., W6: 4 ex., W7: 1 ex.); Natuna – P. Laut (W8: 45 ex.), P. Natuna Besar (J8: 15 ex., W13: 20 ex., DW0201: 16 ex., DW0203: 3 ex.).

Remarks. – This species is distributed through Sumatra, the southern Malay Peninsula and western Borneo (see Meisner, 2001: 241).

Hemirhamphodon pogonognathus (Bleeker) !
Material examined. – Natuna - P. Natuna Besar (W12: 2 ex.).
Zenarchopterus gilli Smith
Material examined. – Anambas - P. Siantan (J5: 1 ex.); Natuna - P. Laut (J6: 2 ex.).

Family **Adrianichthyidae** (ricefishes)
Oryzias javanicus (Bleeker)
Material examined. – Natuna - P. Natuna Besar, P. Laut (J6: 12 ex., W8: 1 ex., DW0205: 10 ex.).

Order **Cyprinidontiformes**
Family **Aplocheilidae** (rivulines)
Aplocheilus panchax (Hamilton)
Material examined. – Natuna - P. Laut (J6: 12 ex., W8: 22 ex.).

Order **Atheriniformes**
Family **Phallostethidae** (priapus-fishes)
Neostethus lankesteri Regan
Material examined. – Anambas – P. Siantan (J5: 5 ex.).

Order **Syngnathiformes**
Family **Syngnathidae** (pipefishes and relatives)
Doryichthys heterosoma (Bleeker)
Material examined. – None.
Remarks. – This freshwater pipefish has not been collected from Pulau Natuna Besar (Bunguran) since 1854 (see Dawson, 1981: 14; 1985: 56; Roberts, 1989: 159; Kottelat et al., 1993: 137).
Hippichthys spicifer (Rüppell)
Material examined. – Anambas - P. Jemaja (W4: 1 ex.).

Order **Synbranchiformes**
Family **Synbranchidae** (swamp-eels)
Monopterus albus Zuiew !
Material examined. – Anambas - P. Siantan (W7: 2 ex.).

Order **Perciformes**
Family **Ambassidae** (glass perchlets)
Ambassis interrupta Bleeker
Material examined. – Anambas - P. Jemaja (W4: 2 ex.).
Ambassis urotaenia Bleeker
Material examined. – Anambas - P. Jemaja (W4: 18 ex.).

Family **Terapontidae** (grunters)
Terapon jarbua (Forsskål)
Material examined. – Anambas - P. Jemaja (W4: 1 ex.).

Family **Apogonidae** (cardinalfishes)
Apogon amboinensis Bleeker
Material examined. – Anambas - P. Jemaja (W4: 2 ex.).
Apogon hyalosoma Bleeker
Material examined. – Anambas - P. Jemaja (J3: 1 ex.).
Apogon lateralis Valenciennes
Material examined. – Anambas - P. Jemaja (W4: 33 ex.); Natuna - P. Laut (J3: 3ex.).

Family **Lutjanidae** (snappers)
Lutjanus argentimaculatus (Forsskål)
Material examined. – Anambas - P. Jemaja (J3: 1 ex.); Natuna – P. Natuna Besar (J9: 1 ex.).
Lutjanus russelli (Bleeker)
Material examined. – Anambas - P. Jemaja (W4: 1 ex.), P. Siantan (J5: 2 ex.).

Family **Gerreidae** (mojarras)
Gerres macracanthus Bleeker
Material examined. – Anambas - P. Jemaja (W4: 1 ex.); Natuna - P. Laut (W9: 1 ex.).
Gerres oyena (Forsskål)
Material examined. – Anambas - P. Siantan (J5: 4 ex.).

Family **Monodactylidae** (fingerfishes)
Monodactylus cf. *argenteus* (Linnaeus)
Material examined. – Natuna - P. Laut (W9: 2 ex.).
Remarks. – Our identification is tentative for the vertically elongate (body depth 1.1 times in SL) appearance of the two specimens of about 60 mm SL strongly suggests *Monodactylus kottelati* Pethiyagoda, which is thus far known only from the Indian Ocean, and perhaps the northern Malacca Straits (see Kottelat, in Carpenter & Niem, 2001: 3217).

Family **Toxotidae** (archerfishes)
Toxotes jaculatrix (Pallas)
Observed at. – Natuna - P. Natuna Besar (Sungai Segaram).

Family **Scatophagidae** (scats)
Scatophagus argus (Linnaeus)
Material examined. – Anambas - P. Jemaja (W4: 1 ex.).

Family **Nandidae** (leaf-fishes)
Nandus nebulosus (Gray)
Material examined. – Natuna - P. Natuna Besar (W11: 2 ex., DW0204: 3 ex.).

Family **Pomacentridae** (damselfishes)
Hemiglyphidodon plagiometopon (Bleeker)
Material examined. – Anambas – P. Siantan (J5: 4 ex.).
Pomacentrus taeniometopon Bleeker
Material examined. – Anambas - P. Jemaja (W4: 5 ex.), P. Siantan (J5: 1 ex.).

Family **Cichlidae** (cichlids)
Oreochromis mossambicus (Peters)
Material examined. – Anambas - P. Siantan (W6: 3 ex.).
Remarks. – An introduced species.

Family **Mugilidae** (mullets)
Chelon macrolepis (Smith)
Material examined. – Natuna - P. Laut (W8: 6 ex., W9: 1 ex.).
Ellochelon vaigiensis (Quoy & Gaimard)
Material examined. – Natuna – P. Panjang (J7: 1 ex.).

Family **Blennidae** (blennies)
Praealticus striatus Bath
Material examined. – Natuna – P. Panjang (J7: 18 ex.).

Family **Eleotridae** (gudgeons)
Butis gymnopomus (Bleeker)
Material examined. – Anambas - P. Jemaja (W2: 2 ex.); Natuna - P. Natuna Besar (W11: 3 ex.).
Eleotris melanosoma Bleeker
Material examined. – Natuna - P. Natuna Besar (W11: 4 ex.).
Ophiocara porocephala (Valenciennes)
Material examined. – Anambas - P. Jemaja (J3: 4 ex., W4: 7 ex.), P. Bajau (W14: 1 ex.); Natuna - P. Laut (W8: 2 ex.), P. Panjang (J7: 1 ex.).

Family **Gobiidae** (gobies)
Acentrogobius janthinopterus (Bleeker)
Material examined. – Natuna - P. Natuna Besar (DW0205: 5 ex.).
Amblygobius linki Herre
Material examined. – Anambas – P. Jemaja (J1: 5 ex.), P. Siantan (J5: 1 ex.).
Bathygobius fuscus (Rüppell)
Material examined. – Anambas – P. Jemaja (J3: 1 ex.).
Bathygobius cocosensis (Bleeker)
Material examined. – Natuna – P. Panjang (J7: 1 ex.).

Brachygobius doriae (Günther)
Material examined. – Natuna - P. Natuna Besar (W11: 90 ex., W13: 1 ex.).
Brachygobius kabiliensis Inger
Material examined. – Natuna - P. Natuna Besar (DW0205: 1 ex.).
Eugnathogobius siamensis (Fowler)
Material examined. – Natuna - P. Natuna Besar (W11: 11 ex.).
Favonigobius reichei (Bleeker)
Material examined. – Anambas - P. Jemaja (W4: 7 ex., W5: 11 ex.).
Glossogobius biocellatus (Valenciennes)
Material examined. – Anambas - P. Jemaja (W4: 1 ex.); Natuna - P. Natuna Besar (DW0205: 1 ex.).
Glossogobius giuris (Hamilton)
Material examined. – Anambas - P. Jemaja (W1: 1 ex.).
Gobiopterus chuno (Hamilton)
Material examined. – Natuna - P. Natuna Besar (W11: 20 ex.).
Remarks. – The identification is tentative for the genus is in need of revision.
Hemigobius mingi (Herre)
Material examined. – Natuna - P. Natuna Besar (J8: 8 ex.).
Mugilogobius chulae (Smith)
Material examined. – Anambas - P. Bajau (W14: 1 ex.); Natuna - P. Natuna Besar (J8: 16 ex.), P. Laut (W8: 3 ex.).
Pandaka pygmaea Herre
Material examined. – Anambas - P. Jemaja (J1: 2 ex., W4: 50 ex.); Natuna - P. Natuna Besar (DW0205: 5 ex.).
Periophthalmus argentilineatus Valenciennes
Material examined. – Anambas - P. Jemaja (J1: 3 ex., W4: 2 ex.), P. Siantan (J5: 3 ex.); Natuna - P. Natuna Besar (DW0205: 3 ex.), P. Panjang (J7: 4 ex.).
Periophthalmus kalolo Lesson
Material examined. – Natuna – P. Panjang (J7: 1 ex.).
Pseudapocryptes elongatus (Cuvier)
Material examined. – Anambas – P. Jemaja (W5: 1 ex.).
Pseudogobius javanicus (Bleeker)
Material examined. – Anambas – P. Jemaja (J1: 1 ex.), P. Siantan (J5: 11 ex.); Natuna - P. Laut (W8: 17 ex.), P. Natuna Besar (DW0205: 17 ex.).
Redigobius balteatus (Herre)
Material examined. – Anambas - P. Jemaja (W4: 1 ex.).
Redigobius bikolanus (Herre)
Material examined. – Anambas - P. Jemaja (W4: 1 ex.); Natuna - P. Natuna Besar (DW0201: 4 ex.).
Redigobius isognathus (Bleeker)
Material examined. – Anambas - P. Jemaja (W1: 1 ex., W2: 1 ex.); Natuna - P. Natuna Besar (DW0205: 2 ex.).
Yongeichthys nebulosus (Forsskål)
Material examined. – Anambas - P. Jemaja (W4: 5 ex.); Natuna - P. Natuna Besar (DW0205: 3 ex.).

Family **Anabantidae** (climbing perches)
Anabas testudineus (Bloch) !
Material examined. – Natuna - P. Laut (J6: 1 ex., W8: 1 ex.).

Family **Osphronemidae** (gouramies and relatives)
Betta aurigans, new species
(See Appendix 3 for Material, Description and Remarks)
Betta pugnax (Cantor) !
Material examined. – Anambas - P. Siantan (W1: 6 ex.).
Remarks. – *Betta pugnax* is distinguished from *B. aurigans* in having bluish-green opercle scales instead of non-iridescent greenish-gold or brown scales on the opercle.
Luciocephalus pulcher (Gray) !
Material examined. – Natuna - P. Natuna Besar (W11: 4 ex., W12: 1 ex., DW0204: 2 ex.).

Family **Channidae** (snakeheads)
Channa gachua (Hamilton) !
Material examined. – Natuna - P. Laut (W8: 8 ex.).
Channa lucius (Cuvier) !
Material examined. – Anambas - P. Jemaja (W3: 2 ex.); Natuna - P. Natuna Besar (DW0207: 1 ex.).

Family **Mastacembelidae** (spiny eels)
Macrognathus maculatus (Cuvier) !
Material examined. – Anambas - P. Jemaja (W1: 5 ex.); Natuna - P. Natuna Besar (W11: 2 ex., DW0201: 3 ex., DW0204: 4 ex., DW0209: 1 ex.).

Order **Pleureonectiformes**
Family **Soleidae** (soles)
Pardachirus pavoninus (Lacepède)
Material examined. – Anambas - P. Jemaja (W4: 1 ex.).

Order **Tetraodontiformes**
Family **Tetraodontidae** (pufferfishes)
Tetraodon nigroviridis Marion de Procé
Observed at. – Natuna - P. Natuna Besar (Sungai Segaram).

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LITERATURE CITED

Adrim, M., I-S. Chen, Z.-P. Chen, K. K. P. Lim, H. H. Tan, Y. Yusof & Z. Jaafar, 2004. Marine fishes recorded from the Anambas and Natuna Islands, South China Sea. In: Ng, P. K. L., D. Wowor & D. C. J. Yeo (eds.), Scientific Results of the Anambas Expedition 2002. *The Raffles Bulletin of Zoology*, Supplement No. **11**: 117-130.

Brittan, M. R., 1951. New cyprinid fishes of the genus *Rasbora* from Borneo and Bunguran Islands. *Proceedings of the California Zoology Club*, **2**: 1-5.

Brittan, M. R., 1954. A revision of the Indo-Malayan fresh-water fish genus *Rasbora*. *Monograph of the Institute of Science and Technology, Manila*, **3**: 1-224.

Carpenter, K. E. & V. H. Niem (eds.), 2001. *FAO species identification guide for fishery purposes. The living marine resources of the Western Central Pacific. Volume 5. Bony fishes part 3* (*Menidae to Pomacentridae)*. FAO, Rome. p. 2791-3380.

Dawson, C. E., 1981. Review of the Indo-Pacific doryrhamphine pipefish genus *Doryichthys*. *Japanese Journal of Ichthyology*, **28**: 1-18.

Dawson, C. E., 1985. *Indo-Pacific Pipefishes*. Gulf Coast Research Laboratory, Ocean Springs, Mississipi, USA. 230 pp.

Kottelat, M., A. J. Whitten, S. N. Kartikasari & S. Wirjoatmodjo, 1993. *Freshwater Fishes of Western Indonesia and Sulawesi*. Periplus Editions, Hong Kong. 259 pp., 84 pls.

Meisner, A. D., 2001. Phylogenetic systematics of the viviparous halfbeak genera *Dermogenys* and *Nomorhamphus* (Teleostei: Hemiramphidae: Zenarchopterinae). *Zoological Journal of the Linnean Society*, **133**: 199-283, 69 figs.

Paepke, H.-J., 1989. Zur Kenntnis von *Barbus dunckeri* und *Barbus everetti*. *Aquarien Terrarien*, **36**: 404-407.

Rainboth, W. J., 1985. *Neolissochilus*, a new genus of South Asian cyprinid fishes. *Beaufortia*. **35** (3): 25-35.

Randall, J. E. & K. K. P. Lim (eds.), 2000. A checklist of the fishes of the South China Sea. *The Raffles Bulletin of Zoology*. Supplement No. **8**: 569-667.

Roberts, T. R., 1989. The freshwater fishes of Western Borneo (Kalimantan Barat, Indonesia). *Memoirs of the California Academy of Sciences*, **14**: 1-210.

Tan, H. H. & M. Kottelat, 1998. Two new species of *Betta* (Teleostei: Osphronemidae) from the Kapuas basin, Kalimantan Barat, Borneo. *The Raffles Bulletin of Zoology*, **46**: 41-51.

Appendix 1. Inland collection and observation sites visited during the Anambas Expedition.

ANAMBAS ARCHIPELAGO

J1 – Pulau Jemaja: northern edge of Teluk Tiru, opposite Pulau Punisan; 12 Mar.2002: 1030-1345 hrs; coastal *Rhizophora* mangrove on sand substrate.
J2 – Pulau Jemaja: Teluk Tiru, opposite northern coast of Pulau Punisan; 12 Mar.2002: 1515-1530 hrs; 50m *Rhizophora* patch adjacent to sandy beach and dead coral on intertidal zone.
J3 – Pulau Jemaja: Teluk Jebung at northern and eastern mangrove inlets; 13 Mar.2002: 0930-1630 hrs; deep sheltered sandy bay with dead coral, fringing *Rhizophora*, *Bruguiera* inland.
J4 – Pulau Matak: southeast coast of Niulwan Peninsula off Selat Peninting; 14 Mar.2002: 1500-1600 hrs; 50m patch of fringing *Rhizophora* mangrove at low tide.
J5 – Pulau Siantan: Teluk Baruk, waterfall along Sungai Temburun; 15 Mar.2002: 0900-1615 hrs; fringing *Rhizophora* mangrove and *Nypa*, at edge of waterfall.
W1 – Pulau Jemaja: Teluk Tiru, Air Neraja waterfall (2°54.57'N 105°46.88'E); 12 Mar.2002.
W2 – Pulau Jemaja: Teluk Tiru, Sungai Air Maras (2°54.57'N 105°46.88'E); 12 Mar.2002.
W3 – Pulau Jemaja: Teluk Jebung, freshwater stream inland of northern mangrove inlet (2°56.98'N 105°50.17'E); 13 Mar.2002.
W4 – Pulau Jemaja: Teluk Jebung at northern mangrove inlet (2°58.35'N 105°40.18'E); 13 Mar.2002: 1000-1111 hrs; brackish water stream lined with *Lumnitzera*, *Rhizophora* and *Sonneratia*.
W5 – Pulau Jemaja: Teluk Jebung at southern mangrove inlet (2°56.54'N 105°48.52'E); 13 Mar.2002: 1630 hrs; sand flat at river mouth lined with *Nypa* and *Rhizophora*.
W6 – Pulau Siantan: stream inland of Teluk Tarempa (3°12.86'N 106°12.99'E); 14 Mar.2002.
W7 – Pulau Siantan: eastern region, Temburun Waterfall and stream inland of Teluk Temburun (3°10.99'N 106°16.31'E); 15 Mar.2002.
W14 –Pulau Bajau: southern region, Kampung Belimbing, stream inland of northern-most bay of Teluk Dumang; north of dive site (3°56'16.9"N 106°17'53.5"E); 19 Mar.2002.

NATUNA ARCHIPELAGO

J6 – Pulau Laut: south coast; 16 Mar.2002: 1030-1615 hrs; coastal fringe mangrove with extensive sand spit to the east.
J7 – Pulau Panjang: northeast coast; 17 Mar.2002: 0945-1230, 1800-2015 hrs; beach, rock pools and small patch of mangrove.
J8 – Pulau Natuna Besar: north bank of Sungai Sekeram, about 150 m inland; 18 Mar.2002: 1200-1400 hrs; slow-moving brackish-water stream with leaf-litter.
J9 – Pulau Natuna Besar: small brackish-water stream about 20 m north of Sungai Sekeram, about 150 m inland; 18 Mar.2002: 1200-1400 hrs; mangrove estuary about 50 m wide with sandstone banks.
W8 – Pulau Laut: Teluk Air Payang (4°41.98'N 107°57.15'E); 16 Mar.2002: 1205 hrs; seasonal stream, muddy substrate, boulders surrounded by *Nypa* and cultivated land.
W9 – Pulau Laut: Sungai Air Papan at Teluk Air Payang (4°42.86'N 107°57.79'E); 16 Mar.2002: 1437 hrs; seasonal meromictic stream enclosed by sandbar, coconut plantation, inland *Nypa* grove, sand substrate with accumulations of leaf litter.
W11 –Pulau Natuna Besar: Sungai Sekeram (3°58'06.4"N 108°03'22.4"E); 18 Mar.2002; pH 7.2.
W12 –Pulau Natuna Besar: blackwater tributary of Sungai Sekeram (3°50'28.6"N 108°03'47.1"E); 18 Mar.2002; pH 3.4.
W13 –Pulau Natuna Besar: blackwater tributary of Sungai Sekeram (3°50'28.6"N 108°03'47.1"E); 18 Mar.2002; pH 3.4.
DW0201 – Pulau Natuna Besar: Sungai Air Tayan and surrounding areas at Ranai (3°56.7'N 108°22.04'E); 30 Oct.2002; stream with stone and sand substrate and moderately slow-flowing water next to 'Natuna Hotel' through orchard, pH 6.7.
DW0202 & DW0206 – Pulau Natuna Besar: waterfall and surrounding areas at Mount Ranai; 31 Oct.2002 and 4 Nov.2002; forest stream with total canopy cover, sandy substrate and few rocks, moderate flowing water, pH 6.9.
DW0203 – Pulau Natuna Besar: outside of Ranai enroute to Binjai (3°54.69'N 108°20.68'E); 2 Nov.2002; stream with muddy substrate and moderate to slow flowing water, pH 6.0.
DW0204 – Pulau Natuna Besar: peat swamp between Desa Harapan Jaya and Desa Binjai (3°50.51'N 108°16.48'E); 2 Nov.2002; open area, brown-coloured water, sandy substrate, fast flowing to semi-stagnant water, pH 4.8.
DW0205 – Pulau Natuna Besar: Sungai Silas and surrounding village and mangrove (4°2.42'N 108°18.82'E); 3 Nov.2002; river mouth, brown-coloured water at low tide, clear water at high tide, sandy substrate, pH 7.9.

DW0207 – Pulau Natuna Besar: stream under last wooden bridge towards waterfall from Ranai; 4 Nov.2002; substrate with boulders.
DW0208 – Pulau Natuna Besar: blackwater stream under second bridge after junction of Desa Harapan Jaya towards Desa Cempaga, 19.2 km from Ranai (from Natuna Hotel), includes surrounding peat swamp and tributary about 300 m east (3°48.64'N 108°18.6'E); 5 Nov.2002; water tea-coloured, fast to moderate current, sandy substrate, pH 4.6-4.7.
DW0209 – Pulau Natuna Besar: blackwater stream under first bridge after junction of Desa Harapan Jaya towards Desa Cemaga, 16.1 km from Ranai (from Natuna Hotel), includes surrounding peat swamp (3°50.27'N 108°17.14'E); 5 Nov.2002; water tea-coloured, fast to moderate current, sandy substrate, pH 5.5.

Appendix 2: Distribution of fish species restricted to freshwater in the Anambas and Natuna islands.

	Anambas Archipelago		Natuna Archipelago	
Taxa	Jemaja	Siantan	Natuna Besar	Laut
Cyclocheilichthys apogon	+	–	+	–
Neolissochilus cf. *soroides*	+	+	–	–
Puntius banksi	+	–	+	–
*Puntius everetti**	–	–	+	–
Puntius hexazona	–	–	+	–
Puntius lateristriga	+	–	+	–
Rasbora bunguranensis	–	–	+	–
Rasbora einthovenii	–	–	+	–
Rasbora elegans	+	–	–	–
Rasbora gracilis	–	–	+	–
Rasbora pauciperforata	–	–	+	–
Tor tambra	–	+	–	–
Homaloptera nebulosa	–	–	+	–
Nemacheilus spiniferus	–	–	+	–
Silurichthys marmoratus	–	–	+	–
Clarias leiacanthus	+	+	+	–
Hemirhamphodon pogonognathus	–	–	+	–
Macrognathus maculatus	+	–	+	–
Nandus nebulosus	–	–	+	–
Channa gachua	–	–	–	+
Channa lucius	+	–	+	–
Anabas testudineus	–	–	–	+
Betta aurigans	–	–	+	–
Betta pugnax	+	–	–	–
Luciocephalus pulcher	–	–	+	–

+ – presence confirmed by collections or literature records*.
– – not collected (but may not indicate absence on island).

Appendix 3. Description of *Betta aurigans*, new species.

***Betta aurigans*, new species**
(Figs. 5, 6)

***Material examined.* –** Holotype – MZB 10709, male, 66.3 mm SL, W13.

Paratypes – 7 ex., MZB 10710; 8 ex., ZRC 49159, 15.6-72.5 mm SL, W13; 3 ex., ZRC 49160, 32.8-56.4 mm SL, W12.

Non-types – 5 ex., BMNH 1912.12.10:36-40, 34.1-62.0 mm SL.

All specimens from Pulau Natuna Besar in the Natuna Archipelago.

***Diagnosis.* –** *Betta aurigans* belongs in the *B. akarensis* group that is characterised by the combination of the following characters (but none unique to this species group): 1) a central black stripe from tip of snout to eye, with a complete chin-bar and a post-orbital stripe from hind eye margin to gill opening [terminology of colour marks follows Tan & Kottelat, 1998: 42]; 2) caudal fin usually rhomboid with median rays elongated in adult males, and usually with transverse bars on the inter-radial membranes on the caudal fin; 3) greenish to bluish iridescence on the body scales of some (Tan & Kottelat, 1998: 42). *Betta aurigans* differs from its congeners within the *B. akarensis* group in having the following combination of characters: a greenish-gold opercle, gold scales on the belly, a distinct hump behind head of large males, 29-30 anal fin-rays and 33-33½ lateral scales.

***Description.* –** General appearance is shown in Figs. 5 and 6. Head relatively pointed, eyes large (orbit diameter 23.3-26.0 % HL). Large males with hump above head just behind eye. Body relatively stout (25.2-27.4 % SL). Dorsal fin positioned after mid-body (predorsal length 65.0-69.0 % SL). Dorsal fin pointed, distal rays reaching beyond base of caudal fin. Pectoral fin rounded. Pelvic fin filamentous and long, reaching 12th anal fin ray. Anal fin with sub-distal rays elongate and pointed, almost reaching end of caudal fin.

Caudal fin rounded with central rays elongated into a point. Meristic and morphometric data in Appendix 4.

***Colour pattern.* –** In life (Fig. 5), head dark brown above, eye light brown. Opercle greenish-gold or brown without markings, throat with chin-bar. Body darker brown dorsally, lighter brown ventrally and cream belly. Mature males with iridescent gold scales on lateral and belly area, without iridescent scales on opercle. Dorsal fin interradial membranes with up to 20 black bars. Caudal fin interradial membranes with up to 24 black bars. Anal fin with base dark brown, middle band lighter brown and thin distal black edge. Pelvic fin yellowish brown with distal filamentous ray white. Females with less iridescence and lacking caudal transverse bars. Juveniles have a distinct black central stripe on body and a black caudal peduncle spot. Preserved coloration (Fig. 6) as in life except for the absence of iridescence.

Fig. 5. *Betta aurigans*, live specimen, ca. 60 mm SL.

Fig. 6. *Betta aurigans*, freshly preserved, 73.2 mm SL.

***Distribution.* –** Apparently endemic to Pulau Natuna Besar of the Natuna Archipelago.

***Etymology.* –** The latin name *aurigans* (with gold iridescence) refers to the iridescent golden scales on the body and belly of the present species.

***Field notes.* –** *Betta aurigans* occurs in heath-peat swamp forest habitat, usually in blackwater pools and streams among the roots and submerged leaf litter. Syntopic species include: *Cyclocheilichthys apogon*, *Puntius hexazona*, *Rasbora bunguranensis*, *R. einthovenii*, *R. gracilis*, *R. pauciperforata*, *Homaloptera nebulosa*, *Silurichthys marmoratus*, *Clarias leiacanthus*, *Dermogenys collettei*, *Hemirhamphodon pogonognathus*, *Nandus nebulosus*, *Butis gymnopomus*, *Eleotris melanosoma*, *Brachygobius doriae*, *Eugnathogobius siamensis*, *Gobiopterus chuno*, *Luciocephalus pulcher* and *Macrognathus maculatus*.

***Remarks.* –** *Betta aurigans* differs from its congeners within the *B. akarensis* group in the following characters: opercle without pattern (versus with stripe or speckles in *B. akarensis*, *B. balunga*, *B. chini* and *B. pinguis*); presence of iridescent gold scales on body and belly (versus absence); more subdorsal scales than *B. akarensis* and *B. pinguis* (mode 6 versus 5-5½); more lateral scales than *B. balunga*, *B. chini* and *B. pinguis* (33-33½ versus 29-32½); more lateral scales above anal fin origin than *B. balunga* (7 versus 6); more predorsal scales than *B. balunga* (24-26 versus 21-23); more postdorsal scales than *B. akarensis*, *B. balunga*, *B. chini* and *B. pinguis* (mode 13 versus 9-11); smaller preanal length than *B. balunga* (43.0-46.5 versus 49.2-52.2 % SL); smaller body depth at dorsal fin origin than *B. balunga* and *B. pinguis* (25.2-27.4 versus 28.0-31.6 % SL); smaller orbit diameter than *B. chini* (23.3-26.0 versus 26.2-30.8 % HL).

***Comparative materials.* –** See Tan & Kottelat (1998) for material examined of *Betta akarensis*, *B. balunga*, *B. chini* and *B. pinguis*.

Appendix 4. Meristics and morphometrics of *Betta aurigans*, new species.

	Betta aurigans
no. of specimens	5 of 8 paratypes
SL (mm)	52.9-72.5
catalogue nos.	ZRC 49159
	MZB10709
	MZB10710
MERISTICS	
anal fin-rays	0-II, 27-30 (total 29-30, mode 30)
dorsal fin-rays	0-I, 8-9 (total 9, mode 9)
caudal fin-rays	5+7
pelvic fin-rays	I, 5
pectoral fin-rays	14-15 (mode 15)
sub-dorsal scales	5½-6 (mode 6)
dorsal depth scales	10
lateral scales	33-33½ (mode 33½)
no. of lateral scales below dorsal fin origin	16-18
no. lateral scales above anal fin origin	7
predorsal scales	24-26
postdorsal scales	11-13 (mode 13)
MORPHOMETRICS - %SL	
total length	144.4-154.6
trunk length	68.8-71.7
predorsal length	65.0-69.0
postdorsal length	21.4-23.8
caudal peduncle depth	18.1-20.2
preanal length	43.0-46.5
head length	31.3-33.4
body depth at dorsal fin origin	25.2-27.4
pelvic fin length	31.9-47.2
anal fin base length	55.4-58.1
dorsal fin base length	13.1-14.3
% head length	
orbit diameter	23.3-26.0
postorbital length	44.3-52.0
interorbital width	34.5-40.9
snout length	24.7-26.4