

***Halichoeres salmofasciatus*, a new species of wrasse (Pisces: Labridae) from Isla del Coco, tropical eastern Pacific**

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Abstract

Halichoeres salmofasciatus, n.sp., is described from 23 specimens, 28.5 - 62.9 mm SL, collected at Isla del Coco, Costa Rica, in 1997. Among the 12 other known species of this genus in the tropical eastern Pacific it appears to be most closely related to *H. malpelo* and *H. melanotis*, but differs from both those species in maximum size, colour pattern, and certain meristics. The terminal phase adult of *H. salmofasciatus* has an olive back, an indistinct dark olive stripe along the body at eye level, and a pale orange tail with a broad, grey terminal edge. The initial phase adult of *H. salmofasciatus* is pale grey and white with two salmon red stripes running along the length of the body (one at eye level and a narrower one along the upper back), two black spots within the midlateral stripe (one on the opercular membrane, the other on the caudal peduncle), and a pale orange tail.

Zusammenfassung

Halichoeres salmofasciatus, n. sp. wird anhand von 23 Exemplaren beschrieben, 28,5 bis 62,9 mm SL, die bei Isla del Coco, Costa Rica gesammelt wurden. Unter den 12 bereits bekannten Arten dieser Gattung im tropischen Ost-Pazifik, diese Art scheint am Nah-esten mit *H. malpelo* und *H. melanotis* verwandt zu sein; sie unterscheidet sich aber von diesen beiden Arten in Gesamtgröße, Farbmuster und gewissen kör-perlichen Merkmalen. In der Endphase haben erwachsene *H. salmofasciatus* einen olivenfarbigen Rücken, einen undeutlichen dunklen, olivenfarbigen Streifen entlang dem Körper in Augenhöhe, sowie einen blassen orangefarbenen Schwanz mit einer brei-ten, grauen Endkante. Junge, ausgewachsene Exemplare sind blass grau und weiß mit zwei lach-sroten Streifen entlang des ganzen Körpers (einer davon in Augenhöhe und ein schmälerer entlang des

oberen Rückens), zwei schwarze Punkte innerhalb des mittleren Seitenstreifens (einer auf der Kiemen-membrane und der andere auf dem Schwanzstiel), und einen orangefarbigen Schwanz.

Résumé

Halichoeres salmofasciatus n. sp. est décrit d'après 23 spécimens, 28,5-62,9 mm de longueur standard, récoltés près de l'Isla del Coco, Costa Rica, en 1997. Parmi les douze autres espèces connues de ce genre dans le Pacifique tropical occidental, il apparaît plus proche de *H. malpelo* et de *H. melanotis*, en différant toutefois par la taille maximale, le patron de coloration et certains caractères méristiques. La phase adulte terminale de *H. salmofasciatus* a le dos olive, une bande olive foncé indistincte le long du corps à la hauteur de l'oeil et la caudale orange pâle avec une large bordure grise. La phase adulte initiale de *H. salmofasciatus* est gris pâle et blanche avec deux bandes rouge saumon le long du corps (l'une à la hauteur de l'oeil et l'autre, plus étroite, sur le dos), deux taches noires sur la bande longitudinale principale (l'une sur la membrane operculaire, l'autre sur le pédicule caudal), et la caudale orange pâle.

Sommario

Ventitré esemplari di 28.5 - 62.9 mm SL, raccolti nel 1997 a Isla del Coco, Costa Rica, hanno fornito mate-riale per la descrizione di *Halichoeres salmofasciatus*, n. sp. Tra le 12 specie presenti nel Pacifico orientale appartenenti allo stesso genere, questa nuova specie sembra più vicina ad *H. malpelo* e *H. melanotis*, da cui però si differenzia per le dimensioni, la livrea e alcuni dati meristici. La fase terminale di *H. salmofasciatus* ha il dorso oliva, una fascia olivastra indistinta che attraversa il corpo all'altezza dell'occhio e una pinna caudale arancione chiaro con un'ampia banda grigia lungo il margine. La fase iniziale adulta *H. salmofasciatus* ha, invece, il corpo di una tinta che va dal grigio chiaro al bianco ed è attraversato da due fasce longitudinali color rosso salmone (una a livello

dell'occhio, l'altra, più stretta, lungo la parte superiore del dorso), due macchie nere entro la fascia longitudinale mediale (una sull'opercolo e l'altra sul peduncolo caudale) e una pinna caudale arancione chiaro.

Introduction

The tropical eastern Pacific biogeographic region stretches from lower Baja California and the Gulf of California, at latitude 26°N, to just south of the Ecuador/Peru border, at latitude 30°S, and includes five offshore islands and groups of islands - the Revillagigedos, Clipperton, del Coco, Malpelo, and the Galapagos (Briggs, 1974). There are 12 described members of the labrid genus *Halichoeres* known from this region. These include 11 shallow-water species: *H. adustus* (Gilbert, 1890) (Isla del Coco and Islas Revillagigedos, with vagrants at the tip of the Baja peninsula and mainland Costa Rica); *H. aestuaricola* Bussing, 1972 (Gulf of California to Colombia); *H. chierchiae* Di Capriacco, 1947 (Gulf of California to Colombia, plus the Galapagos); *H. discolor* Bussing, 1983 (endemic to Isla del Coco); *H. dispilus* (Günther, 1864) (Gulf of California to Peru, plus Isla del Coco and the Galapagos); *H. insularis* Allen & Robertson, 1992 (endemic to the Revillagigedos); *H. malpelo* Allen & Robertson, 1992 (endemic to Isla Malpelo); *H. melanotis* (Gilbert, 1890) (the mouth of the Gulf of California to Colombia, and, reportedly (Bussing, 1987), from Isla del Coco); *H. nicholsi* (Jordan & Gilbert, 1882) (Gulf of California to Ecuador, plus all the offshore islands except Clipperton); *H. notospilus* (Günther, 1864) (Gulf of California to Peru, plus the Galapagos, Malpelo, and the Revillagigedos); and *H. semicinctus* (Ayres, 1859) (California to lower Baja California and the upper 2/3 of the Gulf of California)

(see Allen & Robertson, 1992; Allen & Robertson, 1994; Bussing 1987; Fischer et al, 1995; Grove and Lavenberg, 1997; Parenti & Randall, 2000). In addition a deep-water species, *H. raisneri* Baldwin & McCosker, 2001, has recently been described from the Galapagos, and may also occur at Cocos (Baldwin & McCosker, 2001).

This paper describes a new species of shallow-water *Halichoeres* collected by D. R. Robertson at Isla del Coco, a small (9 km diameter) isolated island 450 km offshore of the coast of Costa Rica, at 5033°N, 8703°W.

Materials and Methods

Type specimens of the new species are deposited at the US National Museum of Natural History, Washington DC (USNM), and the Museo Zoologico de la Universidad de Costa Rica (UCR).

Methods of counting and measuring specimens are as follows: standard length (SL) is the straight-line distance from the front of the upper lip to the base of the caudal fin (posterior end of the hypural plate); body depth is the maximum depth from the base of the dorsal spines; body width is measured just posterior to the gill opening; head length is taken from the front of the upper lip to the posteriormost point of the opercular flap; snout length is measured from the same anterior point to the fleshy edge of the orbit; orbit diameter is the greatest fleshy diameter of the orbit; interorbital width is the least bony width between the orbits; caudal peduncle depth is the least depth of the peduncle; caudal peduncle length is the horizontal distance from the rear base of the anal fin to the base of the caudal fin; pectoral and pelvic fin lengths are the lengths of the longest rays; pectoral ray counts include the

Table I. Proportional measurements of type specimens of *Halichoeres salmofasciatus* deposited in the USNM expressed as percentages of the standard length. TP = terminal phase, IP = initial phase

Character	Holotype	Paratype	Paratype	Paratype	Paratype	Paratype	Paratype
Colour Phase	TP	TP	TP	TP	IP	IP	IP
Standard length (mm)	62.9	62.9	54.2	50.6	50.0	45.0	40.0
Body depth	26.2	25.4	24.4	26.7	28.0	25.1	24.3
Body width	12.3	12.4	11.1	12.1	13.0	9.3	12.5
Head length	32.6	33.4	34.1	35.0	35.0	32.7	34.8
Snout length	8.8	8.9	9.2	8.9	9.4	8.4	8.0
Orbit diameter	6.2	7.2	8.3	8.9	7.2	7.3	8.0
Interorbital width	5.0	5.9	5.5	5.1	5.4	4.9	5.5
Caudal peduncle depth	11.0	12.2	11.3	12.5	13.6	11.6	12.5
Caudal peduncle length	9.6	10.3	10.9	10.1	12.6	10.2	11.3
Length 1st dorsal spine	7.4	7.2	5.2	5.9	6.0	6.2	5.5
Length last dorsal spine	10.8	8.9	9.4	9.5	8.5	8.4	7.7
Longest dorsal soft ray	13.3	12.9	13.0	13.0	12.2	11.4	11.2
Length 2nd anal spine	4.3	4.4	4.6	4.5	4.6	4.1	4.0
Length 3rd anal spine	7.5	7.8	7.2	6.9	7.2	5.7	5.6
Longest anal soft ray	12.3	11.8	11.0	11.1	12.0	10.0	9.7
Caudal fin length	23.3	22.9	23.4	21.3	21.4	22.4	19.5
Pectoral fin length	20.5	21.0	20.8	21.7	20.8	20.05	19.5
Pelvic fin length	17.4	17.3	16.2	16.8	14.8	13.8	13.5

rudimentary, splint-like, uppermost ray; lateral line scale counts are taken to the base of the caudal fin; the gill raker count is the total number of rakers, including all rudiments, on the first branchial arch (total counts are given due to difficulty deciding which raker lies at the angle of the gill arch).

Counts and morphometric proportions in parentheses refer to the range for paratypes where these data differ from those for the holotype.

Halichoeres salmofasciatus n. sp.

(Figs. 1-3 and Table I)

Holotype: USNM 350110, male, 62.6 mm SL, Chatham Bay, Isla del Coco (approximately 5033'N, 8703'W), collected by D. R. Robertson on November 1, 1997.

Paratypes: USNM 350111, 6 specimens, 45.0-62.9 mm SL; UCR 2517-1, 16 specimens, 30.0-54.8 mm SL; all collected with holotype.

Diagnosis

A species of *Halichoeres* with the following combination of characters: dorsal rays IX, 12; anal rays III, 12; pectoral rays 14; caudal rays 14; lateral line scales 27; scales above lateral line to origin of dorsal fin 4; scales below lateral line to origin of anal fin 8; circumpeduncular scale rows 16; gill rakers on first arch 18; terminal phase adult olive on back with

diffuse dark mid-lateral stripe from head to tail; initial phase adult white on lower half of body with pair of salmon red stripes on upper half, a black spot on the opercular membrane and another on caudal fin base.

Description

Dorsal rays IX, 12; anal rays III, 12; pectoral rays 13; pelvic rays I, 5; principal caudal rays 14 (middle 12 branched); upper and lower procurent caudal rays 4 or 5; lateral line scales 27; scales above lateral line to origin of dorsal fin 4; scales below lateral line to origin of anal fin 8; circumpeduncular scale rows 16; gill rakers on first arch 18; vertebrae 25.

Body moderately elongate, its depth 3.8 (3.6-4.1) in SL, and somewhat compressed, its width 2.1 (1.9-2.7) in depth; head length 3.1 (2.9-3.1) in SL; snout length 3.7 (3.7-4.3) in head; eye diameter 4.2 (3.9-4.9) in head; interorbital space convex, the least bony width 6.6 (5.7-6.8) in head; caudal peduncle depth 3.0 (2.6-3.0), caudal peduncle length 3.4 (2.8-3.5), both in head length.

Lower jaw slightly inferior, maxilla reaching to a vertical line in front of orbit or just slightly anterior to orbit; lower lip with a downward projecting flap along the side; inner surface of upper lip with dermal ridges. Gill membranes broadly attached to isthmus. Upper half of preopercle margin hidden under skin, lower half free and exposed.

Front of upper and lower jaws with one pair of large, projecting, slightly recurved canine teeth; remaining



Fig. 1. (a) Terminal phase (holotype) of *Halichoeres salmofasciatus*, 62.9 mm SL; (b) initial phase of *Halichoeres salmofasciatus*, 50.0 mm SL. Aquarium photographs shortly after collection. Photos by D. R. Robertson.

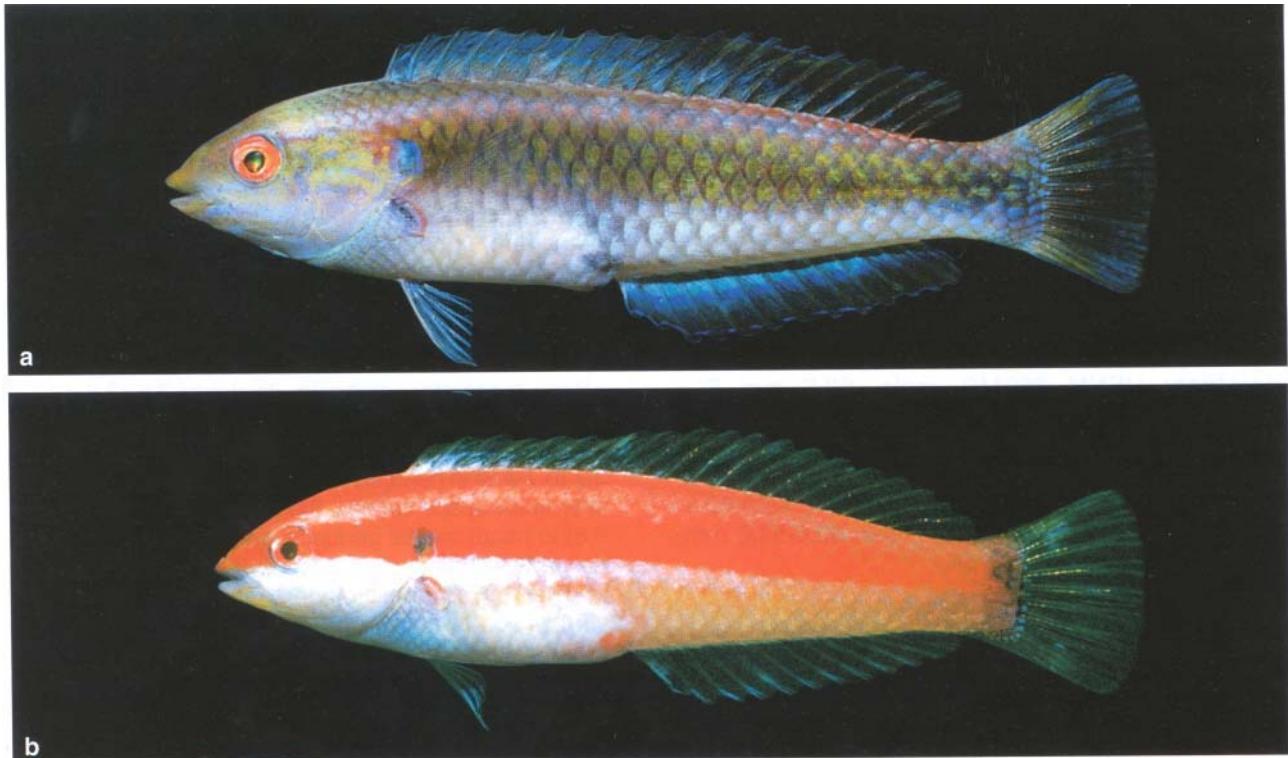


Fig. 2. Terminal phase (a) and initial phase (b) adults of *Halichoeres salmofasciatus* in the field immediately after collection with rotenone ichthyocide. Photos by D. R. Robertson.

13-18 teeth on each side of upper and lower jaw conical with recurved tips, decreasing in size posteriorly, with last few teeth being notably smaller; rear of top jaw without canine teeth. No teeth on palate.

Nostrils small, in front of upper anterior edge of eye, the anterior nostril in a short membranous tube, the posterior nostril diagonally upward and behind the anterior nostril, covered by a flap from its anterior margin. Suborbital pores around rim of eye from mid-posteriorly to below front edge of orbit.

Head naked except for triangular zone of scales on each side of nape; scales on midside of thorax less than half as large as those on side of body, becoming even smaller ventrally and anteriorly; fins naked except for progressively smaller scales on basal portion of caudal fin; lateral line complete, the anterior part more or less straight, bending sharply ventrally beneath posterior portion of dorsal fin to straight peduncular portion; tubes of lateral line scales branched, except those on caudal peduncle, which are straight.

Origin of dorsal fin above second lateral line scale; dorsal spines progressively longer, the first 6.0 (4.7-6.6) and the ninth 4.0 (3.2-4.3) in head; fifth to eleventh dorsal rays about equal in height, 2.9 (2.5-2.9) in head; first anal spine slender and hidden under skin, its length 8.2 (7.4-8.2) in head; third anal spine 5.8 (4.2-5.8) in head; fourth to tenth soft anal rays longest, 3.3 (2.8-3.3) in head; caudal fin truncate to slightly rounded, 1.5 (1.4-1.6) in head; pectoral fin 1.8 (1.6-

1.8) in head, the upper rays longest, the first (uppermost) ray rudimentary and splint-like, all rays branched except the two uppermost; origin of pelvic fin below pectoral fin base; pelvic spine slender, flexible distally; pelvic fin relatively short, falling well short of anus when depressed, its length 2.3 (1.9-2.6) in head.

Coloration in life

Terminal phase adult - (Figs. 1a, 2a, and 3a) upper half of body pale olive to pale brown, with an indistinct darker olive stripe extending from snout to the end of the caudal peduncle at eye level, the portion of that stripe between eye and end of operculum yellowish; an indistinct dark grey spot on the opercular membrane; lower face and belly pale grey with a faint lavender tint; iris red; a pale blue longitudinal line below eye; tail pale orange with terminal half dark grey; anal fin pale violet with outer edge pale orange and a pale orange stripe along centre of fin; dorsal fin pale violet, with an indistinct blackish blotch basally on the first 1-2 spines, pale orange outer edging and pale orange fin rays; pelvic fin pale pink; pectoral fin clear with dusky tip and a narrow sooty bar across the fin base. In sexually active, terminal phase fish (Fig. 3a) the rear half of the tail becomes blackened.

Initial phase adult - (Figs. 1b, 2b, and 3b) upper body and top of head pale grey; lower face white; belly silver white with pink blotch on side immediately above anus; iris red; two salmon red stripes, a broad



Fig. 3. (a) A terminal phase *Halichoeres salmonofasciatus* courting several initial phase conspecifics; (b) a group of alarmed initial phase *Halichoeres salmonofasciatus* displaying pale bars. Photos by D. R. Robertson.

one at eye level running from snout to end of caudal peduncle, a narrower one along the upper back from the head to the caudal peduncle; lower salmon stripe bordered below by a thin silvery white stripe on anterior half of body; two prominent black spots about size of eye, one on the rear of the opercular membrane, the other on caudal peduncle at the terminus of

the midlateral salmon stripe; tail pale translucent orange; pectoral fin clear; pelvic fin clear; dorsal and anal fins clear with pale orange outer margins. When alarmed, initial phase fish can temporarily develop a pattern in which the salmon stripes are overlaid by seven thin whitish vertical bars, one on head, five on body and one on caudal peduncle (Fig. 3b).

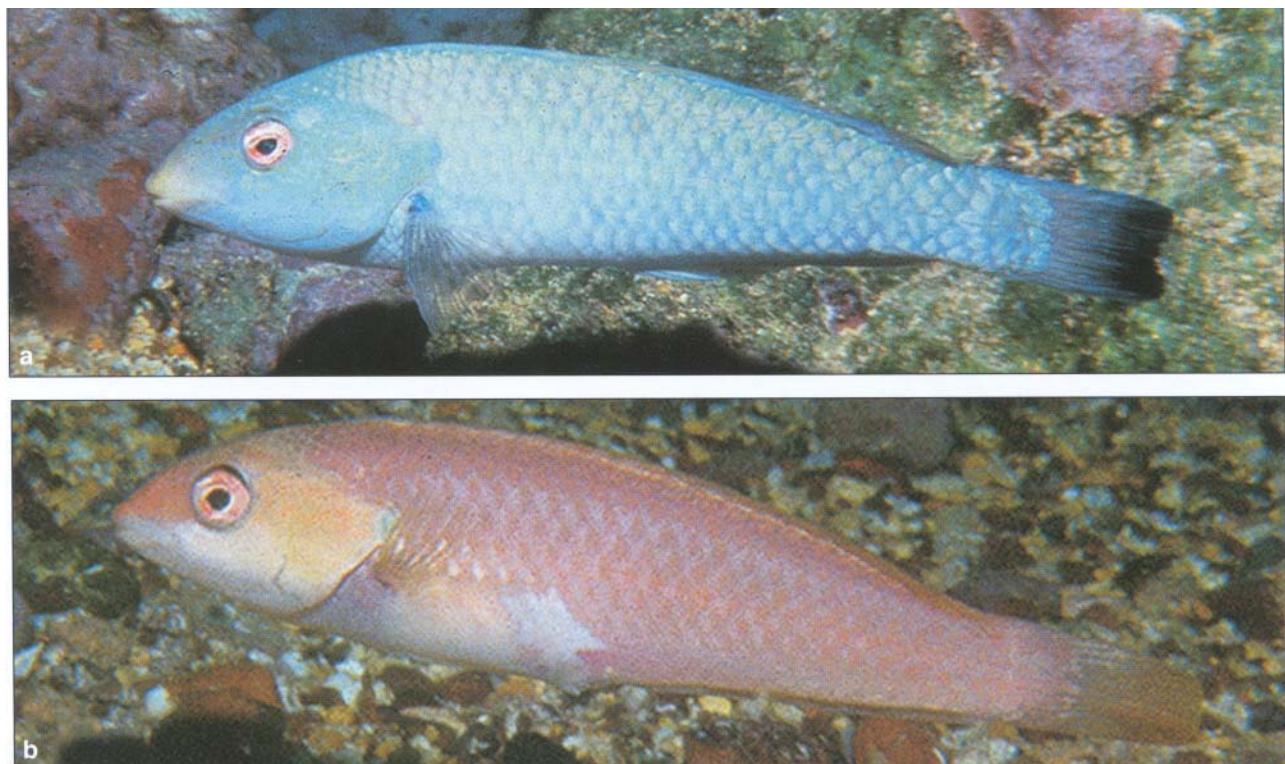


Fig. 4. Living terminal phase (a) and initial phase (b) adults of *Halichoeres malpelo* in the field.
Photos by D. R. Robertson.



Fig. 5. Terminal phase (a) and initial phase (b) adults of *Halichoeres melanotis*, aquarium photographs shortly after collection in Panama. Photos by G. R. Allen.

Juvenile (smaller than about 20 mm SL) – the same basic colour pattern as the initial phase adult, but with a black, white-bordered, ocellus covering the base of the first two soft rays of the dorsal fin, a yellow rather than orange tail, a less distinct black spot on opercular membrane, and white patches on the upper and lower borders of the black spot on the caudal peduncle.

Coloration in alcohol

Terminal phase adult (holotype) – overall dusky brown with numerous tan vertical lines on side; head similar to body except operculum mostly dark brown; dorsal, anal, and pelvic fins translucent to tan; caudal fin light dusky brown on basal half, dark brown on outer half with narrow white margin; pectoral fin tan with prominent diagonal dark area from middle of fin to tip of uppermost rays, and a blackish blotch on base of uppermost rays; largest terminal phase specimen considerably darker than the holotype, particularly on its head and caudal fin, and with a faint broad pale bar behind the head.

Initial phase adult – similar to life coloration, except that the central dark stripe is broken into a series of 5-6 large dark blotches posteriorly.

Juvenile - overall tan with a midlateral row of 7-10 dark spots, including enlarged spot on the base of the caudal fin.

Size

Numerous underwater observations by D. R. Robertson during dozens of dives around Isla del Coco indicate that *H. salmofasciatus* grows to about 10 cm total length.

Habitat

H. salmofasciatus occurs commonly in areas of sand covered with a dense scattering of small scale rubble composed of either volcanic rock chips or calcareous

algae, at depths of from 7 m to at least 30 m. It can also be found in small numbers on sand at sand/reef interfaces. *H. melanotis* and *H. malpelo* occur in similar habitat, on the continental mainland and at Isla Malpelo, respectively.

Affinities and remarks

Among the *Halichoeres* species in the region, *H. salmofasciatus* is most similar to *H. malpelo* (Fig. 4) and *H. melanotis* (Fig. 5) in its colour patterns. However, colours of adults and juveniles of these three species differ (see Table II). While the terminal phase colour pattern of *H. salmofasciatus* is intermediate between that of *H. melanotis* and *H. malpelo*, the initial phase colour patterns of the three species are clearly different. *H. salmofasciatus*, which reaches a maximum of approximately 10 cm total length, is also smaller than *H. melanotis* (reaches about 13 cm) and *H. malpelo* (reaches at least 18 cm). *H. salmofasciatus*, with only one pair of canine teeth at the front of the top and bottom jaws, differs in this regard from both *H. malpelo* (one pair of lower canines and two pairs of upper canines) and *H. melanotus* (two pairs on the top and bottom jaws). *H. salmofasciatus* also differs from *H. malpelo* and *H. melanotus* in having fewer pectoral rays (13 vs 14 in the latter two species). *H. salmofasciatus* further differs from *H. malpelo* in having fewer scales between the lateral line and the dorsal fin origin (4 vs 5) and between the lateral line and the anal fin origin (8 vs 9), as well as in having a relatively larger eye (20.4-25.6% of head length vs 15.9-19.2%) and a relatively longer tail (62.5-71.4% vs 52.6-58.8% of head length).

Five species of *Halichoeres* have been previously recorded from Isla del Coco (Bussing, 1987; Allen & Robertson, 1994; Fischer et al, 1995, Garrison, 2000) - *H. adustus*, *H. discolor*, *H. dispilus*, *H. nicholsi*, and *H. melanotis*. During two weeks spent in an intensive

Table II. Differences in the colour patterns of three species of *Halichoeres*

Species	Juvenile	Initial Phase Adult	Terminal Phase Adult
<i>H. salmofasciatus</i>	as initial phase adult, plus invariably (n=65) with ocellus on dorsal fin	body pale grey with 2 salmon red stripes, black spot on operculum and another on caudal peduncle; belly white	upper body and head olive, body with indistinct midlateral darker olive stripe, dark spot on opercular membrane, tail pale orange with terminal half dark grey
<i>H. melanotis</i> (Panama)	body bright yellow with two black stripes, occasionally (1 of 20) with ocellus on dorsal fin	body pale brown, two brown stripes, grey patch behind eye ending in black spot on opercular membrane, belly pink with white bars	similar to initial phase, but body stripes and dark area on cheek less distinct, belly white, tail pale orange with sooty outer edging
<i>H. malpelo</i>	no data	body and upper head pale pinkish brown; top of head and operculum yellowish; belly white, yellowish behind pectorals	body and head bluish green, tail bluish green with terminal half blackish

survey of that island's fish fauna in October/November 1997, D. R. Robertson observed the first three species, and thousands of individuals of *H. salmofasciatus*, but no individuals whose colours matched those of *H. melanotis* from the mainland. We therefore conclude either that previous records of *H. melanotis* from the island refer to *H. salmofasciatus*, or that *H. melanotis* was present only as a vagrant at Isla del Coco prior to 1997.

Allen and Robertson (1994) recorded the Indo-Pacific labrid *Pseudojulis cerasinus* as occasionally occurring in the tropical eastern Pacific, with their information indicating that it had been observed at Isla del Coco. That record is very likely incorrect: Firstly, it was based on observations alone (no specimens of *P. cerasinus* have been collected from Isla del Coco - W. Bussing, personal communication, 1998). Secondly, those observations may well refer to *Halichoeres salmofasciatus*, as *P. cerasinus* and *H. salmofasciatus* are both small species, occur in the same type of habitat, and have terminal phase colour patterns with the same basic structure (photograph of *P. cerasinus* in Allen and Robertson 1994; and observations on *P. cerasinus* at Hawaii and Christmas Island by D. R. Robertson).

Etymology

The specific name *salmofasciatus* refers to the two salmon red stripes on the body of initial phase fish. "Red-striped wrasse" is proposed as the common name of this species.

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