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**A REVIEW OF THE LABRID FISHES OF THE GENUS *HALICHOERES* OF THE
WESTERN INDIAN OCEAN, WITH DESCRIPTIONS OF SIX NEW SPECIES.**

by

John E. Randall and Margaret M. Smith

ABSTRACT

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Fifteen species of the labrid fish genus *Halichoeres* occur in the western Indian Ocean (west of the southern tip of India): *hortulanus* (*centiquadrus* of many authors), *scapularis*, (*ziczac* is a synonym), *marginatus* (*lamarii*, *ianthinus* and *virescens* are synonyms), *dussumieri* (*nigrescens* of many authors; *javanicus*, *dubius* and *dianthus* are synonyms), *pardaleocephalus* (first western Indian Ocean record), *hoevenii* (*vrolikii* is a synonym), *nebulosus* (previously confused with *margaritaceus* which does not occur in the Indian Ocean), *zeylonicus* (*bimaculatus* of most authors is a synonym), *lapillus*, and six new species (*stigmaticus*, *pelicierei*, *cosmetus*, *iridis*, *trispilus*, and *leucoxanthus*). *H. stigmaticus* from the Persian Gulf is distinctive in having 28 lateral-line scales, 6 or 7 suborbital pores, and a U-shaped black mark on side above pectoral fin tips in males; *H. pelicierei* from Mauritius is a close relative of *H. zeylonicus*, differing chiefly in the colour of males (*pelicierei* with a broad blackish zone in dorsal fin and no large black spot on upper side); *H. cosmetus*, wide-ranging in the western Indian Ocean and a close relative of *H. ornatissimus* of the Pacific and Cocos-Keeling Islands, is alternately striped with bluish gray to green and salmon pink or yellow; *H. iridis*, also a species of the western Indian Ocean, has a dark brown body except for a red band along the back and an orange-yellow head with green bands; *H. trispilus*, known only from Mauritius and the Maldives, is pale pink with a diagonal row of three dark brown spots on upper caudal base and usually three black dots on back; *H. leucoxanthus*, known only from the Maldives, southwest Thailand and Java, is yellow dorsally and abruptly white on ventral half of body with a dark spot behind the eye, a black spot on upper caudal base, and three others in the dorsal fin.

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A REVIEW OF THE LABRID FISHES OF THE GENUS *HALICHOERES* OF THE WESTERN INDIAN OCEAN, WITH DESCRIPTIONS OF SIX NEW SPECIES

by

John E. Randall¹ and Margaret M. Smith²

The wrasse genus *Halichoeres* is the largest genus of the family Labridae. Much research is needed to clarify the classification of the Indo-Pacific species of this genus. In the present paper the authors review only the species of the western Indian Ocean.

Like many of the labrid fishes, the species of *Halichoeres* generally exhibit sexual dichromatism as well as a different colour pattern in juveniles. As might be expected, this has led to a duplication in scientific names. The distinguishing of species of this genus on the basis of meristic characters is often not possible. In addition, there are complexes of closely related species that have proven most difficult to separate even on the basis of colour pattern. Kuitert and Randall (1981) have worked out one such complex, a group of three species of which one, *H. nebulosus*, ranges into the western Indian Ocean.

We suspect that the initial colour form of most *Halichoeres* is consistently female. However, we have determined the sex of an adequate number of specimens for only a few species such as *H. nebulosus*. That all *Halichoeres* do not fit this pattern is evident from the initial phase of *H. marginatus* which may be either female or male.

We define the western Indian Ocean as that part west of the longitude of the southern tip of India, including the Persian Gulf and Red Sea. Thus, Sri Lanka (Ceylon) is excluded. The labrid fauna of Sri Lanka includes several species that appear not to range west of the island e.g., *Halichoeres argus* (Bloch & Schneider, 1801) (*H. leparensis* (Bleeker, 1862), named for the female, is a synonym) and *H. timorensis* (Bleeker, 1862) (*H. kawarin* Bleeker, 1862 is a junior synonym).

Smith (1957) prepared a list of the labrid fishes of the western Indian Ocean, 16 of which are species of *Halichoeres*. We recognise 15 species of the genus from the region, six of which are described as new. Only four of the names on Smith's list are retained by us; the remaining names are misidentifications, junior synonyms (some based on colour phases) or species extralimital to the western Indian Ocean.

Smith (*op. cit.*) included three other nominal *Halichoeres* in a list headed "Doubtful or Unknown Species Recorded from the Western Indian Ocean": *H. dubius* (Steindachner, 1864) from Zanzibar, *H. maculatus* (Jatzow and Lenz, 1898) from Zanzibar, and *H. robinsoni* (Gilchrist and Thompson, 1914) from Natal, all of which were originally described in *PlatyGLOSSUS*. *H. dubius* appears to be the species we identify below as *H. dussumieri*. We are unable to positively identify *H. maculatus* from the brief description with any known member of the genus from the Indo-Pacific, but we

suspect it also is *H. dussumieri*. A request was made of Wolfgang Klausewitz of the Senckenberg Museum in Frankfurt for information on the type specimens. He replied, "While the other labrid fishes collected by Voeltzkow near Zanzibar and described by Jatzow and Lenz are to be found in our collection, we are not yet able to discover the type specimens of *PlatyGLOSSUS maculatus*." Smith (1949) initially recognized *H. robinsoni*, stating that only one specimen was ever found, and it has apparently been lost. We have ascertained, however, that the type of *PlatyGLOSSUS robinsoni* is extant at the South African Museum at Cape Town. It was loaned recently to Barry C. Russell who identified it as *Labrus ornatus*, a species known from Tristan da Cunha. This species was incorrectly referred to the genus *Labrichthys* Bleeker by Regan (1913) and subsequent authors also have misapplied this generic name. Russell (*pers. comm.*) regards *L. ornatus* as sufficiently distinct from other labrid fishes to warrant separate generic status and will propose a new generic name in a forthcoming paper. We believe that there was an error in recording the locality of *PlatyGLOSSUS robinsoni* as Natal. If *Labrus ornatus* were to be found in South Africa, one would expect it in the region of the Cape, not Natal.

Two species of *Halichoeres* often listed as occurring in the western Indian Ocean are *H. chloropterus* (Bloch) and *H. margaritaceus* (Valenciennes) in Cuvier and Valenciennes. Neither, however, are known from the region. The basis for the record of *H. chloropterus* is the description of *Julis semidecorata* Lesson from Mauritius. Bleeker (1862), Günther (1862) and others have listed this as a junior synonym of *H. chloropterus*. It is however, a synonym of *Halichoeres hortulanus* (Lacepède) (*centiquadrus* of many authors). *H. margaritaceus* is primarily a Pacific species which ranges into the Indian Ocean only as far west as the Cocos-Keeling Islands. More western localities attributed to this species are a result of confusion with the closely related *H. nebulosus* (Valenciennes) (Kuitert and Randall, 1981).

Burgess and Axelrod (1973: 602, fig. 48) recorded *Halichoeres melanocheir* Fowler and Bean from the Maldives Islands. A western Indian Ocean record for this distinctive species is very surprising, because its known distribution is southern Japan to Australia. The senior author has made three separate collecting and photographic trips to the Maldives and never saw this wrasse there. Herwarth Voigtman, an underwater photographer and former aquarium fish collector who has operated a diving concession in the Maldives for over 5 years, has stated (*pers. comm.*) that he has never seen the species there. Suspecting a locality error, we note that the same dead coral background was used for the surgeonfish photographs (Figs 299 and 300) in the same book. Fig. 299, identified as the juvenile of *Acanthurus tennentii* Günther, is actually the young of *A. olivaceus*

¹Bernice P. Bishop Museum, P.O. Box 19000-A, Honolulu, Hawaii 96819, USA

²J.L.B. Smith Institute of Ichthyology, Private Bag 1015, Grahamstown, Republic of South Africa.

Bloch and Schneider, a Pacific species unknown from the Indian Ocean (Randall, 1956). We conclude that the specimen of *H. melanochir* in the photograph of Burgess and Axelrod (1973: Fig. 48) was taken at some Pacific locality.

Methods and Materials

We have examined labrid fishes of the genus *Halichoeres* at the following institutions: Academy of Natural Sciences of Philadelphia (ANSP); Australian Museum, Sydney (AMS); Bernice P. Bishop Museum, Honolulu (BPBM); British Museum (Natural History), London BM(NH); California Academy of Sciences, San Francisco (CAS); Hebrew University, Jerusalem (HUF); J.L.B. Smith Institute of Ichthyology, Rhodes University, Grahamstown (RUSI); Museum National d'Histoire Naturelle, Paris (MNHN); Queensland Museum, Brisbane (QM); Rijksmuseum van Natuurlijke Historie, Leiden (RMNH); Senckenberg Museum, Frankfurt (SMF); U.S. National Museum of Natural History, Washington, D.C. (USNM); Western Australian Museum, Perth (WAM); and Zoologisch Museum, Amsterdam (ZMA).

A loan of selected specimens of *Halichoeres* from the Chagos Archipelago was made by the Royal Ontario Museum, Toronto (ROM).

Type specimens of the new species have been variously deposited at the Academy of Natural Sciences of Philadelphia, Bishop Museum, British Museum (Natural History), California Academy of Sciences, J.L.B. Smith Institute of Ichthyology, Museum National d'Histoire Naturelle, Royal Ontario Museum, and U.S. National Museum of Natural History.

In the descriptions of the new species, data in parentheses refer to paratypes if different from the holotype. More measurements of type specimens are presented in the tables than are summarized in the text. Proportional measurements in the text are rounded to the nearest .05. Meristic data are recorded only for Indian Ocean specimens.

Standard length (SL) is measured from the most anterior end of the snout in the median line (either upper lip or upper canines, whichever is more anterior) to the base of the caudal fin (posterior end of hypural plate). Head length is measured from the same anterior point to the posterior end of the opercular flap. Body depth is the greatest depth, taken from the base of the dorsal spines to the ventral margin of the abdomen (though correcting for any obvious malformation of preservation). Width of body is measured just posterior to gill opening. Orbit diameter is the greatest fleshy diameter, but the interorbital width is the least bony width. The length of the upper jaw is measured from the front of the snout to the end of the maxilla (dissection often necessary on larger specimens to expose maxilla). The depth of the caudal peduncle is the least depth; the length of the peduncle is measured between verticals at the rear base of the anal fin and base of caudal fin. The lengths of the fin spines and rays were measured from radiographs or by transmitting light through the base of the fins. Pectoral-fin length is the length of the longest ray. Lateral-line scale counts do not include the pored scale on the caudal fin. The upper rudimentary pectoral ray is included in the counts of the rays of these fins. Gill-raker counts include all rudiments. In the descrip-

tion of colour patterns, stripes are horizontal markings and bars are vertical.

Except for the three underwater photographs of *H. pelicier* by Daniel Pelicier, all of the photographs were taken by John E. Randall.

Genus *Halichoeres* Rüppell

Halichoeres Rüppell, 1835: 14 (type-species, *Halichoeres bimaculatus* Rüppell, 1835 = *Halichoeres zeylonicus* (Bennett, 1832) by subsequent designation of Jordan & Snyder, 1902, 636).

DIAGNOSIS: Body moderately elongate, the depth 2.7-4.6 in standard length (SL), and compressed, the width 1.9 to nearly 3.0 in depth; head somewhat pointed; mouth terminal, small, slightly oblique, the maxilla not reaching a vertical at front edge of orbit; lips rather fleshy, the lower with a broad, ventrally projecting flap on side; inner surface of upper lip strongly plicate; teeth conical, uniserial (except for a few small teeth anteriorly in an inner row in jaws), progressively longer anteriorly, the anterior pair (in some species two pairs) usually enlarged as canines; a canine tooth (rarely 2 or 3) posteriorly on upper jaw at corner of mouth (absent in juveniles and subadults of a few species); pharyngeal teeth well developed; gill membranes broadly attached to isthmus with a small free fold across; branchiostegal rays 6; preopercular margin smooth; lateral line complete, abruptly bending downward beneath posterior part of dorsal fin to a straight mid-lateral portion on caudal peduncle; scales cycloid, large, 25 to 29 in lateral line; scales on thorax and nape distinctly smaller than elsewhere; head scaleless except for nape, a patch of small scales on upper opercle of a few species (and a narrow near-vertical band of small scales behind the eye in *H. hortulanus*); fins scaleless except for base of caudal fin and a few small scales at base of dorsal and anal fins of some species; dorsal fin continuous with IX spines and 11 to 14 rays; anal fin with III spines (the first small) and 10 to 13 rays; membranes of spinous portion of dorsal and anal fins scarcely or not incised, each supported anteriorly by a slender, flexible, rod-like structure curving distally and posteriorly from behind tip of spine; caudal fin slightly to moderately rounded (slightly double emarginate in large adults of a few species) with 14 principal rays (middle 12 branched); pelvic fins I, 5, inserted beneath base of pectoral fins; vertebrae 25.

REMARKS: Warren C. Frehofer has informed us that his study of the cranial nerves in numerous species of *Halichoeres* has revealed three different patterns that he believes may warrant generic status. We are unable to find any obvious external character or characters to correlate with these cranial nerve patterns. Clearly, more study is needed to determine if *Halichoeres* (*sensu lato*) can be divided into three separate taxa. We retain *Halichoeres* in the broad sense in the present paper, but with the knowledge that the genus may later be divided.

The following genera are here accepted as junior synonyms of *Halichoeres*: *Hemiulus* Swainson, 1839; *PlatyGLOSSUS* Bleeker, 1861; *Guentheria* Bleeker, 1861; *Hemitautoga* Bleeker, 1841; *Choerajulis* Gill, 1862; *Iridio* Jordan & Evermann, 1896; *Octocynodon* Fowler, 1904; and *Halinanodes* Whitley, 1931. Randall (1979) added *Pseudojulis* Bleeker, 1862 as an additional probable synonym.

**KEY TO THE SPECIES OF HALICHOERES OF
THE WESTERN INDIAN OCEAN¹**

- 1a. An isolated patch of small scales on upper part of opercle; lateral-line scales 262
- 1b. No scales on opercle; lateral-line scales 27 or 28 ...3
- 2a. A near-vertical band of small scales immediately behind eye; suborbital pores of adults 20-40; no dark stripe on body; adults with series of black-edged square white blotches following scale rows; a yellow spot on body at base of 4th and 5th dorsal spines, followed by a large black blotch (Indo-Pacific)
.....*hortulanus*
- 2b. No band of scales immediately behind eye; suborbital pores 9-11; a dark stripe from eye to upper caudal base (zigzag on body of adults); no series of dark-edged white spots following scale rows: no yellow spot or black spot at base of dorsal fin (western Pacific and Indian Ocean)*scapularis*
- 3a. Dorsal soft rays 13 or 14; ground colour of head and body dark brown to blackish (Indo-Pacific)
.....*marginatus*
- 3b. Dorsal soft rays 11 or 12 (rarely 13 for *peliciery*); ground colour of head and body not dark brown or blackish (except in *peliciery* where much of body is dark brown)4
- 4a. Pectoral rays usually 15 (rarely 14 or 16)²5
- 4b. Pectoral rays usually 13 or 14 (rarely 12 or 15)² ...6
- 5a. Lateral-line scales 27; suborbital pores 8-12; ninth dorsal spine 2.7-2.85 in head; a small triangular black spot at upper base of pectoral fins; terminal males without a U-shaped black mark above pectoral fins (western Pacific and Indian Ocean)
.....*dussumieri*
- 5b. Lateral-line scales 28; suborbital pores 6 or 7; ninth dorsal spine 2.8-3.2 in head length; no black spot at upper base of pectoral fins; terminal males with a prominent blackish U-shaped mark between lateral line and pectoral fin tips (Persian Gulf)
.....*stigmaticus* n. sp.
- 6a. Pectoral rays usually 14 (rarely 13 or 15)7
- 6b. Pectoral rays usually 13 (rarely 12 or 14)9
- 7a. Suborbital pores 16-23; pores of anterior lateral-line scales 3-9; body with five vertical rows of indistinct blotches (formed by dark edges on scales) arranged in three longitudinal series (Indonesia and India)*pardaleocephalus*
- 7b. Suborbital pores 6-14; pores of anterior lateral-line scales 1-3; colour not as in 7a 8
- 8a. Dorsal and anal soft rays 12; suborbital pores 6; first dorsal spine 2.3-2.8 in ninth dorsal spine; dark stripes or rows of dark spots following scales of body (Indo-Malayan region to Maldives)
.....*hoevenii*
- 8b. Dorsal and anal soft rays 11; suborbital pores 10-14; first dorsal spine 1.6-1.9 in ninth dorsal spine; no dark stripes or rows of dark spots on body (except faintly dorso-anteriorly) (western Pacific and Indian Ocean)
.....*nebulosus*
- 9a. Anterior lateral-line scales with 1 pore; a small black spot at upper base of pectoral fins; a yellow stripe on upper side of body in life (largely replaced by blackish in female and by a band of pink spots in male *peliciery*).....10
- 9b. Anterior lateral-line scales with 2-5 pores; no black spot at upper base of pectoral fins; no yellow stripe on side of body11
- 10a. Caudal fin of males slightly double emarginate; a large black spot on upper side, usually centered on lateral line; no broad blackish stripe in dorsal fin (Indian Ocean)*zeylonicus*
- 10b. Caudal fin of males rounded; no large black spot on upper side; a blackish median stripe in dorsal fin occupying most of height of fin except posteriorly (Mauritius)*peliciery*, n. sp.
- 11a. Median dorsal region of nape and median ventral region of thorax scaleless; third anal spine relatively long, its length 3.2-3.5 in head; third and fourth dorsal spine slightly longer than fifth and sixth; colour in preservative pale with two rows of irregular dark brown spots as large or larger than eye on side of body and other similar spots on thorax and abdomen (terminal males darker on body, the dark brown spots faint or absent except a prominent one behind upper end of gill opening); two dark near-vertical bands on head below eye (Mauritius, southern Mozambique and KwaZulu).....*lapillus*
- 11b. Median dorsal region of nape and median ventral region of thorax scaled (though scales of mid-dorsal zone of nape may be partially embedded; third anal spine not long, 3.6-4.8 in head; third and fourth dorsal spines shorter than fifth and sixth spines; colour not as in 11a12
- 12a. Dorsal and anal soft rays 11; body with alternating stripes of brown and pale (the dark stripes bluish gray to green in life and the pale stripes salmon pink to yellow), the brown stripes persisting only on dorsal part of body in preservative (western Indian Ocean)*cosmetus*, n. sp.
- 12b. Dorsal and anal soft rays 12; colour not as in 12a13
- 13a. Body dark brown except for thorax and a pale longitudinal band along back (red or brownish red in life), in contrast to the pale head (yellow-orange in life with green bands) (western Indian Ocean)
.....*iridis*, n. sp.
- 13b. Body pale in preservative (yellow and white or pale pink in life)14
- 14a. A diagonal row of three dark brown spots on upper base of caudal fin, the posteriormost largest (larger than pupil); three dark dots usually present in a horizontal row dorsally on body (one on nape and two beneath spinous portion of dorsal fin); no prominent black spot behind eye (a small dark smudge sometimes present); body pink in life; upper half of head finely striped with red and white (Maldivian Islands and Mauritius)
.....*trispilus*, n. sp.
- 14b. A single small dark spot (smaller than pupil) in caudal fin slightly above centre; no dark dots dorsally on body; a prominent black spot behind eye; in life, upper half of body bright yellow, lower half white or pinkish white (Maldivian Islands, Thailand, and Java)*leucoxanthus*, n. sp.

¹Lateral-line scale counts do not include the pored scale on the caudal fin. Pectoral fin ray counts include the upper rudimentary ray.

²See Table 1

Halichoeres hortulanus (Lacepède)

Plate 1, Figs. A, B, C

Labrus hortulanus Lacepède, 1801: 449, 518, pl. 29, fig. 2 (type-locality, "le grand Océan équatorial").

Labrus centiquadrus Lacepède, 1801: 437, 493 (type-locality, Madagascar, Mauritius, and Réunion; spelled *centriquadrus* by some authors).

Julis semi-decorata Lesson, 1828: 403 (type-locality, Mauritius); Lesson, 1831: 138, pl. 35, fig. 2.

Sparus decussatus Bennett, J.W. 1834: pl. 14 (type-locality, Ceylon).

Halichöres eximius Rüppell, 1835: 16, pl. 5, fig. 1 (type-locality, Red Sea).

Julis (Halichoeres) notophthalmus Bleeker, 1849: 20 (type-locality, Java).

Hemitautoga notophthalmus: Bleeker, 1862: 140, pl. 21, fig. 1.

Halichoeres nigrescens (non Bloch & Schneider) Fowler, 1946: 166, fig. 33 (Ryukyu Islands).

DIAGNOSIS: Dorsal fin rays IX,11; anal fin rays III,11; pectoral fin rays 14 (rarely 13); lateral-line scales 26; anterior lateral-line scales with 1 pore; suborbital pores increasing with age from 12 in a 28-mm specimen to 40 in a 194-mm specimen; gill-rakers 20-25.

Depth of body 2.95-3.25 in SL; head length 2.95-3.2 in SL; snout 2.5-3.0 in head; origin of dorsal fin over first to second lateral-line scales; ninth dorsal spine 3.0-3.4 in head; first dorsal spine 1.35-1.85 in ninth dorsal spine; caudal fin slightly rounded; pelvic fins moderately long, nearly, or just, reaching anus.

Two pairs of large projecting canines at front of upper jaw, the first slightly recurved, the second nearly as large and strongly recurved; remaining teeth small except posterior canine at corner of mouth; lower jaw with a pair of large slightly recurved canines anteriorly; second teeth about half as long as anterior pair, the tips recurved; a pair of small conical teeth at front of jaws medial to canines followed by a series of small nodular teeth in 1 or 2 irregular medial rows reaching more than half-way back in upper jaw (medial teeth more numerous and extending farther posteriorly on larger individuals, in general).

A patch of about 10 to 12 small scales dorsally on opercle at level of upper part of eye; a near-vertical band of about 15 to 17 small scales in 2 to 3 rows behind eye; no median naked zone on nape; scales on nape extending to or slightly anterior to a vertical at rear edge of orbit; small scales basally on dorsal and anal fins.

Juveniles (about 25-60 mm SL) are pale in alcohol (white in life) with a broad blackish bar or coarse black reticulum in middle of body continuing into adjacent parts of dorsal and anal fins and another across most of caudal peduncle; a large blackish area on thorax and one dorsally on nape; two dark spots on postorbital head, a dark streak on side of snout and another (reddish in life) on cheek below eye; a large pale-edged (yellow in life) black spot at front of soft portion of dorsal fin and a small black spot anteriorly in fin; caudal fin pale (yellow in life) with two white spots in vertical alignment at base.

Colour of females pale (white in life), with a narrow black bar or two vertically aligned black dots joined by a faint dark line separating adjacent scales (these black vertical markings along with a faint dark longitudinal banding at upper and lower edges of scales create an unusual pattern of longitudinal series of square white spots outlined in black); a large pale spot (yellow in life) on body centred at base of fourth and fifth dorsal spines and extending into fin, followed by a large black blotch;

sometimes a second yellow spot on back posterior to black blotch; a faint dark band on side of snout; a long slightly diagonal band on cheek below eye and irregular bands behind eye sometimes visible (bands on head pink in life); fins pale (caudal fin yellow in life) except for some faint diagonal dark markings basally in dorsal fin, a black spot the size of pupil or smaller at upper base of caudal fin and a small triangular black spot at upper base of pectoral fins.

Males have the same basic colour pattern as females but the ground colour in life is light blue-green and the caudal fin orange-red with yellow spots.

REMARKS: Valenciennes *in* Cuvier and Valenciennes (1839), who had the syntypes of both *H. hortulanus* (Lacepède) and *H. centiquadrus* (Lacepède) at his disposal at the Museum National d'Histoire Naturelle, was the first to realize that these represent the same species. He placed the name *hortulanus* first in both the species heading and the table of contents and referred to *centiquadrus* as "cette seconde espèce nominale". As first revisor, his choice of *hortulanus* takes precedence over the page priority of *centiquadrus*.

As mentioned in the introductory remarks, *Julis semidecorata* Lesson has erroneously been regarded by a number of authors as a junior synonym of *H. chloropterus* (Bloch), thus giving rise to the false record of the latter species at Mauritius. Lesson's *semidecorata* is easily recognised as the male of *H. hortulanus* (though the bands on the head in his colour illustration are shown in yellow instead of pink).

Schultz (in Schultz *et al.*, 1960) determined that *H. notophthalmus* (Bleeker) is the young of *H. hortulanus*. He also noticed that three specimens of *H. hortulanus* from Mauritius as well as Rüppell's illustration of *H. eximius* from the Red Sea have a small dark spot at upper end of caudal fin base, which he found lacking on specimens from the tropical Pacific. Because of this he distinguished two species, the Indian Ocean *H. centriquadrus* (*sic*) and the Pacific *H. hortulanus*. However, we have a specimen from Guam (BPBM 138, 116 mm SL) with this caudal spot. In any event, we do not believe that such a minor colour difference between Indian Ocean and the Pacific populations in a species such as *H. hortulanus* with such a unique and complex colour pattern, could be the basis for the distinction of two allopatric species.

H. hortulanus is a common reef fish found throughout much of the tropical Indo-Pacific region. It is present in the western Pacific and islands of Oceania except Hawaii, Pitcairn, Easter, and Lord Howe. In the western Indian Ocean it ranges from the northern Red Sea to Natal (our specimens from Sodwana Bay, RUSI 9295, 9801, 9903, represent the first South African record) and can be expected from all insular areas with coral reefs. It was not observed in the Persian Gulf.

As noted by Randall (1955), *H. hortulanus* is not restricted to any specific reef habitat. It is, however, rather closely tied to reefs.

Large for a *Halichoeres*, this species attains at least 22 cm SL (our largest specimen, BPBM 699, from Tahiti, measures 212 mm SL). As may be noted from the Key and Diagnosis, it is one of the morphologically more distinctive species of the genus. It is the type-species of the genus *Hemitautoga* Bleeker which Norman (1957) synonymized with *Guentheria* Bleeker, a genus he regarded as distinct from *Halichoeres* on the

basis of the small scales on the head behind the eye. The type-species of *Guentheria* is *H. scapularis*. This and the allied *H. trimaculatus* tend to link *H. hortulanus* to the more typical *Halichoeres*. We therefore retain *hortulanus* in *Halichoeres*.

Halichoeres scapularis (Bennett)

Plate 1, Figs. D & E

- Julis scapularis* Bennett, 1831: 167 (type-locality, Mauritius).
Halichoeres coeruleo-vittatus Rüppell, 1835: 14, pl. 4, fig. 1 (type-locality, Djedda, Red Sea).
Julis Leschenaulti Valenciennes IN Cuvier & Valenciennes, 1839: 453 (type-locality, Réunion).
Julis elegans Kuhl & Van Hasselt IN Cuvier & Valenciennes, 1839: 467 (type-locality, Java).
Julis (Halichoeres) phaiotaenia Bleeker, 1855: 322 (type-locality, Batu Archipelago).
Güntheria coeruleovittata: Bleeker, 1862: 137, pl. 32, fig. 2.
Pseudojulis ziczac DeVis, 1885: 882 (type-locality, Murray Island, Australia).
PlatyGLOSSUS (Güntheria) Pagenstecheri Kossmann & Räuber, 1877: 407 (sep. p. 25), pl. 1, fig. 5 (type-locality, Red Sea).
Halichoeres cymatogrammus Jordan & Seale, 1905: 787, fig. 8 (type-locality, Negros, Philippine Islands).

DIAGNOSIS: Dorsal fin rays IX, 11; anal fin rays III, 11; pectoral fin rays 14; lateral-line scales 26, anterior lateral-line scales with 1 pore, suborbital pores 9-11; gill rakers 17-21.

Depth of body 2.4-3.9 in SL (increasing with age); head length 2.8-3.2 in SL; snout 2.4-3.05 in head (increasing with age) origin of dorsal fin over first to second lateral-line scales; ninth dorsal spine 2.9-3.3 in head; first dorsal spine 1.7-2.1 in ninth dorsal spine.

Dentition similar to that of *H. hortulanus*.

A patch of 9-12 small scales dorsally on opercle at level of center of eye; no small scales in a band immediately behind eye; no narrow median naked zone on nape; scales on nape extending anterior to a vertical at posterior edge of orbit; some small scales on extreme base of dorsal and anal fins.

Colour of initial phase (in alcohol) pale, with dark brown stripe from eye along upper side (primarily on row of scales just under anterior lateral line) to upper base of caudal fin, this stripe broader and more solid on head and anteriorly on body; much of stripe on body with a zigzag pattern as a result of pigment extending diagonally upward from each scale below lateral line to lateral-line scale (stripe narrower posteriorly sometimes broken into a series of dark brown spots); body above stripe (greenish to yellowish in life) with a little dusky pigment on edges of scales, body below stripe uniformly pale (white in life); an indistinct broad dark stripe from front of snout to eye; some specimens with a faint dark band curving from behind eye (where it joins dark lateral stripe) to below front of orbit; a narrow median brown band from origin of dorsal fin to interorbital space where it divides to two faint narrow dark lines that extend onto snout; a small dark spot dorsally on front of snout; fins entirely pale (occasionally a faint dark smudge on first interspinous membrane of dorsal fin). In life, a yellow band on side of snout and a broad yellow margin along lower edge of dark lateral stripe behind eye on head.

Terminal males retain zigzag dark stripe, but it is not as contrasting as on initial phase except anteriorly on body where it is very broad and dark. In life the

stripe posterior to the dark brown anterior section is primarily pink, narrowly edged with blue, and the part on postorbital head may also be pink, edged with blue, this section continuing as a pink band which curves to beneath eye where it broadens; a broad blue-edged pink band on snout from eye to edge of upper lip; body above dark stripe and dorsal part of head green, the head and nape with pink spots and short irregular bands; lower part of head may be yellow; caudal fin yellow, the basal part with irregular and interconnecting vertical narrow blue-edged pink bands.

REMARKS: *H. scapularis* is a common shallow-water species which occurs in the western Pacific from southern Japan to Queensland and throughout the tropical Indian Ocean including the Red Sea. Along the east African coast it ranges south to Natal (Gilchrist and Thompson, 1917). Typically it is found in the protected waters of lagoons and bays where it is associated more with sand, rubble, or seagrass near coral reefs or rocky areas than the reefs themselves, many live in the sand.

The initial phase of this species may be either female or male.

In the Red Sea and Gulf of Aden, terminal males appear to be smaller in size and differ in colour. The back is yellow instead of green and the interspaces between pink bands on the head blue or blue-green instead of green; the caudal fin often has a large blackish area in the middle partially obscuring the pink bands. If nomenclatorial recognition at the subspecific level for this form is desired, the available name would be *Halichoeres scapularis coeruleovittatus* Rüppell, 1835.

Our largest specimen, BPBM 21947, from Malaysia, measures 156 mm SL.

Halichoeres marginatus Rüppell

Plate 2, Figs. A, B, C

- Halichoeres marginatus* Rüppell, 1835: 16 (type-locality, Mohila and Massawa, Red Sea).
Julis Lamarii Valenciennes IN Cuvier & Valenciennes, 1839: 481 (type-locality, Mauritius).
Julis annularis Kuhl & Van Hasselt IN Cuvier & Valenciennes, 1839: 482 (type-locality, Java).
Julis notopsis Kuhl & Van Hasselt IN Cuvier & Valenciennes, 1839: 485 (type-locality, Guam).
Halichoeres ianthinus Fourmanoir, 1955: 217 (type-locality, Domoni, Comoro Islands).
Halichoeres virescens Fourmanoir & Guézé, 1961: 13 (type-locality, Pointe-des-Galets, Réunion).

DIAGNOSIS: Dorsal fin rays IX, 13 or 14 (three of 15 specimens with 14 rays); anal fin rays III, 12 or 13 (two of 15 specimens with 13); pectoral fin rays 14 or 15 (one of 15 specimens with 15); lateral-line scales 27 or 28 (one of 15 with 28); anterior lateral-line scales with 2-4 pores (usually 3); suborbital pores 10-14; gill-rakers 17-20.

Depth of body 2.6-3.2 in SL; head length 3.0-3.45 in SL; snout 3.0-3.35 in head; origin of dorsal fin over first to second lateral-line scales; first dorsal spine 2.0-2.8 in ninth dorsal spine; ninth dorsal spine 2.0-2.55 in head; distal margin of interspinous membranes of dorsal fin almost without indentations, caudal fin rounded; pelvic fins of terminal males long, reaching beyond origin of anal fin.

Teeth in jaws close-set, forward-projecting, progressively longer anteriorly, the most anterior nearly straight and only slightly longer than second teeth; a

row of 3 or 4 small teeth medial to anterior teeth, the first two pairs compressed, with rounded tips.

No patch of small scales on opercle or behind eye; no naked narrow median zone on nape; median scales on nape extending anterior to a vertical at posterior edge of orbit; some small scales basally on dorsal and anal fins.

Colour in alcohol of juveniles: pale (light yellow in life) with four to six dark brown stripes (stripes in larger juveniles bisected with rows of pale dots), the upper stripe broken by a pale spot in two places, these spots continuing broadly into dorsal fin; dorsal fin otherwise brown except for a small black spot anteriorly, a large ocellated black spot on second to fourth soft rays (rimmed with bright yellow in life) and a smaller ocellated black spot posteriorly; caudal fin transparent except scaled basal portion coloured like body.

Colour of initial phase: dark brown, usually with narrow darker brown stripes following centres of scale rows; head usually with parallel double dark brown lines which angle upward as they pass posteriorly; dorsal fin brown with faint longitudinal banding, a pale-edged small black spot on first interspinous membrane; a large pale-edged round to oval black spot on second to fourth dorsal rays, often with a narrow dark line around the pale edge; a smaller ocellated black spot frequently present on last three rays and associated membranes; anal fin a little darker than dorsal and also faintly banded; caudal fin whitish on smaller individuals, developing a very broad dusky crescentic area in posterior part of fin; on still larger individuals the caudal is almost entirely dark except for a narrow pale posterior margin; pectoral fins pale with a dark spot at upper base, sometimes extending as a narrow bar across most of base; pelvic fins dark brown. In life this phase is unusually drab for a wrasse, mainly dark brown, the paler interspaces between bands light brown to greenish; the ocellated spots in the dorsal fin are broadly dark blue with the rims light yellowish; paired fins yellowish, the pelvics darker.

Terminal males dark brown with a darker brown spot at base of each scale which join to form narrow dark lines antero-dorsally on body. In life, the ground colour is yellowish to orangish brown, the spots dark bluish, each separated from adjacent spots by a quadrangular blue-edged green spot; head with narrow dark bands (blue, the edges darker blue in life) which are very irregular on operculum; dorsal and anal fins dark brown (dull reddish in life) with dark-edged pale spots, and bands (blue-edged yellowish green in life), a pale margin (yellow and white) and blackish submarginal line (dark blue); caudal fin with a large dark semicircular bar (reddish in life with blue-edged green spots), with a whitish (blue) margin; broad marginal region posterior to bar pale (yellow) and unscaled part of fin anterior to bar pale (green in life); pectoral fins with basal third blackish, outer two-thirds pale (in life there may be a wedge of yellow distal to dark basal region); pelvic fins pale (rays yellowish in life) with a darker lateral edge (light reddish in life).

REMARKS: Two syntypes of *Halichoeres marginatus* (SMF 1155, 101 and 121 mm SL) were examined at the Senckenberg Museum at Frankfurt. Both are alcoholic specimens in good condition. The larger of the two is here selected as the lectotype; it is nearly 6 inches

in total length (the only length given by Rüppell in the original description).

The holotype of *Julis lamarii* (MNHN A.8312, 130 mm SL) was examined at the Museum National d'Histoire Naturelle in Paris. It is a dried, varnished specimen in poor condition. Bauchot (1963) wrote that some authors have placed this species in the synonymy of *Thalassoma hebraicum* (Lacepède) but that she believed it to be a *Macropharyngodon*. It is, however, the terminal male of *H. marginatus*.

This species is a common and wide-ranging reef fish; it occurs from the east coast of Africa to French Polynesia. A single specimen has just been recorded from the island of Hawaii (Randall, in press). In the western Indian Ocean it has been found from the northern Red Sea to Mozambique and at the following islands: Madagascar, Réunion, Mauritius, Aldabra, Seychelles, and Maldives. The senior author has recently collected it near Muscat, Oman, and at Kovalam, south-east India.

Randall (1955) determined that *H. notopsis* is a junior synonym of *H. marginatus*. He and Schultz (1960) regarded this form as the young of the species. It is, however, not the juvenile but the initial mature phase. This phase may be either male or female.

In the Pacific, terminal males have two or more horizontal rows of inter-connected bright red spots beneath the pectoral fin. We have not seen this colour on individuals from the Indian Ocean.

H. marginatus is a moderately large species, the terminal male attaining a standard length of 14 cm.

H. marginatus is the type species of the genus *PlatyGLOSSUS* Bleeker, which some authors regard as distinct from *Halichoeres*.

Halichoeres dussumieri (Valenciennes)

Plate 2, Figs. D & E

Julis Dussumieri Valenciennes IN Cuvier & Valenciennes, 1839: 478 (type-locality, coast of Malabar, India).

Julis exornatus Richardson, 1846: 258 (type-locality, Canton and Hong Kong).

Julis (Halichoeres) javanicus Bleeker, 1857: 341 (type-locality Karangbollong, southern Java).

Julis (Halichoeres) mola Bleeker, 1859: 98 (based on Sahnee moia of Russell, fig. 120).

Halichoeres nigrescens: Bleeker, 1862: 118, pl. 37, fig. 4.

Halichoeres javanicus: Bleeker, 1862: 125, pl. 40, fig. 3.

PlatyGLOSSUS dubius Steindachner, 1864: 210, pl. 2, fig. 2 (type-locality, Zanzibar).

?*PlatyGLOSSUS maculatus* Jatzow & Lenz, 1898: 520, pl. 36, fig. 16 (type-locality, Zanzibar).

Halichoeres leucostigma Fowler & Bean, 1928: 299, pl. 40 (type locality, Pujada Bay, Mindanao, Philippine Islands).

Halichoeres dianthus Smith, 1947: 802 (type-locality, Inhaca Island, Mozambique); Smith, 1949: 289, pl. 55, fig. 789.

DIAGNOSIS: Dorsal fin rays IX,12 (one of 24 with X,12); anal fin rays III,12 (one of 24 with III,11); pectoral fin rays 15 (one of 24 with 14); lateral-line scales 27; anterior lateral-line scales with 2 to 5 pores (usually 3 or 4); suborbital pores 8-12; gill-rakers 18-22.

Depth of body 2.9-3.6 in SL; head length 2.85-3.2 in SL; snout 2.7-3.2 in head; origin of dorsal fin over first lateral-line scale (slightly posterior to upper end of gill opening); ninth dorsal spine 2.7-2.85 in head; first dorsal spine 1.7-2.1 in ninth dorsal spine; membranes between second and fifth dorsal spines of males elevated above those of rest of fin; caudal fin rounded; pelvic fins of males moderately long, nearly or just reaching anus.

A pair of slightly recurved protruding canine teeth anteriorly in jaws; second teeth about two-thirds as large as the anterior, the tips recurved; a pair of small conical teeth medial to anterior canines, followed by a row of 3 or 4 small nodular teeth.

No patch of scales on opercle or behind eye; no median naked zone on nape; scales on nape extending to or slightly anterior to a vertical at rear edge of orbit; no small scales at base of dorsal and anal fins.

Colour in alcohol of females pale (light greenish dorsally, shading to white ventrally in life) with six or seven irregular dark bars (reddish brown in life) on upper two-thirds of body, the second to fourth in an approximate X-shape (bars the result of a large dark spot on individual scales); an irregular faint dark band (blue-edged pink in life) beginning vertically behind eye (where darkest), extending posteriorly a short distance, then abruptly ventrally to edge of operculum at level of upper base of pectoral fins; a broad dark band on side of snout and a faint diagonal one on cheek below eye (also blue-edged pink in life; other pink markings in life dorsally on head not apparent on preserved specimens); fins pale (though a little dusky pigment may be seen anteriorly toward base of dorsal fin on some specimens) except for a small triangular black spot at upper base of pectoral fins. In life there may be a longitudinal series of four white spots on side of body (rarely persisting after preservation).

Males have the same basic colour pattern on the body but the dark spots on the scales forming the irregular barred pattern are more red and have narrow blue edges; the pink bands on the head more evident (there is also a second diagonal one on cheek); a black spot, partially surrounded by yellow, on dorsal fin between fifth and sixth (or fifth to seventh) rays and a large crescent-shaped dark area covering most of caudal fin (reddish in life, containing blue-edged greenish spots, the hind margin blue); upper and lower front edges of crescent with a pale band (blue-edged yellow-green in life); upper and lower corners of fin (above and below dark crescent) pale (yellow-green in life).

REMARKS: We follow Günther (1862) in applying the name *H. dussumieri* to this species, in contrast to most recent authors who use *H. nigrescens* (Bloch and Schneider). Bloch and Schneider based their brief description of *Labrus nigrescens* on plate 31, fig. 2 of Seba. This illustration is poor and cannot convincingly be ascribed to any *Halichoeres* (it is too deep-bodied, the lower jaw is strongly protruding, the dorsal fin commences well behind the head, and the anal ray count, as given by Bloch and Schneider, is III,15). Only a black spot between the fourth and fifth dorsal spines and another between the fifth and sixth is suggestive of several species of the genus including *H. dussumieri* (males have a black spot between the fifth and sixth spines), but this alone is insufficient evidence on which to establish a species. H.-J. Paepke of the Zoologisches Museum of Humboldt Universität, Berlin, was asked if any type-specimens of *Labrus nigrescens* are present at this institution; he replied that there are none.

The three syntypes of *Julis dussumieri* Valenciennes (MNHN A.9111, 89-93 mm SL) in the Museum National d'Histoire Naturelle in Paris were examined by the senior author. They are alcoholic specimens, in good condition, and clearly conspecific with the species as

here diagnosed. The colour pattern shows best on the smallest specimen; it is here selected as the lectotype.

As pointed out by Günther (1862), plate 387 in Cuvier and Valenciennes (1839), purported to be *H. dussumieri*, is incorrect. Consequently, we have omitted it from our synonymy.

Halichoeres dussumieri is a shallow-water species of the western Pacific and Indian Oceans. It is found along the shores of continents and large islands on rocky or weedy bottoms. We have seen no individuals on coral reefs of oceanic islands such as the Maldives. The species is not yet known from the Red Sea or Persian Gulf. Smith (1949) recorded it (as *H. nigrescens*) "quite abundant in Delagoa Bay, rarely reaches Durban." We collected two specimens (BPBM 21700, 101-104 mm SL) from the channel at the entrance to the estuary of Kosi Bay, KwaZulu. These are our largest specimens, but the species probably reaches at least 120 mm SL.

The Bishop Museum also has specimens from southeast India, Sri Lanka, Singapore, Philippines, and Hong Kong.

Halichoeres stigmaticus, n. sp.

Plate 3, Figs. A & B

HOLOTYPE: BPBM 21241, 99.6 mm SL, male, Persian Gulf, Bahrain, about 4 miles east of Muharrak Island, silty sand bottom next to wreck in 12 m, spear, J.E. Randall, 18 February 1977.

PARATYPES: ANSP 144093, 77.5 mm SL and BPBM 22957, 3: 74.1-105.5 mm SL, same data as holotype; BPBM 21250, 4: 74.0-105.0 mm SL, Persian Gulf, Bahrain, about 4 to 5 miles east of Sitra Island, sand and rubble around patch reef, 3 m, spear, J.E. Randall, 19 February 1977; BM(NH) 1980.5.20.4, 74.5 mm SL, CAS 46031, 74.3 mm SL, MNHN 1980-1305, 81.3 mm SL, RUSI 444, 103 mm SL, and USNM 221541, 92.2 mm SL, Persian Gulf, Bahrain, about 5 miles east of Sitra Island, reef in 15-25 m, spear J.E. Randall, 25 February 1977; BPBM 21314, 68.5 mm SL, Persian Gulf, north of Bahrain, inshore, shrimp trawl, staff of Fisheries Resources Bureau, 1 March 1977; BPBM 20977, 3: 48.8-62.0 mm SL, Persian Gulf, Kuwait, Green House Beach, 15 km south of Mina Abdullah, K. Relyea, 22 September 1977; BPBM 20976, 2: 57.7-76.2 mm SL, Persian Gulf, Kuwait, Al-Fintas, K. Relyea, 23 September 1977.

DESCRIPTION: Dorsal fin rays IX,12; anal fin rays III,12 (1 of 19 paratypes with 11 and 1 with 13 rays); pectoral fin rays 16 (4 of 19 paratypes with 14, the rest with 15); lateral-line scales 28 (1 of 19 paratypes with 27 and 1 with 29); scales above lateral line to origin of dorsal fin 5½ (4½-5½); scales below lateral line to origin of anal fin 10½ (9½-10½); circumpeduncular scales 20; gill rakers 19 (18-21 — see Table 2).

Depth of body 3.6 (3.35-3.8) in SL; width of body 2.1 (2.05-2.5) in depth; head length 3.15 (3.0-3.2) in SL; snout length 2.85 (2.7-3.2) in head; orbit diameter 6.1 (4.45-6.95) in head; interorbital space convex, the bony width 5.7 (5.55-6.0) in head; depth of caudal peduncle 1.2 to 1.5 times greater than length, the least depth 2.25 (2.15-2.45) in head.

Front of jaws with a pair of projecting, slightly recurved canine teeth followed by a second recurved pair about three-fourths as long; sides of jaws with conical teeth, shorter posteriorly, 6 to 8 in lower jaw, 8 to 11 in upper; a large canine tooth (sometimes two) at corner of mouth projecting downward and anteriorly from posterior end of upper jaw, the tip slightly outcurved; two

pairs of small conical teeth medial to anterior canines along with one to two rows of small nodular inner teeth that extend posteriorly to or beyond middle of jaws.

Pharyngeal dentition of 105-mm paratype: triangular upper pharyngeal plate on each side with 17 teeth in about 6 anterior to posterior rows, the medial and posterior 6 somewhat molariform (none with flat or concave occlusal surfaces) and none significantly enlarged; T-shaped lower pharyngeal plate with a mid-posterior ovoid molar of moderate size, 11 teeth on each side, and 18 teeth anteriorly on median limb; most of teeth on posterior limb and teeth on posterior half of median limb bluntly rounded or molariform, the remaining teeth conical (the sharpest most anterior on median limb).

Lower free margin of preopercle extending to or anterior to a vertical at front edge of orbit; upper (posterior) margin free to level of corner of mouth or to a point slightly above it.

Anterior nostril in a short membranous tube, slightly elevated posteriorly, situated in front of upper third of eye; posterior nostril obliquely dorsal and posterior to anterior nostril, the aperture covered by a flap from anterior margin.

Suborbital pores rimming eye from mid-posteriorly to below front edge of orbit 6 (6 or 7).

Scales of anterior portion of lateral line with three to five (usually three) branches bearing pores; tubes of descending and straight peduncular portions of lateral line simple or with three branches (upper and lower branches, if present, short); tubes of peduncular part mostly simple.

Head naked except for a triangular zone of small scales on nape which extend forward to or slightly anterior to a vertical at upper end of preopercular margin; median zone of nape naked or with embedded scales; scales on mid-section of thorax about half as high as scales on side of body, becoming even smaller anteriorly and ventrally; fins naked except for scales on about basal third of caudal fin (these scales progressively smaller posteriorly) and a single pointed scale mid-ventrally at base of pelvic fins.

Caudal fin slightly to moderately rounded, its length 1.45 (1.4-1.6) in head; caudal fin with 5 to 7 upper and 5 or 6 lower procurrent rays; origin of dorsal fin slightly posterior to upper end of gill opening; dorsal spines progressively longer, the first 4.35 (4.45-5.6) and the ninth 2.85 (2.8-3.2) in head; first to sixth dorsal soft rays longest, 2.3 (2.2-2.55) in head; all dorsal and anal soft rays branched, the last to base; origin of anal fin below base of first and second dorsal soft rays; first anal spine slender and short, 8.6 (8.2-9.7) in head; third anal spine 3.4 (3.45-4.0) in head; second to fifth anal soft rays longest, 2.8 (2.4-2.8) in head; pectoral fins 1.65 (1.65-1.8) in head, the third ray longest (but second and fourth nearly as long), the first ray rudimentary, the second unbranched; pelvic fins short, not reaching anus, 2.1 (2.0-2.35) in head.

Colour of holotype (a male) in alcohol: pale with a dark brown U-shaped mark about size of eye just below eighth lateral-line scale (upper ends of U reaching median tubule at anterior and posterior edges of eighth scale); fins pale except for a large dark spot on outer part of first interspinous membrane of dorsal fin.

In life the holotype was pale blue and pale yellow on dorsal half of body [above lateral line, scales broadly

edged with pale blue, the centres yellow, below lateral line the colours are reversed, the blue appearing as longitudinal series of spots (joined anteriorly)], gradually shading to whitish ventrally; a U-shaped black mark suffused with blue on upper side above tip of pectoral fin; head coloured like body but the pale blue and yellow markings appearing mainly as irregular longitudinal and diagonal bands (the yellow broader than blue) from level of eye ventrally; dorsal fin with alternating diagonal markings of pale blue and pale yellow, the first interspinous membrane with a large blue area distally, and the second membrane mainly yellow; margin of fin blue; caudal fin with alternating narrow vertical bands of pale blue and pale yellow, the corners of the fin with blue margins; anal fin pale bluish, with two faint narrow longitudinal bands of pale yellowish basally; paired fins pale (membranes clear, rays whitish).

The dark mark on upper side of male paratypes varies from U- or Y-shaped to irregularly lobed.

Female paratypes are pale in alcohol without a dark mark on side; a dusky spot about size of pupil or a little smaller at upper base of caudal fin (in outer part of basal scaled portion of fin at level of first row of scales above lateral line); a large dusky spot distally at front of dorsal fin.

Colour of 86.4-mm female paratype in life: similar to holotype but the pale yellow of the back is olivaceous and the demarcation to the lower whitish half of body is abrupt; pale blue and yellow banding of dorsal fin faint and even less apparent on caudal fin.

REMARKS: Named *stigmaticus* from the Greek in reference to the brandlike marking on the side of the male phase.

H. stigmaticus may be endemic to the Persian Gulf. All our specimens have been collected there, and the species has not been observed in the Gulf of Oman or elsewhere in the Indian Ocean. Only one other species of *Halichoeres*, *H. zeylonicus*, is known from the Persian Gulf. The fish fauna of the Gulf is impoverished, as might be expected from the large range in sea temperature from summer to winter.

The specimens of *H. stigmaticus* were collected in the depth range of 3 to 25 m. The largest measures 105.5 mm SL.

Halichoeres pardaleocephalus (Bleeker)

Plate 3, Figs. C & D

Julis (*Halichoeres*) *pardaleocephalus* Bleeker, 1849: 8 (type-locality, Boleling, Bali).

Halichoeres pardaleocephalus: Bleeker, 1862: 123, pl. 35, fig. 5.

DIAGNOSIS: Dorsal fin rays IX,11; anal fin rays III,11; pectoral fin rays 14 or 15 (1 of 7 specimens with 15); lateral-line scales 27; anterior lateral-line scales with 3-9 pores; suborbital pores 16-23; gill-rakers 20-21 (rakers complexly branched).

Depth of body 3.2-3.5 in SL; head length 2.8-3.1 in SL, snout length 2.8-3.2 in head; origin of dorsal fin over second lateral-line scale; ninth dorsal spine 2.4-2.7 in head; first dorsal spine 1.6-1.8 in ninth dorsal spine; caudal fin slightly rounded; pelvic fins just reaching anus on 91-mm male but not on other specimens.

Anterior pair of canine teeth in jaws protruding and slightly recurved; second teeth of upper jaw about two-thirds as long as front pair; second teeth of lower

jaw only slightly shorter than anterior pair; a pair of short conical teeth medial to anterior canines followed by 3 to 8 small nodular teeth in an inner row along side of jaws.

No patch of small scales on opercle or behind eye; no narrow median naked zone on nape; scales on nape nearly or just reaching a vertical at posterior edge of orbit; no small scales basally on dorsal and anal fins.

Colour in alcohol: light brown with five vertical rows of dark blotches (formed by dark edges on scales) in three horizontal rows on body; head with diagonal dark lines (except postero-ventrally on operculum where irregular), one of which extends ventrally onto chin; a vertically-elongate dark brown spot behind eye; dorsal edge of upper lip with two short converging dark brown lines; a dark brown spot near base of first interspinous membrane; an ocellated dark spot below middle of soft portion of dorsal fin between second and fourth rays (lacking in largest male specimen); caudal fin with small faint brown spots on membranes arranged in irregular vertical rows; a triangular dark brown spot at upper base of pectoral fin. Colour in life greenish with brownish orange longitudinal lines on body and dark brown spots forming blotches as described above; head with narrow blue-edged orange bands and a black spot behind eye with a narrow yellow anterior margin; median fins dull red with blue-edged green spots and bands, the dorsal with a black spot anteriorly and a blue-edged black ocellus (middle of spot dark blue) anteriorly on soft portion of fin; triangular bluish black spot at upper pectoral base with an orange spot below it grading into yellow on rest of base.

REMARKS: Known in the literature only from Sumatra and Bali. The senior author and William F. Smith-Vaniz collected the two specimens (BPBM 24798, 74-105 mm SL, both female) illustrated in Plate III C and D inshore on rock and sand bottom at Kovalam on the southwest coast of India on February 12, 1980. The diagnosis above was based on these two specimens and seven others from Vizagapatam, Madras, India (BPBM 20689-90, 52-91 mm SL).

Halichoeres hoevenii (Bleeker)

Plate 4, Figs. A & B

Julis (Halichoeres) Hoevenii Bleeker, 1851: 250 (type-locality, Banda Neira).

Julis (Halichoeres) Vrolikii Bleeker, 1855: 233 (type-locality, Batu Archipelago).

PlatyGLOSSUS Hoevenii: Bleeker, 1862: 111, pl. 42, fig. 3.

PlatyGLOSSUS Vroliki: Bleeker, 1862: 110, pl. 42, fig. 2.

DIAGNOSIS: Dorsal fin rays IX,12; anal fin rays III,12; pectoral fin rays 14 (rarely 13); lateral-line scales 27 (rarely 26); anterior lateral-line scales with 1-3 pores (usually 2); suborbital pores 6 (rarely 7); gill-rakers 19-21.

Depth of body 3.0-3.4 in SL; head length 2.9-3.3 in SL; snout length 2.8-3.3 in head; origin of dorsal fin over second lateral-line scale; ninth dorsal spine 2.25-2.7 in head; first dorsal spine 2.3-2.85 in ninth dorsal spine; caudal fin rounded; pelvic fins of males long, reaching origin of anal fin.

One pair of projecting canines anteriorly in jaws, the second teeth about three-fourths as long as anterior pair; 3 pairs of small conical to incisiform teeth medial

to anterior canines in upper jaw and 2 in lower; no small inner nodular teeth along sides of jaws.

No patch of small scales on opercle or behind eye; no narrow median naked zone on nape; scales on nape reaching to or slightly anterior to a vertical at posterior edge of orbit; small scales basally on dorsal and anal fins.

Colour in alcohol of initial phase pale with narrow brown (dark-edged blue in life) stripes which are narrower than pale interspaces (yellow in life) following scale rows; stripes continuing onto head (though indistinct on lower half); a vertically elongate dark brown spot immediately behind eye; a small brown spot directly in front of eye (actually an intensification of pigment posteriorly on the lateral brown stripe on snout); a small black spot (sometimes just a smudge) on first interspinous membrane of dorsal fin and an ocellated black spot on second and third soft rays nearer base than distal edge of fin; an ocellated black spot about size of pupil on upper base of caudal fin, nearer centre line of fin than dorsal edge (in life ocellated spots black with blue centres edged in blue).

Colour in alcohol of terminal male brown (salmon pink in life) dorsally, shading to light brown (light green) on sides and ventrally; base of exposed part of each scale with a darker brown spot (green with blue edge in life); four narrow pale bars (green in life) dorsally on posterior half of body, the first at base of juncture of spinous and soft portions of dorsal fin and the last dorsally on caudal peduncle (first three pale bars reaching ventrally to lateral line); a vertically elongate dark brown spot just behind eye with a brown stripe (this and other dark markings on head and thorax salmon pink, edged with blue, in life) running posteriorly on head from upper and lower edges of this spot; a V-shaped brown mark dorsally on head from interorbital to front of snout (apex on snout); a brown band on side of snout from mouth to front edge of orbit; a brown band curving upward from front of lower edge of preopercle, passing below eye and curving across operculum to its edge at level of pectoral base; a brown spot on opercular flap; a short brown band in front of pectoral base and two long ones below it on thorax extending onto anterior abdomen; a jet black triangular spot at upper pectoral base; rest of pectoral base broadly pale (bright yellow in life); median fins pale (salmon to orange in life) with faint dark spots and bands (green, edged with blue in life).

REMARKS: *H. vrolikii* is the more colorful male form of *H. hoevenii*, the latter name having priority.

H. hoevenii is one of a complex of at least three closely related species for which the female colour form is very similar (the males also bear much resemblance to one another). Schultz (1960) used the name *H. hoeveni (sic)* mistakenly for the female phase specimens of *H. melanurus* (Bleeker) from the Marshall Islands. Masuda *et al* (1975: pl. 109 C) have illustrated the male form of *H. melanurus* in colour (identified as *H. kallochroma*).

More study is needed of this complex of *Halichoeres* before the distributions of the species can be determined. The only area of the western Indian Ocean where we have observed *H. hoevenii* is the Maldives Islands.

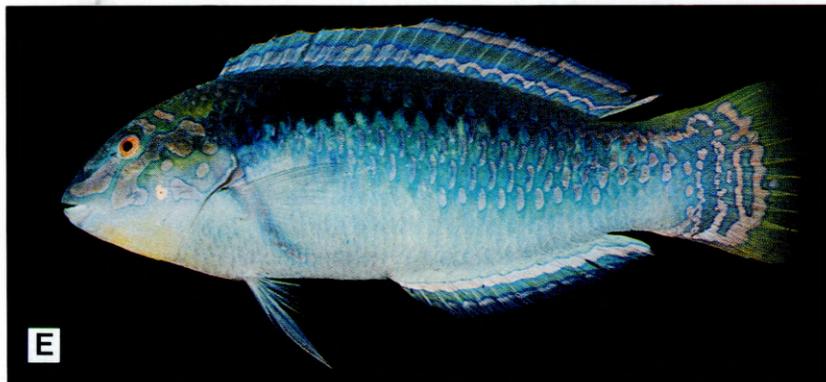
**A****B****C****D****E**

Plate 1: A) *Halichoeres hortulanus*, juvenile, 32 mm SL, BPBM 11331, Tutuila, American Samoa. B) *Halichoeres hortulanus*, female, 158 mm SL, BPBM 20096, Mauritius. C) *Halichoeres hortulanus*, male, 193 mm SL, BPBM 7649, Fanning Island, Line Islands. D) *Halichoeres scapularis*, female, 79 mm SL, BPBM 17602, Mafia Island, Tanzania. E) *Halichoeres scapularis*, male, 151 mm SL, BPBM 20093, Mauritius.

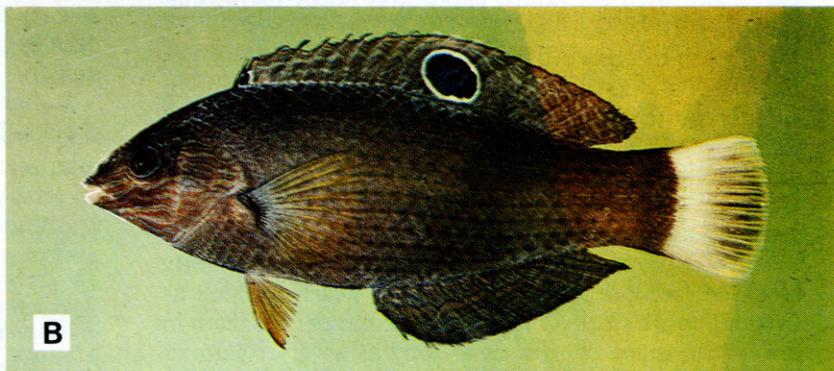


Plate 2: A) *Halichoeres marginatus*, juvenile, 27 mm SL, BPBM 11310, Tutuila, American Samoa. B) *Halichoeres marginatus*, female, 65 mm SL, BPBM 12913, Enewetak, Marshall Islands. C) *Halichoeres marginatus*, male, 123 mm SL, BPBM 20088, Mauritius. D) *Halichoeres dussumieri*, female, 66 mm SL, BPBM 18813, Sri Lanka. E) *Halichoeres dussumieri*, male, 91 mm SL, BPBM 22058, Singapore.

Halichoeres nebulosus (Valenciennes)

Plate 4, Figs. C & D

Julis nebulosus Valenciennes IN Cuvier & Valenciennes, 1839: 461 (type-locality, Bombay).

Julis (*Halichoeres*) *pseudominiatus* Bleeker, 1856: 62 (type-locality, Ambon, Manado [Celebes], Timor and Prianam [Sumatra]).

Julis (*Halichoeres*) *Reichei* Bleeker, 1858: 43 (type-locality, Trussan (Sumatra), Ambon, and Kajeli (Buro Is.)).

Halichoeres kawarin (non Bleeker) Smith 1949: 507 pl. 55 fig. 792a.

DIAGNOSIS: Dorsal fin rays IX,11 (1 of 24 specimens with 12); anal fin rays III,11; pectoral fin rays 14 (rarely 13 or 15); lateral-line scales 27; anterior lateral-line scales with 1-3 pores; suborbital pores 10-14; gill-rakers 17-21.

Depth of body 3.0-3.6 in SL; head length 2.8-3.1 in SL; snout 2.8-3.4 in head; origin of dorsal fin over or slightly posterior to upper end of gill opening; ninth dorsal spine 2.6-2.9 in head; first dorsal spine 1.6-1.9 in ninth dorsal spine; caudal fin moderately rounded; pelvic fins of males moderately long, nearly or just reaching anus.

Anterior canines in jaws projecting and slightly recurved; second pair of upper teeth nearly as long as first and more strongly recurved; second pair of teeth in lower jaw about two-thirds as long as anterior canines and slightly more recurved; a pair of small compressed conical teeth medial to anterior canines in jaws, followed by a row of about 4 lesser nodular teeth extending nearly half way back in jaws.

No patch of small scales on opercle or behind eye; narrow median zone of nape naked except a few partially embedded scales just anterior to origin of dorsal fin; scales on nape not reaching a vertical at posterior edge of orbit; no small scales on base of dorsal and anal fins.

Colour in alcohol of females: pale with a vertically elongate subquadrangular black spot behind eye; a larger but less distinct blackish spot posteriorly on opercle; dusky blotches forming irregular bars (one on nape and three on anterior upper half of body) and a series of irregular interconnected dark blotches mid-laterally from middle of body to caudal base. Some specimens with a dark band from maxilla to orbit (darker near orbit) and a highly irregular one behind eye partially enclosing postorbital black spot, the most prominent part a lower branch which curves across opercle ending at level of upper pectoral base; a faint boomerang-shaped dark band across cheek below eye (head bands dusky reddish, edged with light blue in life); a small dark spot on first interspinous membrane of dorsal fin; a large dark spot (edged with yellow in life) in outer part of dorsal fin between first and third soft rays; irregular diagonal dark bands (reddish in life) may be visible in dorsal fin and small dusky (red in life) spots on caudal rays which form irregular vertical bands; no black spot at upper base of pectoral fin.

In life, a large light red to pink area posteriorly on abdomen with a narrow white band at the front and one or two in the middle; an irregular white spot on opercle in front of dark opercular spot, and similar white blotches in irregular rows on body.

Males may lose all the black spots except that on opercle, but the one on the soft portion of the dorsal fin is often present, though relatively smaller in size than on females; the pink area on the abdomen is reduced in size or lost; the ground colour is more green.

REMARKS: The holotype of *H. nebulosus*

(MNHN A.9125, 79 mm SL) was examined at the Museum National d'Histoire Naturelle in Paris.

This species is common inshore (often in less than a metre of water) on exposed reefs and rocky bottom throughout the western Pacific and Indian Oceans. In the western Pacific it ranges from the Ryukyu Islands to the southern border of New South Wales. In the western Indian Ocean it occurs from the northern end of the Red Sea to South Africa at 32°S.

The female form of this species in the Indian Ocean has often been misidentified as *H. margaritaceus* and the male as *H. kawarin*. As mentioned, the former is a closely related species which does not penetrate the western Indian Ocean, and the latter is the male of *H. timorensis*.

Largest specimen examined, 88 mm SL, from Seal Rocks, New South Wales.

Halichoeres zeylonicus (Bennett)

Plate 5, Figs. A & B

Julis zeylonicus Bennett, 1832: 183 (type-locality, Ceylon).

Halichöres bimaculatus Rüppell, 1835: 17, pl. 5, fig. 2 (type-locality, Massawa, Red Sea).

PlatyGLOSSUS zeylonicus: Günther, 1862: 158 (unjustified emendation of *zeylonicus*).

Pseudojulis trifasciatus (non Weber): Kuroshima & Abe, 1972: 96, pl. 15.

DESCRIPTION: Dorsal fin rays IX,11; anal fin rays III,11; pectoral fin rays 13; lateral-line scales 27; scales above lateral line to origin of dorsal fin 4½; scales below lateral line to origin of anal fin 10½; circum-peduncular scales 16; gill-rakers 17-21.

Depth of body 3.65-4.0 in SL; width of body 1.95-2.15 in depth; head length 2.9-3.1 in SL; snout length 3.15-3.35, orbit diameter 4.4-6.1 in head; interorbital space convex, the bony width 4.8-5.4 in head; depth of caudal peduncle only slightly greater than length; peduncle depth 2.4-2.7 in head.

Front of jaws with a pair of projecting, slightly recurved canine teeth about twice as long as adjacent posterior conical teeth (also slightly recurved); lower canines fitting inside uppers when mouth is closed; side of upper jaw with 9 or 10 and of lower jaw with 11-13 conical teeth that are progressively shorter posteriorly; a canine tooth at corner of mouth projecting obliquely downward and forward from posterior end of upper jaw (absent on specimens as large as 107 mm SL and present on some as small as 95 mm SL — see Remarks); an inner row of small nodular teeth in jaws extending posteriorly to about mid-point of side of jaws.

Pharyngeal dentition: each half of upper pharyngeal plate approximately triangular with 13 to 20 teeth in 6 rows anterior to posterior, the medial and posterior 6 to 10 teeth molariform, the largest being the medial one in third row (about twice as large as average size of remaining molars); T-shaped lower pharyngeal plate with a large subtriangular molar mid-posteriorly flanked by a narrower diagonal molar and 9 to 13 smaller teeth; large molar preceded on median limb by 3 molars (the middle one largest, about one-third size of large centro-posterior molar) and 12 to 30 smaller teeth anterior to these, those at front more conical.

Lower free margin of preopercle extending anterior to or almost to a vertical at front edge of orbit; upper

free margin of preopercle reaching or nearly reaching level of lower edge of orbit.

Nostrils anterior to upper third of eye, the anterior in a small short membranous tube (higher dorso-posteriorly); posterior nostril a little larger than anterior, nearly covered by a flap from anterior edge.

Suborbital pores rimming eye from mid-posteriorly to below front edge of orbit 8-11.

Lateral line following contour of back to beneath ninth and tenth dorsal soft rays where it descends to straight portion on caudal peduncle; each lateral-line scale with a horizontal tubule ending in a single posterior pore.

Head naked except for small scales (partially embedded anteriorly) on side of nape (narrow median region of nape scaleless) which extend anterior to a vertical at upper edge of preopercular margin (on some specimens nearly to hind edge of orbit); scales on mid-side of thorax less than half as high as largest scales on side of body, becoming progressively smaller anteriorly and ventrally, the narrow mid-ventral isthmus naked; fins naked except basally on caudal fin (scales on fin base progressively smaller posteriorly) and 1 or 2 scales in mid-ventral line at base of pelvic fins.

Caudal fin slightly rounded, becoming slightly double emarginate in males, length 1.65-1.8 in head; caudal fin with 7 upper and 6 lower procurrent rays; origin of dorsal fin slightly posterior to upper end of gill opening; dorsal spines progressively longer, the first 5.5-7.5 in head, the ninth 2.85-3.3 in head; second to ninth or tenth dorsal soft rays sub-equal, 2.35-2.6 in head; all dorsal and anal rays branched, the last to base, origin of anal fin below base of ninth dorsal spine; first anal spine slender and short, 7.4-9.8 in head; third anal spine 3.9-4.8 in head; fourth to tenth anal rays longest, 2.6-2.7 in head; pectoral fins 1.55-1.8 in head, the third ray longest (but second and fourth rays subequal), the first ray rudimentary, the second ray unbranched; pelvic fins not reaching anus, their length 1.9-2.3 in head.

Colour of subadults and females in alcohol: uniformly pale except for a black spot the size of pupil or a little larger on caudal fin slightly above mid-line about one-third distance to posterior margin, a very small black spot superiorly on pectoral base, and ventro-anterior margin of the orbit which is narrowly dark brown. In life, a broad yellow stripe passing from snout through eye and along side of body at level of upper end of gill opening; body above stripe pink to pinkish gray, usually with some yellow on lateral-line scales; body below stripe white or pinkish white, often with a faint narrow yellow stripe or row of yellow spots at level of lower pectoral base.

Males light brown, a little darker (greenish on some specimens) anterior to pectoral-fin tips, with a vertically-elongate, oval to slightly irregular, black spot, larger than eye, on upper side centred on lateral line and covering all of ninth lateral-line scale (often a second black spot on mid-side below distal part of pectoral fin); a faint irregular dark stripe posteriorly on some specimens adjacent to and above peduncular portion of lateral line (irregular dark border of this stripe may extend more anteriorly on body); a row of faint dark spots, one per membrane, basally in dorsal fin (some specimens with a middle row of similar but fainter spots in fin), and a faint dark submarginal line; caudal fin with faint irregular dark vertical bands or rows of dark spots; re-

maining fins pale except for a small black spot at upper base of pectoral fins. In life, an orange-yellow lateral stripe on body with a wavy margin of bright blue (stripe better developed posteriorly, containing dark pigment on some specimens); body above stripe blue-green anteriorly with orange-yellow on lateral-line scales, mainly yellow posteriorly; body below stripe white; head and pectoral base with pink bands as on Plate VB; black spot or spots on side of body and upper pectoral base edged in blue; dorsal fin pink basally, shading to light yellow distally, with two rows of blue spots and a dark-edged blue submarginal line; anal fin light yellowish with two narrow dark-edged light blue longitudinal bands; caudal fin orange with dark-edged vertical blue lines and spots, paired fins with whitish rays and clear membranes.

REMARKS: A description instead of a diagnosis is given above for *H. zeylonicus* because the original account of E.T. Bennett is brief and because this is the type species of the genus *Halichoeres*.

Günther (1862) emended the spelling of *zeylonicus* to *ceylonicus*, but it seems obvious that the initial z was intended because Bennett named another fish in the same paper *zeylonicus*. Günther stated, "The typical specimen of this species appears to be lost, nor has the species been recognized . . ." Bennett's description of the colour, however, leaves no doubt that the species is what most authors have called *Halichoeres bimaculatus* Rüppell.

The senior author examined the holotype of *H. bimaculatus* at the Senckenberg Museum in Frankfurt (SMF 1164, 134 mm SL). Its measurement and meristic data are included in the description above.

We have obtained specimens of *H. zeylonicus* at southeast India (Tuticorin), Sri Lanka, Seychelles, and Mauritius in the depth range of 20-85 m. This fish is usually seen on open rubble-sand bottoms, sometimes with isolated small coral heads.

H. zeylonicus is very closely related to the sympatric *H. pelicieri* of Mauritius (see Remarks under *H. pelicieri*). It is also a near relative of the allopatric *H. hartzfeldii* (Bleeker, 1852) of the western Pacific. Both lack the canine tooth at the corner of the mouth in small sizes, have the same caudal shape, a narrow median zone of the nape scaleless or nearly so, the same meristic data, lateral-line scales with a single unbranched tubule, and similarity in colour. The initial phases of both are identical. The terminal males are remarkably close in general coloration, in the pattern of pink bands on the head and pectoral base, and the banding in the median fins. They appear to differ only in the black spot of *hartzfeldii* being mid-lateral beneath the pectoral fin instead of on the lateral line, and in developing one or two black spots posteriorly along the upper edge of the lateral yellow stripe. It is expected that *H. hartzfeldii* will ultimately be regarded as a subspecies of *H. zeylonicus*.

Our largest specimen of *H. zeylonicus*, BPBM 20574, from India, is a male measuring 159 mm SL.

There is considerable variation in the size at which the canine tooth in the corner of the mouth develops. In a series of 12 specimens 100-133 mm SL (BPBM 20575) from Tuticorin, India, five fish, 100-117 mm SL, lack the canine; and the others, 104-133 mm SL, have it, though on some it is small. All of these specimens have a black spot on upper side, and all are probably males



A



B



C



D

Plate 3: A) *Halichoeres stigmaticus*, paratype, female, 86.4 mm SL, BPBM 21250, Bahrain. B) *Halichoeres stigmaticus*, holotype, male, 99.6 mm SL, BPBM 21241, Bahrain. C) *Halichoeres pardaleocephalus*, female, 74 mm SL, BPBM 24718, southwest India (caudal fin damaged). D) *Halichoeres pardaleocephalus*, female, 105 mm SL, BPBM 24798, southwest India (dorsal fin damaged).



Plate 4: A) *Halichoeres hoevenii*, female, 36 mm SL, BPBM 18943, Maldives Islands. B) *Halichoeres hoevenii*, male, 76 mm SL, BPBM 18943, Maldives Islands. C) *Halichoeres nebulosus*, female, 47 mm SL, BPBM 21694, KwaZulu, South Africa. D) *Halichoeres nebulosus*, male, 64 mm SL, BPBM 22120, Cebu, Philippines.

(though the sex could be determined for only about half of them due to poor condition). A 93-mm SL male collected in the Seychelles (BPBM 21624) has the canine at the corner of the mouth.

Halichoeres pelicieri, n. sp.

Plate 5, Figs. C & D; Plate 6, Figs. A & B

HOLOTYPE: BPBM 17349, 86.4 mm SL, female, Mauritius, Cannoner's Point, 20 m, hand net, D. Pelicier, April 1974.

PARATYPES: USNM 222296, 50.7 mm SL, Mauritius, Gunner's Quoin, west side, sand and rubble bottom, 35 m, spear, J.E. Randall, 6 April 1979; BPBM 22908, 50.0 mm SL, same locality as preceding, 35 m, hand net, D. Pelicier, 6 April 1979; RUSI 457, 49 mm SL, same data as preceding; BPBM 22917, 109.5 mm SL, Mauritius, west coast, reef about 2 miles north of Flic en Flac, 30 m, spear, D. Pelicier, 30 July 1979; BPBM 24765, 2: 117.5-142.5 mm SL, Mauritius, Gunner's Quoin, west side, rubble and sand bottom, 30 m, spear, D. Pelicier, 10 June 1980.

DESCRIPTION: Dorsal fin rays IX,11; anal fin rays III,11; pectoral fin rays 13; lateral-line scales 27; scales above lateral line to origin of dorsal fin $4\frac{1}{2}$ ($4\frac{1}{2}$ -5); scales below lateral line to origin of anal fin $10\frac{1}{2}$ ($9\frac{1}{2}$ - $10\frac{1}{2}$); circumpeduncular scales 16; gill rakers 19 (18-21).

Depth of body 3.7 (3.6-4.0) in SL; width of body 2.0 (1.95-2.15) in depth; head length 3.0 (2.9-3.1) in SL; snout length 3.2 (3.1-3.35) in head; orbit diameter 5.9 (4.4-6.15) in head; interorbital space convex, the bony width 5.1 (4.45-5.4) in head; depth of caudal peduncle slightly greater than peduncle length, the least depth 2.4 (2.55-2.7) in head.

Front of jaws with a pair of projecting, slightly recurved canine teeth about twice as long as adjacent posterior conical teeth (also slightly recurved); lower canines fitting inside uppers when mouth is closed; side of upper jaw with 11 (9-12) and of lower jaw with 14 (13-15) conical teeth; a canine tooth (2 on one side of largest male and largest female paratypes) at corner of mouth projecting obliquely anteriorly and ventrally from posterior end of upper jaw (absent on three smallest paratypes); an inner row of small nodular teeth in jaws extending more than half way back along side of jaws.

Pharyngeal dentition of 117.5-mm paratype: each upper half of pharyngeal plate approximately triangular with 21 teeth in 6 rows anterior to posterior, the medial and posterior 10 molariform, the largest the medial one in third row (about twice as large as average size of remaining molars); T-shaped lower pharyngeal plate with a large subtriangular molar mid-posteriorly, flanked by a narrower diagonal molar and 10 lesser teeth; large molar preceded on median limb by 3 molars of about equal size and 15 submolariform to conical teeth (those at front more conical).

Lower free margin of preopercle extending forward to or nearly to a vertical at anterior edge of orbit; upper free margin of preopercle reaching level of lower edge of orbit.

Nostrils anterior to upper third of eye, the anterior in a short membranous tube (higher dorsoposteriorly); posterior nostril a little larger than anterior, nearly covered by a flap from anterior edge.

Suborbital pores rimming eye from midposteriorly to below front edge of orbit 11 (8-11).

Lateral line following contour of back to beneath ninth and tenth dorsal soft rays where it descends to straight portion on caudal peduncle; each scale of anterior series with a slightly oblique tubule ending in a single posterior pore.

Head naked except for small scales (partially embedded anteriorly) on nape (narrow median region naked except for a few scales just anterior to origin of dorsal fin), extending anteriorly to or nearly to a vertical at hind edge of orbit; scales on mid-side of thorax about half as high as largest scales of side of body, becoming progressively smaller anteriorly and ventrally, the anterior isthmus naked; fins naked except for scales basally on caudal fin which are progressively smaller posteriorly and one scale (thickened on adults) extending posteriorly from mid-base of pelvic fins.

Caudal fin slightly rounded, its length 1.65 (1.5-1.75) in head; caudal fin with 7 upper and 6 lower procurrent rays; origin of dorsal fin slightly posterior to upper end of gill opening (over first to second lateral-line scales); dorsal spines progressively longer, the first 5.6 (5.3-6.4) in head, the ninth 3.0 (2.95-3.05) in head; ninth or tenth dorsal soft rays usually the longest, 2.4 (2.4-2.6) in head; all dorsal and anal soft rays branched, the last to base; origin of anal fin below base of ninth dorsal spine; first anal spine slender and short, 10.0 (7.9-12.5) in head; second anal spine about twice as long as first; third anal spine longest, 3.6 (3.25-4.5) in head; fourth to tenth anal soft rays longest, 2.45 (2.4-2.75) in head; pectoral fins 1.6 (1.5-1.65) in head, the third ray longest (but second and fourth nearly as long), the first ray rudimentary, the second unbranched; pelvic fins not reaching anus, their length 2.1 (1.9-2.4) in head.

Colour of holotype (a female) in alcohol: pale with a longitudinal row of brown spots on upper side (each spot in centre of scales of row beneath anterior portion of lateral line), the spots darker posteriorly; a smaller series of brown spots in a row above this series and another in row below it on about posterior third of body; vertically-elongate dark brown spot nearly as large as eye basally on caudal fin slightly dorsal to centre of fin; a small dark brown spot at upper base of pectoral fin.

Colour of holotype when fresh: a broad yellow stripe from front of snout, across postorbital head, along upper side of body, and ending in a large black spot in basal part of caudal fin centred slightly above mid-line; scales of posterior part of yellow stripe with an orangish brown spot in centre; back above yellow stripe pink, the edges of the scales whitish; body below yellow stripe white; head above and below yellow stripe white except for pale pink in region of nape; dorsal fin with lower half to two-thirds pinkish white, distal part yellow except for a bluish white margin; anal fin yellowish white basally, shading soon to light yellow, the margin pale bluish; caudal fin coloured like body on basal scaled portion, the unscaled part yellow (this colour best developed broadly along upper and lower edges) except for a vertical band of light blue behind and adjacent to dark caudal spot and extending dorsal and ventral to it; paired fins whitish, the pelvics tinged with yellowish distally, the pectorals with a small black spot at dorsal edge of base; iris yellow.

Colour in alcohol of juveniles (49.0-50.7 mm SL): pale overall, the lower operculum and thorax whitish; fins translucent (the spines faintly greenish), the caudal with a roundish black spot slightly larger than pupil in outer part of scaled basal portion of fin, the lower edge resting on the mid-lateral line; a small black spot dorsally on base of pectoral fin.

Colour of juveniles when fresh: yellow stripe on upper side as described above for holotype, but without any dark spots posteriorly; head and body above yellow stripe dull pink with some small yellow spots along lateral line and an indistinct yellow line from snout across nape and along back at base of dorsal fin; head below stripe, thorax, and abdomen white; body just below stripe pink, shading to whitish ventrally, with a row of pale yellow spots, one per scale, on lower side commencing behind pectoral axil; dorsal and anal fins translucent, somewhat whitish basally, with a broad submarginal zone of pale yellow; caudal fin translucent with a tinge of yellow; paired fins with transparent membranes and whitish rays, the pectorals with a small dark spot at upper base; iris yellow.

Colour in preservative of the two male paratypes (109.5 and 142.5 mm SL): pale (the recently collected largest specimen still retaining some greenish color), with a broad dark brown stripe on upper side (more diffuse on larger specimen), this stripe poorly defined anteriorly on both specimens; dark caudal spot as seen on females still present on males, but somewhat obscured by a dark stripe; a faint pattern of broad irregular bands on head (described in colour note of fresh specimen below); dorsal fin pale on about basal fourth and posteriorly, dark brown on rest of fin except for a pale margin bisected by a black line; caudal fin pale with an extension of the dark stripe into centre of fin beyond dark spot (in the case of the larger specimen there is a large complex dark reticular pattern over much of central part of fin); remaining fins pale except for the usual small black spot at upper pectoral base.

Colour of 109.5 mm male when fresh (intermediate in colour to females and fully developed males): broad yellow stripe from eye to caudal fin which is infused with blackish in pectoral region, the pigment increasing posteriorly such that the stripe is mainly black from about mid-body to caudal fin (only edges of the scales narrowly yellow); rest of body light blue-green, the back faintly mottled with pinkish; a spot of yellow around each pore of anterior lateral-line; a triangular area of yellow projecting anteroventrally onto snout from eye, the lower part of which is continuous beneath eye with postorbital yellow stripe; a large quadrangular area of yellow dorsally at front of snout and a small patch of yellow anteriorly on upper lip; dorsal fin with a broad median blackish band, becoming diffuse and disappearing in soft part of fin; fin below dark band pale blue-green, above yellowish except for a pale blue margin and black submarginal line; anal fin yellowish gray with a light yellow band broadly edged in deep blue anteriorly at base of fin, breaking up into a series of five light yellow spots (centred on base of fourth to eighth rays); caudal fin coloured like body on basal scaled portion, bluish on unscaled part (blue most evident in a broad irregular bar posterior to end of lateral black stripe), this bar followed by a broad zone of yellow; paired fins pale, the pelvic rays faintly blue-green; iris orange.

Colour of 142.5-mm male when fresh (and from an underwater photo of a male of about the same size): light blue-green; centres of scales on a wide zone of upper side broadly pink narrowly edged in darker blue-green, these spots coalescing posteriorly to form an irregular pink stripe; a pink band from corner of mouth to lower part of eye, continuing narrowly beneath orbit and broadening across entire upper operculum between levels of upper end of gill opening and dorsal base of pectoral fin; a ventral continuation of pink band along posterior edge of operculum and narrowly on ventral edge; a pink band passing ventrally from behind opercular flap to upper axil of pectoral fin; a diagonal sigmoid pink band from beneath pectoral fin onto abdomen and another parallel to it on thorax from in front of pectoral base onto lower abdomen; a broad squarish zone of pink antero-dorsally on snout; front of upper lip pink; dorsal fin with a broad blackish zone nearly full height of fin, the demarcation with the narrow blue basal part of fin wavy; margin of dorsal fin pale blue with a black submarginal line (most evident on soft portion where a zone of greenish yellow develops in distal part of fin, this zone broad posteriorly); anal fin green with a broad blue zone at base containing a large pink spot at base of each ray (spots joined to form a solid band on spinous portion and first four rays); margin of anal fin light blue with a thin submarginal dark line; caudal fin coloured like body on basal scaled portion, the distal part broadly reticulated with pink and blue green except a wide posterior border of yellowish green; pectoral fin hyaline with dusky rays and a black spot at upper end of base edged in bright blue; pelvic fins hyaline, the rays pale blue-green; iris mainly salmon pink.

REMARKS: Named *pelicierei* in honour of aquarium fish collector Daniel Pelicier of Mauritius who obtained all but one of the type specimens for us and provided the photograph of the holotype and our only photographs of the male phase of this species.

All of our specimens have been taken at Mauritius in the depth range of 20 to 35 m. The typical habitat is open rubble and sand bottom, though the fish may be seen around small isolated rocks or coral heads on such open bottom. This species is difficult to approach underwater, especially the large males.

H. pelicierei is very closely related to *H. zeylonicus*. The yellow-striped juveniles and small females of both species are virtually indistinguishable. We could find no meristic or morphological differences except for a slight distinction in caudal fin shape of males. Initially we considered the possibility that *H. pelicierei* might be only a geographical variant of *H. zeylonicus* at Mauritius; but when Pelicier caught a 140-mm male *H. zeylonicus* (BPBM 22918) by hook and line from 85 m at Mauritius, we realized that the two forms were distinct species.

Preserved specimens of males of the two species may be distinguished by the caudal fin shape (rounded in *pelicierei*, slightly double emarginate in *zeylonicus*), the lack of a large black spot on or below the lateral line in *pelicierei*, and the broad blackish band in the dorsal fin of *pelicierei*. The larger females of *pelicierei* develop blackish posteriorly in the yellow lateral stripe (lacking on female *zeylonicus*). Many differences are evident in life colours of males of the two species (compare Plates 5 and 6), particularly the retention of the yellow stripe by *zeylonicus* (at least posteriorly) in contrast to a broad



Plate 5: A) *Halichoeres zeylonicus*, female, 100 mm SL, BPBM 20575, southeast India. B) *Halichoeres zeylonicus*, male, 133 mm SL, BPBM 20575, southeast India. C) *Halichoeres pelicierii*, paratype, female, 50 mm SL, BPBM 22908, Mauritius. D) *Halichoeres pelicierii*, holotype, female, 86.4 mm SL, BPBM 17349, Mauritius (photo D. Pelicier).

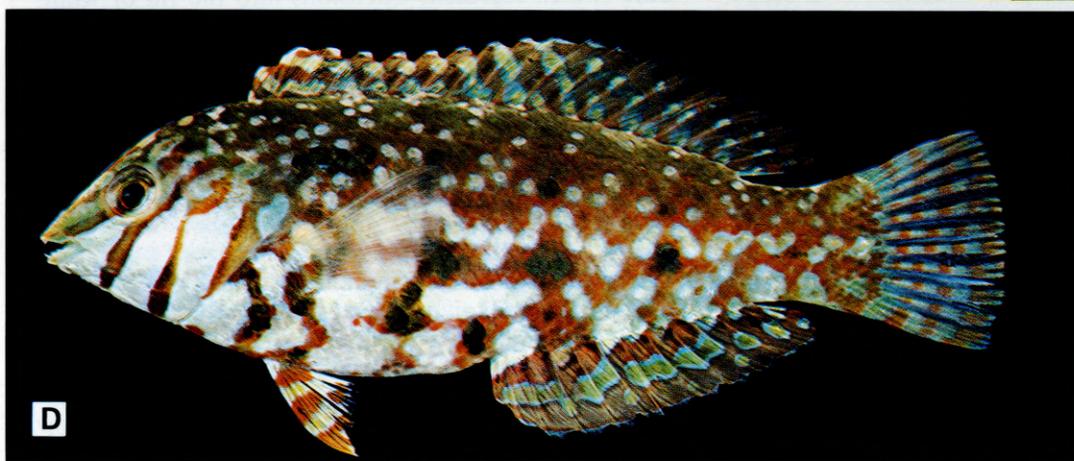
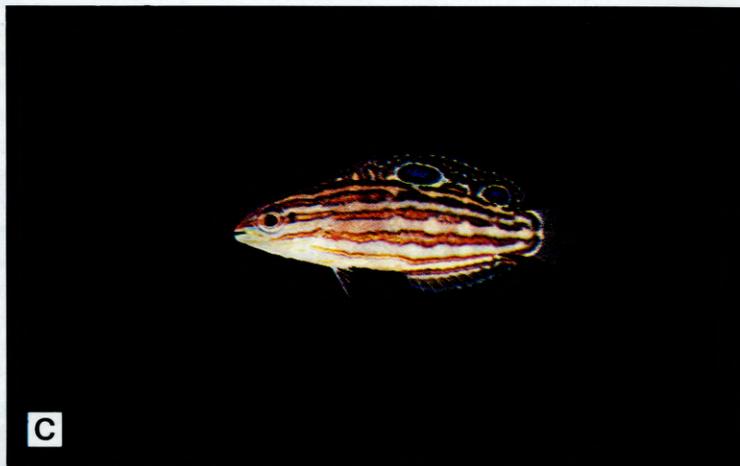
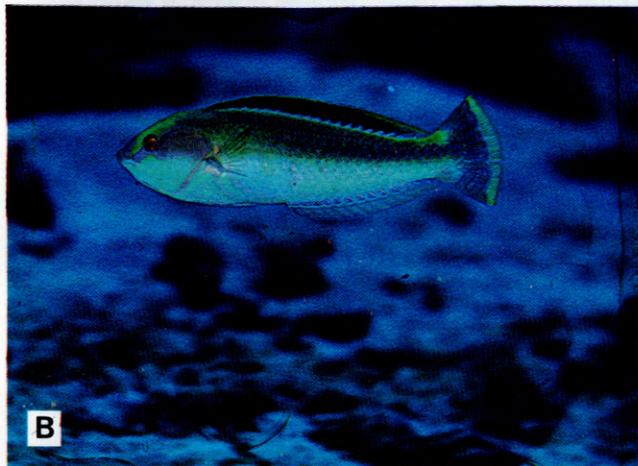


Plate 6: A) *Halichoeres pelicieri*, paratype, male, 109.5 mm SL, BPBM 22917, Mauritius (photo, D. Pelicier; spear wound on lower head and thorax). B) *Halichoeres pelicieri*, male, Mauritius (underwater photo by D. Pelicier). C) *Halichoeres cosmetus*, paratype, juvenile, 24 mm SL, BPBM 22911, KwaZulu, South Africa. D) *Halichoeres lapillus*, female, 72 mm SL, BPBM 19634, Mauritius. E) *Halichoeres lapillus*, male, 98 mm SL, BPBM 16351, Mauritius.

zone of pink spots, the pattern of pink bands on the head, thorax and abdomen, and in the coloration of fins.

Halichoeres lapillus Smith

Plate 6, Figs. D & E

Halichoeres lapillus Smith, 1947: 801 (type-locality, Inhaca island, Mozambique); 1949: 289 pl. 55.

DESCRIPTION: Dorsal fin rays IX,11 (1 of 18 specimens with X,10); anal fin rays III,11; pectoral fin rays 13; lateral-line scales 27; gill rakers 17-21.

Depth of body 2.8-3.3 in SL; width of body 2.3-2.9 in depth; head length 2.85-2.95 in SL; snout 3.1-3.6 in head; orbit diameter 4.55-5.6 in head; least depth of caudal peduncle 2.15-2.35 in head; caudal fin slightly rounded, 1.35-1.55 in head; origin of dorsal fin slightly anterior to upper end of gill opening; first dorsal spine 4.55-5.35 in head; third and fourth dorsal spines slightly longer than fifth and sixth; last dorsal spine the longest, 3.1-3.5 in head; third to fifth dorsal rays the longest, 2.25-2.5 in head; first anal spine 7.0-8.9 in head; third anal spine 3.25-3.5 in head; fourth or fifth anal rays the longest, 2.2-2.5 in head; pectoral fins 1.5-1.55 in head; pelvic fins not reaching anus (but nearly reaching in some specimens). 1.75-1.8 in head.

Upper jaw with 1 pair of prominent canine teeth anteriorly which are nearly straight and strongly projecting; second pair of teeth about half as long as anterior pair and slightly recurved; remaining teeth progressively shorter, bluntly conical to nearly rounded, 6-8 on side of jaw except large posterior canine which is about as long as anterior canine; lower jaw with 1 pair of nearly straight canines anteriorly; second pair about three-fourths as long; remaining teeth progressively shorter, bluntly conical, 6-9 on side of jaw.

Each upper pharyngeal plate with three large medial subquadrate molars preceded by about 12 conical teeth; lower pharyngeal plate with a large posterior subtriangular to oval molar flanked by 9 to 11 conical teeth and preceded on the median limb by 10 to 14 conical teeth.

Upper preopercular margin free nearly to level of lower edge of orbit and lower margin free nearly to a vertical at front of orbit.

Two to 5 (usually 2 or 3) pores in each scale of anterior straight portion of lateral line and 1 to 4 in descending and straight peduncular portion.

Head naked except for partially embedded scales on each side of nape (small anteriorly) which extend no farther forward than a vertical at upper end of preopercular margin; median zone of nape scaleless; scales on mid-side of thorax about half as high as scales on side of body; mid-ventral and antero-ventral region of thorax naked, fins scaleless except approximately the basal third of caudal fin which has progressively smaller scales posteriorly and a triangular scale midventrally at base of pelvic fins.

Colour in alcohol of initial phase: body pale with traces of dusky pigment in irregular areas, mainly on upper half of body; dark brown, irregular V-shaped mark with apex near upper end of gill opening; two rows of roundish dark brown (nearly black) spots on side of body which converge to a single small spot in

middle of caudal peduncle; two diagonal dark brown bars on thorax (one beginning on pectoral base) and three dark brown spots forming a triangle on abdomen; head pale with two parallel diagonal near-vertical broken dark brown bands running from ventral part of head under eye to opercle; traces of another dark diagonal band on side of snout, that continues behind and above eye; some specimens with a small median dark spot on snout; median fins pale except anal which is irregularly blotched with brown, often with two or three dark brown spots at base (in addition the dorsal and anal fins usually have a dark brown spot or at least a vestige of it posteriorly, and some specimens have a black spot anteriorly in outer soft portion of anal fin); pectoral fins pale; pelvic fins pale with a dark spot about half way between base and tip on lateral half of fin (one specimen with a second lateral spot near base).

Colour in life of initial phase olive-brown dorsally, reddish brown ventrally, with black spots as described above and many small round white spots dorsally and larger white spots ventrally, some interconnected to form irregular bands (principal one along mid-side in a lengthwise zigzag pattern); head olive dorsally, white over most of operculum and ventrally, with white spots dorsally and five diagonal reddish brown bands, the upper two from snout through eye; dorsal fin brownish red with irregular white spots, some interconnected; membrane at spine tips white (in soft portion the spots are light greenish and arranged in irregular diagonal bluish bands); anal fin reddish brown with whitish spots along base (which represent extensions into the fin of white spots ventrally on body), a broken median band of green edged in blue, an outer row of four or five spots of the same color, and a narrow bluish margin; caudal fin whitish with small orange spots on rays arranged in irregular vertical rows; pectoral fins whitish, the rays narrowly edged in red; pelvic fins white, tinged with yellow, with three transverse bands of brownish red.

Colour of terminal phase in alcohol: body dark brown with indistinct pale spots about size of pupil, pale ventrally and a little lighter antero-dorsally, below base of dorsal fin and on upper caudal peduncle; an irregular black spot slightly larger than eye centered below fifth dorsal spine between pectoral fin and lateral line; a short irregular longitudinal dark-edged pale band beneath pectoral fin and a second band lower on body centered above origin of anal fin; two adjacent rows of similar but less distinct pale-edged bands posteriorly on side of body just below lateral line; two dark brown bars low on side of body, one ending at base of second and third anal soft rays and the second at seventh ray; two dark brown blotches ventrally on abdomen and two slightly diagonal lighter brown bars on thorax (one running from pectoral base irregularly to origin of pelvic fins); head brown with indistinct pale spots dorsally and four dark-edged diagonal pale bands (one from front of snout, interrupted in region of nostrils, and continuing through upper edge of eye onto nape; second from lower lip, joined by a branch from chin, to lower edge of eye and reappearing in same alignment on head behind center of eye; third from throat, interrupted above upper end of preopercular margin, and continuing to opercle at upper end of gill openings; and fourth from near isthmus to upper opercle where it joins the third); chin blackish; dorsal fin pale except basal half of soft portion which is light gray brown with two longitudinal

rows of dark-edged pale spots, the lower row at base, one spot per membrane, and the upper row in middle of fin with each spot centered on a ray; anal fin grayish brown with three rows of dark-edged pale spots, the lowest row of half spots at base of fin (first three spots joined); the second row of spots in median position linked to form three irregular bands except for last three spots which are discrete, and the last row of small spots centered on rays in outer part of fin; caudal fin pale, becoming dusky to blackish posteriorly; paired fins pale.

In life, ground colour of terminal phase is red-orange becoming dusky over most of body, the spots and bands yellowish green, narrowly edged with blue and purple; the large black humeral spot has three flecks of bright yellow; dorsal and anal fins are light red-orange with rows of greenish yellow spots edged inwardly with blue and outwardly with red; dorsal fin with a narrow blue margin and red submarginal line and the anal with a narrow bluish margin; caudal fin light orange with two highly irregular partially broken curved bands of light green edged with blue; pectoral fins whitish, the rays narrowly edged with dark reddish; pelvic fins light greenish except for a lateral band of light red-orange.

REMARKS: Because the original description of *Halichoeres lapillus* was based on a single specimen and was not very detailed, we have given a complete description of this species instead of just a diagnosis. In addition to the holotype, our description is based on two specimens from off Tuléar, Madagascar (MNHN 1976-2, 67.3 mm SL and RUSI 837, 72 mm SL) collected in 25 m by M.L. Harmelin-Vivien in 1972 and four specimens from Mauritius (BPBM 16351 and 19634, 3: 72.4-97.3 mm SL and CAS 34701, 60.5 mm SL) collected with spear by the senior author in 12-14 m in 1973. Additional specimens were collected by us and colleagues from KwaZulu, South Africa in 1976-1977 and deposited in the Bishop Museum (BPBM 21715, 3: 64-114 mm SL) and J.L.B. Smith Institute of Ichthyology (RUSI 12503-5, 8: 30.5-47.5 mm SL). The specimens from Madagascar, Mauritius, and KwaZulu represent first records of the species from these areas.

H. lapillus is associated primarily with relatively shallow (generally 5 to 15 m) reefs and rocky areas where algal growth is more prominent than coral.

In general habits and in configuration *H. lapillus* is more suggestive of *Macropharyngodon* than *Halichoeres*. Its pharyngeal dentition approaches that of *Macropharyngodon*, differing principally in having more small conical teeth associated with the molars. It lacks the restricted free margin of the preopercle characteristic of *Macropharyngodon*. It appears to be a link between the two genera. A broader study of *Halichoeres* may result in the consideration of *Macropharyngodon* as a subgenus of *Halichoeres*.

Halichoeres cosmetus, n. sp.

Plate 6, Fig C; Plate 7, Figs A & B

HOLOTYPE: BPBM 18925, 72.2 mm SL, male, Maldive Islands, North Male Atoll, Villingili Island, northeast side, reef front, 2-20 m, spear, J.E. Randall, 21-22 March 1975.

PARATYPES: ANSP 107762, 55.9 mm SL, Seychelles, Praslin vicinity just north of Round Island, 12-15 m, J.E. Böhlke *et al.*, 22 February 1964; ANSP 110993, 89.5 mm SL, Seychelles, Amirantes, African Islands, off north end of North Island, 8-9 m, J.E. Böhlke *et al.*, 3 March 1964; ANSP 107458, 3: 44.2-61.0 mm SL, Seychelles, Amirantes, Eagle Island, off north end, 6-9 m, J.E. Böhlke *et al.*, 4 March 1964; ANSP 107498, 5: 27.2-69.3 mm SL, Seychelles, Amirantes, D'Arros Island, off east end, 21-30.5 m, J.E. Böhlke *et al.*, 6 March 1964; ANSP 107403, 2: 45-72.8 mm SL, Seychelles, Amirantes, vicinity of St. Joseph Island, southwest of Ressource Island, off small boat passage to lagoon, 15-27.5 m, J.E. Böhlke *et al.*, 10 March 1964; ANSP 107566, 2: 64.4-92.2 mm SL, same data as preceding; MNHN 1980-1304, 3: 56-89.5 mm SL, Réunion, west coast, off Villa Bourbon, 10 m, spear, J.E. Randall, 21 October 1973; BPBM 16325, 84.9 mm SL, Mauritius, off Grand Baie, 12 m, spear, J.E. Randall, 15 November 1973; BM(NH) 1980.5.20.1-2, 2: 60.0-60.7 mm SL, and USNM 221540, 2: 60.6-68.9 mm SL, same data as preceding; BPBM 17621, 69.3 mm SL, Tanzania, Mafia Island, Chole Bay, 6 m, spear, J.E. Randall, 11 December 1973; BPBM 16398, 78.2 mm SL, Tanzania, Mafia Island, southeast end of island, outer reef just north of passage, 4 m, spear, J.E. Randall, 12 December 1973; CAS 33414, 2: 42.0-45.3 mm SL, Comoro Islands, Grande Comore Island, N'Gouni Reef, about .5 km north of Iconi in surge channel at far end of small cove, rock and coarse sand bottom in 5 m, Pronoxfish, J.E. McCosker, S. Mead, D. Powell, J. Breeden, 1 March 1975; BPBM 22947, 3: 60.7-69.2 mm SL, same data as holotype; CAS 39128, 2: 63.4-73 mm SL, same data as holotype; BPBM 21625, 2: 66.1-74.9 mm SL, Seychelles, Cocos Island (Albatross Is.), reef in 8-9 m, spear, J.E. Randall, 4 June 1977; ROM 36069, 83.8 mm SL, Chagos Archipelago, Peros Banhos, lagoon side off north end of Isle Poule, large isolated patch reef, 13 m, rotenone, R. Winterbottom, A.R. Emery and R. Perry, 13 February 1979; ROM 35934, 3: 34.6-43.9 mm SL, Chagos Archipelago, Salomons, north side of Isla Diabole, drop off in 20-26 m, rotenone, R. Winterbottom and A.R. Emery, 17 March 1979; ROM 35933, 62.0 mm SL, Chagos Archipelago, Isle Poule, east side to northeast of Isle Boddam, bottom of sponges, gorgonians, and some corals, 18-25 m, rotenone, A.R. Emery, R. Winterbottom, B. Simm, and A. Ryan, 22 March 1979; ROM 35937, 37.8 mm SL, Chagos Archipelago, Salomons, eastern tip of northernmost island (Isle de la Passe), sea fans, corals, and sponges on drop off, 18-25 m, rotenone, A.R. Emery, R. Winterbottom, A. Ryan, and B. Simm, 23 March 1979; BPBM 22911, 2: 24.0-68.7 mm SL, South Africa, KwaZulu, off Sodwana Bay, reef in 12-15 m, rotenone, J.E. Randall, M. Smale, and R. van der Elst, 18 April 1979; BPBM 22910, 38 mm SL, South Africa, KwaZulu, off Sodwana Bay, reef in 23 m, rotenone, J.E. Randall, G.R. Allen, M. Smale, and R. van der Elst, 19 April 1979; BPBM 22912, 99.5 mm SL, South Africa, Natal, Aliwal Shoal (about 30 miles southeast of Durban); rocky bottom in 20 m, spear, J.E. Randall, 26 April 1979; RUSI 973, 70.7 mm SL.

DESCRIPTION: Dorsal fin rays IX,11 (1 of 30 specimens with 12); anal fin rays III,11; pectoral fin rays 13 (1 of 30 with 12 and 2 with 14); lateral-line scales 27 (3 of 30 specimens with 26 and one with 28); scales above lateral line to origin of dorsal fin 4½ (4½-5½); scales below lateral line to origin of anal fin 10½ (9½-10½); circumpeduncular scales 20; gill rakers 18 (17-20, modally 18, see Table 1).

Depth of body 3.35 (3.25-4.1) in SL; width of body 2.3 (2.3-2.7) in depth, head length 3.2 (2.7-3.3) in SL; snout length 3.15 (2.85-3.35) in head; orbit diameter 4.95 (3.55-6.0) in head; interorbital space convex, the bony width 5.2 (4.9-5.4) in head; caudal peduncle nearly twice as deep as long, depth 1.85 (1.8-2.45) in head.

Front of jaws with a pair of projecting, slightly recurved, canine teeth about twice as long as adjacent posterior teeth; canines in lower jaw fitting inside those of uppers when mouth closed; side of upper jaw with 7 to 10 close-set, somewhat compressed, conical teeth which are progressively less projecting, shorter, and more bluntly rounded posteriorly; a large canine (2 on one side of holotype) at corner of mouth projecting obliquely downward and anteriorly from posterior end of upper jaw; lower jaw with 9 to 12 teeth on each side



Plate 7: A) *Halichoeres cosmetus*, paratype, female, 38 mm SL, BPBM 22910, KwaZulu, South Africa. B) *Halichoeres cosmetus*, holotype, male, 72.2 mm SL, BPBM 18925, Maldive Islands. C) *Halichoeres iridis*, juvenile, Natal, South Africa (underwater photo). D) *Halichoeres iridis*, holotype, female, 67.3 mm SL, BPBM 16335, Mauritius. E) *Halichoeres iridis*, paratype, male, 84.7 mm SL, BPBM 22955, Mauritius.



A



B



C



D

Plate 8: A) *Halichoeres trispilus*, holotype, male, 50.4 mm SL, BPBM 18882, Maldive Islands. B) *Halichoeres trispilus*, paratype, male, 70 mm SL, BM(NH) 1980.5.20.5, Mauritius. C) *Halichoeres leucoxanthus*, paratype, female, 49.4 mm SL, BPBM 18911, Maldive Islands. D) *Halichoeres leucoxanthus*, holotype, male, 65 mm SL, BPBM 22906, east Java.

posterior to anterior canines, similar to upper teeth but not so bluntly rounded; front of upper jaw with a pair of small compressed teeth lingual to anterior canines and a shorter more conical tooth behind each of these; front of lower jaw also with 2 small inner teeth on each side, the first pair more conical and more medial than comparable upper teeth.

Pharyngeal dentition of a 92-mm specimen: each triangular upper pharyngeal plate with 14 to 15 teeth in 4 to 5 rows, the medial and posterior 7 or 8 molariform (largest are medial teeth of the 2 middle rows), the anterior 2 or 3 teeth rather conical; T-shaped lower pharyngeal plate with a large subtriangular median posterior molariform tooth with 5 adjacent small molars, flanked by 13 or 14 teeth in 3 rows on each side (including small molars) and preceded on median limb by 11 teeth in 2 irregular rows, the most anterior conical.

Lower free margin of preopercle extending to a vertical at front edge of orbit; upper margin free to level of mouth.

Nostrils small, in front of upper fifth of eye, the anterior in a membranous tube (higher posteriorly) and the posterior diagonally upward and behind the anterior, covered by a flap from front margin.

Suborbital pores rimming eye from mid-posteriorly to below front edge of orbit 11 (8-11).

Scales of anterior and descending part of lateral line with 2 to 4 branched tubules (usually 3), each ending posteriorly in a pore; scales on straight peduncular portion of lateral line with a single horizontal tubule (rarely with 1 small dorsal or ventral branch), ending in a pore.

Head naked except for a triangular zone of small scales on nape (partially embedded anteriorly and mid-dorsally) the medial apex of which extends anterior to a vertical at upper end of preopercular margin; scales on side of thorax about half as large as those on side of body, becoming still smaller ventrally and anteriorly; fins naked except basal third of caudal fin (scales on fin base progressively smaller posteriorly), a few small scales along extreme base of dorsal and anal fins, and 1 or 2 large pointed scales mid-ventrally at base of pelvic fins.

Caudal fin rounded, its length 1.25 (1.25-1.5) in head; caudal fin with 5 upper and lower procurrent rays; origin of dorsal fin slightly posterior to a vertical at upper end of gill opening; dorsal spines progressively longer, the first 5.8 (5.15-6.3) in head; eighth to tenth (first to third on juveniles) dorsal soft rays longest, 1.9 (1.9-2.5) in head; all dorsal and anal soft rays branched, the last to base; origin of anal fin below base of first to second dorsal soft rays; first anal spine slender and short, 8.95 (7.1-10.1) in head; third anal spine 4.2 (3.6-4.4) in head; pectoral fins 1.5 (1.55-1.7) in head, the third ray longest (but second and fourth nearly as long), the first rudimentary and the second unbranched; pelvic fins not reaching anus (though approaching anus in male and extending slightly beyond anus in 84.9-mm paratype), the longest (first) ray 1.5 (1.2-2.25) in head.

Colour of holotype (a male) in alcohol: body pale with brown stripes about a half eye diameter in breadth (broader than pale interspaces) following contour of back (stripes faint on mid-side and disappearing ventrally); upper stripes continuing anteriorly onto nape and

faintly and irregularly onto postorbital head; three vertical pale zones on posterior half of body interrupting brown stripes; head with a vertically elongate dark brown spot behind eye, a mid-dorsal irregular brown band from snout to origin of dorsal fin, a dark band from front of snout to lower third of eye, and a faint dark band from below corner of mouth across cheek below eye to opercle (some paratypes show a band above eye from snout to behind interorbital space; this is extremely faint on holotype); edge of orbit narrowly dark brown; fins pale except a blackish spot slightly smaller than pupil basally on first interspinous membrane of dorsal fin and a second blackish spot about half the size of eye on second soft dorsal ray and adjacent membranes situated about one-third distance from base to margin of fin. On some paratypes the dark spot anteriorly in dorsal fin is faint or absent; the second spot may be as large as eye and ocellated, and there is often a third smaller ocellated spot toward base of fin at ninth and tenth rays.

In life the dark stripes on the holotype were green (darker dorsally) and the intermediate paler bands salmon pink dorsally and yellow laterally and ventrally; upper 3 green stripes overlaid with a series of pale green spots (at this point stripes are broader) arranged in 3 vertical rows beneath soft portion of dorsal fin; thorax and abdomen greenish white; head green with irregular blue-edged pink bands and a black spot behind eye; dorsal fin salmon pink suffused with green, bearing two longitudinal series of large spots (joined to form bands over much of spinous portion) each spot with a large green centre bordered in blue with a narrow outer reddish edge; margin of fin blue-green; anal fin similar to dorsal but with a single median blue and reddish-edged longitudinal band; caudal fin with irregular vertical and interconnecting bands of green and orange, the green broadly edged with blue and the orange narrowly with reddish and containing greenish centres; posterior margin of caudal fin narrowly light blue; pectoral fins clear, the edges of the rays narrowly dark; pelvic fins with clear membranes and greenish rays except first ray and part of adjacent membranes which have a streak of light red.

Some paratypes have bluish gray stripes suffused with pink instead of green stripes; the second and third black dorsal-fin spots may be rimmed with bright blue and dark reddish (on juveniles these spots have dark blue centers).

REMARKS: Named *cosmetus* from the Greek for adorned, in reference to the brilliant and complex colours displayed by this beautiful fish.

H. cosmetus is a common wrasse of coral reefs and rocky substrata throughout much of the western Indian Ocean in relatively shallow water; our specimens have been taken in the depth range of 5 to 30.5 m. Surprisingly, it seems not to have been collected prior to 1964. We have specimens from the Maldives, Seychelles, Chagos Archipelago, Mascarenes, Comoros, and Tanzania and Natal on the east coast of Africa. The southernmost record is Aliwal Shoal (about 30 miles SE of Durban). The senior author has photographed this species underwater off Lamu in northern Kenya; probably it ranges north along the Somalia coast. It was not observed in the Gulf of Aden, Red Sea, Persian Gulf, or coast of India.

H. cosmetus is most closely related to the allopatric *H. ornatissimus* (Garrett). Although known in the literature only from the Hawaiian Islands (type locality) and Society Islands (Randall, 1973), *H. ornatissimus* has been taken by the senior author at Johnston Island, Marquesas, Tuamotus, Australs, Wake, Marcus, Samoa Islands, and the Ryukyu Islands. William F. Smith-Vaniz and associates collected specimens from Cocos-Keeling Islands in the eastern Indian Ocean (deposited in the Academy of Natural Sciences of Philadelphia).

H. cosmetus is very similar in colour pattern to *ornatissimus*, especially in the smaller sizes. The latter differs in the adult pattern principally in having the green stripes alter to longitudinal series of spots. More significant is the difference in the number of soft rays of the dorsal and anal fins; *cosmetus* has 11 and *ornatissimus* 12.

Our largest specimen of *H. cosmetus* (BPBM 22912) which was taken at Aliwal Shoal, Natal, measures 99.5 mm SL. Table 5, with proportional measurements of specimens ranging from 24 to 99.5 mm SL, shows a remarkable consistency over this wide range in size for most characters. As is expected the eye diameter decreases in relative size with age. The head length also decreases. The bases of the dorsal and anal fins and the length of the pelvic fins increase in relative size with age.

Halichoeres iridis, n. sp.

Plate 7, Figs C, D, E

HOLOTYPE: BPBM 16335, 67.3 mm SL, female, Mauritius, west coast off La Fouche, Medine (about 1 mile north of Flic en Flac), coral and rock patch on sand and rubble, 30 m, hand net, J.E. Randall and D. Pelicier, 19 November 1973.

PARATYPES: ANSP 107544, 12: 34.0-61.6 mm SL, Seychelles, Mahé Island, off northern end in 18 m, J.E. Böhlke *et al.*, 14 February 1964; ANSP 107141 17.3 mm SL, same locality, 26 m, J.E. Böhlke *et al.*, 15 February 1964; ANSP 111003, 73.2 mm SL, Seychelles, Curieuse Island, southeast of Rouge Point (east of a line between it and St. Pierre Islet), 26 m, J.E. Böhlke *et al.*, 23 February 1964; ANSP 107164, 6: 17.0-63.6 mm SL, Seychelles, Amirantes, vicinity of St. Joseph Island, southwest of Ressource Island near drop-off outside small boat passage, 24-30.5 m, J.E. Böhlke *et al.*, 7 March 1964; ANSP 107180, 28.9 mm SL, same locality and collectors as preceding, 10 March 1964; ANSP 107422, 31.0 mm SL; Seychelles, Mahé Island, Beau Vallon Bay, 12-15 m, J.E. Böhlke *et al.*, 19 March 1964; BPBM 18057, 58.2 mm SL, Madagascar, Tulear, barrier reef, inner reef slope, patch reef on sand, 6 m, dynamite, M.L. Harmelin-Vivien, 28 October 1972; BM(NH) 1980.5.20.3, 43.9 mm SL, Mauritius, west coast, 1.5 miles north of Flic en Flac, patch reef in 28 m, spear, J.E. Randall, 17 November 1973; BPBM 22955, 84.7 mm SL, same data as holotype; BPBM 16394, 78.2 mm SL, Tanzania, Mafia Island, off southeast side of island north of passage, base of drop-off, rubble and rock bottom 30 m, spear, J.E. Randall, 12 December 1973; CAS 46032, 42.3 mm SL, Seychelles, Cocos Island (Albatross Is.), rock and sand bottom, 15 m, spear, J.E. Randall, 4 June 1977; USNM 221542, same data as preceding; RUSI 972, 3: 61.9-91.0 mm SL, South Africa, KwaZulu, Sodwana Bay, 22 m, rotenone, P.C. Heemstra, M.N. Bruton, and T. Hecht, 3 April 1979; ROM 35935, 44.0 mm SL, Chagos Archipelago, Salomons, 100 m north of Isle Diabole, drop-off in 40-43 m, small caves, sand, rock and soft corals, rotenone, R. Winterbottom, A.E. Emery, A. Ryan, J. Griffiths, J. Liptrot, and S. Syson, 20 March 1979; ROM 35940, 2: 39.6-53.9 mm SL, Chagos Archipelago, Salomons, off Isle Poule just north of eastern tip of Boddam, drop-off slope including 12-m cliff, gulleys and caves with *Dendrophilia*, sea fans, and some coral, 35-43 m, rotenone, A.R. Emery, R. Winterbottom, J. Liptrot, S. Syson, B. Simm, J. Griffiths, and A. Ryan, 21 March 1979; BPBM 22954,

38 mm SL, South Africa, Natal, Aliwal Shoal (about 30 miles south-east of Durban), rocky bottom, 22 m, spear, J.E. Randall, 26 April 1979; BPBM 22942, 2: 41.5-57.4 mm SL, Seychelles, Mahé, southwest side of island, base of inshore rocky slope, bottom mainly rubble, 16 m, spear, J.E. Randall, 7 April 1980.

DESCRIPTION: Dorsal fin rays IX,12 (1 of 9 paratypes with 13); anal fin rays III,12; pectoral fin rays 13 (1 of 9 paratypes with 14); lateral-line scales 27; scales above lateral line to origin of dorsal fin 4½ (4½-5½); scales below lateral line to origin of anal fin 10½; circumpeduncular scales 20; gill rakers 18 (15-19).

Depth of body 3.45 (3.35-3.9) in SL; width of body 2.4 (2.05-2.35) in depth; head length 3.05 (3.0-3.2) in SL; snout length 3.2 (2.8-3.3) in head; orbit diameter 5.1 (4.3-5.75) in head; interorbital space convex, the bony width 4.9 (4.6-4.85) in head; depth of caudal peduncle about twice as great as length, the least depth 2.2 (2.0-2.25) in head.

Front of jaws with a pair of projecting, slightly recurved, canine teeth which are twice as long as adjacent posterior teeth; side of upper jaw with 9 or 10 and lower jaw with 10 to 12 somewhat compressed, close-set conical teeth which are progressively shorter posteriorly; a large canine at corner of mouth projecting obliquely downward and anteriorly from posterior end of upper jaw; 2 pairs of small blunt teeth at front of jaws medial to anterior canines (anterior pair compressed).

Pharyngeal dentition of 84.7 mm paratype: triangular upper pharyngeal plate on each side with 17 teeth in 5 rows anterior to posterior, the medial and posterior 6 molariform but only slightly enlarged; T-shaped lower pharyngeal plate with an enlarged subtriangular median posterior molariform tooth surrounded anteriorly and laterally with 5 smaller molariform teeth; large molar flanked by 9 bluntly rounded teeth on each side (including small molars) in one to 3 rows and 14 teeth anteriorly on median limb in 1 to 3 rows, the most anterior teeth conical.

Lower free margin of preopercle extending to or nearly to a vertical at rear edge of orbit; upper margin free to or slightly above level of corner of mouth.

Suborbital pores rimming eye from mid-posteriorly to below front edge of orbit 12 (9-11).

Scales of lateral line with 3 to 5 branched tubules, each ending posteriorly in a pore.

Head naked except small scales in a triangular area on nape, the median apex nearly reaching a vertical at hind edge of orbit (anterior scales on nape embedded); scales on side of thorax about half as high as those on side of body, becoming still smaller anteriorly and ventrally; fins naked except for basal two-fifths of caudal fin (scales progressively smaller distally), extreme base of dorsal and anal fins with a few small scales and two or three mid-ventral scales at base of pelvic fins.

Caudal fin moderately rounded, its length 1.55 (1.4-1.55) in head; caudal fin with 5 upper and lower procurrent rays; origin of dorsal fin slightly posterior to a vertical at upper end of gill opening; dorsal spines progressively smaller posteriorly, the first 5.65 (4.45-5.1) in head and the ninth 3.3 (2.65-3.0) in head; fifth to seventh dorsal soft rays longest, 2.4 (2.05-2.35) in head; all dorsal and anal soft rays branched, the last to base; first anal spine slender and short, 9.1 (7.05-8.5) in head; third anal spine 4.8 (3.8-4.6) in head; third to eighth anal soft rays longest, 2.55 (2.25-2.45) in head; pectoral fins 1.8 (1.5-1.7) in head, the third ray longest (but se-

cond and fourth nearly as long), the first rudimentary, the second unbranched; pelvic fins not reaching anus, 1.85 (1.55-2.05) in head.

Colour of holotype (a female) in alcohol: head, dorsal part of body (including anterior portion of lateral line), and ventral part of thorax and abdomen pale; rest of body dark brown; a dark brown spot larger than pupil behind eye centered above upper free end of preopercle; fins pale except for a black spot on outer half of first interspinous membrane of dorsal fin and dark brown scaly base of caudal fin.

In life, pale upper part of body bright red, the dark part dark brown with a reddish cast (deepest red in centre of scales); snout and dorsal part of head orange-yellow shading to orange on postorbital and ventral part of head; black spot behind eye edged posteriorly with yellow; an irregular dull greenish yellow band from below eye across operculum at level of upper pectoral base; a similar band ventral and parallel to first just above lower free margin of preopercle; thorax red-orange shading to brown posteriorly, with a curved greenish band; dorsal fin yellowish white with a translucent whitish margin and a black spot anteriorly; anal fin red on basal half, orangish distally, with a narrow red band, a translucent whitish margin and narrow blackish submarginal line; caudal fin with scaly base dark brown and red in alignment with these colours of body, the red continuing as a band around posterior edge of dark brown basal region; rest of fin whitish tinged with pink except for broad region of posterior corners and a pale yellow streak dorsally and basally just above red band; paired fins pale with pinkish rays, the base of the pectorals yellow and the lateral edge of pelvics yellowish white.

The 84.7-mm paratype, a male, is similar in colour in alcohol to the holotype, differing in a larger dark spot (as large as orbit) behind eye, more distinct banding on head, dusky pigment on nape, and a curved submarginal dark line in caudal fin (nearly reaching margin of fin mid-posteriorly but curving proximally from posterior corners).

In life the male differed from the holotype in having an indistinct reddish brown instead of red band along the back, the orange colour and green banding of the head and thorax more intense; green markings posteriorly on opercle and dorsally on head; a faint median blue-edged red band in dorsal fin and hemispherical blue-edged red band posteriorly in caudal fin.

Juveniles have two large ocelli basally on soft portion of the dorsal fin, one centred on the third ray and the other on the tenth and eleventh rays and two small obscure black spots, one above the other, posteriorly in dark basal part of caudal fin; anal fin dark brown.

REMARKS: This species is named *iridis* from the Greek for "of the rainbow" in reference to the many colours that may be seen on a single individual.

H. iridis appears to be confined to the western Indian Ocean. We have specimens from Mauritius, Madagascar, Natal (30°S), Tanzania, Chagos Archipelago and the Seychelles. The senior author observed it off Shimoni, Kenya, though collected no specimens there. It has not been seen in the Maldives or any locality east of these islands.

This species is usually found at depths greater than 20 m. The type specimens have been taken in the depth range of 15 to 43 m except for the one from Madagascar

(BPBM 18057) collected by M.L. Harmelin-Vivien for which a depth of 6 m was recorded.

With its unusual colour pattern, *H. iridis* cannot be confused with any other Indo-Pacific species of the genus. Its colour is a little reminiscent of *H. cyanocephalus* (Bloch) from the tropical western Atlantic which has a very broad dark brown stripe behind the eye on the side of the head and body, extending partially into the caudal fin. The Atlantic fish, however, is clearly distinctive in having two pairs of enlarged canines anteriorly in the lower jaw and 18-21 gill rakers. *H. iridis* is most closely related to the sympatric *H. leucoxanthus* and an undescribed Pacific ally of this species. These three wrasses appear to differ significantly only in colour.

Halichoeres trispilus, n. sp.

Plate 8, Figs. A & B

HOLOTYPE: BPBM 18882, 50.4 mm SL, male?, Maldives Islands, North Male Atoll, Villingili Island, lagoon reef in 30 m, spear, J.E. Randall, 18 March 1975.

PARATYPES: BM(NH) 1980.5.20.5, 70 mm SL, Mauritius, off Grand Baie, patch reef in 37 m, spear, J.E. Randall, 28 November 1973; BPBM 16370, 50.5 mm SL, Mauritius, west coast off Wolmar, base of vertical drop-off in 56 m, spear, J.E. Randall, 4 December 1973; RUSI 446, 44.5 mm SL, Maldives Islands, North Male Atoll, Villingili Island, lagoon reef, 30 m, spear, J.E. Randall, 16 March 1975; USNM 221543, 68 mm SL, Mauritius, west coast off Flic en Flac, 24 m, D. Pelicier, 1978.

DESCRIPTION: Dorsal fin rays IX,12; anal fin rays III,12; pectoral fin rays 13; lateral-line scales 27; scales above lateral line to origin of dorsal fin 4½; scales below lateral line to origin of anal fin 9; circum-peduncular scales 20; gill rakers 16 (16-18).

Depth of body 3.6 (3.4-3.6) in SL; width of body 2.25 (2.3-2.45) in depth; head length 2.9 (2.9-2.95) in SL; snout length 3.45 (3.2-3.4) in head; orbit diameter 4.2 (3.95-4.75) in head; interorbital space convex, the bony width 5.45 (5.1-5.55) in head; depth of caudal peduncle about twice as great as length, the least depth 2.3 (2.1-2.35) in head.

Front of jaws with a pair of projecting, slightly recurved, canine teeth which are nearly twice as long as adjacent posterior teeth (also slightly recurved); sides of jaws with 8 to 12 somewhat compressed conical teeth which are progressively shorter, less projecting, and more bluntly rounded posteriorly; a large canine at corner of mouth projecting obliquely downward and anteriorly from posterior end of upper jaw; 2 pairs of small blunt conical teeth at front of upper jaw and 3 similar pairs in lower jaw medial to anterior teeth (anterior pair of upper lingual teeth compressed).

Pharyngeal dentition of largest paratype: each approximately triangular half of upper pharyngeal plate with a total of 15 blunt teeth in 5 anterior to posterior rows, the medial tooth of the third and fourth rows somewhat enlarged and molariform; lower pharyngeal plate T-shaped with a large sub-triangular molar mid-posteriorly, 11 small blunt teeth laterally on each side and 13 in 1 or 2 irregular rows anterior to the molar on the median limb.

Lower free margin of preopercle extending anterior

to a vertical at front edge of pupil; upper margin free to or almost to level of lower edge of eye.

Anterior nostril in a small membranous tube anterior to middle of eye; posterior nostril diagonally posterior and dorsal to anterior, covered by a membranous flap from the anterior margin.

Suborbital pores rimming eye from mid-posteriorly to below front edge of orbit 9 (10-11).

Scales of anterior and descending part of lateral line with 2 or 3 branched tubules (usually 3), each ending posteriorly in a pore; scales on straight peduncular portion of lateral line with a single horizontal tubule ending in a pore.

Head naked except for a triangular zone of small partially embedded scales on nape, the medial apex of which extends anteriorly nearly to a vertical at posterior edge of orbit; scales on mid-side of thorax about half as large as those on side of body, becoming still smaller ventrally and anteriorly; fins naked except basally on caudal fin (scales progressively smaller posteriorly) and ventral surface at base of pelvic fins (the most prominent being 3 scales in a median row which are progressively larger posteriorly).

Caudal fin slightly rounded, its length 1.5 (1.45-1.55) in head; caudal fin with about 10 upper and lower procurrent rays; origin of dorsal fin slightly anterior to a vertical at upper end of gill opening; dorsal spines progressively longer, the first 4.7 (4.3-5.2) and the ninth 3.3 (2.7-3.15) in head; second to sixth dorsal soft rays longest, subequal, 2.3 (2.2-2.55) in head; all dorsal and anal soft rays branched, the last to base; origin of anal fin below base of second dorsal soft ray; first anal spine slender and short, 9.5 (9.15-11) in head; third anal spine 4.35 (3.85-4.55) in head; third to fifth anal soft rays longest, subequal, 2.9 (2.6-2.9) in head; pectoral fins 1.7 (1.65-1.85) in head, the third ray longest (but second and fourth nearly as long), the first ray rudimentary, the second unbranched; pelvic fins not reaching anus, 2.1 (1.6-2.05) in head.

Colour of holotype (a male) in alcohol: pale brown with a row of three small black spots on back just above level of lateral line, the first on nape, the second below third dorsal spine and the last below eighth dorsal soft ray (a faint fourth spot below base of eighth dorsal soft ray on one side of holotype only; not evident on paratypes); an indistinct subquadrangular small dark brown spot immediately behind eye at level of upper edge of pupil, followed by a faint dusky streak to upper edge of opercular flap; a second faint horizontal brown streak passing from behind lower third of eye to posteriormost part of opercular flap; a third horizontal streak from behind corner of mouth below eye to upper preopercular margin; membranous rim of orbit narrowly dark brown; dorsal fin pale with three round black spots, the first nearly as large as eye covering much of second interspinous membrane and extending partly onto first and third (most of remaining first membrane dusky), the second half way out in fin on fourth soft membrane and extending partly onto third, and the last on penultimate membrane, extending partly onto the last; a row of dusky spots at base of dorsal fin, one per membrane, beginning with the fourth; above these a median row of dusky spots in fin; caudal fin pale with an oval dark brown to black spot larger than pupil situated between upper third to sixth branched rays where basal scales of fin terminate; smaller dark spots (two of which are most

prominent) diagonally anterior and dorsal to principal caudal spot; remaining fins pale (no dark spot at base or axil of pectoral fins). Paratypes coloured much like the holotype, though some have two (and the 68-mm paratype three) black spots posteriorly on dorsal fin.

Live colour of holotype shown in Plate 8 fig. B.

The following colour note is of a 50.5-mm female paratype (BPBM 16370) shortly after capture: body with indistinct alternating narrow stripes of light red and pale pink; head above level of corner of mouth red, below whitish; thorax and lower abdomen whitish; a bluish white line passing from corner of mouth, curving below eye, extending slightly irregularly to upper pectoral base, and then curving to axil of fin; a second whitish line, slightly broader and less distinct than the first, passing from eye to end of opercle; a third narrow bluish white line from upper lip through eye to upper end of gill opening; a fourth very thin slightly irregular bluish white line through top of eye and extending slightly anterior and posterior to it; dorsal fin light olive with a row of interconnected white spots at base, a second smaller row above (most spots discrete), a white border, and three black ocelli (the first larger than eye at front of fin, the second bilobed at front of soft portion, and the third a double ocellus posteriorly in fin, its two black spots about size of pupil); anal fin whitish with two dull yellow stripes; caudal fin with an ocellated black spot at base above mid-line, the white rim of ocellus continuous with a white band on basal third of fin; some interconnected brown blotches above and anterior to caudal ocellus; remainder of caudal fin yellow except a hyaline posterior margin about as broad as pupil in middle of fin and slightly broader on upper and lower corners; pectoral fins faintly pink; pelvic fins whitish, the first soft ray slightly pinkish.

A colour photo of the 70-mm male paratype, BM(NH) 1980.5.20.5, differs from the preceding only in the paler body (very pale pink dorsally shading to white ventrally), the striping very indistinct, and in the small size of the two posterior black spots of the dorsal fin (a little smaller than pupil). A narrow red bar at the pectoral base is more evident because of the lighter colour of the body.

A live individual of *H. trispilus* in an aquarium at the hotel Villas Caroline at Flic en Flac, Mauritius, estimated at 77 mm SL was photographed by the senior author in early April 1980. The two posterior dark spots in the dorsal fin and the three dark dots on the back have disappeared, the pale ring around the anterior spot of the fin is more blue, and the narrow red band at the base and axil of the pectoral fin is very prominent. The submarginal yellow line anteriorly in the dorsal fin on this fish and clearly visible on the photo of the holotype was not mentioned in the note of the 50.5-mm female paratype. It is not known if this yellow marking was overlooked when the note was written or if it might be a sexual colour difference. The 70-mm paratype is a male, and the holotype appears to be a male, though evidently one that has recently undergone sexual reversal (gonad very small).

REMARKS: *H. trispilus* is unusual among the species of *Halichoeres* and the Labridae in general in the relatively small difference in colour with sex. It is named *trispilus* in reference to the series of three black spots that appear at three different locations: along the back, on the dorsal fin (though, as mentioned, the posterior

two disappear in large males), and at the upper base of the caudal fin.

Although known thus far only from the Maldive Islands and Mauritius, it can be expected from other Indian Ocean sites such as the Seychelles (the senior author's fish collections in the Seychelles were all less than 20 m). This wrasse was collected in the depth range of 24 to 56 m; it was not seen in shallower water.

In the depths at which *H. trispilus* has been observed, the red and pink hues are not visible; thus the fish seems almost white except for the dark markings.

Halichoeres leucoxanthus, n. sp.

Plate 8, Figs. C & D

HOLOTYPE: BPBM 22906, 65.0 mm SL, male, Indonesia, Java, eastern end, aquarium fish collector of P.T. Vivaria, via Dick B.B. Liem, 20 August 1978.

PARATYPES: BPBM 18911, 49.4 mm SL, Maldive Islands, Villingili Island, south side, reef in 35 m, spear, J.E. Randall, 21 March 1975; RUSI 445, 75.1 mm SL, same data as preceding.

DESCRIPTION: Dorsal fin rays IX,12; anal fin rays III,12; pectoral fin rays 13; lateral-line scales 27; scales above lateral line to origin of dorsal fin $5\frac{1}{2}$ ($4\frac{1}{2}$); scales below lateral line to origin of anal fin $10\frac{1}{2}$ ($9\frac{1}{2}$); circumpeduncular scales 20; gill rakers 16 (17-18).

Depth of body 3.65 (3.55-3.85) in SL; width of body 2.35 (2.45-2.6) in depth; head length 3.15 (3.1-3.15) in SL; snout length 3.15 (3.15-3.2) in head; orbit diameter 4.75 (4.8) in head; interorbital space convex, the bony width 4.9 (4.8-4.95) in head; caudal peduncle nearly twice as deep as long, the least depth 2.05 (2.25) in head.

Front of jaws with a pair of projecting, slightly recurved, canine teeth which are nearly twice as long as adjacent posterior teeth (which are also somewhat recurved); lower canines fitting inside uppers when mouth closed; side of jaws with 9 to 11 somewhat compressed conical teeth which are progressively shorter and more bluntly rounded posteriorly; a large canine tooth (2 on one side of holotype) at corner of mouth extending obliquely downward and anterior from posterior end of upper jaw; a pair of small compressed conical teeth in upper jaw medial to anterior canines and a few small nodular teeth medially at front of lower jaw.

Pharyngeal dentition of largest paratype: each half of upper pharyngeal plate with a total of 14 teeth in 5 anterior to posterior rows, the median 3 of the posterior rows comprised of moderate molars and the adjacent lateral teeth of last 2 rows molariform; remaining teeth bluntly conical; lower pharyngeal plate T-shaped with a large subtriangular median posterior molar and 8 smaller bluntly rounded teeth on each side; 16 smaller teeth anterior to large molar on median limb in one to three irregular rows (teeth on median limb progressively more conical anteriorly); teeth adjacent to prominent molar larger than remaining teeth and nearly molariform.

Lower free margin of preopercle extending anteriorly to (or nearly to) a vertical at front edge of orbit; upper margin free almost to level of lower edge of eye.

Nostrils small, in front of upper third of eye, the anterior in a small membranous tube, the posterior diagonally above and behind the anterior nostril, nearly covered by a flap from ventro-anterior margin.

Suborbital pores rimming eye to below front edge of orbit 9 (10-11).

Scales of anterior and descending part of lateral line with 2 or 3 (mostly 3) branched tubules, each ending posteriorly in a pore; scales of straight peduncular portion of lateral line with tubules branched or unbranched (mostly unbranched).

Head naked except for a triangular zone of small scales on nape, the medial apex of which extends anteriorly to a vertical between upper end of preopercle and posterior edge of orbit, the scales partially embedded anteriorly (narrow median anterior zone on nape of holotype scaleless); scales on mid-side of thorax about half as high as those on side of body, becoming still smaller ventrally and anteriorly; fins naked except basal two-fifths of caudal fin (scales on fin base progressively smaller posteriorly); a few small scales at extreme base of dorsal and anal fins, and a row of three scales in mid-ventral line at base of pelvic fins.

Caudal fin moderately rounded, the length 1.4 (1.35-1.45) in head; caudal fin with 5 or 6 upper and lower procurvent rays; origin of dorsal fin very slightly posterior to a vertical at upper end of gill opening; dorsal spines progressively longer, the first 5.05 (4.95) and the ninth 2.95 (2.7-2.85) in head; third to eleventh dorsal soft rays subequal, the longest (ninth to eleventh on holotype, third to sixth on paratype) 2.4 (2.25-2.3) in head; all dorsal and anal soft rays branched, the last to base; origin of anal fin below base of first dorsal soft ray; first anal spine slender and short, its length 10 (8.5-9) in head; third anal spine 4.1 (4.2-4.4) in head; third to eleventh anal soft rays subequal, the longest (tenth or eleventh in holotype, third to fifth in paratypes) 2.6 (2.55-2.6) in head; pectoral fins 1.75 (1.65-1.7) in head, the third ray longest (but second and fourth nearly as long), the first ray rudimentary, the second unbranched; pelvic spine slender, flexible distally; pelvic fins not reaching anus, 1.85 (1.85-2.1) in head.

Colour of holotype (a male) in alcohol: pale with a vertically elongate black spot larger than pupil behind upper half of eye slightly anterior to a vertical from upper end of preopercular margin; edges of small scales on nape dusky; fins pale except three black spots in dorsal fin (one semicircular, slightly larger than pupil, on outer half of first interspinous membrane, one about the size of pupil on basal third of membrane mostly between second and third soft rays but partly extending over the third ray onto next membrane, and one a little smaller than pupil on front half of basal third of last membrane and eleventh soft ray) and one blackish spot smaller than pupil on fifth branched caudal ray at a point where the basal scales on fin terminate.

Colour of smallest paratype very similar to that of holotype, the dark spot behind the eye nearly round and the dark spots on the soft portion of the dorsal fin a little larger.

Colour of holotype (a male) when fresh: upper half of head and body bright yellow, lower half of body pinkish white (centers of scales broadly pale pink, edges white); edges of scales on nape dusky; a vertically elongate greenish black spot behind eye; behind and ad-

adjacent to this a yellow spot of similar size that is lighter and brighter than rest of head behind eye; a longitudinal slightly diagonal band of deep yellow above eye extending in front of and behind interorbital space; a second deep yellow band, faintly edged in blue, from front of snout to eye; two similar bands extending across upper operculum from behind eye, one running dorsal to and the other ventral to postorbital spots; head below these bands light yellowish green with a yellow band, faintly edged in light blue, passing from chin below eye across upper free margin of preopercle to end of operculum; a similar less distinct band ventrally on head (underwater photos of male fish in the Maldive Islands and off Thailand show the lower head more green and the bands of the lower part of the head and to a lesser extent the ones extending anterior and posterior to lower part of eye light pink); dorsal fin yellow with a longitudinal band of deeper yellow above basal third of fin; the distal part of membranes and tips of soft rays pale bluish; black spots as described for preserved specimen, the anterior one (except flatter upper edge) with a narrow rim of bluish white; anal fin with longitudinal bands of pink, blue-edged green, pink suffused with green, from base to margin, which is light blue; caudal fin with a central region of yellow continuous with yellow of upper part of body and a lower region of pink containing a blue-edged diagonal green band; upper and lower posterior corners of fin broadly light blue, these separated from yellow and pink central zones by a broad band of dull yellow-orange; black spot on fifth branched caudal ray; pectoral fins clear with pinkish rays; pelvic fins clear with pale bluish rays except a streak of pale salmon on first ray and partly on an adjacent region of posterior membrane; iris yellow with a narrow green ring; lower edge of orbit narrowly pale blue.

The 49.4-mm female paratype was bright yellow on snout and upper half of head and body without the pale green and pink bands of the lower part of the head as seen on holotype; the dorsal fin is entirely yellow except pale bluish margin, the three black spots distinctly rimmed with white; anal fin faintly banded longitudinally with pink and light blue; basal scaled part of caudal fin colored like body, the distal part with clear membranes, the rays light yellowish dorsally and pinkish ventrally; paired fins pale, the pectoral rays faintly pinkish.

REMARKS: Named *leucoxanthus* for the striking half white, half yellow coloration.

H. leucoxanthus is a species of moderate depths, not observed in less than 20 m and usually seen in more than 30 m. It is generally found on small patch reefs often well isolated by stretches of open sand bottom.

This species has been collected thus far only in the Maldive Islands and Java. The senior author was present at the P.T. Vivaria aquarium fish supply house in Jakarta when the holotype came in alive from eastern Java. As this fish had been seen previously only in the

Maldives, surprise was registered at the Java record. The president of P.T. Vivaria, Dick B.B. Liem, said there could be no question of the locality. Later the senior author observed the species at the Similan Islands off Phuket, southwest Thailand and photographed it underwater.

H. leucoxanthus is extremely closely related to an all-yellow species that has just been described by Randall (in press). We are able to separate these two species only on colour. The most obvious distinction is the solid yellow colour of one compared to the half-yellow, half white of the other. In addition, females of *leucoxanthus* lack the pair of small dark spots dorsally on the front of the snout, and males may have three black spots in the dorsal fin (no males of the yellow species were found which still retained the blackish spot on the penultimate dorsal-fin membrane). Also, males of *leucoxanthus* do not exhibit the continuation of the orange-yellow and yellowish green bands of the head onto the thorax as may be seen in the yellow species. There may be a gill-raker count difference, but more specimens of *leucoxanthus* are needed to confirm it. The average gill-raker count of 25 specimens of the yellow species is 15.76 (range 14 to 19) while that of the three *leucoxanthus* is 17.

If these two fishes were separated geographically, we would regard them as subspecies of a single species. Their ranges, however, overlap. The yellow species occurs throughout the western Pacific from the Ryukyu Islands through the Philippines and Indonesia to New South Wales; it ranges into Micronesia as far as the Marshall Islands. Allen and Steene (1979) recorded it from Christmas Island in the eastern Indian Ocean.

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Table 4. Proportional Measurements of Type Specimens of *Halichoeres pelicieri* expressed as a Percentage of the Standard Length

	Holotype	Paratypes					
	BPBM 17349	RUSI 457	BPBM 22908	USNM 222296	BPBM 22917	BPBM 24765	BPBM 24765
Standard length (mm)	86.4	49.0	50.0	50.7	109.5	117.2	142.5
Depth of body	27.2	24.9	25.0	25.4	26.0	27.6	27.6
Width of body	13.4	12.2	11.9	11.8	13.3	13.7	13.5
Head length	33.6	34.3	34.0	34.1	32.5	34.5	33.1
Snout length	10.5	10.3	10.4	10.6	10.3	10.8	10.7
Orbit diameter	5.7	7.6	7.6	7.7	5.3	6.1	5.4
Bony interorbital width	6.6	6.3	6.4	6.5	6.8	7.0	7.5
Length of upper jaw	9.5	8.6	8.6	8.5	9.7	9.7	9.6
Least depth of caudal peduncle	13.9	12.9	13.4	12.6	12.8	12.8	12.9
Length of caudal peduncle	11.4	12.2	12.3	11.8	10.6	11.2	11.5
Predorsal length	30.8	31.4	31.8	30.8	29.9	31.6	31.1
Preanal length	52.1	53.5	53.4	54.2	56.4	54.9	56.1
Prepelvic length	32.5	34.5	34.0	33.3	33.3	34.2	34.7
Length of caudal fin	20.5	22.2	22.4	22.1	19.5	19.8	19.0
Length of first dorsal spine	6.0	5.5	6.1	5.9	6.1	5.4	5.7
Length of second dorsal spine	7.5	7.6	7.8	7.5	7.3	7.0	7.3
Length of ninth dorsal spine	11.3	11.2	11.8	11.8	11.0	10.3	10.5
Length of longest dorsal ray	13.9	14.1	14.3	14.2	13.6	13.2	13.2
Length of dorsal fin base	61.8	59.6	58.0	57.8	59.0	58.4	59.0
Length of first anal spine	3.4	3.5	4.0	4.3	3.7	2.8	3.6
Length of second anal spine	6.8	7.1	8.2	7.9	7.0	5.7	5.6
Length of third anal spine	9.3	9.8	10.4	10.5	9.0	7.7	8.2
Length of longest anal ray	13.7	12.9	14.0	13.8	12.9	12.5	12.2
Length of anal fin base	38.3	35.9	35.6	35.7	35.5	35.7	34.5
Length of pectoral fin	20.8	20.6	20.8	20.7	21.5	21.8	21.8
Length of pelvic fin	15.9	14.1	14.6	14.8	17.2	15.8	16.9

Table 5. Proportional Measurements of Type Specimens of *Halichoeres cosmetus* expressed as a Percentage of the Standard Length

	Holotype	Paratypes						
	BPBM 18925	BPBM 22911	BPBM 22910	BPBM 22947	BPBM 22911	BPBM 22947	BPBM 16325	BPBM 22912
Standard length (mm)	72.2	24.0	38.0	60.7	68.7	72.5	84.9	99.5
Depth of body	29.9	30.8	24.2	30.3	29.4	30.0	29.0	30.2
Width of body	13.0	11.5	10.5	11.7	12.2	11.9	11.0	13.0
Head length	31.3	37.1	34.5	34.1	32.8	31.0	30.6	30.3
Snout length	10.0	11.3	10.3	11.0	10.9	10.3	10.5	10.6
Orbit diameter	6.3	10.4	8.4	7.0	6.8	6.1	5.7	5.0
Bony interorbital width	6.0	7.1	6.6	6.3	6.1	6.1	6.3	6.2
Length of upper jaw	9.3	9.2	8.4	8.6	9.2	8.4	8.8	8.8
Least depth of caudal peduncle	16.9	15.2	14.7	15.2	15.6	15.4	15.0	16.9
Length of caudal peduncle	9.1	9.2	8.7	8.9	8.7	9.0	9.6	9.0
Predorsal length	29.8	34.9	31.6	31.8	30.4	30.2	28.9	27.9
Preanal length	55.8	60.4	59.2	60.8	57.8	55.4	56.2	54.0
Prepelvic length	31.6	35.4	33.7	34.6	33.8	32.1	32.3	30.4
Length of caudal fin	25.1	25.2	25.0	25.2	23.6	23.6	24.0	23.4
Length of first dorsal spine	5.4	6.3	6.1	5.4	5.5	5.8	5.9	5.9
Length of second dorsal spine	7.2	7.9	7.8	broken	7.1	abnormal	7.2	7.2
Length of ninth dorsal spine	11.4	12.5	12.1	11.8	10.9	11.3	10.8	10.3
Length of longest dorsal ray	16.5	15.0	15.5	15.6	15.0	15.4	15.9	16.0
Length of dorsal fin base	66.3	60.4	60.5	61.4	61.4	66.5	63.7	66.7
Length of first anal spine	3.5	3.8	3.9	3.6	3.3	3.4	4.3	3.0
Length of second anal spine	5.3	8.3	7.7	5.4	5.2	5.5	5.9	5.0
Length of third anal spine	7.5	10.0	9.6	7.9	7.4	7.5	8.1	7.5
Length of longest anal ray	15.4	14.6	14.5	14.2	13.7	13.9	15.0	14.0
Length of anal fin base	38.1	33.3	33.9	33.7	34.8	37.2	37.7	38.4
Length of pectoral fin	20.7	22.0	20.5	20.8	19.5	20.1	18.8	19.5
Length of pelvic spine	12.2	12.1	12.3	12.4	13.0	12.6	13.1	13.0
Length of pelvic fin	20.9	16.3	17.1	18.5	18.3	18.8	25.6	19.9

Table 6. Proportional Measurements of Type Specimens of *Halichoeres iridis* expressed as a Percentage of the Standard Length

	Holotype	Paratypes					
	BPBM 16335	BPBM 22942	BPBM 22942	BPBM 18057	BPBM 16384	BPBM 22955	RUSI 972
Standard length (mm)	67.3	41.5	57.4	58.2	78.2	84.7	91.0
Depth of body	29.0	27.7	25.7	27.5	27.7	29.7	28.6
Width of body	12.2	12.5	11.0	12.1	12.4	14.2	14.0
Head length	32.8	33.4	31.5	31.0	31.6	33.3	31.0
Snout length	10.2	10.1	9.8	9.7	10.5	12.0	11.0
Orbit diameter	6.4	7.8	7.0	6.9	6.1	5.8	5.8
Bony interorbital width	6.7	7.0	6.7	6.4	7.0	7.1	6.7
Length of upper jaw	9.2	8.5	7.6	8.5	8.4	9.4	9.0
Least depth of caudal peduncle	15.0	14.9	15.3	15.0	14.9	15.2	15.5
Length of caudal peduncle	7.4	7.2	7.9	8.0	8.4	7.2	7.4
Predorsal length	30.5	29.6	28.1	28.9	27.5	30.2	28.3
Preanal length	55.8	58.5	54.5	54.3	57.2	55.1	54.5
Prepelvic length	31.2	33.7	31.7	30.4	31.1	33.8	30.8
Length of caudal fin	21.1	21.7	21.8	22.2	21.2	21.9	22.0
Length of first dorsal spine	5.8	6.5	7.1	6.7	6.2	6.7	6.6
Length of second dorsal spine	7.5	7.7	8.7	8.2	8.0	9.2	abnormal
Length of ninth dorsal spine	10.0	12.0	11.6	11.6	10.5	11.2	11.0
Length of longest dorsal ray	13.8	14.9	14.8	14.3	14.4	14.2	15.2
Length of dorsal fin base	64.2	60.8	65.3	66.3	65.3	67.5	63.8
Length of first anal spine	3.6	4.2	3.8	4.3	3.7	4.4	4.4
Length of second anal spine	4.6	5.8	6.5	5.3	5.2	6.1	5.5
Length of third anal spine	6.8	7.9	8.3	7.5	6.9	8.1	7.4
Length of longest anal ray	12.9	13.5	14.1	13.1	13.2	13.6	13.5
Length of anal fin base	38.0	34.0	36.8	38.1	36.8	39.6	38.7
Length of pectoral fin	18.3	19.5	20.2	19.2	19.1	19.8	20.6
Length of pelvic spine	11.6	12.4	12.3	11.6	13.0	13.1	11.2
Length of pelvic fin	17.5	16.3	19.8	17.5	20.2	21.4	19.8

Table 7. Proportional Measurements of Type Specimens of *Halichoeres trispilus* expressed as a Percentage of the Standard Length

	Holotype	Paratypes			
	BPBM 18882	RUSI 446	BPBM 16370	USNM 221543	BM(NH) 1980.5.20.5
Standard length (mm)	50.4	44.5	50.5	68.0	70.0
Depth of body	27.7	28.7	27.7	27.9	29.4
Width of body	12.3	11.7	11.9	11.9	12.3
Head length	34.3	34.8	33.9	33.7	33.7
Snout length	9.9	10.6	9.9	10.5	10.3
Orbit diameter	8.1	8.8	7.8	7.1	7.2
Bony interorbital width	6.3	6.6	6.1	6.2	6.6
Length of upper jaw	8.9	9.0	8.9	8.7	8.7
Least depth of caudal peduncle	14.9	16.5	15.2	14.4	14.3
Length of caudal peduncle	8.4	7.9	7.9	8.1	8.0
Predorsal length	30.4	31.0	29.9	31.3	30.6
Preanal length	57.2	56.0	57.4	58.0	57.1
Prepelvic length	31.7	33.5	32.3	34.1	32.9
Length of caudal fin	22.8	24.2	23.6	21.5	22.9
Length of first dorsal spine	7.3	6.8	7.7	7.8	abnormal
Length of second dorsal spine	8.9	8.8	9.5	9.4	abnormal
Length of ninth dorsal spine	10.4	12.8	broken	10.7	11.1
Length of longest dorsal ray	14.9	15.7	14.5	13.2	14.4
Length of dorsal fin base	64.5	65.8	65.5	64.3	65.7
Length of first anal spine	3.6	3.5	3.7	3.5	3.1
Length of second anal spine	5.5	5.6	5.4	5.4	5.9
Length of third anal spine	7.9	9.0	8.1	7.4	7.9
Length of longest anal ray	11.9	13.5	11.7	11.5	12.3
Length of anal fin base	36.1	38.2	36.4	37.3	38.3
Length of pectoral fin	20.4	20.7	19.8	18.4	20.3
Length of pelvic spine	11.8	broken	11.2	11.7	11.8
Length of pelvic fin	16.5	17.9	16.4	17.6	20.7

Table 8. Proportional Measurements of Type Specimens of *Halichoeres leucoxanthus* expressed as a Percentage of the Standard Length

	Holotype	Paratypes	
	BPBM 22906	BPBM 18911	RUSI 445
Standard length (mm)	65.0	49.4	75.1
Depth of body	27.3	28.3	26.0
Width of body	11.7	11.6	10.0
Head length	31.7	32.2	31.7
Snout length	10.0	10.0	10.0
Orbit diameter	6.7	7.7	6.6
Bony interorbital width	6.5	6.7	6.4
Length of upper jaw	8.6	8.3	8.4
Least depth of caudal peduncle	15.5	14.2	14.1
Length of caudal peduncle	8.6	8.5	8.3
Predorsal length	29.1	30.3	30.5
Preanal length	54.8	55.9	54.6
Prepelvic length	30.8	31.4	31.0
Length of caudal fin	22.3	23.7	21.8
Length of first dorsal spine	6.3	6.5	6.4
Length of second dorsal spine	7.7	8.5	8.0
Length of ninth dorsal spine	10.8	11.3	10.7
Length of longest dorsal ray	13.1	13.8	14.0
Length of dorsal fin base	65.2	64.3	64.4
Length of first anal spine	3.1	3.6	3.7
Length of second anal spine	5.1	6.0	5.6
Length of third anal spine	7.7	7.7	7.2
Length of longest anal ray	12.2	12.6	12.5
Length of anal fin base	38.6	34.6	35.0
Length of pectoral fin	18.3	19.6	18.6
Length of pelvic spine	10.6	8.9	9.5
Length of pelvic fin	16.9	15.5	17.2

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