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Two new species of snappers (Pisces: Lutjanidae: *Lutjanus*) from the Indo-West Pacific

GERALD R. ALLEN

Western Australian Museum, Locked Bag 49, Welshpool DC Perth, Western Australia 6986, Australia.

E-mail: tropical_reef@bigpond.com

WILLIAM T. WHITE

CSIRO Marine Research, Wealth from Oceans Flagship, GPO Box 1538, Hobart, Tasmania 7011, Australia

MARK V. ERDMANN

Conservation International, Jl. Dr. Muwardi No. 17, Renon, Denpasar, Bali 80235, Indonesia

Abstract

Two new species of snappers, genus *Lutjanus*, are described from Indo-West Pacific seas. *Lutjanus indicus* is described from 20 specimens, 54.7–226 mm SL, from western Thailand, India, Sri Lanka, and Bahrain. It has also been photographed at Oman and the Andaman Islands (tissue sample also taken). It has invariably been confused with its sibling species, *L. russellii*, from the western Pacific. Comparison of the mitochondrial cytochrome c oxidase subunit 1 (CO1) genetic marker utilised in DNA barcoding produced a genetic divergence of about 4.1 % between *L. indicus* and its closest congener, *L. russellii*. In addition, significant colour differences are useful for separating the two species, specifically a series of seven narrow yellow-to-brown stripes on the side, obliquely rising (except lower two) dorsally and posteriorly, which are present on both juveniles and adults of *L. indicus*. *Lutjanus papuensis* is described from four specimens, 173–259 mm SL, collected at Cenderawasih Bay, West Papua and purchased from fish markets at Bali and western Java, Indonesia. It has also been observed at Timor Leste, northern Papua New Guinea, and the Solomon Islands. It is most closely related to *L. bitaeniatus* from eastern Indonesia and north-western Australia, but differs notably by its unique colour pattern (bluish to grey on upper side, yellow-orange below lateral line with bright yellow anal and pelvic fins), wider interorbital, deeper body shape, and flatter snout-forehead profile. Its status was also confirmed by genetic analysis. Comparison of the mitochondrial cytochrome c oxidase subunit 1 (CO1) genetic marker utilised in DNA barcoding produced a genetic divergence of about 2.7 and 3.9 % between *L. papuensis* and its closest congeners, *L. bitaeniatus* and *L. lemniscatus*, respectively.

Key words: snappers, *Lutjanus*, Lutjanidae, new species, reef fish, taxonomy, DNA barcoding, Indo-Pacific.

Introduction

The family Lutjanidae contains 17 genera and 109 species, which are mainly confined to tropical and subtropical seas (Allen 1985, Eschmeyer 2012). *Lutjanus* Bloch 1790 is by far the largest genus with 70 species, including at least 43 species from the Indo-West Pacific region. The latter group was treated in detail by Allen and Talbot (1985) with the exception of *Lutjanus ophuysenii* (Bleeker 1860), *Lutjanus rufolineatus* (Valenciennes in Cuvier & Valenciennes 1830), and the two new species described herein. *L. ophuysenii* was previously considered a synonym of *Lutjanus vitta* (Quoy & Gaimard 1824), but was resurrected as a valid species by Iwatsuki *et al.* (1993). Similarly, *L. rufolineatus*, included as a synonym of *L. boutton* (Lacepède 1802), was resurrected by Allen (1995).

The current paper describes two new taxa that were detected during an investigation of barcoding data for the genus *Lutjanus* by the second author based on recently collected material from various locations in the Indo-West Pacific. One of the new species is relatively common at Cenderawasih Bay, West Papua, Indonesia, the site of several recent reef fish surveys by Allen and Erdmann. Although, we have been aware of the unique appearance of this fish since 2006, its status was not confirmed until the second author procured market specimens at Bali and West Java, Indonesia in 2010. DNA analysis of tissue samples from these individuals strongly suggested that it was a separate species, distinct from its congeners. Similarly, genetic results indicate that the second new species described herein is closely related to *Lutjanus russellii* (Bleeker 1849), previously thought to be widely distributed in the Indo-West Pacific region. Our results show that the fish from the Indian Ocean is distinct and also deserving of separate species status.

Materials and Methods

Methods and format of the descriptions follow those of Allen and Talbot (1985). The last dorsal and anal rays are frequently bifurcate near the base, but are counted as a single element. They are most easily counted utilising x-rays. The pectoral-ray count includes the small splint-like uppermost element. Lateral-line scales include the tubed scales from the upper edge of the opercle to the caudal-fin base as indicated by the line of flexure of the hypural plate. The smaller tubed scales extending beyond this point on the basal portion of the caudal fin are not included. Horizontal scale rows above the lateral line are counted at the level of the base of the middle dorsal spines. The scale rows on the cheek refer to the transverse rows, which are obliquely aligned. Total gill-raker count includes all distinguishable elements including tiny, low-lying rudiments. This count is given in two parts: number of elements on the upper and lower limbs and the total number of rakers. In addition, the number of distinct rakers, excluding rudiments is given after the total count. Standard length and head length are abbreviated as SL and HL respectively. Body depth refers to the greatest vertical depth (usually at level of pelvic-fin origin). Body width is the greatest width measured just behind the head at the level of the pectoral-fin base. Head length is measured from the snout tip to the posteriormost extension of the opercular membrane/flap. Snout is measured from the anteriormost extension of the upper lip to the anterior edge of the eye. The eye is measured horizontally across the orbital cavity. Interorbital is measured between the eyes and refers to the bony width unless stated otherwise. The maxilla is measured from its rear margin to the snout tip. Suborbital depth is the least distance between the upper margin of the maxilla and the lower edge of the eye. Caudal peduncle depth is measured as the least depth and caudal peduncle length is the horizontal distance between the caudal fin base and a vertical line at the level of the last anal ray. Dorsal and anal spine lengths are measured from the base rather than from the point where they emerge from the basal scaly sheath. Pectoral and pelvic fins are measured from the base to the tip of the longest ray. Caudal-fin length is the horizontal measurement connecting vertical lines from the line of flexure of the hypural plate and the tip of the longest ray.

Counts and proportions appearing in parentheses apply to the range for the paratypes if different from the holotype. Type specimens are deposited at the following institutions: Australian Museum, Sydney (AMS); Bernice P. Bishop Museum, Honolulu (BPBM); Australian National Fish Collection, Commonwealth Scientific and Industrial Research Organisation, Hobart, Tasmania (CSIRO); Museum Zoologicum Bogoriense, Cibinong, Java, Indonesia (MZB); United States National Museum of Natural History, Washington D.C. (USNM); Western Australian Museum, Perth (WAM).

Specimens of the two new species were sequenced for the cytochrome c oxidase I (CO1) DNA barcoding frag-

ment (~650 base pairs) (see Hebert *et al.* 2003, Ward *et al.* 2005, Holmes *et al.* 2009). These sequences were compared with corresponding sequences available for other Indo-West Pacific species of *Lutjanus*. DNA extractions, PCR reactions, and sequencing followed the protocols in Holmes *et al.* (2009). Kimura two-parameter pairwise genetic distances were also estimated for the CO1 datasets and these were subjected to neighbour-joining to generate trees for the species most closely grouped to each of the two new species (www.boldsystems.org). GenBank accession numbers of all CO1 sequences are provided in the associated figures.

Lutjanus indicus, n. sp.

Figures 1–3, Table 1.

Lutjanus russellii Randall 1995: 203 (Oman).

Holotype. BPBM 18803, 225 mm SL, Sri Lanka, Trincomalee, Lively Rocks (08° 21.761'N, 081° 23.664'E), spear, J.E. Randall, 6 April 1975.

Paratypes. AMS I.21115-005, 83.3 mm SL, India, Mumbai (approximately 18° 56'N, 072° 51'E), F. Talbot, 1978; AMS I.21184-006, 2 specimens, 189–226 mm SL, Thailand, Phuket (approximately 07° 52'N, 098° 22'E), Marine Research Centre, 16 November 1972; AMS I.21433-004, 198 mm SL, Sri Lanka, Colombo, John's Fish Market (approximately 06° 55'N, 079° 52'E), T. Iwamoto, 8 May 1970; AMS I.27290-002, 82.8 mm SL, India, Porto Novo (approximately 11° 50'N, 079° 50'E), F. Talbot, 20 January 1969; AMS I.27353-001, 10 specimens, 54.7–66.1 mm SL, India, Porto Novo (approximately 11° 30'N, 079° 45'E), F. Talbot, 20 November 1968; BPBM 41114, 215 mm SL, Sri Lanka, Trincomalee fish market (08° 34.814'N, 081° 13.902'E), J.E. Randall, 6 April 1975; BPBM 29448, 122 mm SL, Persian Gulf, Bahrain, fish market (approximately 26° 15'N, 050° 40'E), J.E. Randall, 2–3 November 1983; WAM P.25986-001, 213 mm SL, Persian Gulf, Bahrain, fish market (approximately 26° 15'N, 050° 40'E), W. Smith-Vaniz, 24 February 1977; WAM P.25987-008, 137 mm SL, Persian Gulf, Bahrain, Sitra Island (approximately 26° 09'N, 050° 40'E), 5 m, rotenone, G.R. Allen, 25 February 1977.

Comparative material. *L. russellii*: WAM P.176, 164 mm SL, Western Australia, Port Hedland; WAM P. 25354-026, 2 specimens, 171–182 mm SL, Western Australia, Monte Bello Islands; WAM P.27067-005, 181 mm SL, Queensland, Elliot Heads; WAM P. 29181-003, 202 mm SL, Western Australia, Broome; WAM P. 31307-036, 9 specimens, 23.1–67.5 mm SL, Indonesia, Riau Islands, Bintan Island; WAM P.31242-010, 177 mm SL, Western Australia, Kimberleys, Maret Islands; WAM unregistered, 211 mm SL, Indonesia, West Papua, Raja Ampat Islands; WAM unregistered, 192 mm SL, Indonesia, West Papua, Cenderawasih Bay.

Diagnosis. A species of *Lutjanus* with the following combination of characters: dorsal rays X,13–14 (usually 14); total gill rakers 12–14; body depth 2.5–2.9 in SL; eye 4.2–4.6 in HL; interorbital 5.9–7.0 in HL; scale rows above lateral line rising obliquely toward dorsal profile; predorsal scales extending forward nearly to level of rear part of orbit; preopercular notch and interopercular knob weakly developed; upper surface of tongue with central patch of fine granular teeth; vomer with diamond-shaped to narrowly crescent-shaped patch of granular teeth with medial posterior extension; caudal fin truncate; colour in life overall pale grey, grading to silvery white on cheek, opercle, and lower side of body with series of seven dark brown to yellow stripes on posterior head and side, prominent black spot, about 1.2–1.5 size of eye, on posterior back below base of first 6–7 soft dorsal rays, its lowermost portion occupying about one scale row below lateral line.

Description. Dorsal rays X,14 (one paratype with X,13); anal rays III,8; pectoral rays 16 (5 of 19 paratypes with 15); lateral-line scales 48 (47–49); oblique scale rows above lateral line 8 (two paratypes with 9); horizontal scale rows below lateral line 14 (15–16); transverse scale rows on cheek 5 (5–6); total gill rakers on first gill arch 6 + 7 = 13 (5–7 + 7–8 = 13–15), developed rakers 1 + 7 (1 + 7–8), excluding 2–3 rough patches on surface of gill arch at end of lower limb.

Body moderately elongate, greatest depth 2.5 (2.6–2.9) in SL, and laterally compressed, greatest width 2.6 (2.2–2.7) in depth; head relatively short with blunt snout profile, its length 2.6 (2.5–2.7) in SL; snout-forehead profile straight to slightly concave; snout 2.8 (2.8–3.2), eye 4.6 (4.2–4.6), interorbital 6.4 (5.9–7.0), maxilla 2.5



Figure 1. Underwater photograph of *Lutjanus indicus*, approximately 320 mm TL, Andaman Islands (G. Allen photo).

(2.4–2.7), suborbital depth 5.4 (5.4–6.4, about equal to fleshy interorbital width), caudal peduncle depth 2.9 (2.8–3.2), caudal peduncle length 2.4 (2.1–2.7), all in HL.

Body, opercle, and preopercle with finely ctenoid scales; predorsal scales extending forward nearly to level of rear part of orbit; parietal, frontal, interorbital, snout, preorbital, lips, dentary, and rear edge of preopercle naked; pair of prominent, ovate nostril openings on each side of snout; nostrils with low membranous rim, forming elevated flap on outer edge of anterior nostril, slight elevations anteriorly and posteriorly on outer edge of posterior nostrils; preopercular margin finely serrate (serrae increasing in size ventrally) with weakly developed notch just above angle; interopercular knob weakly developed and inconspicuous; sharp, flattened, leathery projection at middle of opercular margin, with blunt bony spine (mostly covered by scales) immediately above its base; margins of opercle, interopercle, and subopercle otherwise smooth.

Upper jaw with dagger-like canine tooth, about half pupil diameter in length, on each side anteriorly, with smaller canine tooth (about half size of large canine) between it and symphysis; remaining lateral portion of upper



Figure 2. *Lutjanus indicus*, holotype, 225.8 mm SL, Trincomalee, Sri Lanka, showing fresh colouration (J. Randall photo).

jaw with a series of 10–13 gradually smaller caniniform teeth; lower jaw with 12–13 small canine teeth on each side, (largest posteriorly) and single row of 8–10 minute conical teeth at back of jaw; vomer with diamond-shaped to narrowly crescent-shaped patch of granular teeth with medial posterior extension.

Dorsal-fin outline incised, third to fifth spines longest, remaining spines gradually decreasing in length; profile of soft dorsal fin relatively low and rounded; length of first dorsal spine 9.3 (7.0–11.3), of third dorsal spine 2.8 (2.5–2.9), of fifth dorsal spine 2.7 (2.5–2.9), of tenth dorsal spine 5.0 (3.7–4.6), of longest soft dorsal ray 3.3 (2.6–3.6), of first anal spine 11.3 (7.8–12.1), of second anal spine 4.7 (3.3–5.0), of third anal spine 4.0 (3.6–4.6), of longest soft anal ray 2.5 (2.2–3.2), all in head length; pectoral fins pointed, length 1.4 (1.4–1.5) in HL; pelvic fins relatively short, not reaching anus when depressed, length 1.9 (1.7–1.9) in HL; caudal fin truncate, length 1.5 (1.2–1.4) in HL.

Colour in life. (from underwater photograph, Fig. 1) Overall pale grey, grading to silvery white on cheek, opercle, and lower side of body; series of seven dark brown to yellow stripes on posterior head and side, uppermost nearly on dorsal midline of forehead and lowermost level with upper edge of pectoral-fin base; lower two stripes horizontal, but remainder rising obliquely towards back; snout, interorbital, and nape grey brown to slightly reddish; prominent black spot, about 1.2–1.5 size of eye, on posterior back, below base of first 6–7 soft dorsal rays, its lowermost portion occupying about one scale row below lateral line; median fins translucent whitish, often with bluish cast, caudal and sometimes dorsal fin brown basally; pelvic fins translucent whitish, sometimes with brownish medial portion, and usually with white anterior margin; pectoral fins mainly translucent, often narrowly yellow on upper margin; small brown spot at base of uppermost pectoral-fin ray, invading inner axil of fin where considerably expanded.

Colour of holotype when fresh. (Fig. 2) Grey brown dorsally on snout, dorsal portion of head and upper back, grading to white or silvery ventrally; prominent black spot and pattern of stripes on side as described under life colouration above, stripes generally brown except lowermost very faint and yellowish; dorsal fin bluish-white with brown outer margin; caudal fin with small white scales covering basal portion then dark grey, grading to pale grey distally with narrow brownish margin; anal and pelvic fins mainly white; pectoral fin translucent with dorsal margin of uppermost ray brown basally.

Colour of holotype in alcohol. (Fig. 3) Head and body brown dorsally grading to tan or pale yellowish on ventral third, except chin whitish; prominent dark brown spot, about 1.2–1.5 size of eye, on posterior back, below base of first 6–7 soft dorsal rays, its lowermost portion occupying about one scale row below lateral line; dorsal, anal, pelvic, and pectoral fins yellow-tan; caudal fin dusky brownish basally grading to yellowish towards outer margin. Paratypes (except smallest) are similar, although older specimens are tan to brownish overall, lacking the yellowish hue on the lower third of the head and body. The smallest paratype (122 mm SL) has faint, nar-



Figure 3. *Lutjanus indicus*, preserved holotype, 225.8 mm SL, Trincomalee, Sri Lanka (G. Allen photo).

Table 1. Proportional measurements for selected type specimens of *Lutjanus indicus* as percentage of the standard length.

	Holotype BPBM 18803	Paratype AMS I.21184	Paratype BPBM 41114	Paratype WAM P.25986	Paratype AMS I.21433	Paratype AMS I.21184	Paratype WAM P.25987
Standard length (mm)	225	226	215	213	198	189	137
Body depth	39.8	37.7	34.6	35.2	35.5	37.9	36.5
Body width	15.2	13.9	16.0	14.4	13.5	15.4	13.3
Head length	38.9	39.9	38.3	37.9	37.4	38.3	39.3
Snout length	13.7	13.7	13.1	13.4	13.4	12.3	12.5
Eye width	8.5	9.6	8.5	8.6	8.7	9.1	9.2
Interorbital width	6.1	5.7	6.1	6.1	6.3	6.5	6.1
Suborbital width	7.2	7.4	6.8	6.6	6.2	7.0	6.1
Maxillary length	15.8	16.4	15.7	15.4	15.5	15.8	14.7
Caudal peduncle depth	13.6	12.9	13.8	13.7	13.4	13.8	12.5
Caudal peduncle length	16.3	14.6	16.8	17.4	17.3	16.9	18.7
Predorsal length	46.1	46.0	44.3	44.4	45.3	45.4	44.3
Preanal length	69.4	72.8	70.9	68.9	69.2	69.6	69.1
Prepelvic length	39.1	40.1	40.6	37.7	38.7	38.8	38.5
Spinous dorsal-fin base	27.9	29.3	26.3	30.1	25.9	30.1	27.4
Soft dorsal-fin base	25.4	21.2	23.8	23.3	23.9	21.7	22.0
Anal-fin base	14.8	13.4	15.0	14.7	15.2	15.1	16.2
Pectoral-fin length	27.0	28.5	27.9	25.7	26.2	27.5	26.3
Pelvic-fin length	20.8	21.5	20.1	21.1	22.5	21.5	22.5
Pelvic-spine length	12.0	11.3	11.7	12.5	12.4	12.5	13.1
1st dorsal spine	4.2	3.5	5.0	4.0	5.2	4.7	5.1
3rd dorsal spine	13.7	14.4	13.1	13.5	14.7	14.1	13.4
5th dorsal spine	14.6	16.2	13.7	12.9	13.9	13.8	14.7
Last dorsal spine	7.8	9.1	8.8	8.3	10.2	8.3	10.2
Longest soft dorsal ray	11.7	11.5	11.6	10.5	13.0	10.7	13.3
1st anal spine	3.5	3.8	4.0	3.8	3.3	3.2	5.0
2nd anal spine	8.2	9.9	9.2	8.8	9.2	7.6	10.5
3rd anal spine	9.8	9.8	9.8	9.6	10.3	8.3	10.9
Longest anal soft ray	15.3	12.5	14.7	14.8	16.8	14.6	16.6
Caudal-fin length	25.9	30.3	26.8	28.3	31.0	29.8	29.2



Figure 4. Underwater photograph of *Lutjanus russellii*, adult approximately 350 mm TL, Brunei (G. Allen photo).

row, brown, oblique stripes on the side of the body, which are described in the live and fresh colouration sections above. The oblique stripes are also barely visible on the 198 mm SL paratype, which is mainly yellow-tan overall and has a broad, faint “halo” around the dark brown spot on the back.

Etymology. The species is named *indicus* with reference to its Indian Ocean distribution.

Comparisons. *Lutjanus indicus* has invariably been confused with its sibling species, *L. russellii* from the western Pacific. Allen and Talbot (1985) stated that *L. russellii* was unique among Indo-West Pacific *Lutjanus* in having different colour patterns related to broad geographic areas. Although suspecting species-level differences between Indian Ocean and Pacific populations, they failed to detect any diagnostic differences except colouration. Similarly, we have not found any substantial morphometric or meristic differences, but based on our genetic analysis of the genus (see genetic discussion below) in combination with significant colour pattern differences, we are now confident in recognising the Indian Ocean fish as a separate, new taxon. It differs most notably from *L. russellii* (Fig. 4) in possessing a series of seven narrow, yellow-to-brown stripes on the side, obliquely rising (except lower two) dorsally and posteriorly. Although, small juveniles of the Pacific fish also have stripes, these are generally much wider (Fig. 5), and generally are not apparent in fish larger than about 50 mm SL. There is



Figure 5. Underwater photograph of *Lutjanus russellii*, juvenile approx. 50 mm TL, Palawan, Philippines (G. Allen photo).

also a difference in the position of the large dark spot on the posterior back in relation to the lateral line. The spot on *L. indicus* is mainly well above the lateral line with only about one-scale row within the spot lying below it. In contrast, the more horizontally elongate spot of *L. russellii* is approximately bisected by the lateral line.

Distribution and habitat. The new species is known with certainty from the northern continental margin of the Indian Ocean including western Thailand, Myanmar, Andaman Islands, Sri Lanka, India, Gulf of Oman (Randall 1995), and Arabian Gulf. Allen and Talbot (1985) recorded *L. russellii* from the southern Red Sea, Zanzibar, South Africa, Seychelles, Madagascar, and Mauritius, and we provisionally include these records as *L. indicus*, but the status of the Red Sea and western Indian Ocean population needs to be reassessed, preferably utilising genetic analysis.

We observed this species in coral-reef habitat at western Thailand, Myanmar, and the Andaman Islands. It was generally encountered solitary or in small groups in about 5–15 m depth. It is also taken by trawlers in deeper water (to at least 50 m) and regularly appears in fish markets. There is scant information on juvenile habitat, but we suspect it is similar to that of *L. russellii* young, which consists of brackish mangrove estuaries and lower reaches of freshwater streams.

Lutjanus papuensis, n. sp.

Figures 6–8, Table 2.

Lutjanus species Allen & Erdmann 2012: 455 (West Papua, Papua New Guinea, and Solomon Islands).

Holotype. MZB 21123, (GenBank accession number KC130848), 259 mm SL, Indonesia, West Papua Province, Cenderawasih Bay, East Wandammen (02° 36.153'S, 134° 39.148'E), 10 m, spear, M. Erdmann, 23 March 2012.

Paratypes. CSIRO H 7407-01 (GenBank accession number HM422401), 224 mm SL, Indonesia, West Java, Pelabuhanratu fish market, W. White & Dharmadi, 10 October 2009; USNM 408444 (GenBank accession number JN311961), 173 mm SL, Indonesia, Bali, Kedongan fish market, W. White & Dharmadi, 31 October 2010; WAM P. 33780-001, 240 mm SL, collected with holotype.

Comparative material. *L. bitaeniatus*: CSIRO H 6573-21, 181 mm SL, Western Australia, off Cape Leveque; WAM P.28671-005, 246 mm SL, Indonesia, Java; WAM P. 30572-002, 255 mm SL, Western Australia, Browse Island; WAM P. 30602-002, 4 specimens, 259–269 mm SL, Western Australia, Browse Island; WAM P. 30669-002, 3 specimens, 269–330 mm SL, Western Australia, Browse Island. *L. lemniscatus*: WAM P. 26847-001, 245 mm SL, Western Australia, Monte Bello Islands; WAM P. 27186-001, 323 mm SL, Western Australia, Rankin Bank; WAM P. 27982-001, 240 mm SL, Western Australia, Monte Bello Islands; WAM P. 28305-001, 400 mm SL, Queensland, off Cairns; WAM P. 33378-001, 256 mm SL, Western Australia, Kimberley coast. *L. lunulatus*: WAM P. 26509-010, 170 mm SL, Sri Lanka, Colombo; WAM P. 28671-002, 184 mm SL, Indonesia, Java.

Diagnosis. A species of *Lutjanus* with the following combination of characters: dorsal rays X,13; total gill rakers 16; body depth 2.4–2.8 in SL; eye 4.5–4.7 in HL; interorbital 5.5–6.5 in HL; scale rows above lateral line rising obliquely toward dorsal profile; predorsal scales extending slightly anterior to level of preopercular margin; preopercular notch and interopercular knob weakly developed; upper surface of tongue with central patch of fine granular teeth; vomer with narrow, crescent-shaped patch of granular teeth without medial posterior extension; caudal fin slightly emarginate; colour in life reddish to yellow on head, bluish to grey on upper side, grading to yellow-orange below lateral line; bright yellow anal and pelvic fins, and black spot at base of uppermost pectoral-fin rays.

Description. Dorsal rays X,13; anal rays III,8; pectoral rays 17; lateral-line scales 48 (one paratype with 47); oblique scale rows above lateral line 8 (one paratype with 9); horizontal scale rows below lateral line 15 (14–16); transverse scale rows on cheek 8 (one paratype with 9); total gill rakers on first gill arch 7 + 9 = 16 (developed rakers 1 + 6–8), excluding 2–3 rough patches on surface of gill arch at anterior end of lower limb.

Body moderately elongate, greatest depth 2.8 (2.4–2.6) in SL, and laterally compressed, greatest width 2.1

(2.0–2.2) in depth; head relatively short with blunt snout profile, its length 2.7 (2.5–2.7) in SL; snout-forehead profile slightly concave; snout 2.8 (2.8–2.9), eye 4.7 (4.5–4.6), interorbital 6.5 (5.5–6.5, much broader than suborbital, about equal to distance from lower margin of eye to cleft of mouth), maxilla 2.3 (2.3–2.4), suborbital width 5.2 (5.1–5.3), caudal peduncle depth 3.2 (2.8–3.2), caudal peduncle length 2.5 (2.3–2.4), all in HL.

Body, opercle, and preopercle with finely ctenoid scales; predorsal scales extending slightly anterior to level of preopercular margin; parietal, frontal, interorbital, snout, preorbital, lips, dentary, and rear edge of preopercle naked; pair of prominent, ovate nostril openings on each side of snout; nostrils with fleshy rim, elevated posteriorly and laterally on respective anterior and posterior openings; preopercular margin finely serrate (serrae increasing in size ventrally) with weakly developed notch just above angle; interopercular knob weakly developed; sharp, flattened, leathery projection at middle of opercular margin, with blunt bony spine (mostly covered by scales) immediately above its base; margins of opercle, interopercle, and subopercle otherwise smooth.

Upper jaw with dagger-like canine tooth, about half pupil diameter in length, on each side anteriorly, with smaller canine tooth (about half size of large canine) between it and symphysis; remaining lateral portion of upper jaw with series of 9–11 small caniniform teeth; anterior half of lower jaw with 7–9 small canine teeth on each side, (largest at front and median portion of jaw) and single row of 8–11 small conical teeth at back of jaw; vomer with narrow crescent-shaped patch of fine granular teeth, without medial posterior extension; similar teeth on palatines, and patch of fine teeth at middle of upper surface of anterior part of tongue.

Dorsal-fin outline incised, fourth or fifth spines longest, remaining spines gradually decreasing in length; profile of soft dorsal fin relatively low and rounded; length of first dorsal spine 7.4 (6.4–8.2), of third dorsal spine 3.3 (2.9–3.4), of fifth dorsal spine 2.9 (2.6–3.3), of tenth dorsal spine 4.4 (4.2–4.4), of longest soft dorsal ray 3.0 (3.0–3.2), of first anal spine 7.8 (6.1–8.0), of second anal spine 3.7 (3.2–3.8), of third anal spine 3.5 (3.3–4.1), of longest soft anal ray 2.6 (2.6–2.9), all in head length; pectoral fins pointed, length 1.2 in HL; pelvic fins relatively short, not reaching anus when depressed, length 1.9 (1.7–1.8) in HL; caudal fin truncate or slightly emarginate, length 1.8 (1.5–1.8) in HL.

Colour in life. (from underwater photograph, Fig. 6) Generally brown or often with bluish or purplish cast on upper sides and on dorsal and caudal fins; yellow on most of lower side including belly, and region directly above anal fin; reddish orange on breast and ventral portion of head; naked areas of head grey/brownish to reddish; scaled portions of head pale yellow to orange; pelvic and anal fins bright yellow; pectoral fin translucent yellowish with prominent black spot at base of uppermost rays.



Figure 6. *Lutjanus papuensis*, underwater, approx. 300 mm TL, Cenderawasih Bay, W. Papua, Indonesia (G. Allen photo).

Table 2. Proportional measurements for selected type specimens of *Lutjanus papuensis* as percentage of the standard length.

	Holotype MZB 21123	Paratype WAM P.33780	Paratype CSIRO H7407-01	Paratype USNM 408444
Standard length (mm)	259	240	224	173
Body depth	35.7	38.4	38.9	41.9
Body width	16.8	19.5	19.8	18.7
Head length	37.4	39.2	37.7	38.3
Snout length	13.1	13.6	13.6	13.3
Eye width	8.0	8.6	8.3	8.5
Interorbital width	5.8	6.1	6.8	6.8
Suborbital width	7.2	7.7	7.2	7.2
Maxillary length	16.3	16.7	16.5	16.0
Caudal peduncle depth	11.5	12.4	13.3	13.6
Caudal peduncle length	14.7	16.2	15.5	16.6
Predorsal length	41.9	43.4	42.8	43.9
Preanal length	64.0	67.0	72.8	71.2
Prepelvic length	36.4	39.0	38.6	39.2
Spinous dorsal-fin base	26.1	27.7	27.6	31.4
Soft dorsal-fin base	24.0	24.5	21.5	22.4
Anal-fin base	14.0	14.8	15.3	15.4
Pectoral-fin length	30.0	31.8	32.3	32.5
Pelvic-fin length	19.5	21.3	21.1	22.6
Pelvic-spine length	11.2	12.4	12.1	14.2
1st dorsal spine	5.0	5.0	4.6	6.0
3rd dorsal spine	11.4	11.5	11.2	13.2
5th dorsal spine	13.0	13.2	11.6	14.8
Last dorsal spine	8.6	9.2	8.8	8.8
Longest soft dorsal ray	12.3	13.2	12.2	11.9
1st anal spine	4.8	4.9	5.0	6.2
2nd anal spine	10.0	10.9	10.0	12.0
3rd anal spine	10.8	11.9	9.2	11.5
Longest anal soft ray	14.4	15.3	12.9	14.5
Caudal-fin length	20.7	21.6	25.3	25.9



Figure 7. *Lutjanus papuensis*, paratype (USNM 408444), 173.1 mm SL, Kedongan fish market, Bali, Indonesia (W. White photo).

Colour when freshly collected. (Fig. 7) Generally reddish brown on most of head and body; reddish on lower portion of head grading to rich apricot colouration on ventral third of side; spinous dorsal fin reddish brown, soft dorsal fin dull red; caudal fin dark brown except outer third reddish; pelvic and anal fins bright yellow; pectoral fin translucent yellowish (brighter dorsally) with black spot at base of uppermost rays.

Colour in alcohol. (Fig. 8) Grey on snout, upper surface of head, and upper half of body, grading to yellowish tan on lower third of body (lower fourth on caudal peduncle); preopercle and opercle reddish tan; dorsal fin dark



Figure 8. *Lutjanus papuensis*, preserved holotype, 259.0 mm SL, Cenderawasih Bay, West Papua, Indonesia (G. Allen photo).

grey with narrow white margin on soft portion; caudal fin dark grey; pectoral, pelvic, and anal fins yellowish tan; well-contrasted black spot at base of uppermost pectoral-fin rays.

Etymology. The species is named *papuensis* after the West Papuan location where it was first collected. Also, West Papua (particularly Cenderawasih Bay) appears to be the stronghold of the distribution, judging from its abundance compared to other locations within the known range. The species was also referred to as the Papuan Snapper by Allen and Erdmann (2012).

Comparisons. The new species keys out to couplet 30, utilising Allen and Talbot's (1985) key to the Indo-Pacific species of *Lutjanus*. This couplet contains two choices, *Lutjanus bitaeniatus* (Valenciennes in Cuvier & Valenciennes 1830) and *Lutjanus lemniscatus* (Valenciennes in Cuvier & Valenciennes 1828). Coincidentally, because this key is an artificial one not necessarily intended to reflect phylogenetic relationships, our genetic results indicate these species are also the closest relatives to *L. papuensis*. Morphologically, the new species is most similar to *L. lemniscatus* of the East Indian region, particularly in relation to its narrower interorbital (5.5–6.5 vs. 4.9–5.2 in HL), more slender body shape (2.4–2.8 vs. 2.3–2.5 in SL), and slightly concave (vs. flat or convex) snout-forehead profile in comparison with *L. bitaeniatus*. Both *L. lemniscatus* and *L. papuensis* have a similar body shape, but are easily distinguished on the basis of colour pattern, most notably the lack of yellow on the pelvic and anal fins and lower body of *L. lemniscatus* (Fig. 9). The latter species further differs from *L. papuensis* in having 16 rather than 17 pectoral-fin rays. Genetic results (see discussion below) also confirm the species-level separation of these species.

Contrary to the morphological findings, our genetic analysis of the new species reveals a closer relationship with *L. bitaeniatus* of eastern Indonesia and north-western Australia. In addition to the differences already mentioned in relation to its wider interorbital, deeper body shape, and flatter snout-forehead profile, *L. bitaeniatus* also differs from *L. papuensis* in colour pattern (Fig. 10). It is overall reddish pink without any yellow on the body and fins, except juveniles may exhibit a yellow midlateral stripe on the side of the body. Moreover, *L. bitaeniatus* is not encountered on coral reefs, instead frequenting offshore trawling grounds in about 40–105 m depth.

Lutjanus lunulatus (Park 1797) of the northern Indian Ocean and western Pacific has a similar colour pattern to *L. papuensis*, especially with regards to the yellow colouration of the ventral body and adjoining fins (Fig. 11). However, it differs noticeably in having a large, crescent-shaped black marking on the caudal fin. Young individuals (under about 20 cm SL) of *L. russellii* also sometimes display yellow pelvic and anal fins (Fig. 12), but this species generally lacks bright yellow on the lower body and has a black spot intersected by the lateral line below



Figure 9. Underwater photograph of *Lutjanus lemniscatus*, approx. 350 mm TL, Myanmar, Andaman Sea (G. Allen photo).



Figure 10. *Lutjanus bitaeniatus*, 181.0 mm SL (CSIRO H 6573-21), northwest of Cape Leveque, Western Australia (L. Conboy photo).

the level of the soft dorsal junction, although this feature can be temporarily “switched” off (see Fig. 12). It also differs from *L. papuensis* in having a medial posterior extension of the vomerine tooth patch.

Distribution and habitat. Allen and Erdmann (2012) reported this species from Indonesia (West Papua Province), Papua New Guinea (Manus Island and Milne Bay Province), and the Solomon Islands (Malaita, Santa Ysabel, and New Georgia). In addition, M. Erdmann observed a single individual at Timor Leste during a 2012 survey. Although two of the paratypes were purchased at fish markets in Bali and western Java, their exact origin is uncertain, given that fishes entering these markets can be caught throughout the Indonesian Archipelago.

The habitat consists of coastal fringing reefs in about 6–15 m depth. It is generally seen solitarily or in small groups. Cenderawasih Bay in West Papua Province, Indonesia is the only location where we have seen it on a regular basis. Otherwise, it is generally rare. Only six individuals were encountered during a month-long survey by



Figure 11. Underwater photograph of *Lutjanus lunulatus*, approximately 350 mm TL, Timor Leste (G. Allen photo).



Figure 12. Underwater photograph of *Lutjanus russellii*, approx. 200 mm TL, Raja Ampat Islands, West Papua, Indonesia (G. Allen photo).

G. Allen at the Solomon Islands in 2004. We have not encountered any juvenile fish or subadults under about 150 mm SL despite considerable searching. It appears likely they are confined to a particular habitat not frequented by divers, perhaps either dense mangroves or deeper reefs (i.e. below 70 m).

Barcoding results. DNA barcoding can be a useful tool for distinguishing taxa at the species level. Members of the family Lutjanidae can be readily distinguished based on the barcode sequence (e.g. Victor *et al.* 2009, White & Last 2012). It should be noted that barcoding results should not be used in isolation but can potentially highlight where cryptic speciation may be present. In this study, the barcoding results clearly separated the two new species from their closest congeners.

The three *L. indicus* sequences available in the BOLD database (www.boldsystems.org; one collected during this study and two identified as *L. russellii* from Lakra *et al.* 2011) grouped closest to *L. russellii* from Australia and Indonesia using the CO1 marker (Fig. 13). These two species had an average sequence divergence of 4.1% (minimum interspecific divergence of 4.0%) based on these sequences (Table 3). It should be noted that a second group of *L. russellii* samples from Western Australia and Queensland (not shown in Fig. 13) grouped close to but separate from the *L. russellii* samples in Fig. 13 with a minimum divergence of 2.0%. Investigation into whether this is another cryptic species of *Lutjanus* belonging to the *L. russellii* complex is currently underway. *L. indicus* also aligned closely to, but clearly distinct, from *Lutjanus ehrenbergii* (Peters 1869), *Lutjanus monostigma* (Cuvier in Cuvier & Valenciennes 1828), *Lutjanus fulviflamma* (Forsskål 1775), and *Lutjanus carponotatus* (Richardson 1842), with average divergences from these species of 8.2, 7.0, 8.3, and 6.1% (minimum interspecific divergences of 7.4, 4.0, 8.0, and 5.9%), respectively (Fig. 13, Table 3). The three *L. papuensis* sequences available in the BOLD database grouped closest to *L. lemniscatus* and *L. bitaeniatus* from Australia, from which they had average divergences of 3.9 and 2.7% (minimum interspecific divergences of 3.5 and 2.5%), respectively (Fig. 14, Table 3). *L. papuensis* also grouped closely to but clearly distinct from *Lutjanus decussatus* (Cuvier in Cuvier & Valenciennes 1828) and *L. lunulatus*, with average divergences from these two species of 4.4 and 5.8% (minimum interspecific divergences of 4.3 and 5.9%), respectively (Fig. 14, Table 3).

Of the 30 species of Indo-West Pacific *Lutjanus* species with sequences available in the BOLD database, the average divergence between species is 13.2%. These divergences range from 2.7% between *L. papuensis* and *L. bitaeniatus* to 19.6% between *Lutjanus sebae* (Cuvier 1816) and *Lutjanus madras* (Valenciennes in Cuvier

Figure 13. Neighbour-joining tree of nucleotide sequence divergence at the barcoding region of the COI gene following the Kimura two-parameter model (K2P) generated by BOLD (Barcode of Life Database) for *Lutjanus indicus* and its closest congeners. Scale bar represents 2% K2P distance. GenBank accession numbers are listed.

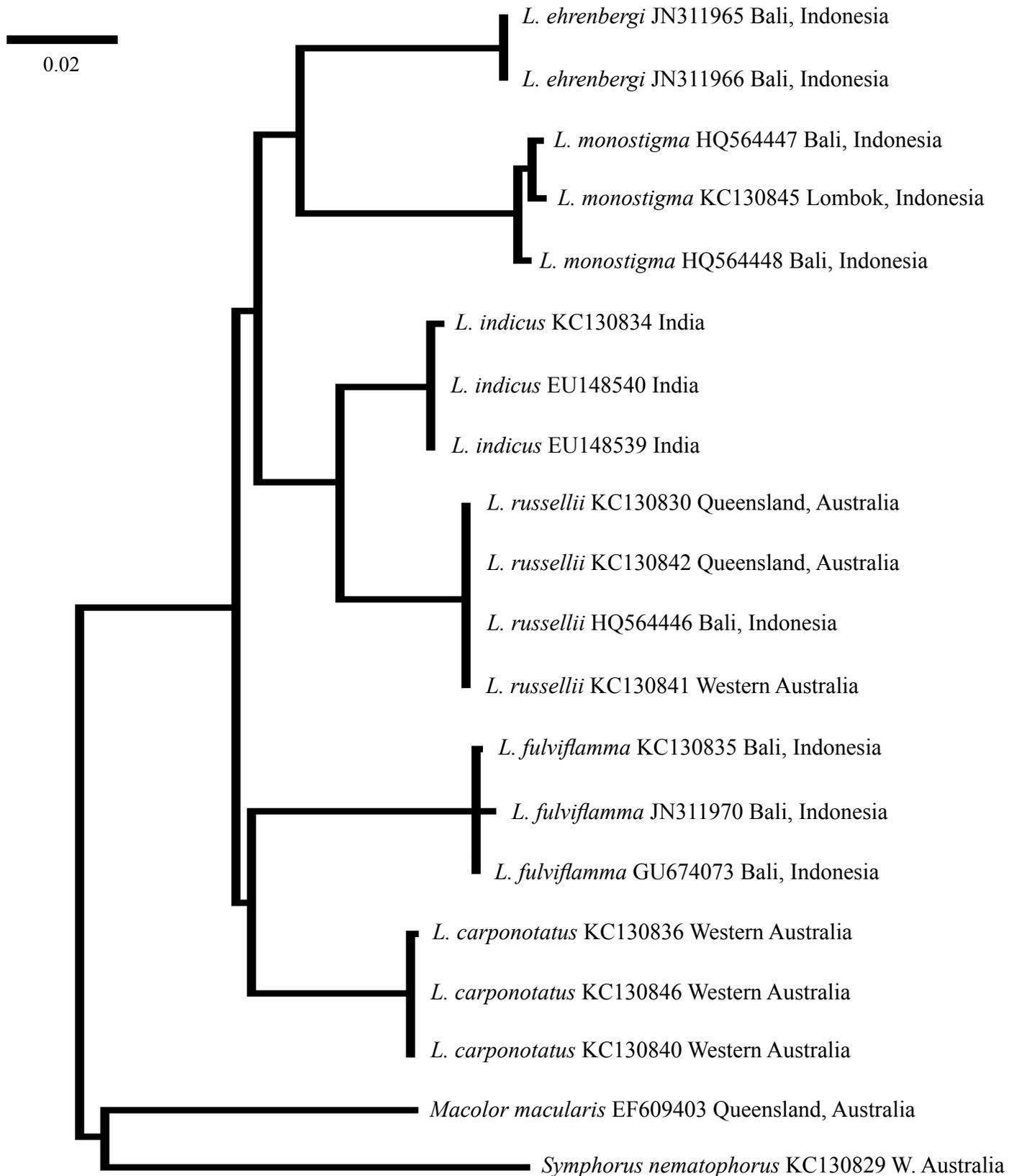
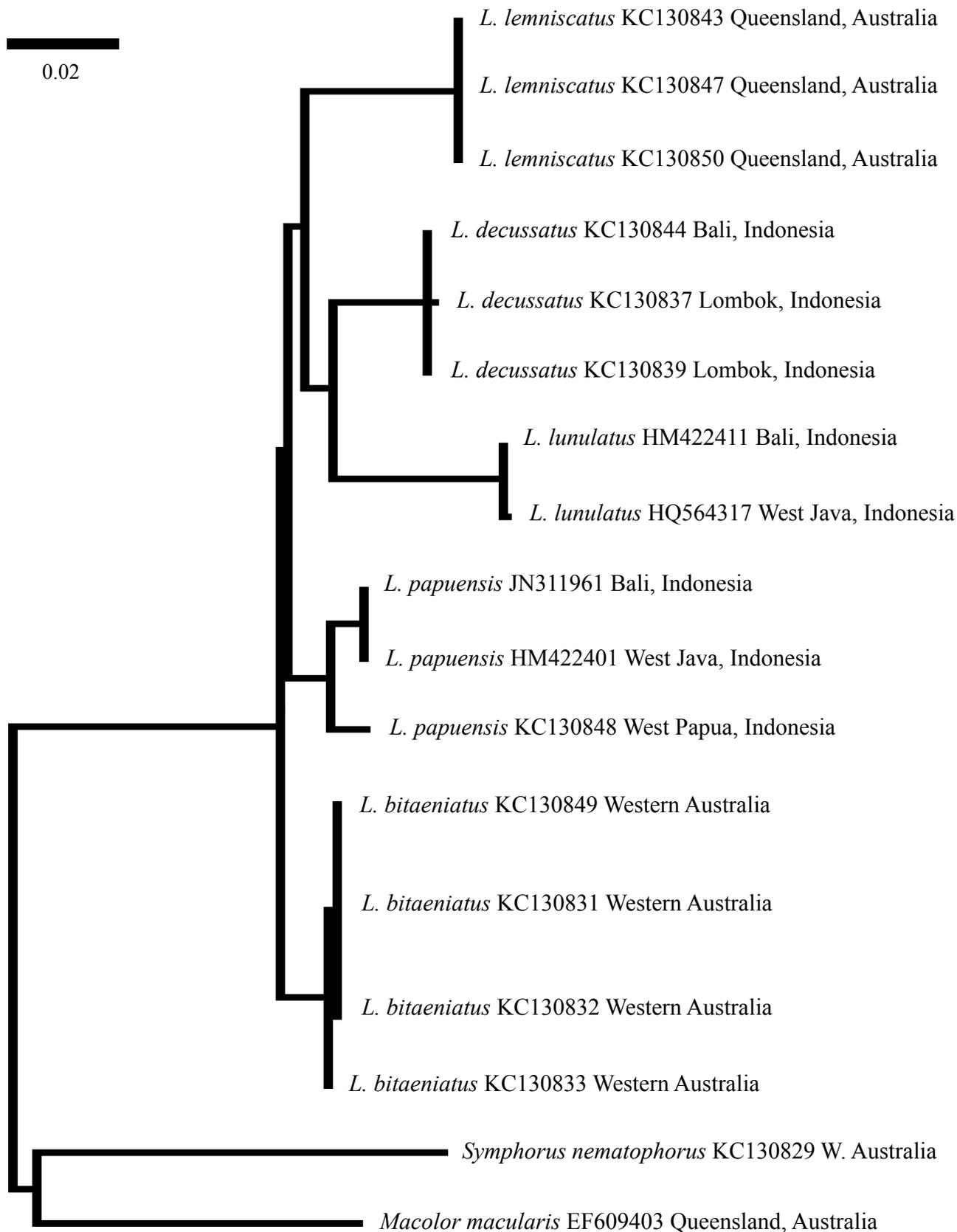


Figure 14. Neighbour-joining tree of nucleotide sequence divergence at the barcoding region of the COI gene following the Kimura two-parameter model (K2P) generated by BOLD (Barcode of Life Database) for *Lutjanus papuensis* and its closest congeners. Scale bar represents 2% K2P distance. GenBank accession numbers are listed.



<i>L. adetii</i>	
<i>L. argenteimaculatus</i>	
<i>L. bengalensis</i>	
<i>L. biguttatus</i>	
<i>L. bitaeniatus</i>	
<i>L. bohar</i>	
<i>L. carponotatus</i>	
<i>L. decussatus</i>	
<i>L. ehrenbergii</i>	
<i>L. erythropterus</i>	
<i>L. fuviflamma</i>	
<i>L. fulvus</i>	
<i>L. gibbus</i>	
<i>L. indicus</i>	
<i>L. johnei</i>	
<i>L. kasmira</i>	
<i>L. lemniscatus</i>	
<i>L. humulatus</i>	
<i>L. lufjanus</i>	
<i>L. madras</i>	
<i>L. malabaricus</i>	
<i>L. monostigma</i>	
<i>L. papuensis</i>	
<i>L. quinquelineatus</i>	
<i>L. rivulatus</i>	
<i>L. rufolineatus</i>	
<i>L. russellii</i>	
<i>L. sebae</i>	
<i>L. timorensis</i>	
<i>L. vilta</i>	
<i>L. argenteimaculatus</i>	16.5
<i>L. bengalensis</i>	15.2 13.5
<i>L. biguttatus</i>	15.5 14.1 13.3
<i>L. bitaeniatus</i>	14.2 11.4 11.3 7.2
<i>L. bohar</i>	15.7 16.8 14.4 14.7 13.6
<i>L. carponotatus</i>	14.9 13.7 13.2 9.8 8.1 13.9
<i>L. decussatus</i>	14.5 12.7 12.5 9.1 3.8 14.0 9.7
<i>L. ehrenbergii</i>	15.1 13.8 12.0 10.4 9.8 14.7 8.2 10.7
<i>L. erythropterus</i>	11.5 17.0 17.3 17.4 16.5 16.5 16.7 16.3 18.5
<i>L. fuviflamma</i>	12.2 14.0 12.9 10.0 8.6 14.9 7.0 8.5 9.2 17.0
<i>L. fulvus</i>	16.2 11.6 10.1 13.6 12.5 13.5 14.0 13.0 13.9 16.4 14.1
<i>L. gibbus</i>	14.8 15.8 16.2 17.5 15.4 11.8 15.3 15.9 15.1 17.0 15.6 15.5
<i>L. indicus</i>	13.6 14.7 14.0 11.2 8.5 14.4 6.1 9.5 8.2 16.8 8.3 14.3 14.8
<i>L. johnei</i>	16.1 14.6 15.4 14.8 12.4 15.4 13.2 12.4 14.0 16.2 12.6 16.0 16.1 14.3
<i>L. kasmira</i>	15.5 11.9 5.2 12.9 11.2 13.7 13.9 12.5 12.6 16.3 14.1 8.2 15.5 14.1 14.8
<i>L. lemniscatus</i>	16.6 12.8 11.2 8.5 4.3 15.3 9.4 5.1 9.5 17.9 9.6 13.6 17.2 10.6 14.0 12.0
<i>L. humulatus</i>	15.4 12.5 12.3 8.9 5.3 14.5 11.1 5.0 11.2 16.8 9.7 13.8 15.2 10.5 13.3 10.9 6.3
<i>L. lufjanus</i>	15.4 14.2 13.9 9.5 9.6 14.3 11.6 10.8 12.0 16.0 11.4 14.6 15.2 12.4 13.7 12.6 10.4 10.7
<i>L. madras</i>	15.6 13.4 13.1 7.5 8.0 14.7 11.0 9.3 10.7 17.5 11.0 15.0 16.3 11.7 13.7 13.2 8.6 9.2 10.0
<i>L. malabaricus</i>	12.8 16.3 17.4 18.2 16.5 15.1 16.3 16.8 17.2 12.7 15.6 16.3 10.8 15.8 17.2 16.5 17.7 16.6 15.2 17.7
<i>L. monostigma</i>	14.2 13.4 12.2 10.7 8.6 14.6 8.5 10.2 8.0 16.6 9.9 14.6 16.8 7.0 13.9 12.7 9.5 9.9 11.8 10.8 16.6
<i>L. papuensis</i>	14.9 12.1 12.3 8.5 2.7 14.9 9.4 4.4 10.1 17.3 8.8 13.7 16.6 9.7 13.1 12.6 3.9 5.9 9.7 8.0 17.0 9.1
<i>L. quinquelineatus</i>	14.1 12.2 6.3 13.9 12.9 13.4 12.4 14.5 12.9 16.0 13.7 9.0 14.6 13.6 14.6 5.5 14.5 12.9 14.1 14.6 16.7 13.2 14.2
<i>L. rivulatus</i>	17.1 13.2 12.6 14.7 11.6 15.8 14.0 13.1 14.7 18.6 14.5 14.4 15.9 13.4 14.4 13.6 13.7 12.7 15.9 14.5 17.3 12.7 12.5 13.1
<i>L. rufolineatus</i>	13.4 11.9 6.3 13.0 12.0 14.7 12.2 13.4 12.2 15.2 13.2 9.4 15.3 13.1 13.6 5.2 12.9 12.3 12.8 13.5 16.4 12.5 13.1 2.9 12.6
<i>L. russellii</i>	13.6 14.4 13.8 10.6 8.4 14.8 6.6 9.5 8.4 16.1 8.4 14.3 15.8 4.1 13.4 13.5 9.3 10.8 12.0 11.3 16.0 7.0 9.1 13.6 13.6 12.6
<i>L. sebae</i>	12.7 18.0 17.4 18.6 16.2 18.7 16.7 18.4 17.9 15.4 16.4 19.2 19.2 16.4 17.2 17.5 18.8 17.6 19.1 19.6 16.2 16.4 16.7 17.1 19.1 16.8 16.8
<i>L. timorensis</i>	12.8 16.7 17.8 18.0 17.3 16.5 15.4 17.3 17.0 11.3 14.8 16.4 15.5 13.9 17.4 16.3 18.6 17.0 15.9 19.4 13.0 15.4 18.3 15.8 17.8 15.6 15.1 15.7
<i>L. vilta</i>	15.6 14.5 11.9 7.6 6.7 13.8 9.8 8.9 9.6 19.0 10.4 13.1 17.1 10.5 13.9 11.9 7.1 9.8 9.6 6.4 18.5 9.5 6.9 12.9 13.8 11.8 10.1 18.7 18.7
<i>L. argenteimaculatus</i>	
<i>L. bengalensis</i>	
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<i>L. bohar</i>	
<i>L. carponotatus</i>	
<i>L. decussatus</i>	
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<i>L. erythropterus</i>	
<i>L. fuviflamma</i>	
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<i>L. lufjanus</i>	
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& Valenciennes 1831) (Table 3). These are similar to the findings of Victor *et al.* (2009) who reported sequence divergences for Western Atlantic *Lutjanus* species of 2.7–11.4% between closest neighbours. Ward *et al.* (2009) recorded an average within-genus divergence for marine fishes of 8.11% based on 1677 sequences from 546 species and 273 genera. The CO1 marker is, therefore, an extremely useful tool for discriminating between the different species of *Lutjanus*.

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