A synopsis of coral and coral-rock associated gobies (Pisces: Gobiidae) from the Gulf of Aqaba, northern Red Sea

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Abstract
Field investigations in the Gulf of Aqaba, northern Red Sea (Dahab, Sinai, Egypt) revealed 21 species in seven genera of gobiid fish associated with corals and/or coral rock. Three as yet undetermined species of Gobiodon (G. sp.1, 2 and 3) were found to be new for the Red Sea. Like the congeneric G. citrinus, G. histrio, G. reticulatus and G. rivulatus, they are obligate dwellers of Acropora corals. Among the other genera, Bryaninops yongei significantly differs from its congener B. ridens in live coloration as well as by its preference for Cirripathes sp., while the latter obligatorily inhabits Millepora dichotoma. A third species, B. natans, exhibits hyperbenthic behaviour, violet eyes and a yellow belly on the otherwise transparent body and is commonly associated with Acropora loriipes and A. squarrosa. The five Eviota species examined were less specialized and associated with live corals of various growth forms and/or with coral rock. Paragobiodon echnicocephalus showed very low occupation rates of the highly abundant Stylophora pistillata and was mostly found in small breeding pairs. Within the genus Pleurosicya, P. micheli is more slender than P. prognatha and shows a distinct longitudinal red internal stripe, while the latter is transparent with a few brown speckles in life. Pleurosicya micheli inhabits massive scleractinians, whereas P. prognatha is found in Acropora. Priolepis semidiolata was rare and associated with coral rock. Weak associations with scleractinians were also found in Trimma avidori, which was common but prefers steep or overhanging substrates mostly consisting of coral rock. Trimma mendelssohni prefers coral rock caves.

Zusammenfassung

Résumé
Des recherches de terrain dans le Golfe d’Aqaba, au nord de la Mer Rouge (Dahab, Sinai, Egypte) ont révélé la présence de 21 espèces, en sept genres de Gobies associés à des coraux ou à des roches corallienes. Trois espèces non encore décrites de Gobiodon (G. sp. 1, 2 et 3) sont nouvelles en Mer Rouge. Comme les congénériques G. citrinus, G. histrio, G. reticulatus et G. rivulatus, ce sont des poissons inféodés aux coraux Acropora. Parmi les autres genres, Bryaninops yongei se distingue significativement
de son congénère B. ridens, autant par sa coloration in vivo que par sa préférence pour Cirripathes sp., alors que celui-ci est inféodé à Millepora dichotoma. Une troisième espèce, B. natans, montre un comportement hyperbenthique, des yeux violets et un abdomen jaune sur un corps transparent par ailleurs et s’associe communément à Acropora loriipes et A. squarrosa. Les cinq espèces d’Eviota examinées étaient moins spécialisées et associées à des coraux vivants de tailles variées et/ou à des roches coralliennes. Paragobiodon echinocephalus présentait une occupation moyenne très faible de la très abondante Stylophora pistillata et apparaissait le plus souvent en petits couples reproducteurs. Dans le genre Pleurosi- cya, P. micheli est plus élancé que P. prognatha et arbore une ligne rouge interne longitudinale bien nette, alors que ce dernier est transparent avec quelques petites raches brunes in vivo. Pleuroscya micheli vit dans des scléactiniens massifs, tandis que P. prognatha fréquente les Acropora. Priolepis semidoliata était rare et en association avec des roches coralliennes. Des associations faibles avec des scléactiniens ont été notées pour Trimma avidori, qui était fréquent, mais préfère les pentes fortes ou des substrats en surplomb composés le plus souvent de roche corallienne. Trimma mendelssonoi préfère des cavités de roche corallienne.

Sommario
Uno studio sul campo del Golfo di Aqaba, Mar Rosso settentrionale (Dahab, Sinai, Egypt) ha rivelato 21 specie in sette generi di ghiozzi associati a substrati corallini e/o rocciosi. Tre specie non ancora determinate di Gobiodon (G. sp.1, 2 and 3) si sono rivelate nuove per il Mar Rosso. Come i congeneri G. citrinus, G. histrio, G. reticulatus e G. rivulatus, si tratta di abitatori obbligati di coralli del genere Acropora. Tra gli altri generi, Bryaninops yongei differsce significativamente dal congenerico B. ridens per la colorazione vitale e per la preferenza verso Cirri- pathes sp., mentre quest’ultimo abita obbligatoriamente Millepora dichotoma. Una terza specie, B. natans, mostra comportamento iperbentico, occhi vio- letti e un ventre giallo su un corpo trasparente ed è comunemente associato ad Acropora loriipes e A. squarrosa. Le cinque specie di Eviota esaminate erano meno specializzate e associate con coralli vivi di varia forma e/o corce corallifere. Paragobiodon echinocephalus mostrava velocità di occupazione molto basse dell’abbandonante Stylophora pistillata e si riscontrava essenzialmente in coppia. Nel genere Pleuroscyca, P. micheli è più assottigliata di P. prog- natha e mostra una distinta stria rossa longitudinale interna, mentre quest’ultima è trasparente con poche macchie brune in vita. Pleuroscya micheli abita sclerattinie di grandi dimensioni, mentre P. prognatha si ritrova su Acropora. Priolepis semidoliata era raro e associato a rocce coralline. Una debole associazione con scleractinie era anche riscontrata con Trimma avidori, una specie piuttosto comune ma che predilige zone di barriera rocciosa ripida o a strapiombo. Trimma mendelssonoi cave rocciose.

Introduction
The Gobiidae is the most diverse marine fish family, comprising more than 1800 species (Nelson, 1994). Decreasing body size in the course of evolution has enabled them to exploit a high variety of spatially small-scaled habitats (Miller, 1996). In tropical coral reefs, the many hermatypic coral genera and their various growth forms represent suitable microhabitats for small gobies. Several lineages of gobiid fish have adapted to those spatially restricted habitats. In the Indo-Pacific, such specialized forms include the genera Bryaninops Smith, 1959, Gobiodon Bleeker, 1856, Paragobiodon Bleeker, 1872 and Pleuroscyca Weber, 1913 (Larson, 1985; 1990; Kuwamura et al., 1994; Munday et al., 1999). Since these tiny components of the tropical reef fauna are of no commercial interest, they have been largely neglected in most ichthyological studies in the tropics. Based on species richness, abundance and degree of habitat specialization, however, the gobids represent an important group among reef fish assemblages, not only in the Indian and Pacific Ocean (Lachner & Karnella, 1980; Larson, 1985, 1990; Munday & Jones, 1998; Munday et al., 1999) but also in the Red Sea (Lachner & Karnella, 1978; Lieske & Myers, 2004). Despite their importance, little attention has been paid to this highly adapted fish fauna in the western Indian Ocean and the north-western boundary of their geographical distribution, the Red Sea. Most studies providing data from the Red Sea are restricted to descriptions of new species or new records for this region (Goren, 1978; 1984; 1985; Goren & Voldarsky, 1980; Goren & Baranes, 1995) and taxonomic studies (Lachner & Karnella, 1978). Other studies focus on the Indo-Pacific and merely provide comments on the Red Sea fauna (Larson, 1985; 1990). Only few recent studies describe material from the Red Sea and provide information on the live coloration of species (e.g. Winterbottom, 1995), which is the major prerequisite for successful field identification and for focused studies of their ecology. Live coloration is mostly shown in field guides (e.g. Debelius, 2001; Lieske & Myers, 2004), but identification of species often relies only on images, without verification on sampled specimens. Thirty-two species in the genera Bryaninops, Eviota Jenkins, 1903, Gobiodon, Paragobiodon, Pleurosi- cya, Priolepis Bleeker (ex Ehrenberg, 1874) and Trimma Jordan and Seale, 1906 are currently recog-
Authors of several field guide books.

The present study provides a detailed description of the coloration and other important diagnostic features of the northern Red Sea gobies that are variously associated with living corals, including the few species that prefer coral rock. About two-thirds of the Red Sea species out of the seven genera mentioned above can now be more easily identified in the field or from collections based on images of live and preserved specimens. Short notes on the species’ typical habitats are also provided. Furthermore, this study presents species of Gobiodon not previously known from this region, which are currently undergoing taxonomic examination and takes the opportunity of correcting some identification errors made by previous authors of several field guide books.

Methods

Field observations were made while scuba diving from September to December 2003 and from March to June 2004 in the Gulf of Aqaba, the north-eastern extension of the Red Sea. Investigations took place at seven dive sites in the region of Dahab (28°28’ N, 34°30’ E). The main investigation site was the so-called “Islands”, a reef at the southern end of Dahab City. Additional investigations were conducted near the “Napoleon Reef”, approximately 0.5 km south of the “Islands”, at the more southern dives sites “Southern Oasis”, “Moray House”, “Caves” and “Um Sid”, about 7 km south of Dahab, and at the “Lighthouse” in the center of Dahab (approximately 2 km north of the “Islands”). Fish were studied in the field by taking random swims at the different sites and through different reef zones (reef flat, crest, slope and fore reef areas). Fish were collected using quinaldine (2-Methylquinaldine, diluted 1:15 with ethanol) and hand nets. Quinaldine is used for various purposes in medicine and chemistry but also has a rapid narcotic effect on fish and is therefore frequently used as a fish anaesthetic. All fish photographs were taken by J. Herler with a Canon Powershot A80 digital camera. The specimens described below as freshly collected are fish which were photographed immediately after being killed by an overdose of quinaldine (a dash of 5% quinaldine in a 50 ml sample tube of sea water): such fish showed a more accurate, near-live coloration than fish photographed in an aquarium. Specimens destined for morphological examination were fixed in 5% formaldehyde for at least 3 days before being transferred to 70% ethanol via a step of 50% ethanol. Specimens designated below as preserved are fish that remained in ethanol for a short period (several days to a few weeks) so as to show the effects of preservation on colour after a short period. Pigmentation in fish preserved for a long time (e.g. museum specimens) may be even more faded than in the fish examined in this study. Morphometric and meristic methods follow Miller (1988). Fish size is given as standard length (SL) + caudal fin length (d=damaged). For each species, the mean standard length and its standard deviation of all specimens is given in parentheses. Fin ray counts are cited as ranges, with frequency of values in parentheses. The last bifid ray of the second dorsal (D2) and anal (A) fin is counted as one. Scale counts in lateral series (LL) and transverse series (TR) are given as ranges, with their mean in parentheses. Bold numbers indicate most frequent counts (fin rays) or means (scale counts). Body proportions are given as mean ± standard deviation. Abbreviations used in this study are: Meristics - A, anal fin; C, caudal fin; D1, D2, first and second dorsal fins; P, pectoral fin; V, ventral fin. Morphometrics - Ad and Aw, body depth and width at anal fin origin; Cl, caudal fin length; CPd, caudal peduncle depth; E, horizontal eye diameter; I, interorbital width; H, head length; Hw, head width between dorsal insertion of left and right opercle; PI, pectoral fin length, SN, snout length; UJ, upper jaw length; V/AN, distance from ventral fin origin to anus; Vd, body depth at pelvic fin origin; VL, pelvic fin length; V4l and V5l, length of 4th and 5th pelvic ray. Abbreviation of names of institutions where specimens are held: CH, private collection Herler; GMBL, Grice Marine Biological Laboratory, Charleston, USA; NMW, Natural History Museum Vienna, Austria; NTM, Museum and Art Gallery of the Northern Territory, Darwin, Australia.

1 - Bryaninops natans Larson, 1985

(Fig.1)

A total of 10 specimens: 8 6 and 2 7, 10.8+2.6 - 17.0+3.8 mm (14.3, 2.0). Gulf of Aqaba, northern Red Sea, 28°28’ N, 34°30’ E: NMW 94943-44, 2 (14.1-14.4 mm SL), “Moray House”, approximately 5 km south of Dahab, J. Herler, Nov. 2003; CH 146-12-001 – 005, 5 (10.8-17.0 mm SL), “Moray House”, approximately 5 km south of Dahab, J. Herler, Nov. 2003; CH
Description

Bryaninops natans occurred in small groups or schools up to 30 individuals. These groups were usually loosely associated with branching colonies of Acropora Oken, 1915 such as A. loripes (Brook, 1892) and A. squarrosa (Ehrenberg, 1834). The fish hovered a few centimetres above the coral colonies and occurred down to a depth of 33m. Flight reactions of this goby were either towards the coral with which they were associated or led them away from the corals, with no obvious search for shelter. Lionfish, Pterois miles (Bennett, 1828), were observed to prey on small groups of B. natans. Chased fish often did not seek shelter in specific corals, and their schooling behaviour may be explained as predator avoidance behaviour. When undisturbed, the individuals often rested on branch tips, as mentioned by Larson (1985).

Remarks

The morphology of the examined specimens corresponds well with the description given by Larson (1985). Supplementing previous studies (Larson, 1985; Akihito et al., 2002), also 10 anal soft rays were counted in the present study. A very similar colour

Fig. 1. Coloration pattern of Bryaninops natans from the Gulf of Aqaba, northern Red Sea. A. Living specimen, unsexed, 16 mm SL. B. Freshly collected female, 16.6 mm SL. C. Preserved male, 16.4 mm SL.
pattern to that described here for freshly collected specimens is indicated in the drawing of Akihito et al. (2002, p. 1214). Goldman (pers. comm. in Larson, 1985) observed much larger groups of individuals (50-100) than found in the present study. The occurrence of *B. natans* in deeper water of the Gulf of Aqaba was already mentioned by Larson (1985). Debelius (2001) showed this species to be also associated with branching *Millepora*. *Bryaninops natans* was also found in the northernmost tip of the Gulf of Aqaba (Aqaba/Jordan: Herler, pers. obs.).

**2 - Bryaninops ridens** Smith, 1959

(Fig. 2)

A total of 10 specimens: 7 and 3 7, 10.9±2.0 - 17.8±3.5 mm (15.6, 2.0). Gulf of Aqaba, northern Red Sea, 28°28’ N, 34°30’ E: NMW 94945-46, 2 (14.4-15.5 mm SL), "Islands", Dahab, 5 m, J. Herler, June 2004; CH 146-16-001, 1 (10.9 mm SL), "Islands", Dahab, 4 m, J. Herler, Dec. 2003; CH 146-16-002 – 003, 2 (17.0-17.2 mm SL), "Islands", Dahab, 3-7 m, J. Herler, May 2004; BR 1, 1 (14.3 mm SL), “Moray House”, approximately 5 km south of Dahab, 3 m, J. Herler, April 2004; BR 2, 1 (16.8 mm SL), “Islands”, Dahab, 4 m, J. Herler, April 2004; BR 3, 1 (15.5 mm SL), “Islands”, Dahab, 11 m, J. Herler, May 2004; BR 4, 1 (17.8 mm SL), “Islands”, Dahab, 3 m, J. Herler, June 2004.

**Diagnosis**

Live coloration less vivid; little pigmentation on trunk, but iris colourful, golden and red, and two darker brown internal stripes along vertebral column. Common on *Millepora dichotoma*. Head stout, body relatively depressed, especially anteriorly (in % SL: Hw, 15.7; Vd, 17.0). Only posterior two-thirds of trunk scaled. Second dorsal and anal fin rays usually 8. Pectoral rays 13 or 14.

**Description**

D1 VI; D2 I/7-8 (7:1, 8:9); A I/7-8 (7:1, 8:8, d:1); C 11 (branched) and 15-17 (segmented); P 13-14 (13:4, 14:6); V I/5 + I/5. Pelvics a cup-like disc, with prominent skin lobes around pelvic spines. LL 31-37 (34.7), TR 5-9 (7.1). Scales found on trunk only: from below end of D1 posteriorly to C base. Few (1-3) isolated scales usually below D1. Body proportions of 10 adults, in % SL: H, 28.6±0.7; Vd, 17.0±0.9; Ad, 14.3±1.6; CPd, 8.2±0.7; Hw, 15.7±0.5; Aw, 12.5±0.7; Cl, 19.6±1.2; Pl, 20.5±1.0; VI, 19.0±1.4; V/AN, 24.4±1.4; E, 9.7±0.4; in % H: Hw, 54.9±2.8; E, 33.8±1.8; UJ, 48.2±2.7; I, 11.1±0.4; SN 29.8±1.7.

**Colour in life**: Body shaded brown, with two darker brown dorsal stripes from behind nape to end of abdomen. Lips reddish-brown. Two stripes extending from upper lip to middle of snout. Orange-brown internal pigment above brain. In narcotised or freshly killed fish, coloration more intensive and bluish internal gleam visible on head and anterior part of abdomen (Fig. 2B).

**Colour in alcohol**: In ethanol, distinct colour marks vanish, except for pigmentation on anterior nape and short brown stripe from posterior eye rim passing over sides of nape (Fig. 2C).

**Biology**

This goby was exclusively found on the hydrozoan coral *Millepora dichotoma* (Forskal, 1775), which was very abundant on the reef edge and upper reef slopes in the investigated area. It clung to the coral, usually in a head down position (Fig. 2A), as described by Larson (1985) for *B. erythrops* (Jordan & Seale, 1906). Behavioural adaptations of the goby to its specific habitat were evident. Individuals of *B. ridens* were extraordinarily quick and difficult to collect. They moved by darting rapidly from one *Millepora* branch to
another and also escaped through the network of branches near their base. This behaviour obviously makes the fish almost inaccessible to predators. *Bryaninops ridens* did not occur on plate-like *Millepora* (e.g. *M. platyphylla* Hemprich and Ehrenberg, 1834), although this coral was common in shallow parts of the investigated reefs. The lack of joining branches and of corresponding gaps between the branches of this coral did not support such efficient escape behaviour, and it was probably avoided for that reason.

**Remarks**

The morphology of the Red Sea specimens corresponds well with the description given by Larson (1985). Goren (1984) described *B. ridens* from the Red Sea as *Lobulogobius bentuviai* Goren, 1984 (synonymized with *B. ridens* by Larson (1985)). Our material included one specimen with lower (7) number of A rays than reported in previous descriptions (Larson, 1985; Akihito et al., 2002). Another minor difference was found in the greater maximum SL than observed by Larson (1985) (17.8 mm versus 16.0 mm). Akihito et al. (2002) reported a higher pectoral fin ray count and Larson (1987) a higher LL scale count in Japanese samples. Larson (1985) found this species to be uncommon and to inhabit corals such as *Porites* Link, 1807, *Pachyseris* Milne-Edwards and Haime, 1849 and *Millepora* L., 1758. In contrast, *B. ridens* was very abundant at the investigation sites in the Gulf of Aqaba but was found only on *Millepora dichotoma*, resembling the ecology of *B. erythrops* in the Indo-Pacific (Larson, 1985). However, a frequent occurrence of *B. ridens* on *Millepora* was also reported from Japan (Larson, 1987). Winterbottom & Emery (1986) found only very small specimens of *B. ridens* (< 12 mm SL) in a small sample from the central Indian Ocean.

**3 - Bryaninops yongei** (Davis & Cohen, 1969) (Fig. 3)

A total of 4 specimens: 3 7, 17.5+3.6 - 22.5+4.2 mm (20.1, 2.5) and 1 juvenile, 9.9+2.3 mm. Gulf of Aqaba, northern Red Sea, 28°28’ N, 34°30’ E: NMW 94947, 1 (20.4 mm SL), “Um Sid”, approximately 6 km south of Dahab, 8 m, J. Herler, May 2004; CH 146-20-001, 1 (9.9 mm SL), “Moray House”, approximately 5 km south of Dahab, J. Herler, Nov. 2003; CH 146-20-002, 1 (22.5 mm SL), “Caves”, approximately 6 km south of Dahab, 6 m, J. Herler, May 2004; specimen stored at Ras Mohammed National Park (field numbers): BY 1, 1 (17.5 mm SL), “Islands”, Dahab, 16 m, J. Herler, April 2004.

**Diagnosis**

Live coloration distinct, with 6 to 7 greenish-brown or reddish-brown vertical bars on dorsal trunk, fused to horizontal stripe from behind pectoral fin to caudal fin origin below lateral midline. Lives on *Cirripathes* sp. A long, slender species, with compressed head (Hw 12.1 % SL) and large mouth. Snout long (31.2 in % H) and mouth opening large. Eyes also large. Second dorsal and anal fin ray count 9. Scales small, about 40 in lateral midline.

**Description**

**D1 VI; D2 I/9 (9:4); P 15-16 (15:2, 16:2); V I/5 + I/5.**

D2 and A rays only slightly branched in larger specimens; not more than one branching point in some rays. Caudal fin truncate, slightly heterocercal. Pelvic disc cup-shaped; spines with long, folded lobes and pocket-like frenum, folded anteriorly. Scale counts of 3 adult specimens: **LL 37-44 (40.0), TR 10-11 (10.3).** Scales only on posterior trunk, from below D1 IV posteriorly to origin of C. Body proportions of 3 adult specimens, in % SL: H, 32.9±0.7; Vd, 16.3±0.3; Ad, 12.8±0; CPd, 7.6±0.2; Hw, 12.1±1.2; Aw, 10.4±0.4; Cl, 19.3±0.9; Pl, 23.0±2.1; VI, 20.4±0.2; V/AN, 25.5±0.5; E, 9.2±0.5; in

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**Fig. 3.** Coloration pattern of *Bryaninops yongei* from the Gulf of Aqaba, northern Red Sea. **A.** Living male, 22.5 mm SL. **B.** Freshly collected male, 20.4 mm SL. **C.** Preserved male, 22.5 mm SL.
% H: Hw, 36.7±3.7; E, 27.9±1.5; UJ, 40.5±2.7; I, 15.3±0.5; SN, 31.2±0.8.

**Colour in life:** Six to seven distinct red-brown or greenish-brown bars, from dorsal midline to about lateral midline (Fig. 3A and B). Broad internal reddish to dark brown stripe along midline of trunk. White internal stripe along vertebral column. Iris red, bordered by dark brown. Dorsally, orange-brown stripes from upper lip to both anterior eye rims, and bars across interorbital region and nape.

**Colour in alcohol:** Coloration in ethanol uniform: either white with many speckles over entire trunk and dorsal head of large fish (Fig. 3C), or white with no distinct colour marks, except for stripe from upper lip to anterior margin of eye and pigmented area above brain.

**Biology**

*B. yongei* was exclusively found on the seawhip *Cirripathes* sp. (Fig. 3A). Larson (1985) and Munday et al. (2002) described this species as an obligate dweller of *Cirripathes anguinea*. During this study, *B. yongei* was only occasionally observed due to the very low abundance of seawhips at most dive sites. But even at sites where there were many, this goby was very rare. At the “Caves” dive site, where its host coral was abundant in sea caves at a depth of about 6 m, of 43 corals between 40 and 270 cm (136 ± 51 cm) in length that were inspected for fish, only two were occupied by gobies. One 180 cm long coral was inhabited by a pair and another, 120 cm long, by a single male.

**Remarks**

The morphology of the examined specimens corresponds well with the description given by Larson (1985). In contrast, the anal fin rays are slightly branched in the larger specimens of the present collection. The live coloration agrees well with that presented by Field & Field (1998). Debelius (2001) shows a species designated as *B. tigris* (page 184, large image), which probably also resembles *B. yongei* because of its similar live coloration and obvious occupation of *Cirripathes* sp., the obligate host of this goby. The species of *Cirripathes* associated with this goby in our study area was not confidently identified.

**4 - Eviota distigma** Jordan & Seale, 1906

(Fig. 4)


**Diagnosis**

Very small (< 14.2 mm SL), and sexually dichromatic. Basic coloration greenish (males) or reddish (females), with red to dark internal, x-shaped bars on trunk. Both sexes with black caudal peduncle spot, but two dark spots on pectoral base only in males. First two dorsal spines may be significantly elongated in males. Second dorsal and anal fin rays usually 8.

![Fig. 4. Coloration pattern of *Eviota distigma* from the Gulf of Aqaba, northern Red Sea. A. Freshly collected male, 13.6 mm SL. B. Freshly collected female, 12.8 mm SL. C. Preserved male, 13.6 mm SL. D. Preserved female, 14.1 mm SL.](image-url)

**Description**

- **D1** VI; **D2** I/8 (8:15); **A** I/7-8 (7:5, 8:10); **C** 11 to 15 (branched) and 17 (segmented); **P** 15-16 (15:6, 16:9); **V** I/5 + I/5. Some D2 and A rays slightly branched at their ends. Upper P rays unbranched. Pelvics: V4 with 3 to 7 branches; V5 reduced to small nubbin. **LL** 24-26 (24.5) and **TR** 6-7 (6.1). Scales only present on trunk. Body proportions of 15 adult specimens, in % SL: H, 31.6±1.4; Vd, 24.2±1.2; Ad, 23.8±1.0; CPd, 16.9±0.7; Hw, 16.0±0.9; Aw, 10.9±0.9; Cl, 29.8±1.6; VI, 34.6±2.0; V5I, 3.5±1.1; V/AN, 27.7±2.7; E, 10.6±0.9; in % H: Hw, 16.0±0.9; E, 33.6±2.2.

**Colour in life:** Basic external pigmentation reddish or greenish, scale pockets bordered with red. Reddish pattern common in females (Fig. 4B), greenish pigmentation frequently seen in males (Fig. 4A). Both sexes with dark caudal peduncle spot. Males with two conspicuous black spots on pectoral base. Dark internal trunk bars found in both sexes, but more distinct in males. Bars as x-shaped patterns on posterior trunk (Fig. 4A, B). First dorsal with 3 oblique red stripes; most distal one mixed with dark greyish pigment. Interspaces between stripes sometimes yellow. Anal fin with 3 to 4 short red bars proximally and dark grey fin membrane distally. Second dorsal and C greyish, interspersed with red pigment.

**Colour in alcohol:** Red and green pigments vanished. Head and body densely sprinkled with dark melanophores. Distinct pigmentation on scale pockets. Large spots on cheek and nape faint. Dark internal bars weak, visible especially in males. Most distinct pigmentation: D1 and A stripes, caudal peduncle spot, six dark spots along ventral midline, from origin of A posteriorly to origin of C, and, in males, two dark spots on pectoral base. Detailed description of colour in preservative provided by Lachner & Karnella (1978, 1980).

**Biology**

*E. distigma* was very cryptic, and individuals of this very small species were only occasionally observed during visual counts. In most cases they were collected during occasional quantitative samplings with the aid of quinaldine. Most fish were detected in crevices and holes of coral rock or beneath dead corals. In several cases, fish were also collected from living corals, such as *Turbinaria reniformis* Bernard, 1896, *Porites* spp. or *Acropora loricipes*.

**Remarks**

The general morphology of the Red Sea specimens resembles specimens described by Lachner & Karnella (1978). Differences, however, were found in the scale counts in lateral series and transverse series (22-25 vs. 24-26 and 5-6 vs. 6-7) but this may be due to differences in the counting methods used, especially for TR for which the former authors counted from the origin of D2 ventrally and posteriorly to anal base. The counts herein were made from the origin of A dorsally and posteriorly to second dorsal fin base. A somewhat higher maximum SL (16 mm) was found by Winterbottom & Emery (1986) in a large sample from the central Indian Ocean. Myers (1989) and Akihito et al. (2002) cited 20 mm SL as the maximum size of *E. distigma*. Tyler (1971) also found this goby on live corals. This author only examined branching corals (*Stylophora* Schweiggerr, 1819 and *Acropora*), and no other growth forms are mentioned as hosts.

5 - *Eviota guttata* Lachner & Karnella, 1978 (Fig. 5)

A total of 15 specimens: 8 6 and 7 7, 11.6+3.2 – 18.9+4.6 mm (16.3, 1.8). Gulf of Aqaba, northern Red Sea, 28°28` N, 34°30` E: NMW 94952-53, 2 (both 16.8 mm SL), “Islands”, Dahab, 9-11 m, J. Herler, May
**Diagnosis**

Relatively large (up to 19 mm SL) with distinct red spots arranged in longitudinal series, largest on abdomen. Males with long to filamentous first dorsal spines. Soft ray counts usually 9 in second dorsal and 8 in anal. Pectoral rays usually 17. About 25 scales in lateral midline.

**Description**

*D*1 VI-VII (VI:14, VII:1); *D*2 I/9-10 (9:14, 10:1); *A* I/7-8 (7:4, 8:11); *C* 11-12 (branched) and 17 (segmented); *P* 15-17 (15:1, 16:5, 17:9); *V* I/5 + I/5. Anterior *D*1 spines usually greatly elongated in mature males (Fig. 5); *D*1 I and II filamentous, III and IV slightly elongated. Slight elongation of *D*1 spines only in large females. Second dorsal and *A* rays only slightly branched; first and sometimes last ray unbranched. Upper (number depending on body size) and lowermost *P* rays unbranched. Pelvics: *V*4 with 6 to 10 branches; *V*5 reduced to small nubbin. LL 23-26 (24.7) and TR 6-8 (6.9). Scales present only on trunk. Body proportions of 15 adult specimens, in % SL: *H*, 28.5±1.1; *Vd*, 21.6±1.0; *Ad*, 19.3±1.0; *CPd*, 13.4±0.7; *Hw*, 13.7±0.8; *Aw*, 10.2±0.9; *Cl*, 27.0±1.6; *VI*, 30.9±1.9; *VII*, 2.8±0.4; *V/AN*, 28.7±3.2; *E*, 8.8±0.5; in % *H*: *Hw*, 48.1±2.1; *E*, 30.8±1.7.

**Colour in life:** Live coloration distinct with both sexes having three main rows of conspicuous large red spots. First row along dorsal midline; spots represented by short transverse bars similar to quotation marks (Fig. 5A, B). About 12 of these marks from *D*1-origin posteriorly to *C*-origin. Below, row of 9 larger, elongate red spots, running from nape along upper lateral midline posteriorly to caudal peduncle. Spot size decreases posteriorly. Third and lowermost row consists of large red spot on the opercle, three large spots on the abdomen, and six red spots at ventral midline, between origins of *A* and *C*. Spots gradually decrease in size posteriorly. Lips, snout and cheek with small red dots. Scale pockets marked by greenish pigment, with dark centres. Little pigmentation in *D*1, except for dark stripe at base. Second dorsal and *C* with numerous tiny dots, most evident in males. In large males, second dorsal with yellow margin. Anal fin with short red stripes proximally and uniform dark grey pigmentation over distal two-thirds.

**Colour in alcohol:** Pigmentation reduced to some rows of dark dots along dorsal parts of head and trunk (Fig. 5C). Dark stripe along the base of *D*1. Caudal fin and proximal parts of *D*2 and *A* pigmented. Detailed description of colour in preservative provided by Lachner & Karnella (1978).

**Biology**

*Eviota guttata* was the most conspicuous species of the genus observed in this study. It was frequently observed because of its relatively large body size, characteristic live coloration and rather epibenthic behaviour. It occurred on living massive corals such as *Favia favus* (Forskål, 1775), *Platygyra Ehrenberg, 1834*, *Porites* spp. and *Astreopora myriophthalma* (Lamarck, 1816) or encrusting corals such as *Montipora* Blainville, 1830, but was also common on coral rock.

**Remarks**

In general, morphological features of the present material correspond with those given by Lachner & Karnella (1978), and Field & Field (1998) have already shown its live coloration in the field. Nevertheless, some previously cited meristic ranges (Lachner & Karnella, 1978; Randall & Goren, 1993; Randall, 1995) must be extended to include our material. The range from 8 to 9 *D*2 soft rays, as mentioned by these authors, is extended to 10, and the low count of 7 *A* rays (range 7 to 9) has also not previously been reported (8 or 9 to 9). Lachner & Karnella (1978) counted a maximum of 24 scales in lateral series, but Randall (1995) cited about 26, as was found here. Also, TR may be somewhat higher (up to 8) than cited by Lachner & Karnella (1978), but this may be explained by the different counting methods used. Randall (1995) cites reefs and rubble in depths between 1.5 to 10 m as typical habitat. However, although most individuals were found on coral rock, this species was also common on live corals and in greater depths in the Gulf of Aqaba. It was also found in the northernmost tip of the Gulf of Aqaba (Aqaba/Jordan: Herler, pers. obs.).

6 - *Eviota prasina* (Klunzinger, 1871) (Fig. 6)

A total of 12 specimens: 7 6 and 5 7, 10.5+2.7 – 17.0+4.4 mm (14.0, 2.1). Gulf of Aqaba, northern Red Sea, 28°28’ N, 34°30’ E: NMW 94954-55, 2 (both 14.7 mm SL) “Islands”, Dahab, 1 m, J. Herler, June 2004; CH 206-53-001 – 002, 2 (11.7-11.9 mm SL), “Islands”, Dahab, 1 m, J. Herler, Dec. 2003; CH 206-53-003, 1 (17.0 mm SL), “Islands”, Dahab, 1.5 m, J.
Herler, March 2004; CH 206-53-004, 1 (15.9 mm SL), "Islands", Dahab, 1.5 m, J. Herler, April 2004; CH 206-53-005, 1 (10.5 mm SL), "Islands", Dahab, 1 m, J. Herler, June 2004; specimens stored at Ras Mohammed National Park (field numbers): EP 1-2, 2 (12.2-12.6 mm SL), "Islands", Dahab, 1.5 m, J. Herler, March 2004; EP 3-5, 3 (14.9-16.8 mm SL), "Islands", Dahab, 1 m, J. Herler, April 2004.

Diagnosis

Description
D1 VI; D2 I/9 (9:12); A I/8-9 (8:11, 9:1); C 12 to 14 (branched) and 17 (segmented); P 14-16 (14:1, 15:3, 16:8); V I/4-5 + I/4-5. In males, first dorsal spine often elongated. First or first and second ray in D2 unbranched. In P, upper half of rays and lowermost ray usually unbranched. Pelvics: V4 with 6 to 12 branches; V5 reduced to small nubbin. LL 24-26 (24.8), TR 6-7 (7.0). Scales present only on trunk. Body proportions of 12 adult specimens, in % SL: H, 28.4±0.9; Vd, 21.8±1.3; Ad, 20.6±1.8; CPd 15.1±0.8; Hw, 13.2±0.7; Aw, 9.8±0.9; Cl, 27.0±1.3; Vi, 33.0±3.0; V5l, 2.1±0.5; V/AN, 27.8±2.1; E, 8.7±1.0; in % H: Hw, 46.5±3.4; E, 30.5±2.8.

Colour in life: Basic green coloration on head and trunk. Large red spots on cheek, opercle, nape and pectoral base, and red to dark internal trunk bars (Fig. 6A, B). Along dorsal midline, short red bars alternating with pale green to yellow bars. Trunk bars variable: red, brownish-green or almost black. Three broad bars on abdomen, alternating with light interspaces. Bars on posterior trunk narrower, extending dorsally to above lateral midline. Small dark caudal peduncle spot usually visible. Most scale pockets marked by short vertical rows of tiny red dots. Dorsal and caudal fins with red dots along fin rays. In males, dots sometimes overlaid by dark grey pigmentation. Anal fin dark grey distally. Black band across lower third of D1, covering interspaces of first 4 to 5 spines, especially distinct in males. Proximally, fin membrane transparent; distally, fin dark grey. Elongate D1 spine usually yellow in males. In females, D1 frequently with yellow margin.

Colour in alcohol: In ethanol, several distinct colour marks: caudal peduncle spot, dark spots on nape, rows of small dots along scale pockets, dark internal trunk bars and dark band on D1 (Fig. 6C). Anal fin and, in males, D1, D2 and C dark grey; with small dots arranged in rows along fin rays. Detailed description of colour in preservative provided by Lachner & Karnella (1980).

Biology
Eviota prasina occurred in high abundance on eroded, rocky reef flat areas, where the fish hid in crevices or holes excavated by the sea urchin Echinometra mathaei (Blainville, 1825). Individuals were also found in living colonies of branching corals, e.g. in Stylophora pistillata (Esper, 1797) and Acropora samoensis (Brook, 1891).

Remarks
The present material is in good agreement with the description of previous authors (Lachner & Karnella, 1978; Randall & Goren, 1993, Randall, 1995; Akihito et al., 2002), except for a somewhat higher count in LL (up to 26) found herein. Other differences were found in the higher pectoral ray counts by the latter authors. Akihito et al. (2002) also mentioned intertidal zones and tide pools as typical habitat. This agrees with our observations, since the species had its high-

Fig. 6. Coloration pattern of Eviota prasina from the Gulf of Aqaba, northern Red Sea. A. Living female, 15.0 mm SL. B. Freshly collected male, 14.7 mm SL. C. Preserved male, 17.0 mm SL.
est abundance on shallow, eroded reef flats in the Gulf of Aqaba.

7 - Eviota sebreei Jordan & Seale, 1906 (Fig. 7)


**Diagnosis**

Small and slender (in % SL: Hw, 11.8; Aw, 9.2), with broad red lateral stripe on the otherwise translucent trunk, and black basicaudal spot. No remarkable dorsal spine elongations or sexual dimorphism. Soft ray counts in second dorsal and anal fin usually 9 and 8, respectively. Pectoral rays usually 16. About 25 scales in lateral midline.

**Description**

D1 VI; D2 I/8-9 (8:1, 9:10); A I/8 (8:11); C 11 (branched) and 17 (segmented); P 16-17 (16:10, 17:1); V I/5 + I/5. No distinct elongation of D1 spines in either sex. Second dorsal, A and P rays all unbranched. Pelvics: V4 highly fringed, 8 to 15 branches; V5 relatively long, about half of pelvic fin length, but unbranched. LL 24-25 (24.9), TR 6-7 (6.7). Scales on trunk only. Body proportions of 11 adult specimens, in % SL: H, 28.3±1.3; Vd, 18.9±1.2; Ad, 17.1±1.2; CPd, 11.4±0.9; Hw, 11.8±0.8; Aw, 9.2±1.6; Cl, 24.8±0.9; VI, 32.4±2.4; V4l, 29.9±1.7; V5l, 17.4±1.4; V/AN, 28.0±1.9; E, 8.8±0.5; in % H: Hw, 41.8±2.9; E, 31.2±2.0.

**Colour in life**: In life, dorsal and ventral body parts translucent (Fig. 7A+B). A broad red horizontal stripe of internal pigment from eye along lateral midline posteriorly to caudal peduncle. Large black spot at origin of C, bordered with yellow or orange anteriorly. Posterior to black spot, orange-red band across base of dorsal C rays. Along vertebral column, white pigment alternating with dark red pigment. Dorsal part of head reddish, with short white stripe behind posterior margin of eye. Iris dark red, with broad white stripe above and narrow white stripe below pupil.

**Colour in alcohol**: Some conspicuous colour marks in ethanol: black caudal spot, dark internal pigment behind orbit and dark stripes along bases of dorsals (hardly visible in living fish). In some specimens, broad internal stripe still visible (Fig. 7C). Detailed description of colour in preservative provided by Lachner & Karnella (1980).

**Biology**

Although E. sebreei was a shy species which fled long distances when threatened or disturbed, it was frequently observed on various living stony corals. This species dwelled preferably on encrusting, plate-like or massive growth forms such as Pachyseris speciosa (Dana, 1846) or Echinopora forskaliana (Milne-Edwards and Haime, 1850). It was rarely observed on coral rock, to which it also escaped when pursued. Because of the long flight distances and its shy behaviour, this species was difficult to collect using quinaldine and just hand nets.

**Remarks**

The morphology of the examined specimens agrees with descriptions given by previous authors (Lachner
Karnella, 1978; Randall & Goren, 1993, Randall, 1995; Akihito et al., 2002), although Randall (1995) cited a much higher LL count (26-27) than the other authors (23-24). However, the present values are in the middle of this total range. Winterbottom & Emery (1986) found a greater maximum SL (18.2 vs. 15.6 mm) from a larger central Indian Ocean sample. Lachner & Karnella (1978) reported 20.4 mm SL as their largest specimen. Randall (1995) mentioned that this species can often be observed on live corals. It was confirmed by the present investigation that this species is the most common of its genus on live corals. The species figured by Field & Field (1998) is not E. sebreei, but E. zebrina, which is described below.

8 - *Eviota zebrina* Lachner & Karnella, 1978 (Fig. 8)

A total of 8 specimens: 5 6 and 3 7, 13.7+3.5 – 16.5+4.6 mm (15.1, 0.8). Gulf of Aqaba, northern Red Sea, 28°28’ N, 34°30’ E: NMW 94958, 1 (15.4 mm SL), “Moray House”, approximately 5 km south of Dahab, 32 m, J. Herler, May 2004; NMW 94959, 1 (15.0 mm SL), “Lighthouse”, Dahab, 26 m, J. Herler, June 2004; CH 206-78-002, 1 (16.5 mm SL), “Moray House”, approximately 5 km south of Dahab, 26 m, J. Herler, May 2004; CH 206-78-003, 1 (14.9 mm SL), “Islands”, Dahab, 14 m, J. Herler, May 2004; CH 206-78-004 – 005, 2 (14.7-14.9 mm SL), “Islands”, Dahab, 16 m, J. Herler, June 2004; specimens stored at Ras Mohammed National Park (field numbers): EZ 1, 1 (15.5 mm SL), “Um Sid”, approximately 6 km south of Dahab, 22 m, J. Herler, April 2004; EZ 2, 1 (13.7 mm SL), “Islands”, Dahab, 12 m, J. Herler, June 2004.

**Diagnosis**

Slender and compressed body (in % SL: H, 28.4±0.8; Vd, 20.2±1.1; Ad, 19.1±1.0; CPd, 12.6±0.6; Hw, 12.0±1.2; Aw, 8.3±0.5; Cl, 28.1±1.3; Vl, 38.0±4.0; V4l, 36.3±3.3; V5l, 2.7±1.2; V/AN, 26.7±2.4; E, 8.8±0.5; in % H: Hw, 42.3±3.8; E, 30.9±2.0.

**Colour in life:** Body translucent, with intensive red colour marks all over head and trunk. Broad internal red stripe from behind eyes over entire lateral midline (Fig. 8A, B). Another internal stripe below, from eye to end of abdomen; connected to former by red bars across abdomen; interspaces bright white. Short bars forming upper horizontal band extended dorsally along entire trunk and, on tail, also ventrally extended bars. Dorsal stripe alternating with white interspaces along entire length of vertebral column, as observed in *E. sebreei*. 14 short vertical red bars along dorsal midline, regularly arranged from behind eyes to origin of C. Dense red pigmentation on nape. Anterior nares long tubular and red. Thin red stripes from bases of nares to anterior margin of eye. Eyes striped with red and white. Small black spot on caudal peduncle and small vertical bar posterior to it. Strong pigmentation on median fins: tiny red or dark dots along spines of

**Description**

**D1 VI; D2 I/8-9 (8.7, 9.1); A I/7 (7.8); C 11 (9-11) branched and 17 (segmented); P 15-16 (15.5, 16.3); V I/5 + I/5. Dorsal spine elongation in both sexes, but filamentous elongation of first two dorsal spines only in males. Second dorsal and A rays some or all (except for the first) slightly branched at their end. Pectoral rays usually 15. About 24 scales in lateral midline.

**Fig. 8.** Coloration pattern of *Eviota zebrina* from the Gulf of Aqaba, northern Red Sea. **A.** Living male, 15.5 mm SL. **B.** Freshly collected male, 16.5 mm SL. **C.** Preserved male, 16.5 mm SL.
D1; D2 with three to four oblique, thin red bars and shades of dark grey distally; four to five wavy vertical bars formed by black dots on C. Ventral part of C darkened; black area originating at caudal peduncle mark extends to posterior part of C. Anal fin shaded dark grey.

**Colour in alcohol:** Some conspicuous colour marks in ethanol: black spot and short black bar on caudal peduncle, small dark saddles in dorsal midline, large internal bars on ventral part of posterior trunk and dark, wavy bars on C (Fig. 8C). Dots on D1 and dark pigment on D2 and A remain. Detailed description of colour in preservative provided by Lachner & Karnella (1978, 1980).

**Biology**

_E. zebrina_ dwelled on live corals but occurs most frequently on coral rock. On stony corals it was mostly found on encrusting growth forms such as _Montipora_ spp. and _Pachyseris speciosa_, where it sometimes occurred together with _E. sebreei_. It was also present on foliose _Turbinaria reniformis_ and massive _Echinopora forskaliana_ or _Favia_ Oken, 1815.

**Remarks**

The morphology of the described specimens agrees with the description given by Lachner & Karnella (1978) except for the higher anal soft ray count of 8 (range 7 to 9) in their large sample. Although the sample of Winterbottom & Emery (1986) was large, they found a smaller maximum SL (14.9 mm) than was observed here. The two species, _E. sebreei_ and _Eviota_ sp., shown by Field & Field (1998, p. 94) obviously represent _E. zebrina_, based on the typical arrangement of white and red colour patterns shown by these specimens, although the black caudal peduncle spot is only weakly visible in the specimen designated as _E. sebreei_. Debelius (2001, p. 183) shows _E. zebrina_ as _E. prasites_. _Eviota zebrina_ was also found in the northernmost tip of the Gulf of Aqaba (Aqaba/Jordan: Herler, pers. obs.).

**9 - Gobiodon citrinus** (Rüppell, 1838) (Fig. 9)

A total of 5 specimens: all unsexed, 20.5±5.6 – 39.6±11.4 mm (28.7, 6.9). Gulf of Aqaba, northern Red Sea, 28°28’ N, 34°30’ E: CH 232-12-001, 1 (39.6 mm SL), “Islands”, Dahab, 1.5 m, J. Herler, April 2004; CH 232-12-002 – 003, 2 (20.5-32.1 mm SL), “Islands”, Dahab, 7 m, J. Herler, May 2004; specimens stored at Ras Mohammed National Park (field numbers): GCI 1-2, 2 (22.4-28.8 mm SL), “Islands”, Dahab, 7 m, J. Herler, May 2004.

**Diagnosis**


**Description**

D1 VI; D2 l/10 (10:5); A l/9 (9:5); C 15-17 (branched) and 17 (segmented); P 18-19 (18.2, 19.3); V l/5 + l/5. First dorsal rounded to almost triangular. Second dorsal and A usually rounded. Caudal fin slightly rounded or truncate. Pelvic disc well developed. Scales absent. Body proportions of 5 adult specimens, in % SL: H, 31.8±0.7; Vd, 39.9±1.5; Ad, 34.0±2.1; Hw, 16.6±0.8; Aw, 14.1±1.0; Cl, 27.9±1.4; Vi, 18.8±0.9; V/AN, 19.7±2.7; E, 9.2±0.9; in % H: Hw, 52.4±3.4; E, 28.9±2.4.

**Colour in life:** Basic coloration canary yellow. Four pale blue vertical bars on head and pectoral base (Fig. 9A, B): first two across eye and cheek, third extends from nape to before about middle of pectoral base and fourth across pectoral base. Distinct blue stripes along posterior third of first dorsal base and

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**Fig. 9.** Coloration of _Gobiodon citrinus_ from the Gulf of Aqaba, northern Red Sea. _A_. Living adult, unsexed, 39.6 mm SL. _B_. Freshly collected specimen, unsexed, 31.1 mm SL. _C_. Preserved specimen, unsexed, 39.6 mm SL.
entire second dorsal base and along anal fin base, respectively. Black spot at dorsalmost part of opercular membrane.

**Colour in alcohol:** Freshly preserved specimens with basic yellow coloration (Fig. 9C). After long term preservation, straw yellow. Head bars and stripes along fin bases grey. Eyes and body surface somewhat opaque due to coagulation of mucus layer.

**Biology**

_Gobiodon citrinus_ occurred most abundantly in fore reef areas and deeper lagoon habitats, where it lived on large tabulate _Acropora_ corals, mainly _A. pharaonis_ (Milne-Edwards and Haime, 1860). It was rarely found in smaller corymbose species of _Acropora_.

**Remarks**

Most previous authors (Randall, 1983; Myers, 1989; Randall _et al._, 1990; Randall & Goren, 1993, Randall, 1995) cite a higher range of D2 fin rays, varying between 9 and 11; some reported only 8 A rays. Nevertheless, the combination of 10 D2 and 9 A rays as observed here is clearly the most frequent in the northern Red Sea and these values were also reported by Rüppell (1838) and Khalaf & Disi (1997). A higher P count of up to 20 rays was cited by Myers (1989). _Gobiodon citrinus_ was also found in the northernmost tip of the Gulf of Aqaba (Aqaba/Jordan: Khalaf & Disi, 1997; Herler, pers. obs.).

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**10 - _Gobiodon histrio_ (Valenciennes, 1837)**

(Fig. 10)


**Fig. 10.** Coloration of _Gobiodon histrio_ from the Gulf of Aqaba, northern Red Sea. **A.** Living adult, unsexed, 34.2 mm SL. **B.** Freshly collected juvenile, 9.5 mm SL. **C.** Freshly collected juvenile, 15.0 mm SL. **D.** Freshly collected juvenile, 22.2 mm SL. **E.** Freshly collected female, 33.9 mm SL. **F.** Preserved male, 34.2 mm SL.
Diagnosis
Large (up to 45 mm total length), highly compressed species (in % SL: Vd, 44.3, Hw, 15.3) with steep head profile. Unmistakable live coloration, basic green with distinct red colour marks, forming bars on head, irregular circles on sides of nape and longitudinal, circular patterns on trunk. Inhabits different Acropora species in mostly shallow water. Second dorsal fin rays usually 10, anal rays 9. Pectoral fin rays about 20. No scales.

Description
D1 V-VI (V.1, VI:15); D2 I/10-11 (10:15, 11:1); A I/9 (9:16); C 15-17 (13-17) (branched) and 17 (16-17) (segmented); P 19-21 (19:5, 20:10, 21:1); V I/5 + I/5. Pelvic disc well developed. Scales absent. Body proportions of 13 adult specimens, in % SL: H, 29.1 ± 1.4; Vd, 44.3 ± 1.5; Ad, 36.7 ± 1.4; Hw, 15.3 ± 0.9; Aw, 12.0 ± 1.2; Cl, 26.3 ± 1.4; VI, 16.3 ± 0.9; V/AN, 20.9 ± 3.0; E, 6.0 ± 0.6; in % H: Hw, 52.5 ± 2.7; E, 20.8 ± 1.4.

Colour in life: Conspicuous basic green coloration on head and trunk, with scattered intense red markings on head and dorsal trunk (Fig. 10A, E). Distinct red bars on head: below eye, across cheek and opercle, and two across pectoral base. Red bars bend over or fuse at lateral sides of nape forming labyrinth-like pattern; posteriorly continued by wavy and irregularly shaped stripes and circles on dorsal trunk. Black spot on dorsalmost part of opercular membrane. First red colour mark developed in small juveniles as red vertical bar below eye (Fig. 10B). Additional vertical bars on head and rows of red spots on the dorsal trunk, forming circles and irregular stripes in larger fish (Fig. 10C-E).

Colour in alcohol: Uniformly straw-yellow. Pectoral spot and some darker bands on head remain visible (Fig. 10F). After removal of mucus layer, trunk stripes and circles of live coloration slightly visible as somewhat darker patterns.

Biology
Gobiodon histrio was frequently observed in shallow water regions, where it mainly occupied Acropora acuminata (Verrill, 1864) but was also found in A. digitifera (Dana, 1846) and A. gemmifera (Brook, 1892) on the reef flat and reef crest. The highly compressed body of the relatively large G. histrio enables this species to inhabit the narrow interspaces of the respective host corals.

Remarks
The coloration pattern of G. histrio from the northern Red Sea differs from that in the western Pacific (Munday et al., 1999). The fish observed here have the red stripes only on the upper half of the trunk, while those from the Pacific have this colour pattern more extended, with stripes also found on the ventral trunk region (Randall et al., 1990; Munday et al., 1999; Akihito et al., 2002). Clearly, the circular arrangement of the red colour marks on the nape and dorsal trunk is typical for the Red Sea population. An even more circular arrangement of the red pattern is shown in Lieske & Myers (2004: as G. rivulatus) in a specimen from Saudi Arabia, although the basic blue coloration is unusual for G. histrio. The present investigation extends the range of variation of the soft ray counts of D2, usually cited with 10 (Cuvier & Valenciennes, 1837; Randall et al., 1990, Akihito et al., 2002), to 11 rays. There is a series of species that are very similar to G. histrio, such as G. erythrospilus Bleeker, 1875, G. sp. A and G. sp. B of Munday et al. (1999), which were shown to be distinct species (Munday et al., 2004). No such forms were found at the Gulf of Aqaba locations investigated here. Detailed taxonomic investigation, including molecular genetics, is needed to reveal the relationship between Red Sea and Pacific populations, especially since there are obvious differences in coloration.

11 - Gobiodon reticulatus Playfair, 1867
(Fig. 11)

Diagnosis
Medium-sized; largest specimen about 38 mm total length. Reddish-brown basic coloration, with blue head bars and stripes along dorsal and anal fins with dark borders. Trunk with scattered light blue spots. In different species of Acropora, preferably in deeper water (> 10 m). Second dorsal and anal fin rays usually 11 and 9, respectively. Pectoral fin rays about 20. No scales.
Description
D1 VI; D2 I/10-12 (10:1, 11:20, 12:1); A I/9-10 (9:19, 10:1); C 15-17 (branched) and 17 (segmented); P 19-21 (19:4, 20:13, 21:5); V I/5 + I/5. Pelvic disc well developed. Scales absent. Body proportions of 20 adult specimens, in % SL: H, 31.1±1.0; Vd, 39.6±1.3; Ad, 34.5±1.4; Hw, 17.2±0.9; Aw, 12.4±1.0; Cl, 26.8±1.5; Vi, 17.1±1.5; V/AN, 20.3±1.6; E, 8.6±0.6; in % H: Hw, 55.3±3.3; E, 27.8±1.8.

Colour in life: Basic reddish to brown coloration and several pale bluish bars on head and pectoral base (Fig. 11A, B). Two bars from lower margin of eye to ventral head side. Another two bars from nape to posterior rim of opercle. Short bar usually present ventrally between those two and the former two bars. Pectoral base with two oblique bars. Additional bluish stripes with dark borders at bases of D1, D2 and A, more distinct in preserved fish after removal of mucus layer. Light spots scattered over entire trunk, hardly visible in small juveniles but distinct in adult fish. First dorsal, D2 and C often with yellow margins.

Colour in alcohol: In ethanol, specimens uniformly brown with dark median fins (Fig. 11C). Head bars, trunk spots and stripes along median fin bases remain visible, especially after removal of coagulated mucus layer.

Biology
Gobiodon reticulatus occurred in deeper water and was mainly found in the lower reef slope and fore reef areas, where it occupied a variety of Acropora corals. It was found in A. loripes, A. samoensis, A. squarrosa, A. digitifera and A. eurystoma (Klunzinger, 1879).

Remarks
The specimens collected in the Gulf of Aqaba agree well with the description of Playfair & Günther (1867) from the Gulf of Aden. The dorsal count of 6 + 12-13 of these authors did not differentiate spines from soft rays, and the D2 count must be assumed to be I/11-12, which is within the variation recorded here. The present ranges of dorsal, anal and pectoral ranges resemble those observed by Randall (1995) from the Gulf of Oman, except for 10 A rays found herein. Khalaf & Disi (1997) showed the same life coloration of G. reticulatus but counted fewer anal rays (8 instead of 9), while the dorsal and pectoral ray counts were within the present range.

12 - Gobiodon rivulatus (Rüppell, 1830)
(Fig. 12)

Diagnosis
Medium-sized (up to 37 mm total length). Two colour morphs present: light form with greenish basic coloration and light blue lines, more or less vertical on head and anterior part of trunk but irregular, labyrinth-like on posterior part of trunk; dark form with dark brown basic coloration and blue lines clearly visible
only on head and anterior part of trunk. In different Acropora corals. Body relatively depressed (Vd 37.8 % SL) when compared with congeneric species. Second dorsal and anal fin rays usually 10 and 8, respectively. Pectoral fin rays usually 19. No scales.

Description

D1 VI; D2 I/9-11 (9:1, 10:13, 11:2); A I/8-9 (8:14, 9:2); C 15-17 (branched) and 16-17 (segmented); P 19-20 (19:12, 20:4); V I/5 + I/5. Pelvic disc well developed. Scales absent. Body proportions of 15 adult specimens, in % SL: H, 30.0±1.1; Vd, 37.8±1.6; Ad, 32.3±1.4; Hw, 16.6±0.9; Aw, 14.0±1.3; Cl, 21.7±1.2; VI, 16.4±1.4; V/AN, 20.6±2.2; E, 7.7±0.6; in % H: Hw, 55.5±3.8; E, 25.8±1.9.

Colour in life: Two colour morphs differ mainly in basic coloration. Dark colour morph with dark reddish brown head and dark brown body; numerous thin blue bars across head and trunk, hardly visible on posterior trunk. Light form showing more distinct bars and light green or reddish-green basic coloration (Fig. 12A, B). Median fins of light form reddish; those of dark form dark brown or almost black. Light form with thin light blue stripes along bases of D1, D2 and A, hardly visible in dark form. In both forms on head: two thin bars through and below the eye to ventral head side; short bar from middle of nape to posterior margin of orbit, usually continued ventrally to across cheek, only briefly interrupted at posterior eye rim; posterior to this, three long bars, all originating on nape, the first across anterior part of opercle, the second across posterior opercle and the third extending over pectoral base; interspaces of these three bars usually bearing two shorter bars. Numerous thin vertical bars on trunk, very variable, more or less straight anteriorly but labyrinth-like on posterior trunk.

Colour in alcohol: In ethanol, specimens uniformly light brown (Fig. 12C) or, in dark colour morph, dark brown. When mucus layer removed, remnants of trunk and head bars visible through somewhat darker pigment.

Biology

Gobiodon rivulatus inhabits several species of Acropora. It was mainly observed in A. secale (Studer, 1878), A. eurystoma, A. loripes, A. digitifera and A. acuminata. It was most common on the reef flat, crest and slope. Gobiodon rivulatus could also be observed in association with other species of the genus.

Remarks

Two colour morphs of this species were found in the Gulf of Aqaba, as also observed by Munday et al. (1999) at western Pacific reefs. Gobiodon rivulatus was often mistaken for G. histrio, although both species are very distinct. The main problem may be the confusing description of its live coloration by Rüppell (1830), who describes red, labyrinth-like patterns on basic green coloration. Fortunately all of the syn-type material is correctly attributed to G. rivulatus and there are no specimens of G. histrio (Winterbottom, pers. comm.) sensu Suzuki et al. (1995) and Munday et al. (1999). Since most of the descriptions of G. rivulatus from the Red Sea (Randall, 1983; Field & Field, 1998; Lieske & Myers, 2004) actually show G. histrio, no live coloration images of the true G. rivulatus were shown from the Red Sea before. Winterbottom & Emery (1986) found a lower maximum SL (27.7 mm) of this species from the central Indian Ocean. However, the largest specimen was of the dark colour morph, which usually represents the largest fish among populations, as mentioned by these authors. Furthermore, a somewhat higher range in soft ray counts of D2 and A was found (9-11 vs. 10 and 8-9 vs. 8) in the specimens from the Gulf of Aqaba. Gobiodon sp. 4 of Akihito et al. (2002, p. 1189) very probably represents G. rivulatus because of agreements in coloration as well as in median fin ray counts. This species was also found in the northernmost tip of the Gulf of Aqaba (Aqaba/Jordan: Herler, pers. obs.).
13 – *Gobiodon* sp. 1
(Fig. 13)


**Diagnosis**

Highly variable live coloration: juveniles with greenish to reddish basic coloration and red bars and spots on head and trunk; adults uniformly red or brownish-green. In different *Acropora* corals. Second dorsal and anal fin rays usually 11 and 9, respectively. Pectoral fin rays usually 20. No scales. Provisionally designated as *Gobiodon* sp.1.

**Description**

D1 VI; D2 I/10-11 (10:4, 11:28); A I/8-10 (8:1, 9:30, 10:1); C 15-17 (branched) and 17 (segmented); P 18-20 (18:1, 19:5, 20:26); V I/5 + I/5. Pelvic disc well

**Fig. 13.** Coloration of *Gobiodon* sp.1 from the Gulf of Aqaba, northern Red Sea. A. Living juvenile, 17.0 mm SL. B. Freshly collected juvenile, 17.9 mm SL. C. Living adult, unsexed, ca. 30.0 mm SL. D. Living adult, unsexed, ca. 30.0 mm SL. E. Freshly collected female, 32.9 mm F. Preserved female, 32.9 mm SL.
developed. Scales absent. Body proportions of 30 adult specimens, in % SL: H, 30.7±1.5; Vd, 38.2±2.2; Ad, 32.3±2.5; Hw, 15.6±1.0; Aw, 12.7±1.5; Cl, 23.4±2.6; Vi, 17.4±2.0; V/AN, 20.2±1.6; E, 7.4±0.9; in % H: Hw, 50.9±3.4; E, 24.0±2.1.

**Colour in life:** Live coloration highly variable, especially between juvenile or small adults (< 25 mm SL) and larger adults (> 30 mm SL). Small juveniles mostly greenish, larger fish reddish, all with distinct red colour marks on head and trunk (Fig. 13A, B). As most conspicuous pattern in juvenile and small adult specimens, light blue bars through and below eyes, across cheek as well as light straight or irregular bars on postorbital region, all alternating with red. Bluish bar on dorsal part of pectoral base at insertion of fin rays, bordered red, distinct in most juveniles but poorly visible in large adults. Rarely, light stripes along dorsal and anal fin bases (mostly in juveniles). In juveniles and small adults, nape and entire trunk scattered with red dots or irregularly arranged, short red stripes. Sometimes, especially in pale juveniles, row of larger red spots along lateral midline. Small adults with more uniform reddish head and trunk. Large adults uniformly red or brownish-green with two bright bars across eye (Fig. 13C-E).

**Colour in alcohol:** In ethanol, specimens uniformly light or dark brown (Fig. 13F) with head bars only visible in formerly intensely coloured smaller fish.

**Biology**

*Gobiodon* sp. 1 was found in several species of *Acropora* corals and was widely distributed across reef zones. It was most commonly observed in *A. gemmifera*, *A. secale*, *A. loriipes*, *A. samoensis* and *A. acuminata*.

**Remarks**

Winterbottom (pers. comm.) reported that another similar, undescribed species exists at Rodrigues in the southern Indian Ocean and at Phuket, Thailand, but that species lacks head bars. The head coloration of the present juveniles matches well with *Gobiodon* sp. 6 of Akihito *et al.* (2002) at similar size, but the material otherwise disagrees in dorsal and anal soft ray counts. Although there is considerable difference in coloration of small and large fish, it is supposed that all specimens included in this description represent a single species. This assumption is mainly based on the consistent fin ray counts of D2 and A and on some transitional colour patterns between small and larger fish, as described above. More detailed morphological and additional molecular genetic investigations shall reveal the identity of this species and its relationship to Indo-Pacific forms in the near future.

**14 - Gobiodon sp. 2**

(Fig. 14)


**Diagnosis**

Small (< 26 mm SL) and uniformly black species, with relatively low body depth (Vd 39.3 % SL) compared to other species of the genus. In few *Acropora* corals. Second dorsal and anal fin rays usually 10 and 8, respectively. Pectoral fin rays usually 19. No scales. Provisionally designated as *Gobiodon* sp. 2.

![Fig. 14. Coloration of *Gobiodon* sp. 2 from the Gulf of Aqaba, northern Red Sea. A. Freshly collected female, 18.5 mm SL. B. Preserved specimen, unsexed, 15.9 mm SL.](image-url)
Description

D1 VI; D2 I/10-11 (10:14, 11:1); A I/8 (8:15); C 16-17 (branched) and 17 (segmented); P 19-20 (19:12, 20:3); V I/5 + I/5. First dorsal short and rounded. Second dorsal and A with long posterior rays; both somewhat rhomboid in shape. Pelvic disc well-developed. Scales absent. Body proportions of 13 adult specimens, in % SL: H, 31.1±0.9; Vd, 39.3±2.3; Ad, 30.1±1.8; Hw, 15.8±0.6; Aw, 12.0±0.7; Cl, 23.1±1.2; VI, 17.8±1.6; V/AN, 25.6±4.2; E, 7.0±0.8; in % H: Hw, 50.8±2.1; E, 22.5±2.4.

Colour in life: Uniformly black, including the eye, the latter poorly visible in living fish in the field (Fig. 14A).

Colour in alcohol: In ethanol, black, but eyes opaque, as in most fishes after preservation. Some body parts, such as cheek and some areas on pectoral and median fins may be lighter and appear dark grey (Fig. 14B).

Biology

Gobiodon sp. 2 was most frequently observed in Acropora corals such as A. gemmifera, A. selago (Studer, 1878) and small tabulate colonies of A. hyacinthus (Dana, 1846). The species occurred mainly in shallow water regions, namely the reef flat and reef crest. Due to its small body size, this species was sometimes difficult to detect between the branches of Acropora colonies. The smallest highly gravid female found was only 18.5 mm SL.

Remarks

This species is most similar to G. ceramensis (Bleeker, 1852) but differences are found in fin ray counts of A (9-10 in Bleeker (1852) vs. constantly 8 in the present study) and in the presence of an interopercle-isthmus groove (absent according to Harold & Winterbottom, 1999). Bamber (1915) reported G. ceramensis from the Red Sea and, based on this, Dor (1984) included it in his checklist of fishes from the Red Sea. But it is doubtful whether Bamber (1915) had material of the true G. ceramensis, and Goren & Dor (1994) did not cite this species in their updated CLORES-checklist. The Red Sea individuals are much smaller than reported for G. ceramensis from the Indo-Pacific. If, however, the present species resembles G. ceramensis of the Indo-Pacific, its habitat choice in the Red Sea is of great interest because, according to Hoese (unpublished manuscript key) and Munday et al. (1999), it is the only species of the genus that mainly inhabits pocilloporid corals in the Indo-Pacific. In contrast, Tyler (1971) showed G. ceramensis was an inhabitant of Acropora corals and his specimen in Figure 6 closely resembles the individuals observed in the northern Red Sea. There is a series of Gobiodon species described that are entirely black, at least when they are adult. Gobiodon acicularis Harold & Winterbottom, 1995 is also entirely black but can be distinguished from the present material by its characteristic elongated first dorsal spines. Gobiodon spilophthalmus Fowler, 1944, is considered to be black when adult (Munday et al., 1999), as it is described for G. albofasciatus Sawada & Arai, 1972 by Akihito et al. (2002), but these two species must be considered as probably synonymous (Winterbottom, pers. comm.). There is no juvenile coloration described for G. ceramensis but its habitat is the same as described by Akihito et al. (2002) for G. albofasciatus (Hoese, unpublished data; Munday et al., 1999). This indicates that these two species might be synonymous as well (Winterbottom, pers. comm.). If this is true, the nominal species in question must be called G. ceramensis (Bleeker, 1852), which would then be characterised by a black and white striped juvenile coloration with black dots on the head and caudal fin base and an entirely black adult coloration. However, also small juveniles of about 13 mm SL in the present material were already uniformly black, which is another indication that G. sp.2 does not resemble G. ceramensis. Nevertheless, the very consistent pattern of 10 second dorsal and 8 anal soft rays observed herein was also found by Sawada & Arai (1972) for G. albofasciatus, but these authors found the black and white longitudinal colour pattern even in relatively large specimens of 18.8 mm SL. Detailed taxonomic investigations shall reveal the identity of this species in the near future.

15 - Gobiodon sp. 3
(Fig. 15)


Diagnosis

Uniform dark brown live coloration, iris light blue. Deep bodied (Vd 42.4 % SL), with compressed trunk (Aw 12.1 % SL). Specialized on few highly branching Acropora corals. Second dorsal and anal fin rays usually 10 and 8, respectively. Pectoral fin rays usually 20. No scales. Provisionally designated as Gobiodon sp. 3.
Description

**D1 VI; D2 I/10-11 (10:10, 11:1); A I/8-9 (8:10, 9:1); C 17 (branched) and 17 (segmented); P 19-20 (19:4, 20:7); V I/5 + I/5.** Dorsals and anal fin short compared to body depth. Caudal fin small and truncate. Pelvic disc well developed. Scales absent. Body proportions of 11 adult specimens, in % SL: H, 31.2±0.8; Vd, 42.4±1.3; Ad, 35.0±1.5; Hw, 15.5±0.6; Aw, 12.1±0.9; Cl, 23.7±1.7; Vi, 17.7±1.1; V/AN, 21.9±2.3; E, 6.5±0.4; in % H: Hw, 49.5±1.6; E, 20.7±1.1.

**Colour in life:** Uniform dark red-brown body coloration with greenish gleam on dorsal trunk (Fig. 15A, B). Median fins with pale margins. Iris light blue.

**Colour in alcohol:** In ethanol, body uniform reddish-brown, often with some paler parts on head, pectoral base and along lateral midline (Fig. 15C). Median fin margins bright.

Biology

*Gobiodon* sp. 3 was found in different highly branched *Acropora* corals such as *A. selago*, *A. acuminata* or *A. hyacinthus*. It occurs mainly on the reef flat and upper reef slope.

Remarks

Winterbottom & Emery (1986) reported a similar species named *G. nr unicolor* from Chagos but differences exist in second dorsal and anal fin counts (11 vs. usually 10 and 9 vs. usually 8) and the photo shown by these authors rather resembles what is described here as *Gobiodon* sp. 2. Furthermore, these authors noted that there is no groove between interopercle and isthmus, but such a groove was found in the Red Sea specimens. Considering these features, the present species resembles the description of *G. unicolor* by Winterbottom & Emery (1986). However, when compared to *G. unicolor* of Akihito et al. (2002), the present material agrees well in coloration and body shape but, again, differs in fin ray counts. High similarities were also found with *Gobiodon* sp. 5 of Akihito et al. (2002, p. 1190), especially in body shape and fin ray counts, but the drawing of these authors suggests a bright body coloration. However, it could well be a separate species belonging to a taxonomically difficult species complex, as stated by Winterbottom (pers. comm.). Detailed taxonomic investigations shall reveal the identity of this species in the near future.

16 – *Paragobiodon echinocephalus* (Rüppell, 1830) (Fig. 16)

A total of 14 specimens: 6 and 8, 7, 11.1+3.2 – 19.4+5.0 mm (15.8, 2.0). Gulf of Aqaba, northern Red Sea, 28°28´ N, 34°30´ E: NMW 94963-64, 2 (14.5-16.6 mm SL), "Napoleon reef", Dahab, 1 m, J. Herler, May 2004; CH 352-02-001 – 003, 3 (11.1 – 19.4 mm SL) "Napoleon reef", Dahab, 1 m, J. Herler, May 2004; CH 352-02-004 – 006, 3 (13.8 – 17.1 mm SL) "Napoleon reef", Dahab, 1-7 m, J. Herler, May 2004; specimens stored at Ras Mohammed National Park (field numbers): PE 1-6, 6 (15.1-18.3 mm SL), "Napoleon reef", Dahab, 1 m, J. Herler, May 2004.

Diagnosis

Head orange-red, trunk dark brown to black. Robust species, with club-like body and rounded head. Exclusively found in *Stylophora pistillata*. Second dorsal and anal fin rays usually 9. Pectoral fin rays usually 20. Trunk covered by large scales, about 25 in LL.

Description

**D1 VI; D2 I/8-10 (8:1, 9:12, 10:1); A I/9-10 (9:13, 10:1); C 15-17 (branched) and 17 (segmented); P 19-21 (19:4, 20:9, 21:1); V I/5+I/5.** Pelvic disc well developed. **LL 24-25 (24.8), TR 7-9 (7.9).** Scales prominent on trunk, with characteristic arrangement: no scales anterior of line from behind P to origin of D2 and to anus, respectively. Head, dorsal area below D1,
breast and anterior part of belly naked. Body proportions of 15 adult specimens, in % SL: H, 32.1±1.6; Vd, 29.7±1.4; Ad, 26.3±1.4; Hw, 19.9±0.8; Aw, 16.5±0.8; Cl, 28.2±1.7; VI, 22.3±1.3; V/AN, 20.6±1.8; E, 7.9±0.9; in % H: Hw, 62.3±3.8; E, 24.6±2.6.

Colour in life: Typical live coloration: orange-red head and dark brown or black median fins and trunk (Fig. 16A, B). Orange-red of head may extend onto anterior trunk to about level of middle of D1. Pupil green and iris orange.

Colour in alcohol: Generally the same head and trunk colour pattern as in life, but head lighter and brownish (Fig. 16C, D).

Biology

*P. echinocephalus* was exclusively found in association with the pocilloporid coral *Stylophora pistillata*, as described by Kuwamura *et al.* (1994). Gravid females were observed in June, when most fish were found as breeding pairs. Males and females were easily distinguished by characteristic dimorphism of the genital papillae (female papillae: short and fimbriate; male papillae: long and tapering). From the 6 pairs collected, females were significantly larger than males (12 ± 6.6 % more in SL; t = 4.3, p < 0.01). The occupation rate of coral colonies was very low at the main investigation site for this species, the "Napoleon reef". At this site, 583 coral colonies between 5 and 30 cm in diameter were counted in a defined area of 200 m², which yielded an abundance of 3 colonies/m² (30.2 ± 8.6 colonies in 20 transects of 10 m² each) of suitable corals. Out of 192 colonies inspected for the presence of fish, only 7 colonies were occupied (3.6 % occupation rate), each by a pair of *P. echinocephalus*. The calculated area for the 192 colonies was 70 m², which yielded 0.10 occupied corals/m². Occasional examination of corals at the “Islands” dive site revealed 2 occupied corals out of 45 colonies, which yielded a similar occupation rate (4.4 %). *Paragobiodon echinocephalus* was found pairwise or single. The colonies found to be occupied were relatively constant in size, varying from 15 to 20 cm in diameter, while smaller and larger colonies did not contain gobies, although according to Kuwamura *et al.* (1994) all corals between 5 and 30 cm diameter should be a proper habitat.

Remarks

Most previous studies (Myers, 1989; Randall *et al*., 1990; Akihito *et al*., 2002) cited the presence of only 8 to 9 D2 soft rays, but 10 were also found in our material, agreeing with Rüppell (1835). The last author obviously corrected himself after he cited 11 second dorsal rays in his original description (Rüppell, 1830), a count not found in any other study. The most frequent value is 9 second dorsal rays, which indicates that Rüppell (1835) may have counted the last bifid ray as two. Higher P ray counts (up to 22) were reported by Winterbottom & Emery (1986) and Randall *et al.* (1990). The former authors cited 25 to 27 LL scales and up to 10 in transverse series, which is somewhat higher than observed herein. This may be due to the very small, though adult, specimens found in the present study. Although these authors examined a smaller sample, they found a greater maximum SL (30.5 mm), with even the smallest specimen in their sample not exceeded by the largest fish of the present study. Small specimens (20 to 23 mm SL) are
also cited by Marshall (1952) from the southern Gulf of Aqaba. In contrast, Kuwamura et al. (1993) found fish of 41.5 mm TL (which is approximately 32.5 mm SL). The latter authors also found high correlations between male and female size in breeding pairs. However, females in the breeding pairs collected here were significantly larger than the males but Fig. 4a of these authors also suggests that females are slightly larger than males in most breeding pairs. The coral occupation rate in the study of Kuwamura et al. (1994) was much higher, with almost every colony larger than 15 cm inhabited. This may be explained by the low abundance of host corals. These authors state a coral abundance of approximately 0.13 colonies/m², which is 20 times less than observed in the present study. As a consequence, the abundance of occupied corals per area is similar to the value we report. Nevertheless, Kuwamura et al. (1994) found more gobies per colony, especially in large colonies exhibiting up to 16 individuals. Since only pairs of *P. echinocephalus* were observed here, lower total fish abundance must be assumed.

17 - *Pleurosicya micheli* Fourmanoir, 1971

(Fig. 17)


**Diagnosis**

In life, distinct red stripe along lateral midline, darker on caudal peduncle and ventral part of caudal fin. Dark colour mark in D1 in most specimens obvious. Frequent massive scleractinian corals. Body elongate, with pointed and depressed head (Hw 13.6 % SL) and compressed trunk (in % SL: Ad, 14.8; Aw, 10.0). Second dorsal and anal fin rays usually 8. Pectoral fin rays usually 17, median rays branched. Nape naked, except for posterior sides; trunk entirely scaled.

**Description**

D1 VI; D2 I/8 (8:12); A I/7-8 (7:1, 8:11); C 11 (branched) and 17 (segmented); P 16-18 (16:4, 17:6, 18:2); V I/5+I/5. D2 and A rays only slightly branched at their end or unbranched, especially in A. Uppermost and lowermost P rays unbranched, latter distally thickened. Pelvic disc well-developed, cup-shaped, with spine lobes and fimbriate frenum. LL 24-27 (25.9), TR 7-9 (7.8). Scales only on trunk and sides of nape. Body proportions of 11 adult specimens, in % SL: H, 31.9±1.1; Vd, 17.1±1.4; Ad, 14.8±1.0; CPd, 9.3±0.5; Hw, 13.6±0.8; Aw, 10.0±0.9; Cl, 24.3±1.0; Pl, 22.2±1.4; VI, 21.7±1.0; V/AN, 22.7±1.8; E, 9.6±0.7; in % H: Hw, 42.8±3.2; E, 29.9±2.1; UJ, 39.6±3.0; I, 3.2±0.7; SN, 27.5±2.8.

**Colour in life:** Characteristic red longitudinal colour pattern (Fig. 17A, B). Red-brown internal pigment as two stripes from behind eyes over dorsal part of abdomen, continued by red streak along vertebral column to origin of C. On caudal peduncle, streak overlaid by additional external pigment and therefore intensified, but usually not as dark as described by

![Fig. 17. Coloration of *Pleurosicya micheli* from the Gulf of Aqaba, northern Red Sea. A. Living adult, unsexed, ca. 15.0 mm SL. B. Freshly collected female, 17.2 mm SL. C. Preserved female, 17.2 mm SL.](image-url)
Larson (1990). Streak continues onto C and covers almost entire ventral half of fin. On head, trunk stripe continued by orange-red stripe from anterior margin of eye to upper lip. Thus, horizontal streak found along entire body, from tip of head to margin of caudal fin. Above this streak, vertebral column banded red and white over entire length, formed by six blocks of white interrupted by red internal pigment. Dorsal midline with light brown saddles, most intense in larger fish. In latter, entire body covered by tiny red-brown dots. First dorsal and A frequently bordered with red. Aside from streak between eye and upper lip, pigmentation on head mainly found as red-brown coloration over brain (Fig. 17A). Iris with inner circle of golden and outer circle of red colour, followed by dark orbital rim. Upper lip yellow. First dorsal often with large, black basal blotch, bordered red along its top, and covering interspaces of spines 2 to 5 or 6.

**Colour in alcohol:** In ethanol, only few distinct colour marks: black blotch on D1, pigment over brain and in some specimens, remnants of longitudinal streak on caudal peduncle and on lower part of C (Fig. 17C). Orbit bordered with black, iris silvery.

**Biology**
P. micheli occurred on massive-growing stony corals and was most frequently encountered on Platygrya spp., Porites spp. and Echinopora forskaliana but occurred on Favia favus as well. Due to the higher frequency of suitable corals in deeper water, this goby was usually found in the lower reef slope and fore reef areas. The fish preferred to stay in a vertical position on the vertical sides of the corals and were usually positioned head down.

**Remarks**
Larson (1990) described the body shape and nape squamation to be different in the similar P. micheli and P. mossambica, both occurring in the Red Sea. Although the present specimens resemble P. micheli of Larson (1990) in most features (Larson, pers. comm.), the less dark longitudinal stripe along the lower posterior trunk and C and especially the dark D1 blotch found in many specimens resemble colour patterns of P. mossambica. Nevertheless, live colouration and habitat choice correspond better with the description of P. micheli by Larson (1990), who cited hard corals as the typical habitat of P. micheli and soft corals more frequently occupied by P. mossambica. Debelius (2001) also shows both species but live colouration is very similar and they must be considered as the same species, P. micheli. Except for one case, all specimens were observed on scleractinian corals during the present study. Pleurosicya micheli was also found in the northernmost tip of the Gulf of Aqaba (Aqaba/Jordan: Herler, pers. obs.).

**18 - Pleurosicya prognatha** Goren, 1984 (Fig. 18)

A total of 11 specimens: 16 and 97, 10.8+2.5 – 15.6+3.7 mm (12.9, 1.6) and 1 juvenile, 8.1+2.1 mm. Gulf of Aqaba, northern Red Sea, 28°28’ N, 34°30’ E: NMW 94967, 1 (11.0 mm SL), “Islands”, Dahab, 1.5 m, J. Herler, April 2004; NMW 94968, 1 (15.6 mm SL), “Islands”, Dahab, 7 m, J. Herler, April 2004; NTM S.16063-001, 1 (14.5 mm SL), “Islands”, Dahab, 1 m, J. Herler, May 2004; specimens stored at Ras Mohammed National Park (field numbers): PP 1-2, 2 (11.7-12.2 mm SL), “Moray House”, approximately 5 km south of Dahab, 4 m, J. Herler, April 2004; PP 3-6, 4 (11.1-13.7 mm SL), “Islands”, Dahab, 11 m, J. Herler, May 2004; PP 9-10, 2 (11.7-12.2 mm SL), “Moray House”, approximately 5 km south of Dahab, 9 m, J. Herler, May 2004.

**Diagnosis**
Transparent in life, with brown speckles all over body and bluish gleam at ventral side of head. Most...
common on branching Acropora corals. Very small (< 16 mm SL), but with broad head (Hw 15.4 % SL), robust body (in % SL: Ad, 21.0; Aw, 13.2) and unique beak-like mouth due to elongation of upper jaw and lip. Second dorsal and anal fin rays usually 8. Pectoral fin rays usually 15 to 16, median ones branched. Only posterior two thirds of trunk scaled, about 25 in LL.

Description

D1 VI; D2 I/7-9 (7:1, 8:8, 9:2); A I/7-9 (7:2, 8:8, 9:1); C 10 to 12 (branched) and 16-17 (segmented); P 14-16 (14:1, 15:4, 16:6); V I/5+I/5. D2 and A rays are all unbranched. Uppermost and lowermost rays of P also unbranched, latter distally thickened. Pelvic disc well-developed, cup-shaped, with spine lobes and fimbriate frenum. Large parts of fin membrane also fimbriate. Frenum folded anteriorly, pocket-like. LL 24-25 (24.6), TR 7-9 (7.9). Scales only on trunk. Body proportions of 10 adult specimens, in % SL: H, 33.5±1.2; Vd, 22.9±1.4; Ad, 21.0±1.9; CPd, 11.7±1.1; Hw, 15.4±1.5; Aw, 13.2±1.0; Cl, 23.2±1.5; Pl, 25.3±1.2; VI, 22.5±1.6; V/AN, 18.8±2.4; E, 10.5±0.6; in % H: Hw, 46.0±3.4; E, 31.2±2.0; UJ, 40.2±2.1; I, 4.3±0.6; SN, 42.7±3.9.

Colour in life: In life, trunk transparent but covered by numerous small brown dots, which intensify in narcotised fish (Fig. 18A, B). Median fins translucent or shaded reddish-brown. Iris with inner circle of golden and outer circle of red colour. In more transparent fish, internal pigment present as white and brown longitudinal stripes along vertebral column, over entire length of abdomen. Bluish gleam present all over head, but in particular on its ventral half. Coloration intensifies in narcotised fish, as body coloration in general does.

Colour in alcohol: In ethanol, colourful marks disappear. Posterior trunk covered with tiny brown dots. Pattern reversed on anterior trunk and head, light dots on brown background (Fig. 18C). Median fins dark. Iris becoming brown, bordered by black orbital rim.

Biology

Pleurosicya prognatha typically inhabits branching corals of the genus Acropora in high abundance. This species was usually found in a series of corymbose coral species such as A. loripes and A. secale but was also observed in large arborescent tables of e.g. A. pharaonis.

Remarks

The present specimens correspond well with the description of Goren (1984) and Larson (1990), although only 7 fin rays were counted here in both D2 and A in one and two specimens, respectively. Pleurosicya prognatha is very similar to P. fringilla Larson, 1990, but can be distinguished by the unique apomorphy of an elongated upper jaw, exhibiting a tooth-bearing cartilaginous projection and an elongated upper lip (Larson, 1990). Furthermore, P. fringilla has not been reported from the Red Sea to date (Larson, pers. comm.). The general habitat choice of this goby mentioned by Larson (1990) resembles that of the present study but with different species of Acropora found to be inhabited.

19 - Priolepis semidoliata (Valenciennes, 1837) (Fig. 19)

Two 7, 13.0+5.1 – 14.0+4.1 mm (12.9, 1.6). Gulf of Aqaba, northern Red Sea, 28°28’N, 34°30’E; NMW 94970, 1 (13.0 mm SL), “Islands”, Dahab, 1 m, J. Herler, June 2004; specimens stored at Ras Mohammed National Park (field numbers): PS 1, 1 (14.0 mm SL), “Islands”, Dahab, 1 m, J. Herler, April 2004.

Diagnosis

Conspicuous live coloration: head orange-red with broad white bars on head, bordered black. Trunk canary-yellow, two to three small white bars bordered dark in dorsal midline, evenly spaced along base of D1. Median fins very large. Second dorsal fin ray counts distinctly higher than anal ray counts, 9 to 10 versus 7. Scales only on trunk, 25 to 27 in LL.

Description

D1 VI; D2 I/9-10 (9:1, 10:1); A I/7 (7:2); C 12 (branched) and 17 (segmented); P 17-18 (17:1, 18:1); V I/5+I/5. Pelvic disc complete, somewhat emarginate

Fig. 19. Coloration of Priolepis semidoliata from the Gulf of Aqaba, northern Red Sea. All the same male; 13.0 mm SL. A. Freshly collected, lateral view. B. Freshly collected, dorsal view. C. Preserved.
on posterior rim and without frenum; V4 slightly longer than V5. LL 25-27, TR 6. Scales relatively large, only on trunk. Body proportions of 2 adult specimens, in % SL: H, 33.3±1.5; Vd, 25.2±2.0; Ad, 21.9±0.9; CPd, 14.8±1.6; Hw, 18.7±0.1; Aw, 10.2±0.2; Cl, 34.1±7.2; VI, 37.9±2.8; V4l, 35.8±2.8; V5l, 29.3±0.6; V/AN, 33.1±1.7; E, 9.6±0.8; in % H: Hw, 56.3±3.0; E, 29.0±1.0.

**Colour in life:** Head orange-red, with several white vertical lines, bordered by black. Trunk canary-yellow (Fig. 19A, B). Dorsally on head, six transverse white bars with narrow black margins across preorbital, interorbital, postorbital region and nape. Laterally, two bars from lower margin of eye to upper lip and two bars across cheek. Last connecting with large bar from middle of nape at posterior eye margin. Sixth dorsal bar across posterior part of nape dividing into two bars at posterior oculoscapular region: anterior across opercle, posterior split into two branches at upper pectoral base, one across and one behind pectoral base. One to three weaker bars across anterior part of dorsal midline, most distinct along base of D1 and origin of D2.

**Colour in alcohol:** In ethanol, trunk light brown, with numerous tiny darker brown dots dispersed all over. Head bars well visible, brown, with thin black margins (Fig. 19C).

**Biology**

Only two individuals of this species were found during the study. Both were detected in holes of the eroded reef flat areas at the “Islands” dive site in 1 to 1.5 m depth. The holes were about 10 cm deep and fish were only found occasionally after applying quinaldine. Despite a subsequent intensive search, no additional individuals were found. *Priolepis semidoliata* shares its habitat with *E. prasina*, but it is much more cryptic.

**Remarks**

Previous studies cited counts of 8 or 9 D2 dorsal soft rays (Myers, 1989; Winterbottom & Burridge, 1993; Randall & Goren, 1993; Akihito *et al.*, 2002) but, although the present study was based on two individuals only, one of the specimens had 10 soft rays. Winterbottom & Burridge (1993) and Akihito *et al.* (2002) counted higher numbers of transverse scales, which is obviously mainly due to different counting methods used. The length of the fourth V ray, which was described as subequal to the fifth by Winterbottom & Burridge (1993), was greater in the present material. A very similar habitat characterisation was given by Randall & Goren (1993), who observed this goby as being cryptic and occurring in water 1.5 m deep.

**20 - Trimma avidori** (Goren, 1978) (Fig. 20)

A total of 8 specimens: 6 and 1 7, 13.8±3.5 – 19.1±4.4 mm (16.9, 2.2) and 1 juvenile, 11.0±3.1 mm. Gulf of Aqaba, northern Red Sea, 28°28’ N, 34°30’ E: NMW 94971, 1 (13.8 mm SL), “Moray House”, approximately 5 km south of Dahab, J. Herler, Nov. 2003; NMW 94972, 1 (17.3 mm SL), “Islands”, Dahab, 17 m, J. Herler, June 2004; CH 430-02-001, 1 (14.0 mm SL), “Islands”, Dahab, 16 m, J. Herler, Sept. 2003; CH 430-02-002, 1 (11.0 mm SL), “Islands”, Dahab, 16 m, J. Herler, Nov. 2003; CH 430-02-003 – 004, 2 (18.3-18.9 mm SL), “Moray House”, approximately 5 km south of Dahab, 9 m, J. Herler, May 2004; specimens stored at Ras Mohammed National Park (field numbers): TA 1-2, 2 (17.0-19.1 mm SL), “Moray House”, approximately 5 km south of Dahab, 9 m, J. Herler, May 2004.

**Diagnosis**

Large red spots on head, in 6 to 7 trunk series and
on median fins. Frequent in small caves and overhangs. Head short (H 26.9 % SL), trunk compressed (Aw 10.5% SL) and tail robust (CPd 13.2 % SL). Pelvics connected, slightly emarginated and without frenum. Second dorsal rays usually 10, anal rays 9 to 10. Pectoral rays 15 to 17.

Description

D1 VI; D2 I/9-10 (9:1, 10:7); A I/9-10 (9:4, 10:4); C 11 (branched) and 17 (segmented); P 15-17 (15:2, 16:3, 17:3); V I/5+I/5. Second dorsal and A rays all or all except for first ray branched. C slightly rounded to truncate. Uppermost and lowermost P rays usually not branched. Pelvics without frenum and slightly emarginated; V4 being slightly longer than V5. LL 24-26 (25.1) and TR 7-8 (7.3). Scales only on trunk. Body proportions of 7 adult specimens, in % SL: H, 26.8±0.7; Vd, 20.6±0.7; Ad, 20.9±0.5; CPd, 13.2±0.7; Hw, 13.8±0.8; Aw, 10.5±0.5; Cl, 23.9±1.0; VI, 24.9±1.1; V4I, 23.2±1.2; V5I, 20.1±0.8; V/AN, 25.9±1.8; E, 9.9±0.8; in % H: Hw, 51.2±2.6; E, 37.0±2.2.

Colour in life: Six to seven rows of distinct red dots in scale centres along the otherwise pale reddish trunk (Fig. 20A, B). Rows of red dots also present on median fins, pectoral base and head, particularly in postorbital region and on nape. Pectoral and ventral fin without distinct pigmentation. Pupil black, surrounded by six white spots on iris. Four small, grey, saddle-like bars in dorsal midline: first at D1 origin, second at end of D1, third at middle of D2 and fourth at end of D2. No distinct pigmentation on ventral head side or anterior part of belly.

Colour in alcohol: Colour pattern reversed. Red dots on head and trunk straw yellow, interspaces grey (Fig. 20C). Due to loss of red pigment, transparent spots on light grey background along median fin rays. Pectoral and ventral fin white. Dorsal saddle-like bars dark grey. Eyes dark grey.

Biology

T. avidori inhabited steep or overhanging substrates and was mostly found on the ceiling of small overhangs or in caves underneath coral structures. The frequent occupation of sea caves by different species of Trimma had already been mentioned by Lieske & Myers (2004). Nevertheless, this goby was also seen resting on massive stony corals like Echinopora forskaliana and Platygyra spp., where it stays on the steeply inclined sides of the colonies.

Remarks

A higher meristic range was found in D2 and A than in previous studies (Goren, 1978; Winterbottom, 1995) (10 and 9, respectively, in both). A further difference exists in the range of pectoral fin rays with 17 to 20 cited by Goren (1978), which is distinctly higher than found in the present study. Field & Field (1998) have shown the live coloration of T. avidori and another species (Trimma sp., p. 98) but the latter species also resembles T. avidori, which can be recognised by the typical arrangement of rows of red dots, as is the case for the Trimma species described as unknown by Debelius (2001, p. 183). Trimma avidori was also found in the northernmost tip of the Gulf of Aqaba (Aqaba/Jordan: Herler, pers. obs.).

21 - Trimma mendelssohni (Goren, 1978)

(Fig. 21)


Diagnosis

Head and trunk vivid orange-red to red-brown. Orange-red bars on ventral head side and broad red bars on trunk interspaced with light grey; up to 6 dark grey saddles in dorsal midline. Anterior trunk and head stout (in % SL: Hw, 17.0; Vd, 21.9) but tail slender (CPd 10.8 % SL). Pelvic disc slightly emarginated, without frenum. Second dorsal rays 9, anal rays 8. Pectoral rays 18 to 19.

Description

D1 VI; D2 I/9 (9:3); A I/8 (8:3); C 12 (branched) and

Fig. 21. Coloration of Trimma mendelssohni from the Gulf of Aqaba, northern Red Sea. A. Freshly collected male, 21.2 mm SL. B. Freshly collected female, 19.5 mm SL. C. Preserved male, 21.2 mm SL.
17 (segmented); P 18-19 (18:2, 19:1); V I/5+I/5. Pelvics without frenum; V5 slightly shorter than V4. Second D1 spine sometimes significantly elongated, also in females (Fig. 21B). LL 26-27 (26.3) and TR 7-8 (7.7). Scales only on trunk. Trenches between and behind eyes and fleshy lappets on anterior nape. Body proportions of 3 adult specimens, in % SL: H, 30.6±0.5; Vd, 21.9±0.4; Ad, 19.4±0.6; CPd, 10.8±0.8; Hw, 17.0±0.7; Aw, 10.2±0.6; Ci, 24.3±0.4; VI, 27.9±0.3; V4l, 26.5±1.2; V5l, 23.4±1.0; V/AN, 25.1±0.8; E, 11.5±0.6; in % H: Hw, 55.5±1.6; E, 37.7±1.4.

**Colour in life:** Intensive reddish brown coloration. On body, 6 broad red vertical bars (Fig. 21A, B). Nape reddish brown. Three orange-red bars from lower orbital rim to ventral head side. Iris red, most intensive around pupil. Males more intensely coloured than females. The latter with light grey interspaces alternated by broad orange-red bars on trunk and head. Across dorsal midline, up to 6 grey saddles, similar to those in *T. avidori*. Orange-red bar before pectoral base and two large spots on bases of pectoral rays. Dorsal fins with red dots arranged in lines, one on first dorsal near its base and about four on entire second dorsal. Anal fin red, with broad grey anterior margin in males.

**Colour in alcohol:** Red markings vanished (Fig. 21C). Entire body covered by dark brown melanophores, most intensive at dorsal body side and at nape. Ventral midline straw-yellow. Dorsal saddles dark brown, especially distinct on caudal peduncle; anteriorly covered by dark pigment but small brighter interspaces still visible. In males, anterior margin of anal fin dark grey.

**Biology**
*T. mendelssohni* was only occasionally found on the ceilings of coral rock caves of various sizes, as already stated by Lieske & Myers (2004) to be typical for many *Trimma* species.

**Remarks**
A slightly higher range in anal and pectoral ray counts was described by Goren (1978) in his four type specimens. The live coloration observed herein closely resembles that of a live photo of Glenn Barrall shown by Winterbottom (1995).

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