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A REVISION OF THE DAMSELFISH GENUS *DASCYLLUS* (POMACENTRIDAE) WITH THE DESCRIPTION OF A NEW SPECIES

BY

HELEN A. RANDALL
Fish Division, Bernice P. Bishop Museum, Honolulu, Hawaii 96818 USA

AND

GERALD R. ALLEN
Department of Fishes, Western Australian Museum, Perth

SUMMARY

The damselfish genus *Dascyllus* (family Pomacentridae) is reviewed. The group contains the following nine species which are primarily inhabitants of tropical reefs: *albisella* (Hawaiian Islands), *aruanus* (widespread Indo-Pacific), *carneus* (Indian Ocean), *marginatus* (Red Sea), *melanurus* (Indo-Australian Archipelago), *reticulatus* (E. Indian Ocean and W. Pacific), *strasburgi* (Marquesas Islands), *trimaculatus* (widespread Indo-Pacific), and *flavicaudus* n.sp. (southeastern Oceania) which is described in detail and compared with its nearest relative, *D. reticulatus*. A brief diagnosis, illustration, and notes on the general biology of each species is provided. In addition, a key to the species of *Dascyllus* and tables of meristic and morphometric data are included.

INTRODUCTION

The present paper is part of a series of generic revisions of the Pomacentridae currently in progress by the junior author; either alone or in conjunction with various colleagues. The need for revision of certain problem genera in this speciose family of tropical reef fishes was discussed previously by Allen and Robertson (1974), Allen (1975), and Allen and Lubbock (1976).

The genus *Dascyllus* Cuvier (1829) contains nine species which inhabit the vast tropical region of the Indo-West Pacific. The genus has not been reviewed previously on a comprehensive basis although it has been treated by authors of large monographic works and regional faunal volumes or reports. Cuvier (1830) recognized three species: *aruanus* (Linnaeus), *marginatus* (Rüppell), and *trimaculatus* (Rüppell). Günther (1862) also placed these three species in the genus along with five others: *albisella* Gill, *melanurus* Bleeker, *xanthosoma* Bleeker, *polyacanthus* Bleeker, and *cyranurus* (Rüppell). However, the latter two do not belong in *Dascyllus* as presently defined and are allocated as follows: *cyranurus* = *Chromis caerulea* (Cuvier); *polyacanthus* = *Acanthochromis polyacanthus*. Furthermore, Bleeker's *xanthosoma* is a synonym of *D. reticulatus* described by Richardson in 1846. Bleeker's (1877) review of the pomacentrids of the East Indies included four species: *arcuatum* (= *aruanus*), *melanurus*, *reticulatum*, and *trimaculatum*; these have been considered as valid entities by most subsequent authors, in addition to *D. marginatus* from the Red Sea and *D. albisella* from the Hawaiian Islands. All of these except *marginatus* were included in Allen's (1975) synopsis of western Pacific pomacentrids. In addition, he recognized *D. strasburgi* Klausewitz, a species described relatively recently from the Marquesas Islands. Smith (1960) in his review of the pomacentrid fishes of the western Indian Ocean placed *D. carneus* Fischer in the synonymy of *D. reticulatus*, but the present study indicates that the former species is valid. *D. flavicaudus* n.sp., the final member of the group, is described below from a series of specimens obtained mainly by Dr. J. E. Randall during a cruise to southeast Oceania abord the sailing ship "Westward" during 1970-71.

Records of The Australian Museum, 1977, **Vol. 31, No. 9,** 349-385, Figures 1-11.

In addition to *polyacanthus* and *cyanurus,* five other species have been erroneously described as members of *Dascyllus: xanthurus* Bleeker = *Neopomacentrus violascens* (Bleeker); *fasciatus* Macleay = *Dischistodus fasciatus* (Cuvier); *pomacentroides* Kendall and Goldsborough = *Chromis lepidolepis* Bleeker; *caudofasciatus* Montalban = *Chromis lepidolepis; isharae* Schmidt = *Chromis chrysura* (Bliss). Whitley (1928) described *Tetradrachmum* (a synonym of *Dascyllus*) *nitidum,* but this species is currently recognized as a valid *Chromis.*

The junior author has observed all the members of the genus except *D. strasburgi* in their natural habitat on various diving and collecting trips to Hawaii, Tahiti, Java, Ceylon, Red Sea, and numerous localities in the western Pacific and Australia. This experience has given us an appreciation of the limits of variability, particularly with regards to colour pattern and has aided us in making difficult taxonomic decisions regarding the status of *D. albisella* and *D. strasburgi* which are obviously offshoots of *D. trimaculatus* ancestral stock.

The members of the genus typically form small to large aggregations in rocky or coraliferous areas. Several of the species aggregate around isolated coral heads where they seek shelter at night or when danger threatens during the day. Sale (1971a) and others have described the permanent nature of these aggregations. The diet consists of a variety of planktonic items with copepods frequently composing the dominant food source. Feeding occurs during most of the daylight hours up to several metres off the bottom with the members of the aggregation facing the oncoming current. *D. aruanus* and *D. melanurus* prefer relatively shallow, protected waters such as those found within the lagoons of oceanic atolls or inside coastal fringing reefs. The remaining species are relatively ubiquitous with regards to vertical distribution and also occur in passages leading to the open sea and on the outer reef slope down to at least 55 metres.

The general behaviour of *Dascyllus,* highlighted by a limited territoriality or home range and relatively stereotyped sequence of courtship and spawning activities, and subsequent nest guarding by the male conforms to the typical pomacentrid pattern described by Reese (1964). More detailed data on these subjects are included below under the biology section for each species.

METHODS OF COUNTING AND MEASURING

The methods of counting and measuring are basically the same as those described by Allen (1972), but several terms require further explanation. Snout length is measured from the anterior edge of the upper lip to the nearest point on the orbit; predorsal length is from the snout tip to the base of the the first dorsal spine; preanal and prepelvic lengths are similar measurements connecting the snout tip with the base of the first anal spine and pelvic spine respectively; dorsal and anal fin rays were measured proximally from the base of the spine or soft ray rather than the point at which the element emerges from the scaly sheath; tubed lateral-line scales refer to the continuous series of sensory scales on the upper back originating near the upper edge of the gill opening, this count excludes the scales with simple pits or pores which sometimes appear at the end of the tubed section and also excludes the series of sensory scales (usually 5 to 9 in number) mid-laterally on the caudal peduncle; caudal fin length is measured from the line of flexure at the base of the fin to the distal tip of the longest ray of the upper lobe; caudal concavity is the horizontal distance between the longest and shortest caudal rays. Measurements were made with dial calipers to the nearest one-tenth mm. The length which is given in mm under the material examined sections and elsewhere in the text refers to the standard length.

The counts and proportions which appear in parentheses in the description of *D. flavicaudus* represent the range for the paratypes if differing from the holotype. A summary of counts for the dorsal, anal, and pectoral fin rays, tubed lateral-line scales, and gill rakers on the first arch is presented in Tables 1 and 2.

During the course of our investigations we have examined all *Dascyllus* specimens from the following institutions (abbreviations indicated are used in subsequent text): American Museum of Natural History, New York; Australian Museum, Sydney (AMS); Academy of Natural Sciences, Philadelphia; British Museum (Natural History), London (BMNH); Bernice P. Bishop Museum, Honolulu (BPBM); California Academy of Sciences, San Francisco (CAS); Field Museum of Natural History, Chicago; Museum of Comparative Zoology, Harvard University; Museum National d'Histoire Naturelle, Paris (MNHN); Queensland Museum, Brisbane (QM); Rijksmuseum van Natuurlijke Histoire, Leiden (RMNH); Natur-Museum Senckenberg, Frankfurt (SMF); United States National Museum of Natural History, Washington, D.C. (USNM); Western Australian Museum, Perth (WAM); Zoologisch Museum, Amsterdam. The total number of specimens examined in more detail (counts or proportions taken) is indicated for each species in the material examined section.

TAXONOMY

Dascyllus Cuvier

Dascyllus Cuvier, 1829: 179 (type species, *Chaetodon aruanus* Linnaeus, by monotypy).

Pirene Gistel, 1848: ix (substitute name for *Dascyllus* Cuvier).

Tetradrachmum Cantor, 1850: 1222 (substitute name for *Dascyllus* Cuvier).

Pellochromis Fowler and Bean, 1928: 14 (type species, *Pomacentrus trimaculatus* Rüppell, by original designation).

Semadascyllus Fowler, 1941: 257 (type species, *Dascyllus albisella* Gill, by original designation.)

DIAGNOSIS: A member of the pomacentrid subfamily Chrominae with the following combination of characters: dorsal rays XII,11 to 16; anal rays II,11 to 15; pectoral rays 17 to 21; tubed lateral-line scales 15 to 20; gill rakers on first arch 5 to 8 + 15 to 23; teeth conical, relatively large at front of jaws and tapering in size posteriorly, a patch of small villiform teeth behind larger teeth at front of jaws, outer row teeth usually numbering about 36 to 44 in each jaw; margin of preorbital, suborbital, and preoperculum finely serrate; opercle bones with hind margin smooth to weakly serrate or crenulate; head entirely scaled except lips and isthmus; double nostril openings connected by shallow naked groove on each side of snout, anterior opening round and conspicuous, posterior opening an inconspicuous slit next to orbital rim; spiniform procurrent rays at dorsal and ventral base of caudal fin 2.

Juvenile specimens are excluded in the following proportional data (see size range under diagnosis section for each species). Body relatively orbiculate, deep for the family, the greatest depth 1.4 to 1.7 in the standard length; head relatively short, its length 2.7 to 3.6 in the standard length; snout length 2.9 to 4.4, eye diameter 2.1 to 3.2, interorbital width 2.4 to 3.5, least depth of caudal peduncle 1.6 to 2.1, length of caudal peduncle 2.3 to 4.5, of pectoral fin 0.9 to 1.3, of pelvic fin 0.8 to 1.1, of caudal fin 0.8 to 1.2, caudal concavity 2.0 to 11.1, all in head length. Maximum size ranges from about 50 mm in *D. carneus* and *D. marginatus* to about 100 to 120 mm for *D. trimaculatus*.

REMARKS: Gistel (1848) introduced the name *Pirene* as a substitute for *Dascyllus* thinking that the latter name was preoccupied by *Dascillus* Latreille a genus of *Coleoptera* described in 1796. However, according to the International Code of Zoological Nomenclature (article 56a) "even if the difference between two genus-group names is due to only one letter, these two names are not to be considered homonyms." Moreover, *Pirene* Gistel itself is considered by some authors (see Whitley, 1929) to be preoccupied by *Pyrene* Bolton, a genus of molluscs. It was this logic which prompted Cantor (1849) to introduce another substitute name, *Tetradrachmum,* which has enjoyed relatively widespread use, particularly among certain Australian and Japanese authors.

Fowler and Bean (1928) established the subgenus *Pellochromis* for *D. trimaculatus* and *D. reticulatus* (referred to as *marginatus* by these authors). They based this division on colour pattern, more specifically due to the presence of a dark or dusky ground colour without transverse black bands. Similarly, Fowler (1941) placed *D. albisella* in *Semadascyllus* which he distinguished from *Pellochromis* "chiefly by the greatly elevated first dorsal fin and very long ventrals." We do not consider these characters to be useful ones. Fowler's specimens were juveniles which characteristically have large fins in relation to overall body size. We prefer to avoid subgeneric divisions in this relatively close-knit genus.

KEY TO THE SPECIES OF *DASCYLLUS*

1a. Soft dorsal rays usually 12 (rarely 11 or 13); colour of head and body pale with three black bars 2

1b. Soft dorsal rays 14 to 16; colour not as in 1a 3

2a. Caudal fin pale; soft anal rays usually 12 (rarely 11 or 13) (Indo-W. Pacific) ..... *aruanus* (Linnaeus)

2b. Caudal fin dark on outer half; soft anal rays usually 13 (occasionally 12) (E. Indies, Philippines, Melanesia, Queensland, Caroline Islands) ..... *melanaurus* Bleeker

3a. Gill rakers on lower limb of first gill arch usually 16 to 18; preserved coloration generally brown to blackish, most scales of body with darker marginal band; frequently with strongly contrasted pale spot on upper portion of side or on forehead, especilly in smaller (less than about 50 mm) specimens; no black bar extending from dorsal fin origin to pelvic base; one or more relatively well developed tubed scales mid-laterally on caudal peduncle 4

3b. Gill rakers on lower limb of first gill arch usually 18 to 23; preserved coloration generally pale tan to brown with or without darker scale margins; strongly contrasted pale spot on upper side and forehead absent; black bar frequently extending from dorsal fin origin to pelvic base and second bar sometimes present immediately anterior to caudal peduncle; lateral-line tubes absent on caudal peduncle, instead grooves, pits, or pores present on mid-lateral scales 6

4a Soft dorsal rays usually 16 (occasionally 15); soft anal rays usually 15 (occasionally 14) (Hawaiian Islands) ..... *albisella* Gill

4b. Soft dorsal rays usually 15 (occasionally 14 or 16); soft anal rays usually 14 (rarely 15) 5

5a. Preserved colour generally dark brown to blackish; fins usually dark or if fins pale at least outer 1/3 of spinous dorsal black (Indo-W. Pacific) ..... *trimaculatus* (Ruppell)

5b. Preserved colour generally tan to brown; fins pale to dusky, outer 1/3 of spinous dorsal pale (Marquesas Islands) ..... *strasburgi* Klausewitz

6a. Head and body mostly without dark markings (in preservative) except most scales of side frequently with dusky streak and large black spot covering pectoral base; pectoral rays usually 18 or 19 (Red Sea and Gulf of Oman) *marginatus* (Rüppell)

6b. Head and body frequently with black bar extending from dorsal fin origin to pelvic base and second bar sometimes present immediately anterior to caudal peduncle (these may be faint and difficult to detect in certain preserved specimens); scales of body usually with dusky margin; black spot at pectoral base relatively small and confined to base of uppermost one or two rays; pectoral rays usually 20 or 21 (rarely 19) 7

7a. Small dark-rimmed spots (blue in life) present on head and breast, approximately one spot per scale in these regions; gill rakers on lower limb of first gill arch usually 18 (occasionally 17 or 19, rarely 20) (Indian Ocean and Java Sea near Sunda Straits) ..... *carneus* Fischer

7b. Small dark-rimmed spots on head and breast absent; gill rakers on lower limb of first gill arch usually 19 to 22 (most frequently 20 or 21, rarely 18) 8

8a. Soft anal rays usually 13 (occasionally 14); posterior edge of anal fin pale, maximum size of adults 60-65 mm (E. Indian Ocean and W. Pacific) ..... *reticulatus* (Richardson)

8b. Soft anal rays usually 14 (occasionally 13); anal fin entirely dark; maximum size of adults 90-100 mm (southeastern Oceania) ..... *flavicaudus* n.sp.

SPECIES ACCOUNTS

Dascyllus aruanus (Linnaeus) Fig. 1

Chaetodon aruanus Linnaeus, 1758: 275 (type locality, Indies).

Chaetodon arcuanus Gmelin, 1789: 1250 (revival of name used by Linnaeus before 1758).

Pomacentrus emamo Lesson, 1830: 190 (type locality, Bora Bora, Society Islands).

Tetradrachmum arcuatum Cantor, 1849: 1223 (type locality, Penang).

Dascyllus blochii Castelnau, 1875: 34 (type locality, Queensland).

Pomacentrus trifasciatus De Vis, 1884: 452 (type locality, South Seas).

Pomacentrus devisi Jordan and Seale, 1906: 284 (substitute name for *Pomacentrus trifasciatus* De Vis).

Abudefduf caroli Curtiss, 1938: 117 (type locality, Tahiti).

DIAGNOSIS: (Proportions based on 30 specimens, 43-57 mm). Dorsal rays usually XII,12; anal rays usually II,12; pectoral rays usually 18; tubed lateral-line scales usually 17 or 18; gill rakers on first arch usually 6 or 7 + 16 or 17; greatest depth of body 1.5 to 1.7, head length 2.9 to 3.1, both in standard length; snout length 3.4 to 4.4, eye diameter 2.5 to 3.0, interorbital width 3.0 to 3.5, least depth of caudal peduncle 1.8 to 2.0, length of caudal peduncle 2.3 to 2.8, of pectoral fin 1.0 to 1.1, of pelvic fin 0.9 to 1.0, of caudal fin 0.8 to 1.0, caudal concavity 2.0 to 3.2, all in head length.

Fig. 1. *Dascyllus aruanus,* approximately 50 mm, Palau Islands in 5 metres depth.

Colour in life: live coloration was illustrated by Allen (1975) and consists of the following pattern: ground colour white with three highly contrasted black bars (see Fig. 1 for position of bars); large pale brown spot covering dorsal portion of snout and interorbital; lips dusky or white; dorsal fin largely covered by continuation of black body bars, except base of spines 2-5 and base of last few spines white, soft dorsal fin transparent on posterior edge; caudal fin mainly transparent, sometimes dusky; anal fin mostly covered by continuation of third black body bar except base of anterior portion white and posterior edge transparent; pelvic fins black; pectoral fins transparent.

Colour in alcohol: similar to live coloration except white ground colour sometimes grey to yellowish or with dusky blotches.

RANGE: Widespread in the Indo-W. Pacific from the Red Sea and east African coast as far south as Durban to the central and western Pacific as far north as southern Japan and south to the Sydney area of Australia; the Line Islands, Marquesas, and Tuamotu Archipelago form the eastern limit of distribution.

BIOLOGY: This species inhabits lagoons and coastal reefs, usually in one to 12 metres depth. It commonly forms aggregations of up to 30 fish which shelter among branched madreporarian corals. The favoured habitat is areas of interspersed sand and coral patches. The diet consists largely of zooplankton and feeding occurs in the water column one or two metres above the coral. Hiatt and Strasburg (1960) listed the following dietary items for *D. aruanus:* copepods, larvae of crustaceans, fishes (gobiids), and fish eggs.

Fortunately, this species has been the focus of several ecological and behavioural investigations. Sale (1970; 1971a & b; 1972a & b) has written a series of papers describing the behaviour of this species in relation to its extremely limited home range which is usually centred on a single coral colony. He observed a hierarchal social structure within each group of fish. This structure was elucidated by Fricke and Holzberg (1974) in their study of 80 aggregations of *D. aruanus* in the Gulf of Aquaba, Red Sea. They found that 38% of the fish in these groups lived in heterosexual pairs, 56% in aggregates of three to six, and 6% in groups of more than six fish. Long term observations of several groups containing three to six fish indicated a harem-type social structure containing a single dominant male (70-80 mm total length) and several females (20-70 mm) with linear size dependent rank order. These authors found that the dominant male spawned with the females in order of rank and also attempted to mate females from nearby territories. The home territory is defended against potential egg predators and other *Dascyllus* primarily by the male and largest female. Gonad examination of a colony of 11 fish revealed one large male, eight females, and two hermaphrodites. Fricke and Holzberg suggest that sex reversal probably occurs in this species and could be a mechanism which would allow young immigrating males to be incorporated in the rank system of large groups. They interpret the different social units of *Dascyllus* as ecological adaptations.

The reproductive behaviour of *D. aruanus* has been described by Chlupaty (1957), Fishelson (1964), and Sale (1970). The male selects a nest site usually near the base of the coral colony and removes some of the algal growth and detritus. Throughout the period of nest preparation, which may last one day or more, the male spends a great deal of time chasing other fishes away from the site and also initiates a characteristic courtship "dance", which consist of a series of rapid up and down swimming movements performed about one metre above the nest. Gravid females are attracted to the display and subsequently are escorted to the nest site where spawning ensues. A single male may spawn with several females, with each depositing up to 1500-2000 elliptical eggs, 0.7-0.8 mm in length.

The male aggressively guards the nest during incubation and actively fans the eggs with the pectoral fins and also "cleans" the site orally. Hatching occurs at 24°-25°C in 44-51 hours. The fry are approximately 2 mm total length at hatching and are presumed to be pelagic for an undetermined period. The smallest individuals residing on coral reefs are about 8 mm total length. Catala (1971) reported several individuals of *D. aruanus* which had been living in the Noumea Aquarium for six years. The same fish were observed three years later by the junior author, indicating a longevity of at least nine years in captivity.

MATERIAL EXAMINED: We have examined more than 400 specimens, 10-65 mm, from the following localities: Red Sea; Kenya; Zanzibar; Amirante Islands; Farquhar Islands; Aldabra Atoll, Madagascar, Mauritius, St. Brandon's Shoals (Cargados Carajos), Maldive Islands, Nicobar Islands, Mentawei Islands (Sumatra), Java, Okinawa, Philippine Islands, Australia, Lord Howe Island, Caroline Islands, Mariana Islands, Marshall Islands, New Guinea, Solomon Islands, New Hebrides, Gilbert Islands, Fiji Islands, Samoa Islands, Tokelau Islands, Phoenix Islands, Line Islands, Society Islands, Tuamotu Islands, Marquesas Islands and Rapa Island. These localities have been reported by previous authors, most of them by either de Beaufort (1940), Smith (1960) or Allen (1975). Smith, however, in reporting the species from the western Indian Ocean did not mention specific localities, merely stating it occurred over the entire region.

We have not examined the type of *aruanus* (presumably deposited at Naturhistoriska Riksmuseet, Stockholm), but there is no doubt about the identity of this species as the description was based on the specimen which was illustrated by Linnaeus (1754). We have examined a copy of this important "pre-Linnaean" work and find the illustration (plate 33, figure 8) of *Chaetodon arcuatus* to be clearly diagnostic.

Castelnau (1875) gave a brief diagnosis of *D. aruanus*. He mentioned that a young Queensland specimen had a rounded instead of bifid tail, suggesting that the shape might be correlated with age. He gave this form the name *blochii* in the event that it might prove to be distinct. The type specimen is apparently no longer in existence (we have checked the MNHN collection), but it is obvious this species should be placed in the synonymy of *D. aruanus*. It seems likely that the caudal fin of Castlenau's specimen was damaged.

The type of *Pomacentrus trifasciatus* De Vis (1884) is apparently missing. It is not among other De Vis types presently lodged at the Queensland Museum. However, the brief colour description and dorsal ray count indicate that this species is a synonym of *D. aruanus*. Somewhat confusing is the soft anal ray count which was given as four, far lower than any known species in the family. We suspect this figure respresent either an error or was based on an aberrant or damaged specimen.

We follow Fowler (1949) in placing *Abudefduf caroli* Curtiss in the synonymy of *D. aruanus*. According to him, the work (Curtiss, 1938) in which the description appears was privately printed in a limited edition and "reveals the efforts of an untrained novice." Apparently no type specimens were designated.

Dascyllus melanurus Bleeker Fig. 2

Dascyllus melanurus Bleeker, 1854: 100 (type locality, Neira, Banda).

Pomacentrus onyx De Vis, 1844: 451 (type locality, South Seas).

DIAGNOSIS: (Proportions based on 18 specimens, 35-61 mm). Dorsal rays usually XII,12; anal rays usually II,13; pectoral rays usually 18; tubed lateral-line scales usually 16

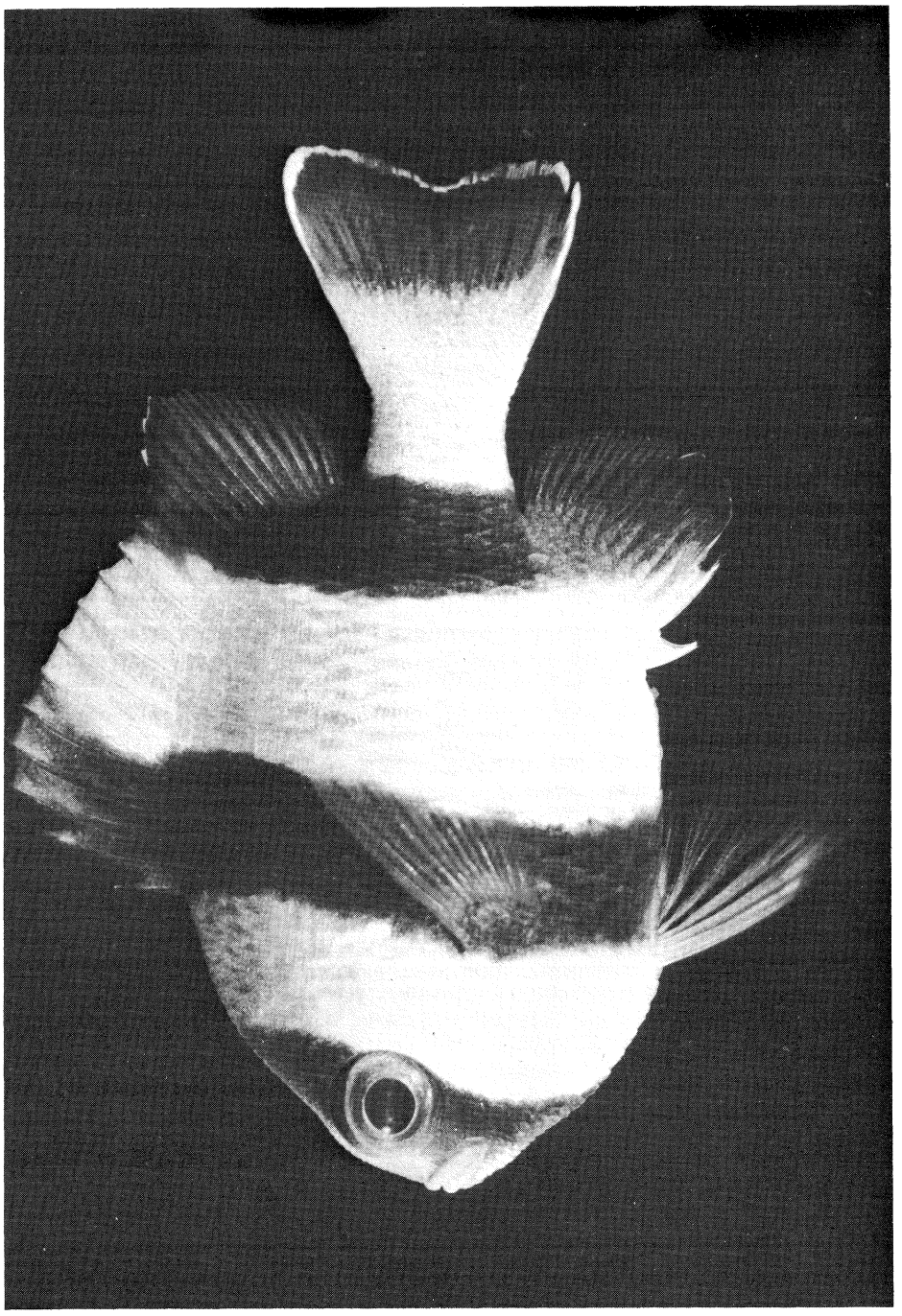

Fig. 2. *Dascyllus melanurus*, 37 mm, Philippine Islands (J. Randall photo).

or 17; gill rakers on first arch usually 6 or 7 + 17 to 19; greatest depth of body 1.5 to 1.7, head length 2.7 to 3.1, both in standard length; snout length 3.4 to 4.3, eye diameter 2.3 to 3.2, interorbital width 2.7 to 3.3, least depth of caudal peduncle 1.8 to 2.1, length of caudal peduncle 2.3 to 2.7, of pectoral fin 1.0 to 1.2, of pelvic fin 0.8 to 1.1., of caudal fin 1.0 to 1.2, caudal concavity 3.5 to 6.0, all in head length.

Colour in life: live coloration was illustrated by Allen (1975) and consists of the following pattern: ground colour white with three highly contrasted black bars (see Fig. 2 for position of bars); dorsal fin largely covered by continuation of black body bars, except middle portion white and posterior edge of soft dorsal transparent; caudal fin mostly black except basal ⅓ white; anal fin mostly covered by continuation of third black body bar except base of anterior portion white and posterior edge transparent; pelvic fins black; pectoral fins transparent.

Colour in alcohol: similar to live colouration except white ground colour sometimes grey to yellowish or with dusky blotches.

RANGE: The distribution includes the islands of Indonesia from Sumatra to West Irian, Philippine Islands, New Guinea, northern Great Barrier Reef of Australia, New Britain, Solomon Islands, New Hebrides, New Caledonia, Palau Islands, Yap Islands and Ponape. Regan (1908) also reported the species from Felidu, Maldive Islands. This is the only record west of the Indonesian Archipelago. Apparently it is rare in the Maldives; large collections from there made by Loren P. Woods and Wolfgang Klausewitz failed to obtain further specimens.

BIOLOGY: This species inhabits sheltered lagoons, harbours, and coastal inlets, usually in one to 10 metres depth. It commonly occurs in aggregations containing 20-30 fish which are associated with isolated coral heads. The diet consists of a variety of planktonic items including larval shrimps, crabs, ostracods, amphipods, pelagic tunicates, copepods, and fish eggs. Some algae is also taken.

Nothing is known about the life history, but the general behaviour of this species is similar to the closely related *D. aruanus*.

MATERIAL EXAMINED: We have examined 115 specimens, 18-61 mm, from the following localities: Indonesia, Philippine Islands, New Guinea, Solomon Islands, New Hebrides, and Palau Islands. The New Hebrides specimen (WAM P25577-001) represents a new locality record.

In addition, we have examined the two remaining syntypes (of eight reported by Bleeker) of *D. melanurus* (RMNH 6452, approximately 41 and 45 mm; bad condition with missing caudal fins and heads detached) and also the lectotype of *Pomacentrus onyx* (QM I.11/99, 34 mm). The latter species was redescribed by Whitley (1929) who concluded it was a synonym of *D. melanurus*.

Dascyllus albisella Gill Fig. 3

Dascyllus albisella Gill, 1862: 149 (type locality, Hawaiian Islands).

Dascyllus edmondsoni Pietschmann, 1934: 100 (type locality, Oahu, Hawaiian Islands).

DIAGNOSIS: (Proportions based on 20 specimens, 58-87 mm). Dorsal rays usually XII, 15 or 16, anal rays usually II, 14 or 15; pectoral rays usually 20; tubed lateral-line scales usually 19; gill rakers on first arch usually 6 or 7 + 16 to 18; greatest depth of body 1.4 to 1.6, head length 3.1 to 3.2, both in standard length; snout length 3.2 to 3.7, eye diameter 2.3 to 2.7, interorbital width 2.8 to 3.1, least depth of caudal peduncle 1.7 to 1.9, length of

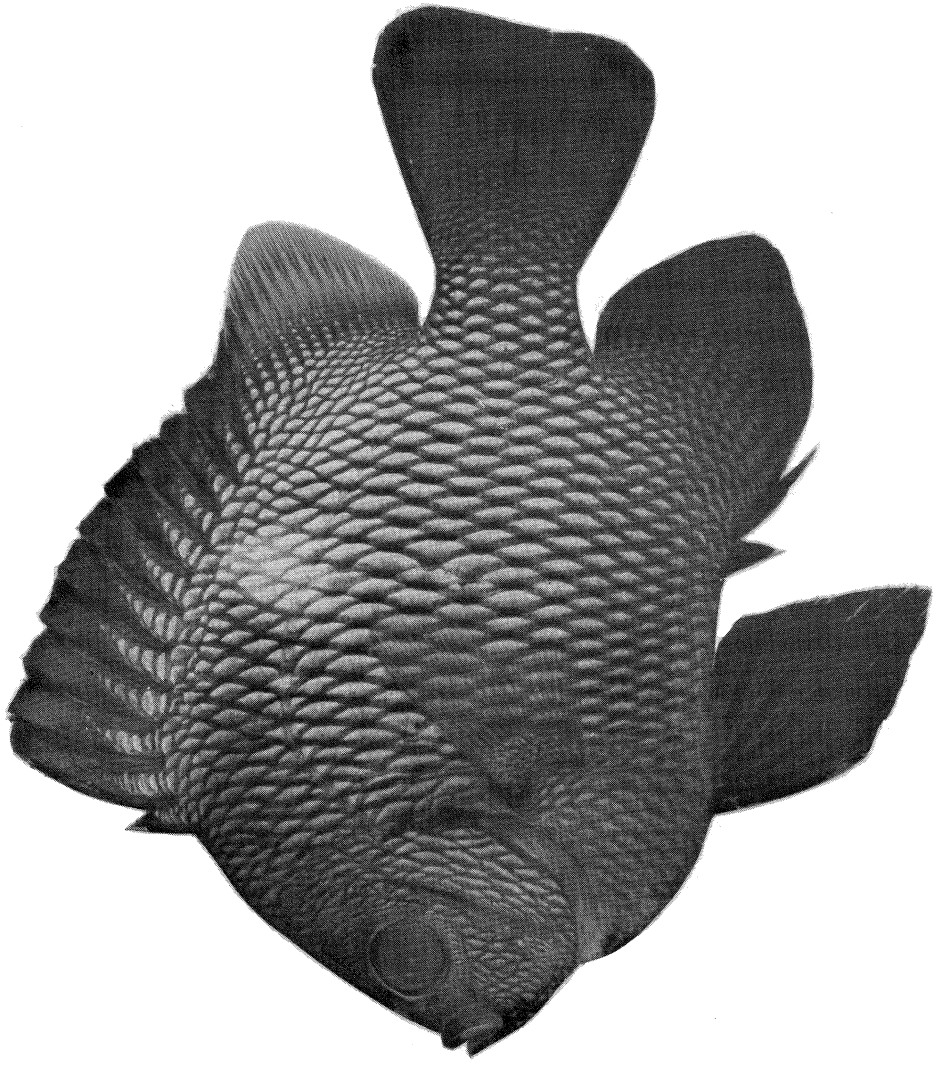

Fig. 3. *Dascyllus albisella*, 79 mm, Hawaiian Islands (J. Randall photo).

caudal peduncle 3.2 to 3.7, of pectoral fin 0.9 to 1.0, of pelvic fin 0.8 to 0.9 of caudal fin 0.9 to 1.1, caudal concavity 6.0 to 8.7, all in head length.

Colour in life: general coloration is similar to *D. trimaculatus* (see Chute, 1936). Juveniles are black with a large white spot on the middle of the upper back; an additional white spot is present on the forehead. These markings become less distinct with increased growth, the forehead spot generally disappearing in subadults. The adult pattern was illustrated by Allen (1975) and consists of a brownish head, ground colour of body whitish or grey and scales with blackish margins. The pectorals and outer half of the soft dorsal are primarily transparent; remainder of fins dark brown or black. In addition, there is usually a trace of the white spot on the upper sides, occupying about 7-9 scales mainly above the 10th-14th tubed lateral-line scales.

Variation in colour influenced by behaviour and ecology was discussed by Stevenson (1963a). He described the normal coloration as being dark (blackish), but turning paler in sandy environments or during feeding and nuptial activities.

Colour in alcohol: similar to that described below for *D. trimaculatus* except the light centres and dark margins of the body scales are generally more strongly contrasted in *albisella*.

RANGE: Known from the Hawaiian Islands and Johnston Island, which lies approximately 1,000 km south of the Hawaiian chain.

BIOLOGY: This species is relatively common in rocky areas to a depth of at least 46 metres. Juveniles are usually associated with small heads of *Pocillopora* coral or occasionally with the sand dwelling anemone, *Marcanthia cookei* (see Stevenson, 1963b).

The life history was studied by Stevenson (1963a). He noted that adults were often found near *Porites* coral and formed feeding aggregations of up to several hundred individuals. The fish feed 3-6 metres off the bottom, preferring planktonic items such as copepods, polychaetes, "larvaceans," and miscellaneous crustacea. Spawning occurs throughout the year with a peak of reproductive activity during June. Courtship and nesting habits are similar to *D. aruanus* and *D. carneus*. An average of 25,000 eggs are spawned by each female. These are very small, measuring .85 x .4 mm. The nest is guarded intensively by the male during the four day incubation period. Intruders are chased away from the site and this aggressive behaviour is often accompanied by loud grunting noises. At hatching the fry are 2.5 mm total length and are presumed to be pelagic for several weeks. The average size of colonising post-pelagic juveniles is about 15 mm total length. Stevenson found that young fish grew at a rate of about 5.1 mm per month and estimated that it takes one year to reach sexual maturity.

MATERIAL EXAMINED: We have examined 37 specimens, 18-97 mm, from Oahu and Hawaii, Hawaiian Islands. In addition, we have studied the three syntypes of *D. albisella*, 22-35 mm, which are deposited at USNM (register number 6274). Although we have not examined the type specimen, the detailed description of *D. edmondsoni* by Pietschmann (1934) clearly indicates it is a junior synonym of *D. albisella*.

Dascyllus trimaculatus (Rüppell) Figs 5 and 6

Pomacentrus timaculatus Rüppell, 1828: 39 (type locality, Massaua, Red Sea).

Pomacentrus nuchalis Bennett, 1830: 688 (type locality, Sumatra).

Dascyllus unicolor Bennett, 1831: 127 (type locality, Mauritius).

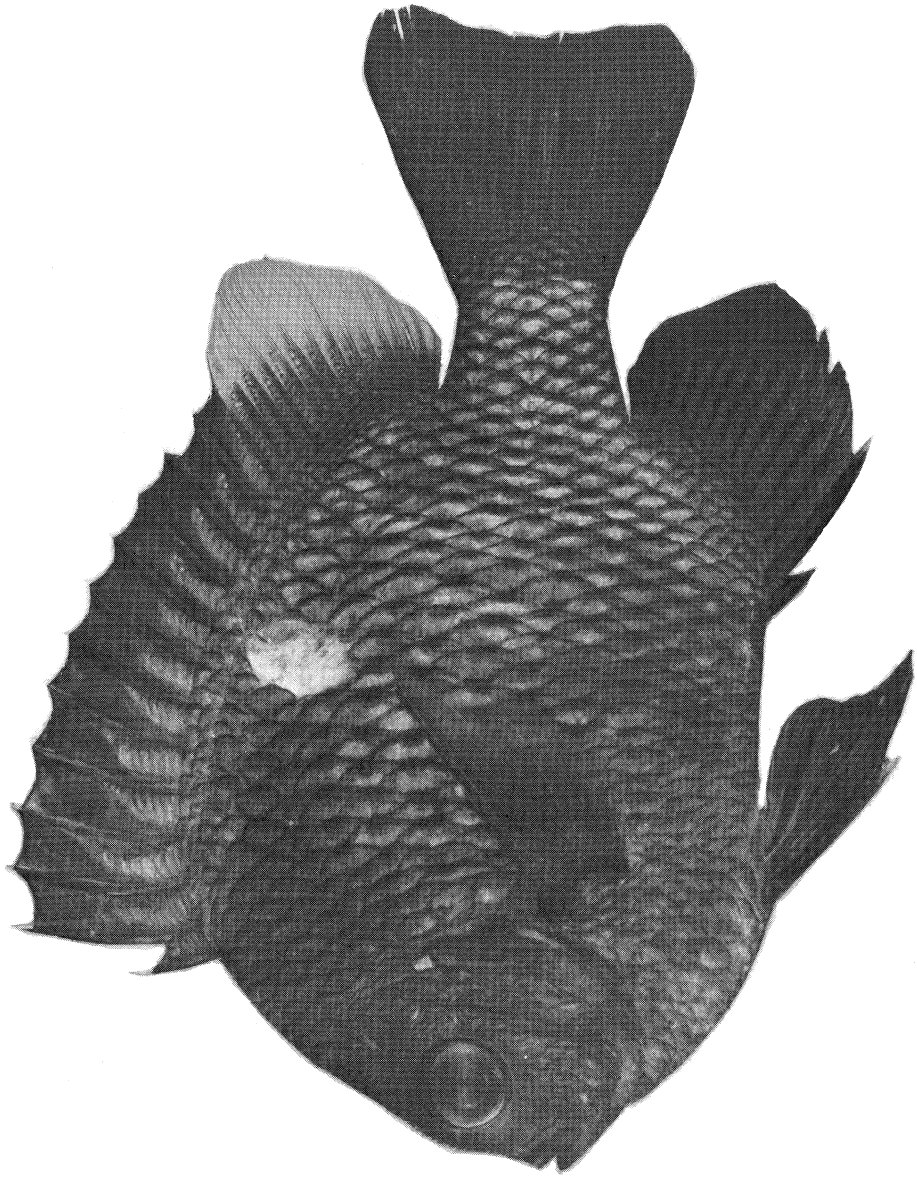

Fig. 4. *Dascyllus trimaculatus*, "normal" variety, 105 mm, Tahiti (J. Randall photo).

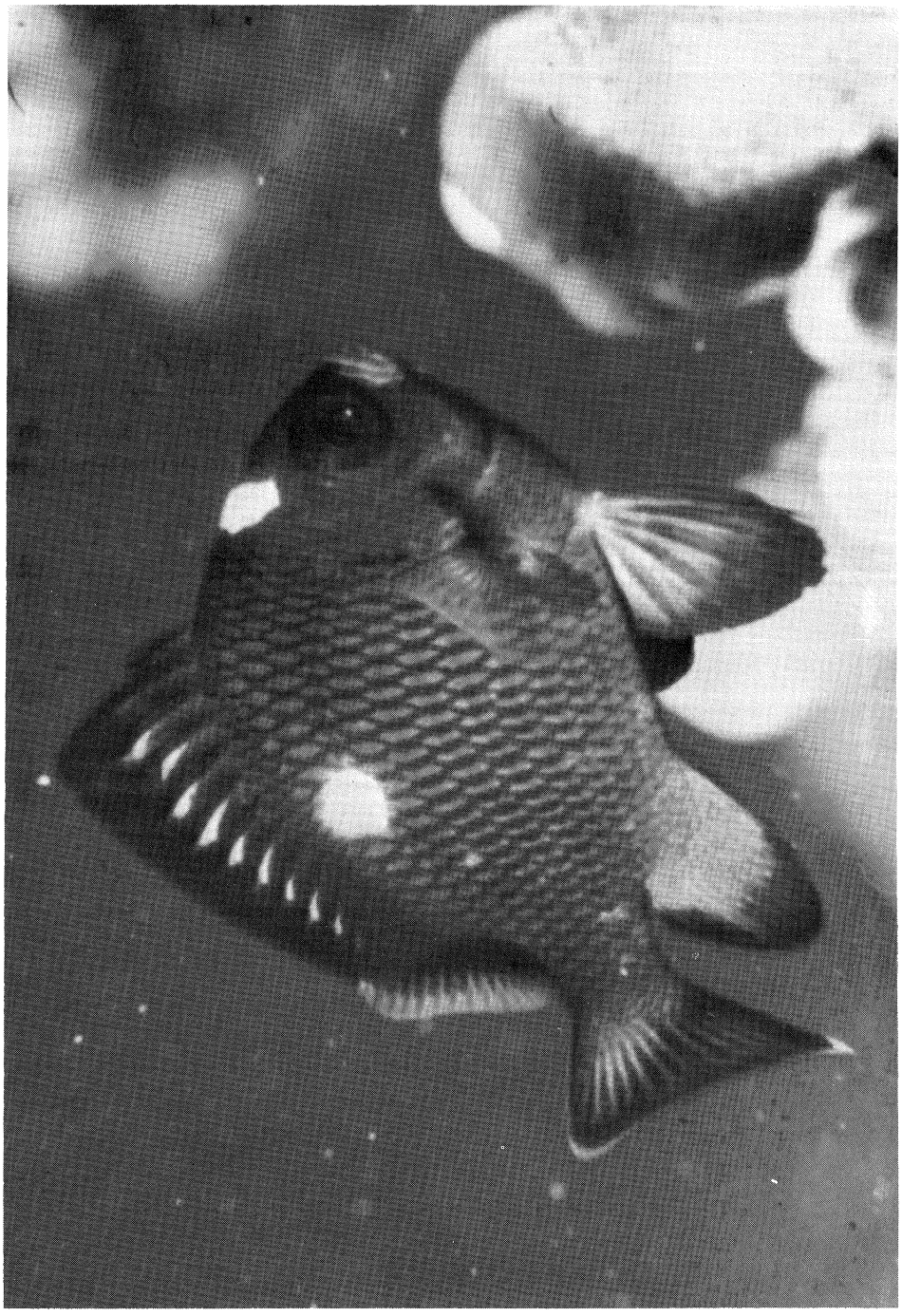

Fig. 5. *Dascyllus trimaculatus*, "intermediate" variety, approximately 60 mm, Fiji Islands in 6 metres depth.

Dascyllus niger Bleeker, 1847: 10 (type locality, Java).

Dascyllus axillaris Smith, 1936: 205 (type locality, South Africa).

DIAGNOSIS: (Proportions based on 30 specimens, 54-100 mm). Dorsal rays usually XII, 15; anal rays usually II, 14; pectoral rays usually 19 or 20; tubed lateral line scales usually 18 or 19; gill rakers on first arch usually 6 or 7 + 17 or 18; greatest depth of body 1.4 to 1.6, head length 3.1 to 3.6, both in standard length; snout length 2.9 to 3.7, eye diameter 2.3 to 3.1, interorbital width 2.5 to 3.0, least depth of caudal peduncle 1.6 to 1.8, length of caudal peduncle 2.4 to 3.1, of pectoral fin 0.9 to 1.1, of pelvic fin 0.8 to 1.0, of caudal fin 0.9 to 1.1, caudal concavity 5.3 to 11.1, all in head length.

Colour in life: juveniles and adults were illustrated by Allen (1972 and 1975). The young are overall black with lighter (bluish) scale centres; prominent white blotch present on forehead and upper sides (bisected by about 10-13th tubed lateral-line scales); all fins black except pectorals and outer half of soft dorsal transparent. Adults are variable in colour according to behavioural "mood" and ecological conditions, but generally lack the forehead spot and have the spot on the upper sides very much reduced, covering only about 1 or 2 scales above the 10th-13th lateral-line scale; in juveniles this spot covers as many as 10-15 scales and extends below the lateral-line. The detailed structure of this spot was described by Amemiya and Hiyama (1941). The head and fins are normally black (sometimes suffused with reddish-brown) and the scales of the body possess black margins; centre of body scales range from dark grey to pale bluish grey. Lighter colours are generally exhibited by fish which are feeding or by males in courtship. As in juveniles all fins are usually black except the transparent pectorals and outer portion of the soft dorsal. However, a peculiar variation exists in some areas which has the pelvic, anal, and caudal fins orange and also this colour may extend on to the abdomen, breast, and lower portion of the head. In addition, there is a row of elongate orange "windows" which occupy the middle portion of the spinous dorsal fin.

Observations by the junior author indicate that the orange-finned variety is correlated with an environment characterised by relatively turbid water and heavy silting. Allen (1975) illustrated a subadult which was intermediate between normal *trimaculatus* and the orange-finned variety. It was photographed (see Fig. 6) off Suva, Fiji Islands in an area of mild turbidity and silting. We have examined the orange-finned variety from the Line, Gilbert, and Fiji Islands.

Colour in alcohol: generally dark brown with scale centres tan to lighter brown; white blotch present on forehead and upper sides of juveniles and subadults; adults without forehead spot and frequently without blotch on back; fins blackish, except pectorals pale and outer half of soft dorsal fin frequently pale; small black spot present at base of upper pectoral rays.

RANGE: Widespread in the Indo-W. Pacific from the Red Sea and east African coast as far south as Durban to the central and western Pacific as far north as southern Japan and south to the Sydney area of Australia; the Line Islands, Tuamotu Archipelago, and Pitcairn Group form the eastern limit of distribution. It is replaced by the closely related *D. albisella* in the Hawaiian Islands and *D. strasburgi* in the Marquesas Islands.

BIOLOGY: This species inhabits lagoons, passes, and outer reef environments at depths ranging from about one to at least 55 metres. It occurs in small to relatively large (over 50 individuals) aggregations in either rocky or coraliferous areas. They spend much of the time feeding on plankton well above the bottom. Allen (1975) examined the stomach contents of several specimens from the Palau Islands and found they contained about 40% algae and 60% copepods and other planktonic crustaceans.

The reproductive behaviour of this species has been studied by Garnaud (1957), Koenig (1958) and Allen (1975). Courtship is characterised by male "signal-jumping" similar to that described above for *D. aruanus*. Eggs are laid on dead coral branches, bare rock, or even man-made substrata such as abandoned cables or shipwrecks. Garnaud reported thrice monthly spawnings in a captive pair of *D. trimaculatus* with a total of 17 over a seven-month period. The number of eggs per spawning was estimated at 20,000-25,000. The male aggressively guards the nest and cares for the eggs during the incubation period which lasts about three days at temperatures ranging between 26°-28°C, or four days at 24°C. The newly hatched fry are slightly under 2 mm total length, but are nearly double this figure after one week. They are presumed to lead a pelagic existence for the first few weeks.

The juveniles of *D. trimaculatus* are usually associated with either branching corals or relatively large sea anemones of the same type which harbour *Amphiprion* and *Premmas* (Mariscal, 1966; Schlichter, 1968 and 1969; Probst, 1969). As many as 60 individuals have been found with a single large anemone (Allen, 1972). Young *Dascyllus* generally remain further away from the anemone than *Amphiprion,* making only infrequent contacts with the tentacles. However, when pursued by a diver they plunge headlong into the tentacles and remain hidden there until the danger has passed. Adult *D. trimaculatus* usually do not associate with anemones, but nevertheless may remain in the immediate vicinity.

MATERIAL EXAMINED: We have examined more than 200 specimens, 19-110 mm, from the following localities: Red Sea, Somali, Kenya, Seychelles, Aldabra Atoll, Comoro Islands, Madagascar, St. Brandon's Shoals (Cargados Carajos), Maldive Islands, Sri Lanka, Thailand, Indonesia, Philippine Islands, Australia, Lord Howe Island, Caroline Islands, Marshall Islands, New Guinea, Solomon Islands, New Hebrides, New Caledonia, Gilbert Islands, Fiji Islands, Line Islands, Society Islands, Tuamotu Archipelago and Pitcairn Group. These localities have been reported by previous authors, most of them by either de Beaufort (1940), Smith (1960) or Allen (1975). In addition, we have examined the type specimens of *trimaculatus* (SMF 1445, 82 mm), *nuchalis* (BMNH 1861.6.4.3, 41 mm), and *unicolour* (BMNH 1855.12.26.474, 81 mm).

The junior author was unable to locate Bleeker's type of *D. niger* during a visit to RMNH in 1975. However, the original description provides enough detail to allow us to confidently place this species in the synonymy of *D. trimaculatus*. Moreover, Bleeker himself included *niger* as a junior synonym of this species in his 1877 review of the East Indian Pomacentridae.

We have not seen the type specimen of *D. axillaris,* a specimen approximately 90 mm TL which is deposited at the J. L. B. Smith Institute of Ichthyology, Grahamstown, South Africa. However, we agree with Smith, the original author of this species, who later (1960) placed it in the synonymy of *D. trimaculatus*.

Dascyllus strasburgi Klausewitz Fig. 6

Dascyllus strasburgi Klausewitz, 1960: 45 (type locality, Marquesas Islands).

DIAGNOSIS: (Proportions based on 15 specimens, 42-82 mm). Dorsal rays usually XII,14 to 15; anal rays usually II,14; pectoral rays 20 or 21; tubed lateral-line scales usually 19; gill rakers on first arch usually 6 or 7 + 15 to 17; greatest depth of body 1.6, head length 3.1 to 3.4, both in standard length; snout length 3.2 to 4.2, eye diameter 2.5 to 2.9, interorbital width 2.7 to 3.1, least depth of caudal peduncle 1.6 to 1.9, length of caudal peduncle 2.3 to 3.0, of pectoral fin 0.9 to 1.1, of pelvic fin 0.8 to 1.0, of caudal fin 0.9 to 1.1, caudal concavity 6.7 to 7.3, all in head length.

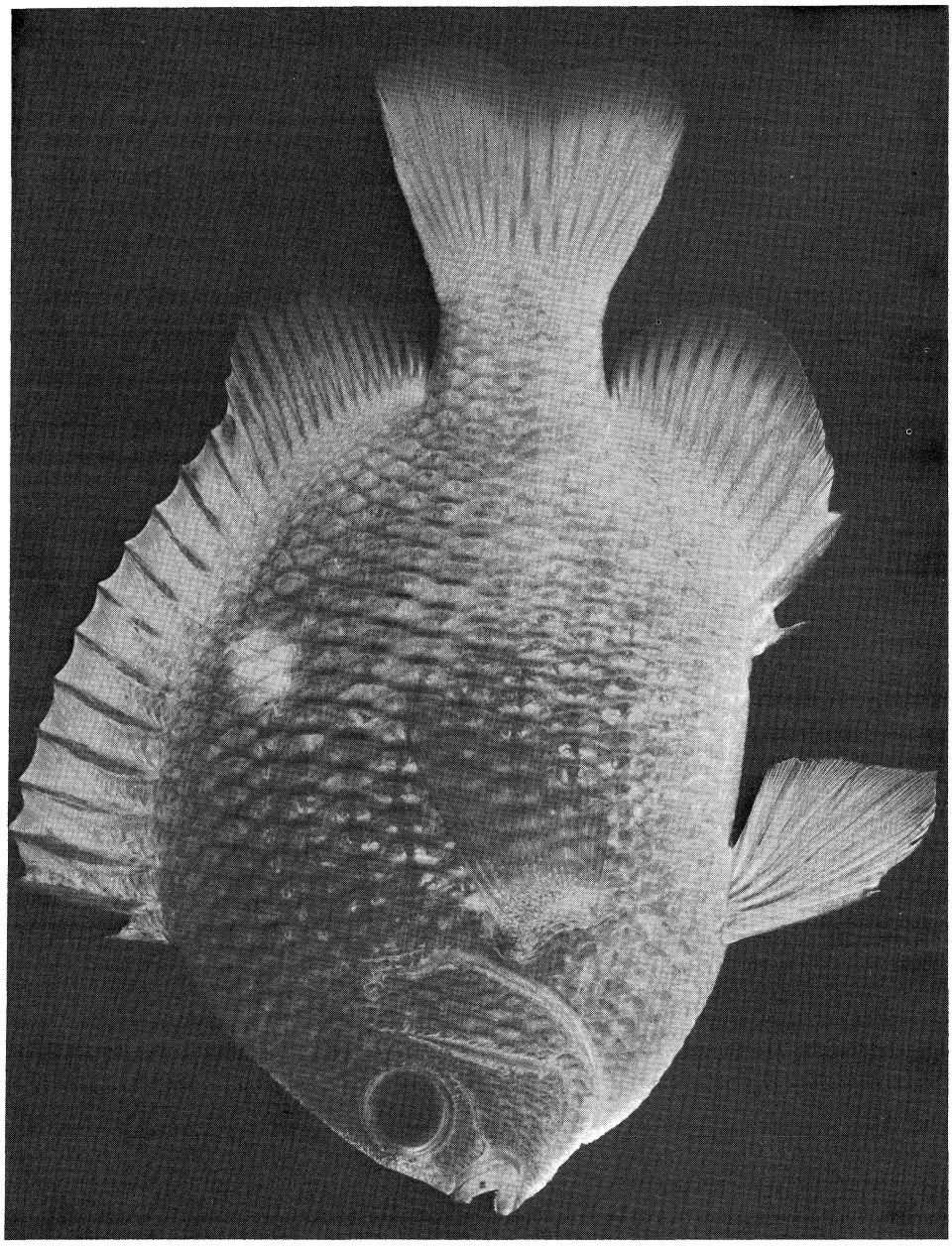

Fig. 6. *Dascyllus strasburgi*, 80 mm, Marquesas Islands (J. Randall photo).

Colour in life: coloration of a fresh specimen was illustrated by Allen (1975). The same individual appears in Fig. 6. The fresh coloration was as follows: head and anterior body dusky grey (slightly greenish), grading to a dirty bluish-white on posterior part of body; opercular membrane and lips light blue; scales of body with dark grey margin and dark grey streak across centre; white spot about size of eye above 11-12th lateral-line scales; fins bluish-white except pectorals transparent; base of pectoral fin bluish-white with small black spot at base of uppermost rays.

Colour in alcohol: head and anterior portion of body brown grading to yellowish posteriorly, lips and opercular membrane pale; scales with brownish margins more noticeable on anterior half of body; remnant of white spot barely distinguishable above 11-12th lateral-line scales; fins yellowish with very narrow dark margin on dorsal and anal; pectorals with small dark brown spot at base of uppermost rays, axil of fin pale.

RANGE: Known only from the Marquesas Islands where it apparently replaces the closely related *D. trimaculatus*.

BIOLOGY: There is no published information on the biology of this species. The behaviour and reproductive habits are probably similar to *D. trimaculatus*. J. Randall (personal communication) collected specimens from rocky areas in five to 12 metres depth during a visit to the Marquesas Islands in 1971.

REMARKS: It is difficult to assess the taxonomic status of *D. strasburgi*. The species is closely allied to *D. trimaculatus* differing primarily in colour pattern; there is also a slight modal difference in the pectoral ray count (see Table 1). It is indeed tempting to consider *strasburgi* as merely a subspecies of *trimaculatus*. However, on the basis of the geographic isolation of the Marquesan population, coupled with the significant colour pattern difference it is our opinion that full specific status is warranted. In spite of the wide distribution of *D. trimaculatus* there is virtually no geographic variation in colour pattern (variation due to ecological conditions may occur at a given locality).

MATERIAL EXAMINED: We have examined 53 specimens, 32-83 mm, including the holotype (USNM 190596, 69 mm) and two paratypes (SMF 5111-12, 57 and 82 mm); all specimens from the Marquesas Islands.

Dascyllus marginatus (Rüppell) Fig. 7

Pomacentrus marginatus Rüppell, 1828: 38 (type locality Red Sea).

DIAGNOSIS: (Proportions based on 21 specimens, 28-43 mm). Dorsal rays XII,14 or 15; anal rays usually II,13; pectoral rays usually 18 or 19; tubed lateral-line scales usually 17 or 18; gill rakers on first arch usually 7 or 8 + 20 to 23; greatest depth of body 1.4 to 1.5, head length 2.9 to 3.1, both in standard length; snout length 3.6 to 4.1, eye diameter 2.3 to 2.8, interorbital width 2.7 to 3.1, least depth of caudal peduncle 1.7 to 2.0, length of caudal peduncle 3.0 to 4.5, of pectoral fin 1.1 to 1.3, of pelvic fin 0.8 to 1.0, of caudal fin 0.9 to 1.2, caudal concavity 3.6 to 5.5, all in head length.

Colour in life (from a 35 mm Ektachrome transparency taken by the junior author at Eilat, Red Sea in 12 metres depth): ground colour of head and body white, slightly yellowish on upper half; most of body scales with bluish margin, most conspicuous on upper half of body; spinous dorsal fin white with broad black outer margin, tapering in width posteriorly and ending at tip of anterior soft rays; soft dorsal and caudal fins transparent, but slightly bluish; anal fin similar to dorsal with prominent black margin covering spinous portion and outer part of first 5 or 6 soft rays; pelvic fins mostly black, except two innermost rays white; pectoral fins transparent with large black spot covering basal portion and axil.

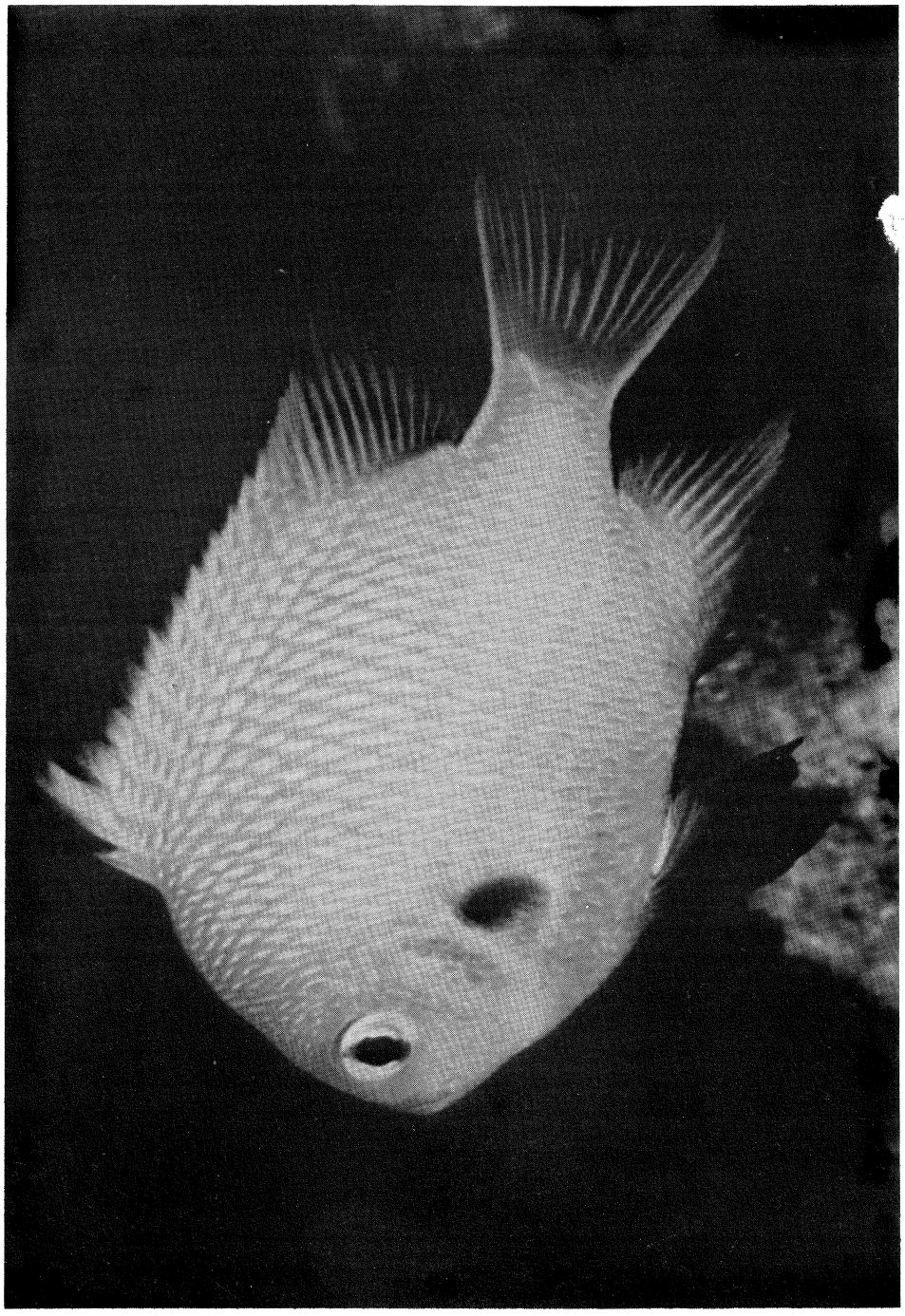

Fig. 7. *Dascyllus marginatus*, approximately 40 mm, Elat, Red Sea in 12 metres depth.

Colour in alcohol: similar to live coloration except ground colour yellow or tan and scale margins dusky.

RANGE: Known in the Red Sea, as far south as Melita Bay, Ethiopia (approximately 15°15'N; 39°49'E) and northward to the Gulfs of Suez and Aqaba; also recently collected by the junior author in the Gulf of Oman, north-western Indian Ocean.

BIOLOGY: Klausewitz (1958) and Fishelson *et al.* (1974) described the habitat and behaviour of *D. marginatus* in the Gulf of Aqaba. Essentially the species is found in association with the branching corals *Stylophora pistillata, S. wehlsi,* and species of *Acropora* and *Porites* in depths ranging to at least 15 metres. Groups of 10-20 individuals inhabit isolated coral heads and the social structure and general behaviour is similar to that of *D. aruanus*. Tortonese (1968) noted this species was the most common *Dascyllus* present at Eilat, Gulf of Aqaba.

REMARKS: *D. marginatus* is most closely allied to *D. carneus* from the Indian Ocean. These species represent the smallest members of the genus, rarely exceeding 50 mm SL. Although very similar in shape they differ significantly in colour pattern and counts for the pectoral rays and gill rakers (see Tables 1 and 2).

Marshall (1952) divided *D. marginatus* into two subspecies, *D. marginatus marginatus* from the Red Sea and *D. marginatus reticulatus* from the Indo-West Pacific. However, we find that the latter grouping is distinct from *marginatus* and actually consists of two species, *D. carneus* and *D. reticulatus*. Marshall suggested that specimens from the Gulf of Aden might be intermediate between *marginatus* and *reticulatus,* but according to his illustration these appear to be conspecific with Red Sea *marginatus*. However, there is a slight difference in the coloration of the dorsal and anal fins. In specimens from the Gulf of Aden the dorsal has a slightly wider black margin and the anal is entirely black except the posterior edge has a narrow pale border. Specimens from the Red Sea have a dark area on the anal fin which is restricted to the spinous portion and outer part of the anterior five or six soft rays. Colour variation of this magnitude which is correlated with geography is not uncommon in pomacentrids (see Allen, 1975).

MATERIAL EXAMINED: We have examined 103 specimens, 12-47 mm, from the Gulf of Aqaba and Melita Bay (Ethiopia). In addition, Rüppell's type, 29 mm, and six paratypes, 27-29 mm, were studied at SMF (register number 1498).

Dascyllus carneus Fischer Figs. 8 and 9

Dascyllus carneus Fischer, 1885: 71 (type locality, Mozambique).

Dascyllus nigripinnis Regan, 1908: 228 (type locality, Maldive Islands).

DIAGNOSIS: (Proportions based on 19 specimens, 30-45 mm). Dorsal rays usually XII,15; anal rays usually II,13; pectoral rays usually 20 or 21; tubed lateral-line scales usually 17 or 18; gill rakers on first arch usually 7 + 17 to 19; greatest depth of body 1.5 to 1.6, head length 3.0 to 3.4, both in standard length; snout length 3.4 to 4.0, eye diameter 2.1 to 2.4, interorbital width 2.9 to 3.4, least depth of caudal peduncle 1.7 to 2.0, length of caudal peduncle 2.5 to 3.2, of pectoral fin 1.0 to 1.2, of pelvic fin 0.8 to 1.0, of caudal fin 0.9 to 1.0, caudal concavity 2.9 to 3.9, all in head length.

Colour in life: there are two colour phases which appear to be correlated with geography. Individuals from the western Indian Ocean have the following coloration (from Burgess and Axelrod, 1973): ground colour of head and body pale yellow, most of head and breast scales with one or more small blue dots, those on forehead and nape

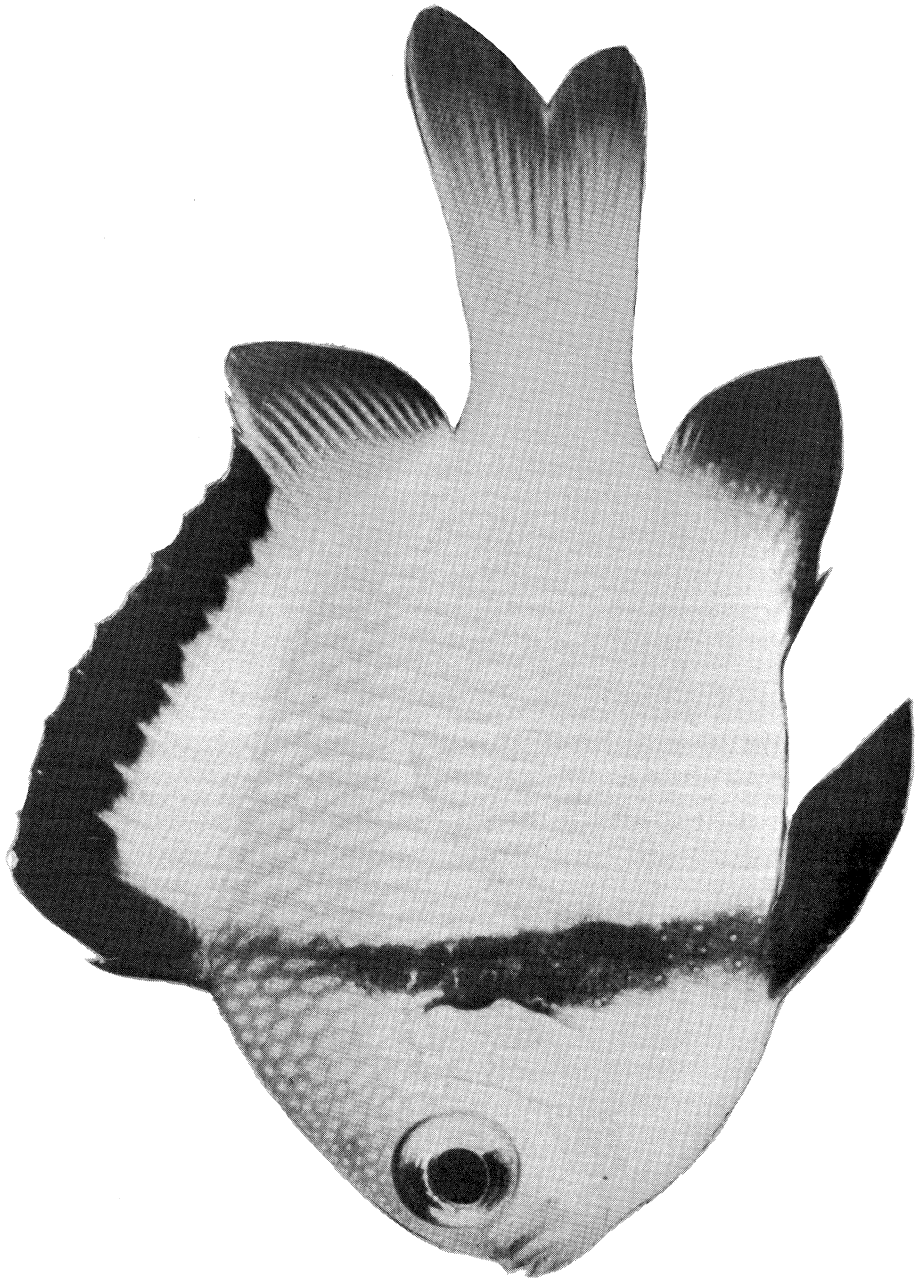

Fig. 8. *Dascyllus carneus*. 34 mm, Seribu Islands, Java Sea (Note — The outer edge of the soft dorsal and caudal fins are transparent, but the specimen was originally photographed on a dark background).

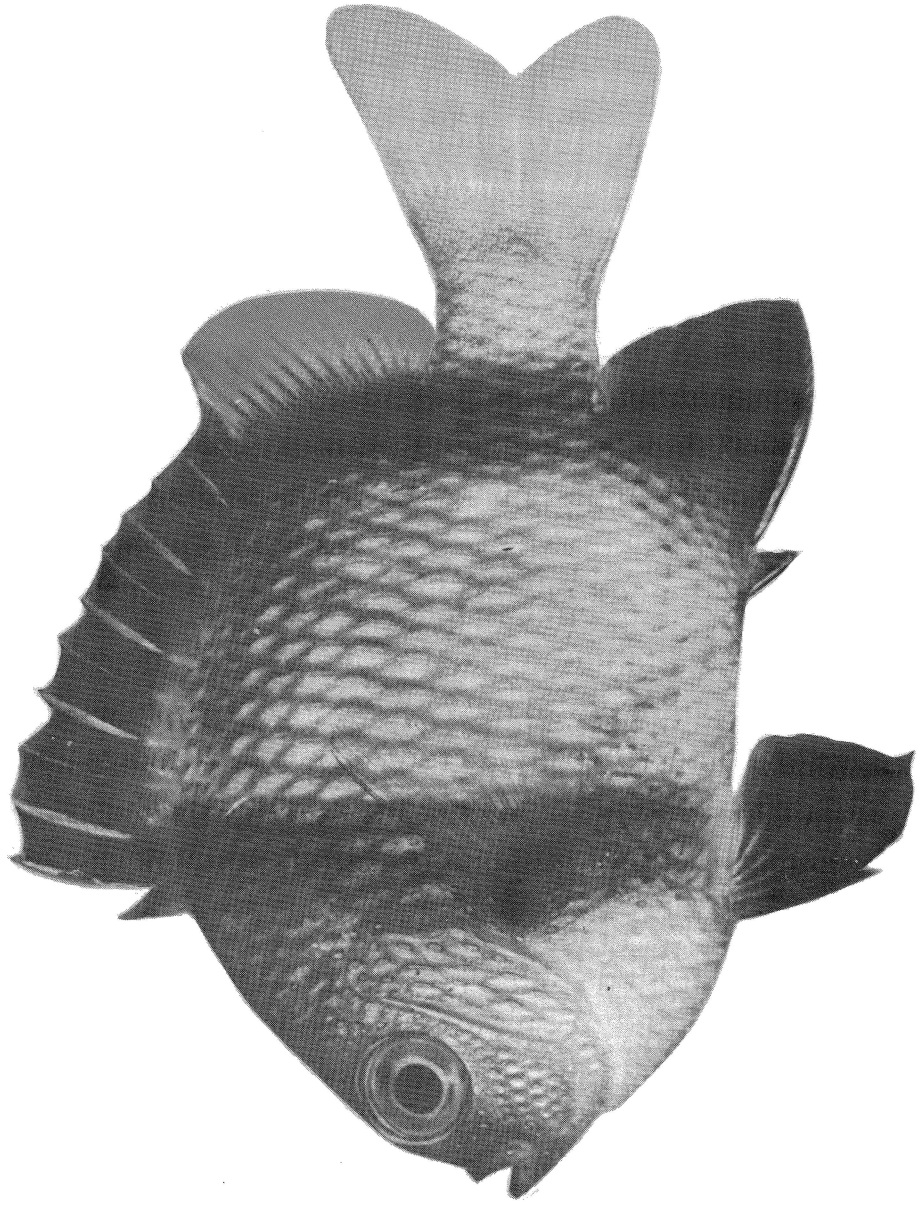

Fig. 9. *Dascyllus carneus*, 44 mm, SL Seychelles (J. Randall photo).

forming oblique rows which ascend toward dorsal fin; lips blue; basal portion of body scales slightly dusky, a blue streak across centre of scales on upper back; a pair of prominent black bars (4-5 scales wide) on body, the first from base of anterior dorsal spines to base of pelvic fins, the second covering basal (i.e., anterior) portion of soft dorsal fin and continued across posterior part of body, also covering most of anal fin; caudal peduncle and base of caudal fin white; large white spot (about three times size of eye) on upper portion of body just behind anterior black bar and below spinous dorsal fin; spinous dorsal and anal fins black with spines blue; soft dorsal fin transparent to slightly bluish except black basal portion; outer half of caudal fin transparent to slightly bluish; pelvic fins black with spine and anterior edge of fin blue.

Individuals from the Maldives, Thailand, and Seribu Islands, Java Sea are somewhat different in coloration. The pattern is described from a 35 mm Ektachrome transparency taken by the junior author in 10 metres depth at Pulau Putri, Seribu Islands: ground colour of head and body white, blue spots present on scales of head and breast; spots fainter than those of western Indian Ocean fish; a single black bar on body in same position as anterior bar in western Indian Ocean specimens; outer half of spinous dorsal fin black, basal half white; soft dorsal and caudal fins transparent to slightly bluish; anal fin mostly black except white on basal portion; pelvic fins black; pectoral fins transparent.

Colour in alcohol: similar to live coloration except ground colour yellowish to dusky grey with black bars less contrasted.

RANGE: Known from the east coast of Africa as far south as Delgoa Bay, Mozambique, and from the islands of the western Indian Ocean including Madagascar, Mauritius, St. Brandon's Shoals (Cargados Carajos), Réunion, Comoro, Seychelles, and Aldabra Atoll. In the central Indian Ocean it is known from the Chagos Archipelago, Maldives and Sri Lanka, and it also occurs off the west coast of Thailand and in the Java Sea at the Seribu Islands, off Jakarta, Java. The latter area represents the only locality outside of the Indian Ocean. This pentration has most likely occurred via the nearby Sunda Strait, the narrow passage between Java and Sumatra. Judging from existing museum collections the penetration into the Java Sea appears to be confined to the area immediately adjacent to this passage. *Amphiprion akallopisos,* another widespread Indian Ocean pomacentrid also occurs in the Seribu Islands (Allen, 1972). Both species, however, are absent from the coast of northwestern Australia, being replaced there by their W. Pacific counterparts, *Dascyllus reticulatus* and *Amphiprion sandaracinos* (Allen, 1976).

BIOLOGY: The junior author has made limited observations of this species at Pulau Putri, Seribu Islands near Jakarta, Indonesia. Groups containing approximately two to 20 individuals were usually associated with isolated colonies of vasiform *Acropora* corals at depths ranging between eight and 15 metres. The fish were confined to the relatively steep slope which descends from the edge of the reef flat to a depth of about 20 metres. The water was relatively turbid (horizontal visibility 10-15 metres) and the thick bottom sediment over much of the reef indicated this was a permanent condition. In the western Indian Ocean at Grande Comoro Island the species occurs to at least 30-35 metres. Specimens were recently collected at this depth by Dr. John E. McCosker.

D. carneus matures at a significantly smaller size than its close relative *D. reticulatus*. The junior author observed spawning of several individuals ranging in length from 25-38 mm at Pulau Putri. *D. reticulatus* does not normally engage in spawning under about 40 mm and in most cases the male is in excess of 55 mm (personal observations). During the spawning period the male (later collected) performed a series of "signal jumps" similar to the courtship "dance" described above for *D. aruanus*. This activity took place about 0.5

metre above an *Acropora* colony measuring approximately 0.5 metre in diameter. A group composed of about 10 smaller individuals (presumed females) either swam close to the coral or fed on plankton a short distance above. Periodically one of the smaller fish was attracted to the male's display with resulted in the latter escorting his mate to the edge of the coral formation where spawning took place. The female's ovipositor was clearly visible as she passed over the nest site, followed closely by the male whose vent was pressed against the coral substrate. Eggs could be seen clinging to the nest site if viewed carefully at very close range. The fish were observed for approximately 15 minutes and during this period the male engaged in spawning activities with at least two different females and possibly more at the same nest site.

Cobb (1975) reported on aquarium spawnings for a pair of *D. carneus*. He observed that spawning behaviour was apparently triggered by the swollen abdomen of the female. The male enticed the female to lay eggs after a period of much physical contact and body vibrations. The spawning sequence lasts approximately two hours with a density of about 100-140 eggs per square cm with an average nest size of 59 sq. cm. After spawning the male cares for the nest until hatching which takes place in about 48 hours at temperatures ranging between 26°-30°C. At this stage the fry are 1.4 mm total length.

Koenig (1957) described sound production in captive specimens of *D. carneus*.

REMARKS: *D. carneus* has been confused with *D. reticulatus* by Smith (1960) and several other authors. The two species are similar, apparently having evolved from the same ancestral stock. *D. marginatus* of the Red Sea is another close relative which differs primarily in colour pattern.

There are several important differences between *D. carneus* and *D. reticulatus*. Colour pattern is the most obvious, particularly the presence of blue spots on the head and nape of *carneus* and the lack of this feature in *reticulatus*. The spots usually show up clearly in preserved specimens and provide a quick means of identification. Maximum size is another feature which differs significantly. *D. carneus* is considerably smaller than *reticulatus,* males attain sexual maturity between 30-35 mm and the maximum length is about 50 mm; in *D. reticulatus* males mature between 45-55 mm and the maximum size is about 65 mm. In addition, there are modal differences in counts for the pectoral rays, lateral-line scales (upper series), and gill rakers (see Table 2). A further difference concerns the pattern of scalation on the chin anterior to the forward extension of the isthmus. In *D. carneus* this area is naked, but in *D. reticulatus* it is largely covered with scales.

We have not seen the types, but Ladiges *et al.* (1958) reported that the lectotype and two paralectotypes are deposited at the Zoologisches Museum, Hamburg. The original description of *D. carneus* is clearly diagnostic.

MATERIAL EXAMINED: We have examined 39 specimens, 17-47 mm, from the following localities: St. Brandon's Shoals (Cargados Carajos), Madagascar, Comoro Islands, Zanzibar, Mombasa, Chagos Archipelago, Maldive Islands, Thailand (Andaman Sea), and the Seribu Islands, Java Sea. This material includes the type of *D. nigripinnis* Regan, a specimen 50.4 mm, examined at BMNH (register number 1908.3.23.98). The Java Sea, Thailand and St. Brandon's Shoals represent new locality records.

Dascyllus reticulatus (Richardson) Fig. 10

Heliases reticulatus Richardson, 1846: 245 (type locality, China and Japan).

Dascyllus xanthosoma Bleeker, 1851: 247 (type locality, Banda Neira).

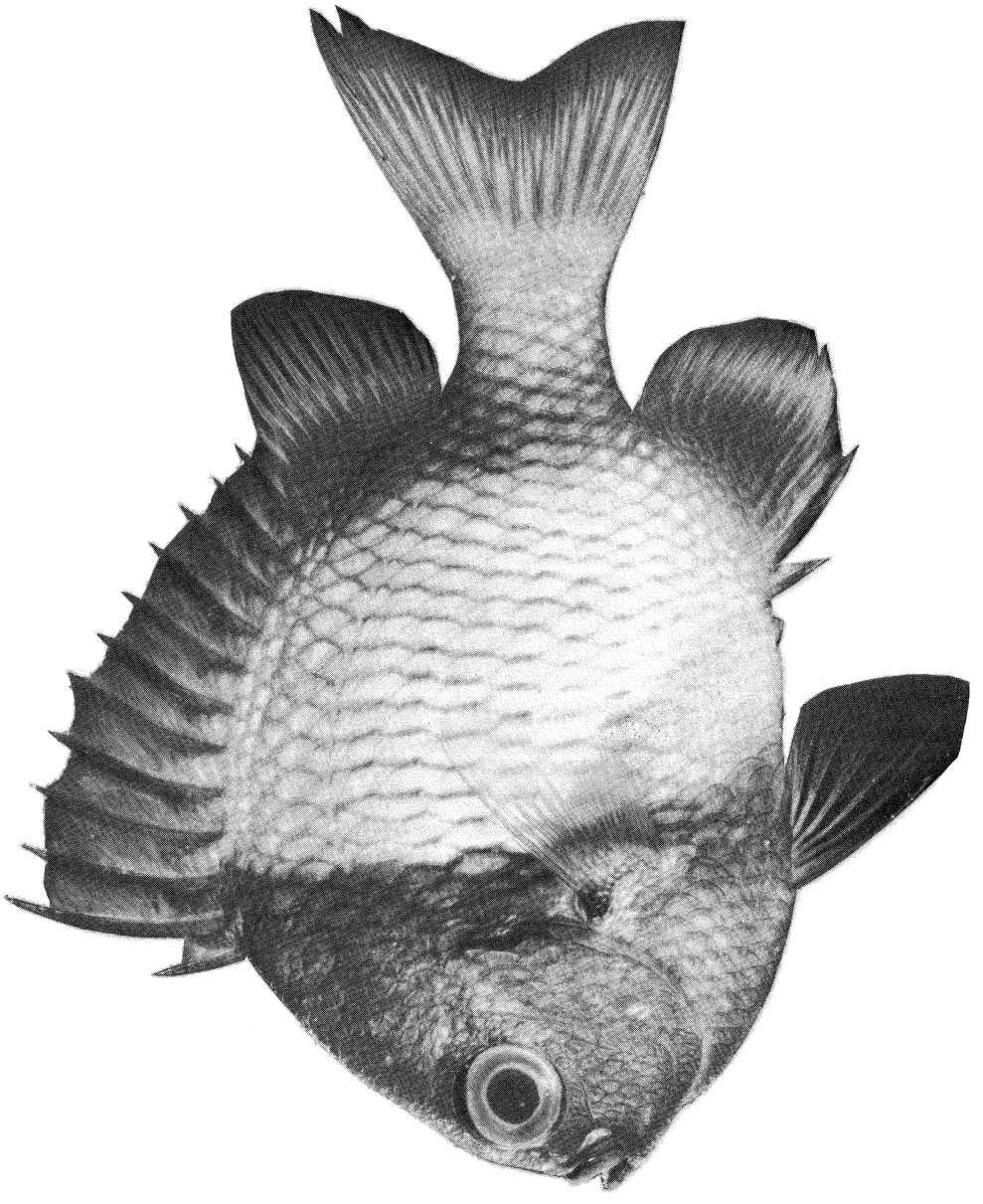

Fig. 10. *Dascyllus reticulatus*, 52 mm, Truk, Caroline Islands (J. Randall photo). (Note — The outer edge of the soft, dorsal, anal and caudal fins are transparent, but the specimen was originally photographed on a dark background).

Pomacentrus unifasciatus Kner, 1868: 348 (type locality, Fiji Islands).

DIAGNOSIS: (Proportions based on 30 specimens, 45-63 mm). Dorsal rays usually XII,15; anal rays II,13; pectoral rays usually 20; tubed lateral-line scales usually 18; gill rakers on first arch usually 7 + 19 to 21; greatest depth of body 1.4 to 1.6, head length 3.0 to 3.3, both in standard length; snout length 3.0 to 3.8, eye diameter 2.3 to 2.8, interorbital width 2.7 to 3.3, least depth of caudal peduncle 1.8 to 2.0, length of caudal peduncle 2.6 to 3.2, of pectoral fin 1.0 to 1.1, of pelvic fin 0.9 to 1.0, of caudal fin 0.9 to 1.0, caudal concavity 2.5 to 3.6, all in head length.

Colour in life: live colours are variable according to ecological conditions and behaviour. The basic pattern was illustrated by Allen (1975) and consists of a whitish ground colour with the following markings: snout, interorbital, and forehead slightly greenish; upper edge of operculum and opercular membrane dark brown; prominent black bar (2-3 scales wide) extending from base of first three dorsal spines to base of pelvic fin, becoming relatively faint below pectoral fin; a second, less distinct bar across anterior half of soft dorsal fin and continued across posterior part of body, extending on to anterior portion of anal fin; scale margins faintly brown or blackish; spinous dorsal fin same as body colour on basal half with broad black margin on outer half; soft dorsal fin transparent to slightly bluish except for black bar on anterior portion; anal fin similar to soft dorsal; caudal mostly transparent, but slightly dusky and bluish on outer edges; pelvic fins mostly black except innermost ray white; pectoral fins transparent with small black spot at base of uppermost rays. The ground colour is often overall dusky with only a faint suggestion of the dark bars.

Colour in alcohol: similar to live coloration except ground colour yellowish to dusky grey and bars far less contrasted. The hindmost bar is frequently absent and occasionally the entire specimen is overall dark grey (except for darker scale margins) without bars.

RANGE: Known from Cocos-Keeling Atoll and Western Australia in the eastern Indian Ocean, the Gulf of Thailand, South China Sea, Indonesia, Philippines, Taiwan, Ryukyu Islands, southern Japan, east coast of Australia, Melanesia, Micronesia, and the islands of Polynesia excluding the Hawaiian Islands and those in the south-eastern portion lying to the east of and including the Society Islands.

BIOLOGY: This species inhabits lagoons, the edge of passes leading to the open sea, and outer reef slopes, usually in one to at least 50 metres. Observations by the junior author at the Marshall Islands, Palau, and off Western Australia indicate the general habits and behaviour are very similar to those described for *D. aruanus*. The spawning behaviour was reported by Wickler (1967) and is typical for the genus.

REMARKS: De Beaufort (1940) incorrectly used the name *D. marginatus* (non Rüppell) for this species. His locality records from the Red Sea and western Indian Ocean refer to *D. marginatus* and *D. carneus* respectively.

MATERIAL EXAMINED: We have examined 179 specimens, 9-63 mm, from the following localities: Cocos-Keeling Atoll, Western Australia, Vietnam, Indonesia, Borneo, Philippine Islands, Palau Islands, New Guinea, Trobriand Islands, New Georgia, Solomon Islands, New Hebrides, Fiji Islands, and the Marshall Islands. All of these localities except Cocos-Keeling were reported previously by either De Beaufort (1940) or Allen (1975 & 1976). The material includes the probable type of *D. xanthosoma* Bleeker, a specimen 41 mm, examined at RMNH (register number 6455).

According to Günther (1862) "the typical specimens [of *Heliases reticulatus*] appear to be lost." However, the characters given by Richardson (1846) in his brief description are diagnostic.

We have not examined the type of *Pomacentrus unifasciatus* which was described by Kner (1868) on the basis of a single Fijian specimen in the Godeffroy Museum, Hamburg (number 3788). However, the original description is very complete and the accompanying figure is clearly diagnostic. On the basis of these items we have placed this species in the synonymy of *D. reticulatus*.

Dascyllus flavicaudus n.sp. Fig. 11

Dascyllus sp. one Harry, 1953: 104 (Raroia Atoll, Tuamotu Islands).

Dascyllus sp. Axelrod, Burgess, and Emmens, 1975: 340.00 (Tahiti).

HOLOTYPE: BPBM 13031, 87.0 mm, collected with spear on reef of Haurei Bay, Rapa (approximately 27°45'S, 144°30'W) in 28 metres by J. Randall on 17th February, 1971.

PARATYPES: AMS I.19109-001, 2 specimens, 53.5 and 64.1 mm, collected with rotenone off small boat passage at Oeno, Pitcairn Group (approximately 23°45'S, 130°45'W) in 20 metres by J. Randall and crew of "Westward" on 18th December, 1970; BPBM 6886, 2 specimens, 78.7 and 80.0 mm, collected with rotenone at Popote Bay, Papara, Tahiti in 5 metres by J. Randall and A. Banner on 22nd February, 1969; BPBM 7192, 4 specimens, 67.1-75.5 mm, collected with rotenone at Popote Bay, Tahiti in 6 metres by J. Randall on 25th February, 1969; BPBM 13102, 5 specimens, 52.0-78.0 mm, collected with rotenone off concrete quay in pass at Takaroa, Tuamotu Islands in 10-15 metres by J. Randall and R. McNair on 13th April, 1971; BPBM 16568, 6 specimens, 52.2-77.0 mm, same collecting data as AMS paratypes; BPBM 16646, 5 specimens, 48.7-56.4 mm, collected with quinaldine at Bounty Bay, Pitcairn Island in 22 metres by J. Randall on 25th December, 1970; BPBM 16926, 66.1 mm, collected with rotenone off "The Rope", Pitcairn Island in 33 metres by J. Randall, D. Cannoy, and S. Christian on 23 December 1970; CAS 38525, 2 specimens, 67.0 and 79.0 mm, collected with rotenone on shore reef near Garumaoa village, west side of Raroia Atoll, Tuamotu Archipelago by R. R. Harry and Raroians on 18th July, 1952; CAS 38526, 66.0 mm, collected with spear off King Pomare's tomb, 2-3 miles east of Papeete, Tahiti by J. Randall on 22nd July, 1956; CAS 38527, 2 specimens, 71.0 and 73.0 mm, collected with spear just east of large wharf off village of Faatoai, Moorea by J. Randall on 27th March, 1957; CAS 38528, 3 specimens, 23.0-39.0 mm, collected with rotenone inside Teputo Pass, Papeari District, Tahiti by Ellsworth and Josef on 4th July, 1957; CAS 38529, 75.0 mm, collected with rotenone at Teauaraa Pass, Atimaono, Papara District, Tahiti by Bingham and Josef on 18th July, 1957; CAS 38530, 70.0 mm, collected with rotenone in Tareu Pass, Papetoai District, Morea by Bingham *et al*, on 27th July 1957; CAS 38531, 23 specimens, 46.0-75.0 mm, collected with rotenone in Iriru Pass, off Iriru Island, Raiatea by Bingham *et al*, on 4th August, 1957; CAS 38532, 34.0 mm, collected with rotenone north of Raititi Point, Nunug District, Bora Bora by Bingham *et al*, on 12th August, 1957; CAS 38533, 5 specimens, 29.0-76.0 mm, collected with rotenone inside edge of Muller Reef, Teavanui Pass, north of Motu Tapu, Bora Bora by Bingham *et al*, on 15th August, 1957; MNHN 1976-101, 2 specimens, 66.0 and 71.8 mm, same collecting data as AMS paratypes; USNM 216381, 3 specimens, 55.6-72.0 mm, same collecting data as BPBM 13102; WAM P25578-001, 2 specimens, 62.5 and 75.5 mm, collected with rotenone 400 m east of Teavaraa Pass, Tahiti in 30-35 metres by G. Allen, J. Randall, and B. Baker on 26th February, 1969.

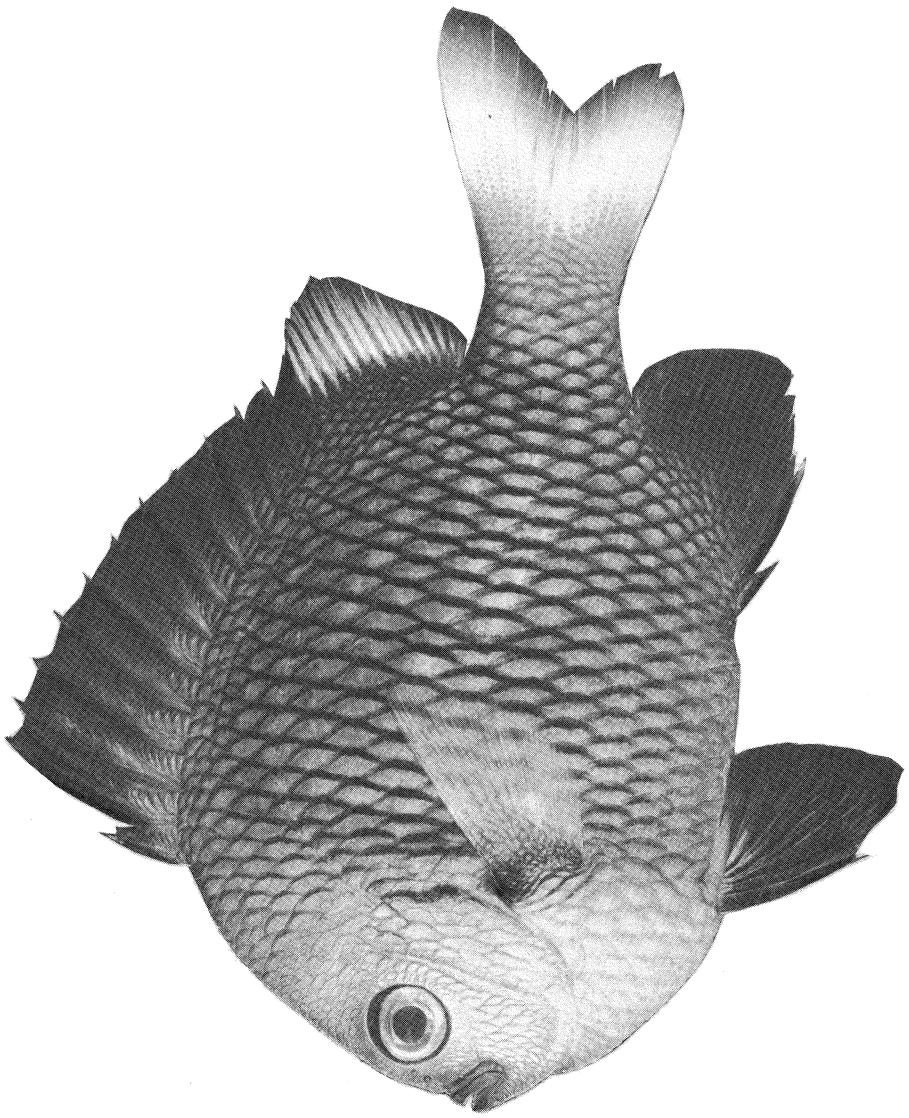

Fig. 11. *Dascyllus flavicaudus*, paratype (BPBM 7192), 75.5 mm, Tahiti (J. Randall photo). (Note — The outer edge of the soft dorsal and caudal fins are transparent, but the specimen was originally photographed on a dark background).

DESCRIPTION: The proportional measurements for the holotype and several paratypes are expressed as percentage of the standard length in Table 3. Proportions given below are based on 25 specimens, 49-87 mm.

Dorsal rays XII,15 (XII,15 or 16); anal rays II,14 (II,13 or 14); pectoral rays 20 (20 or 21); branched caudal rays 13; gill rakers on first branchial arch 7 + 20 (6 or 7 + 19 to 21); branchiostegal rays 6; lateral-line scales with tubes 18 (17 to 19); vertical scale rows from upper end of gill opening to caudal base 27 (27 to 28); horizontal scale rows from lateral-line to base of middle dorsal spines 1½; scale rows below lateral-line to origin of anal fin 10; circumpeduncular scales 15 (14 to 15).

Body relatively deep for the family, the depth 1.4 (1.4 to 1.6) in standard length, and compressed, the width about 10 times in depth; head length contained 3.3 (3.2 to 3.4) in standard length; snout 3.0 (3.1 to 3.5) in head; eye 3.1 (2.4 to 3.1) in head; interorbital space moderately convex, the bony width 3.0 (2.4 to 3.1) in head; least depth of caudal peduncle 1.8 (1.6 to 1.8) in head; length of caudal peduncle 2.3 (2.3 to 2.8) in head.

Mouth oblique, terminally located, the maxillary reaching nearly to a vertical through front edge of eye; teeth of jaws conical, multi-serial at front of jaws; upper jaw with 38 (36 to 42) teeth in outer row, the largest at front of jaw and about equal to length of anterior nostril in height; lower jaw with 30 (38 to 44) teeth, the largest placed anteriorly and similar in size to upper jaw teeth; band of close-set villiform teeth behind large conical ones at front of jaws; double nasal opening on each side of snout; anterior and posterior nostrils joined by shallow naked groove and separated by a distance slightly greater than ½ pupil width; nostrils with a low fleshy rim particularly evident around anterior one; margin of preorbital and suborbital finely serrate; combines suborbital-preorbital moderate in width, the greatest depth slightly greater than ½ eye diameter, the lower margin free; margin of preopercle finely serrate; posterior margin of opercle finely serrate to crenulate.

Scales finely ctenoid; lips naked; remainder of head and body scaled; suborbital with a single row of large scales and 1-2 rows of small axillary scales; 5 parallel rows of scales below this to lower margin of preopercle; dorsal and anal fins with a basal scaly sheath; caudal fin scaled nearly 3/4 distance to end of lobes; paired fins scaled only basally; axillary scale of pelvic fins about ½ length of pelvic spine.

Tubes of lateral-line ending below anterior rays of soft portion of dorsal fin; 2 (1 to 3) pored scales posterior to tubed scales; a series of 7 (6 to 9) pored scales mid-laterally on caudal peduncle to caudal base.

Origin of dorsal fin at level of 3rd tubed scale of lateral-line; spines of dorsal fin gradually increasing in length to 3rd or 4th spine, remaining spines gradually decreasing in length; membrane between spines scarcely incised; first dorsal spine 2.6 (2.5 to 3.2), third dorsal spine 1.2 (1.1 to 1.3), last dorsal spine 1.8 (1.9 to 2.3), longest (5th-6th) soft dorsal ray 1.4 (1.4 to 1.6), all in head; length of base of dorsal fin 1.5 (1.4 to 1.5) in standard length; first anal spine about ½ length of second anal spine or 3.3 (3.1 to 4.1) in head; second anal spine 1.6 (1.5 to 1.7), longest (5th-6th) soft anal ray 1.4 (1.3 to 1.5) in head; base of anal fin 2.4 (2.2 to 2.9) in base of dorsal fin; caudal fin emarginate, the upper lobe slightly longer than lower one, its length 1.0 (0.9 to 1.0) in standard length; caudal concavity 3.6 (2.7 to 4.0) in head length; pectoral fin relatively short, not reaching a vertical through anal opening in adults, the longest ray (uppermost branched one) 1.0 (0.9 to 1.1) in head length; pelvic fins of adults generally not reaching origin of anal fin, the longest ray (2nd from spine) 1.0 (0.9 to 1.0) in head length.

Colour in life: a colour illustration of *D. flavicaudus* by J. Randall was provided by Axelrod *et al*, (1975). The pattern consisted of the following combination: head and

breast medium brown to dark brown; lips dark grey; upper edge of operculum and opercular membrane black; scales of body, and dorsal and anal fin sheaths bluish basally with broad dark grey to blackish margins; faint dark bar extending from base of first few dorsal spines to pelvic fin base; spinous dorsal, basal 1/3 of soft dorsal, anal, and pelvic fins blackish; base of spinous dorsal with slight yellowish suffusion; outer 2/3 of soft dorsal fin pale yellow grading to transparent distally; caudal fin dusky on basal portion, remainder yellow with broad transparent border posteriorly; pectorals transparent, slightly yellowish basally with prominent black spot at base of upper rays.

Colour in alcohol: head and breast tan to light brown; lips dusky; upper edge of operculum and opercular membrane dark brown; scales of body and dorsal and anal fin sheaths light brown to reddish-brown with dusky margins; spinous dorsal, basal 1/3 of soft dorsal, anal, and pelvic fins dark brown to blackish; outer 2/3 of soft dorsal fin mainly transparent; caudal fin dusky on basal portion, remainder pale (slightly yellow) with transparent posterior margin; pectorals transparent with black spot at base of upper rays extending on to upper portion of axil, base of pectoral generally dusky.

The paratypes are generally similar to the holotype, but several are notably darker possibly due to the effects of preservation.

RANGE: Known only from the southeastern corner of Oceania including the Society Islands, Tuamotu Islands, Pitcairn Group, and Rapa.

BIOLOGY: Only sparse data are available for this species. The habitat and general behaviour appear to be nearly identical with that of *D. reticulatus*. It forms small aggregations around isolated coral heads (frequently *Pocillopora*) at depths ranging from five to at least 33 metres in passages and outer reef areas.

REMARKS: The records of *D. reticulatus* from Tahiti, Tuamotus, Rapa, and Pitcairn Group reported by Allen (1975) actually refer to *D. flavicaudus*. The species is very similar to *D. reticulatus* and probably has evolved from the same ancestral stock. However, there are important differences between them. As far as counts are concerned the most significant criteria for separation are to be found in the number of soft dorsal and anal rays and the tubed lateral-line scales (Table 1). *D. flavicaudus* usually has 14 soft anal rays or one more than the normal complement for *D. reticulatus*. The remaining count differences are modal: both species usually possess 15 soft dorsal rays; however, 33% of the *D. flavicaudus* specimens have 16 rays and none show 14 rays compared with 4% with 16 rays and 26% with 14 for *D. reticulatus*: there is a near even distribution between 18 and 19 tubed lateral-line scales for *D. flavicaudus,* whereas in *D. reticulatus* 16% of 104 specimens contained 17 tubed scales, 78% had 18, and the remaining few possessed 19.

Another, although relatively subtle difference concerns the posterior margin of the opercle below the flattened spine at the angle. In *D. flavicaudus* the margin is narrowly naked without any scales making contact with the opercular edge; however, in *D. reticulatus* at least a few scales reach to the edge of the gill flap.

There is also an apparent difference in maximum size. *D. flavicaudus* grows to at least 90 mm SL compared with about 65 mm for *D. reticulatus*. Conceivably the former species could be confused with *D. trimaculatus,* at least in the preserved state, owing to their overlapping distributions, similar size, and dark colour patterns. A good character for immediate separation is the presence of tubed scales mid-laterally on the caudal peduncle of *trimaculatus* and the lack of this feature in *flavicaudus* which only has pores or pits present.

Colour pattern differences constitute the final basis for separation between *D. flavicaudus* and *D. reticulatus*. The latter species lacks the yellow caudal fin, has the posterior portion of the anal fin pale instead of black, and has a ground colour which is largely white rather than brownish. In addition, there is only a faint hint of a dark bar below the first few dorsal spines in fresh specimens of *D. flavicaudus;* in *D. reticulatus* there are usually one or two relatively prominent bars on the body. Finally, the dark margins on the body scales are much wider in *D. flavicaudus* (compare Figs. 10 and 11).

This species is named *flavicaudus* (Latin: "yellow tail") with reference to the characteristic coloration of the caudal fin.

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Table 1. Fin Ray and Tubed Lateral-Line Scale Counts for Species of Dascyllus

Species	Soft dorsal rays						Soft anal rays					Pectoral rays					Tubed lateral-line scales					
	11	12	13	14	15	16	11	12	13	14	15	17	18	19	20	21	15	16	17	18	19	20
albisella				1	7	15				7	16			1	21	1				4	16	3
aruanus	4	223	13				2	218	20			29	197	14			1	6	138	93	2	
carneus				7	31	1			36	3				1	17	21			13	21	5	
flavicaudus					27	25			6	46					30	22			2	30	20	
marginatus				37	66				93	10			5	51	47		1	15	45	40	2	
melanurus		39	16					12	43				8	47			2	19	30	3	1	
reticulatus				27	73	4		1	93	10					5	82	17		18	81	5	
strasburgi				9	40	3			6	45	1				1	36	15			12	40	
trimaculatus				5	95	10				104	6				18	88	4		1	34	75	

Table 2. Gill Raker Counts for Species of Dascyllus

Species	5	6	7	8	+	15	16	17	18	19	20	21	22	23
albisella		8	15				4	12	7					
aruanus	2	160	76	2		3	99	113	22	3				
carneus		3	35	1				7	22	9	1			
flavicaudus			46	6						18	24	9	1	
marginatus			42	61						3	12	19	55	14
melanurus		13	41	1			1	8	36	10				
reticulatus		3	68	33					8	26	43	21	6	
strasburgi		12	38	2			7	37	5	3				
trimaculatus		58	51	1			5	47	56	2				

Table 3. Morphometric Proportions of Selected Type Specimens of Dascyllus Flavicaudus

(expressed in percentage of the standard length)

	Holotype	Paratypes						
	BPBM	BPBM	BPBM	BPBM	BPBM	WAM	BPBM	BPBM
Character	13031	16646	16646	16926	7192	P25578-001	16568	13102
Standard length (mm)	87.0	48.7	56.0	66.1	67.1	75.5	77.0	78.0
Body depth	72.2	72.3	70.5	67.6	72.0	66.2	64.0	66.7
Head length	30.1	30.4	31.8	30.3	29.8	29.4	30.1	31.7
Snout length	9.8	8.6	9.5	9.8	9.2	7.7	9.1	9.0
Eye diameter	9.8	12.7	11.3	11.6	11.9	11.3	10.9	11.5
Interorbital width	10.0	11.3	13.2	11.2	10.6	9.9	10.5	10.1
Caudal peduncle depth	16.9	16.8	17.9	17.1	18.3	17.3	16.9	17.6
Caudal peduncle width	12.9	10.7	11.6	13.0	12.2	10.7	11.2	12.8
Predorsal length	48.3	49.3	48.8	46.9	49.5	45.7	46.2	47.9
Preanal length	74.0	70.8	73.2	69.7	69.6	68.9	66.2	63.7
Prepelvic length	42.3	41.7	43.6	42.2	42.8	39.2	39.9	38.8
Dorsal base length	67.5	65.5	66.4	65.8	70.0	65.3	65.8	65.8
Anal base length	27.9	22.6	26.8	27.2	28.5	29.1	26.0	26.3
Pectoral fin length	31.6	29.2	31.8	22.8	29.8	30.5	30.1	29.7
Pelvic fin length	31.6	35.5	34.8	34.5	32.8	30.5	31.2	31.5
Pelvic spine length	23.0	25.1	25.5	24.2	21.8	23.2	23.0	21.8
1st dorsal spine	11.5	11.7	11.6	12.3	10.4	9.5	12.2	10.4
3rd dorsal spine	24.5	23.8	29.3	24.1	25.0	26.5	23.4	24.1
Last dorsal spine	16.3	15.0	16.3	14.2	15.4	15.9	13.8	13.6
5th soft dorsal ray	22.3	21.6	24.1	18.9	21.6	21.2	21.0	20.3
1st anal spine	9.2	9.7	7.7	9.7	9.6	11.1	9.5	9.6
2nd anal spine	18.6	17.5	20.4	19.7	18.3	19.2	18.2	18.2
5th soft anal ray	21.8	20.5	22.0	21.2	22.4	21.2	19.7	20.5
Caudal fin length	29.1	30.8	31.4	34.2	32.5	31.1	30.5	32.1
Caudal concavity	8.4	10.0	7.5	10.6	10.9	11.3	10.8	11.9