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The new Laser Red Rainbowfish *Melanoteania rubrivittata*. G.L.

Main features in this issue:

Habitat of Dwarf Flathead Gudgeon (page 866) D.S.

Melanotaenia rubrivittata, a New Species of Rainbowfish (Melanotaeniidae) from Northwestern Papua Province, Indonesia

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Abstract

A new species of melanotaeniid rainbowfish, *Melanotaenia rubrivittata*, is described from the Wapoga River system of northwestern Papua Province, Indonesia. The new taxon is described on the basis of 26 specimens, 18.0–48.7 mm SL, collected from two sites near the Tirawiwa River. It is similar to *M. praecox* in general appearance and morphology, but differs in possessing red body stripes, a more slender body shape in adult males, a slightly longer snout, and fewer lateral scales. Genetic analysis provides additional evidence for the separation of these taxa.

Introduction

Rainbowfishes of the family Melanotaeniidae are a spectacularly coloured group of freshwater fishes endemic to the warmer portions of Australia and New Guinea. They live in a variety of habitats from clear streams and lakes through large turbid rivers, floodplain habitats, and isolated rocky pools or waterholes in arid regions. Most species form loose aggregations, which swim either in midwater or just below the surface. The main dietary items include insects which fall onto the surface and micro-crustaceans. Spawning occurs year round in most species, but reproductive activity often peaks at the onset of rainy periods. Rainbowfishes are popular aquarium fishes with dedicated hobbyist groups that specialise in them (Allen 1995; Tappin 2011).

The families Melanotaeniidae, Eleotridae (gudgeons) and Gobiidae (gobies) collectively make up over 50% (~280 species) of the freshwater fish species richness of Australia and New Guinea

Fig. 1. Map of Papua Province, Indonesia showing type locality (star) of *Melanotaenia rubrivittata* near Siewa, an abandoned mining exploration camp.

Fig. 2. Aquarium photograph of freshly collected holotype of *Melanotaenia rubrivittata*, male (upper), 48.7 mm SL and female paratype, 40.8 mm SL (WAM P.31454), Siewa, Papua Province. G.R.A.

(Unmack et al. 2013). Despite the large number of rainbowfish species recognized, there are many species that still require descriptions from Australia and New Guinea (Kadarusman et al. 2012b; Unmack et al. 2013). Furthermore, almost any new regions explored in New Guinea (Allen et al. 2008, Allen & Hadiaty 2011, 2013; Kadarusman et al. 2012a), as well as others re-explored (Allen & Unmack 2012; Allen et al. 2014; Kadarusman et al. 2010) continue to turn up new species at a high rate.

The broader biogeographic patterns within rainbowfishes are now well established from the earlier work of Zhu et al. (1994) and McGuigan et al. (2000) and more recent papers with expanded taxonomic and molecular coverage (Kadarusman et al. 2012b; Unmack et al. 2013). Most species in the family are separated into three monophyletic groups representing western New Guinea (Birds Head/Birds Neck region), northern New Guinea and southern New Guinea and Australia. Western New Guinea can be further separated into three allopatrically distributed lineages, while northern New Guinea contains three largely sympatric lineages and southern New Guinea/Australia has four broadly sympatric lineages. In addition, three early branching lineages represent *Cairnsichthys* Allen 1980, *Rhadinocentrus* Regan 1914 (both restricted to eastern Australia) and *Iriatherina* Meinken 1974 (found in northern Australia and

Table I. Rainbowfish species from Papua New Guinea (PNG) and Indonesia (IND) used in the phylogenetic analysis including locality data, the number of individuals examined (if greater than one) and their GenBank accession number with matching individual fish numbers. In the locality field the code AS indicates fish were sourced from rainbowfish aquarium hobbyists.

Species	Locality	N	GenBank # Cyt*b*	GenBank # S7
Chilatherina alleni	Siriwo R, IND	3	#1 JX532165.1, #2 KP345868, #3 KP345869	KC134073.1
C. alleni	Tirawiwa R, IND	6	#1–2, 4–5 KP345875, #3 KP345876, #6 KP345877	
C. axelrodi	**AS**, Pual R, PNG		JX532166.1	KC134074.1
C. bleheri	**AS**, L. Holmes, IND		KC133594.1	KC134075.1
C. bulolo	Ramu R, PNG		JX532167.1	KC134076.1
C. campsi	Markham R, PNG		JX532170.1	KC134077.1
C. crassispinosa	Markham R, PNG		JX532171.1	KC134078.1
C. fasciata I	Mamberano R, IND		KC133598.1	KC134081.1
C. fasciata II	Tor R, IND		KC133596.1	KC134079.1
C. fasciata III	Hewa R, IND		JX532174.1	KC134082.1
C. fasciata IV	Ramu R, PNG		KC133597.1	KC134080.1
C. pagwiensis	Sepik R, PNG		JX532172.1	KC134085.1
C. pricei	Wapoga R, IND		KC133599.1	KC134083.1
C. sentaniensis	**AS**, L. Sentani, IND		KC133600.1	KC134084.1
C. sp. Gidomen	Mamberano R, IND		KC133601.1	KC134086.1
Glossolepis dorityi	L. Nenggwambu, IND		KC133604.1	KC134089.1
G. incisus	L. Sentani, IND		KC133605.1	KC134091.1
G. kabia I	Sepik R, PNG		KC133606.1	KC134092.1
G. leggetti	Tirawiwa R, IND		KC133608.1	KC134094.1
Melanotaenia japenensis	Yapen Is, IND		KC133614.1	KC134100.1
M. praecox	Kali Tiri, E of Dabra, IND	3	#1–2 KC133602.1, #3 KP345874	#1 KC134087.1, #2 KP345857, #3 KP345858
M. praecox	Biri, Mamberano R, IND	2	#1–2 KP345870	#1–2 KP345859
M. praecox	Pagai, Mamberano R, IND	3	#1 KP345871, #2 KP345872, #3 KP345873	#1 KP345860, #2 KP345861, #3 KP345862
M. rubripinnis	Tirawiwa R trib., IND		KC133613.1	KC134099.1
M. rubrivittata	Tirawiwa R, IND	7	#1–4, 6–7 KP345878, #5 KP345879	#1, 3, 7 KP345863, #2 KP345864, # 4 KP345865, #5 KP345866, #6 KP345867
M. vanheurni	Mamberano R, IND		KC133603.1	KC134088.1

southern New Guinea). Lastly, a seventh lineage contains the recently discovered species *Melanotaenia mairasi* Allen & Hadiaty 2011, known from a single lake. This species was shown by Kadarusman et al. (2012b) to represent an additional lineage restricted to the Lengguru Arch, which was recovered as the sister group to the western lineage.

The current paper describes a new species of *Melanotaenia* from the Wapoga River system of northern New Guinea (northwestern Papua Province, Indonesia, Fig. 1) collected by the first author in 1998 while conducting an ichthyological survey in the vicinity of the Siewa exploration camp of Freeport Indonesia Mining Company (Allen & Renyaan 2000). It was initially identified as *M. praecox* Weber & de Beaufort 1922, originally described from the Mamberamo Drainage, which lies approximately 100 km to the east. However, genetic analysis of recently collected tissue samples provided convincing evidence that the Wapoga population represents a distinct species.

Materials and methods

Counts and measurements in the description that appear in parentheses refer to the range for paratypes if different from the holotype. Type specimens are deposited at Museum Zoologicum Bogoriense, Cibinong, Java, Indonesia (MZB), National Museum of Natural History, Washington, D.C. (USNM), and Western Australian Museum, Perth (WAM). Specimens of *Melanotaenia praecox* were also examined at the Naturalis Biodiversity Center, Leiden, Netherlands (formerly at Zoologisch Museum, Amsterdam and therefore bearing the acronym ZMA).

Comparative material examined: *Melanotaenia praecox* – WAM 26787, 40 mm SL, Pionierbivak, approximately 2°18`S, 138°00`E, Mamberamo River system; WAM P.31027-001, 9 specimens, 30–43 mm SL, near Dabra, 3°16`S, 138°46`E, Mamberamo River system; WAM P.31755-001, 4 specimens, 20–44 mm SL, Tiri Creek, approximately 3°18`S, 138°35`E, Mamberamo River system, about 5 km east of Dabra; ZMA 103.047, 40.0 mm SL, Pioniersbivak, Mamberamo River system; ZMA 103.142 (lectotype), 46.8 mm SL, Pioniersbivak; ZMA 110.165 (paralectotypes), 18 specimens, 28.4–46.5 mm SL.

The methods of counting and measuring are as follows: *dorsal and anal rays* – the last ray of the anal and second dorsal fins is divided at the base and counted as a single ray; *pectoral fin rays* were counted on both sides; *lateral scales* – number of scales in horizontal row from upper edge of pectoral-fin base to caudal-fin base, excluding the small scales posterior to the hypural junction; *transverse scales* – number of scales in vertical row (excluding small truncated scales along base of fins) between anal-fin origin and base of first dorsal fin; *predorsal scales* – number of scales along midline of nape in front of first dorsal fin; *prepelvic scales* – number of scales along ventral midline anterior to base of pelvic fins; *circumpeduncular scales* – number of scale rows completely encircling caudal peduncle at point of least depth; *cheek scales* – total number of scales covering suborbital and preoperculum; *gill rakers* – total number of rakers (including rudiments) on first branchial arch, presented in two parts for the respective upper and lower limb of gill arch; *standard length (SL)* – measured from tip of upper lip to caudal-fin base; *head length (HL)* – measured from tip of upper lip to upper rear edge of gill opening; *body depth* – measured vertically from anal-fin origin to base of first dorsal fin; *body width* – measured at level of pectoral-fin base; *snout length* – measured from tip of snout to anterior edge of *eye*; *maxillary length* – measured from tip of snout to posterior end of upper jaw; *eye diameter* – horizontal measurement across the middle of the *eye*; *interorbital width* – least width measured between the bony upper edges of the *eye* sockets; *predorsal, preanal, and prepelvic distances* – measured from tip of snout to origin of respective dorsal, anal, and pelvic fins; *length of second dorsal-fin base* – measured from the origin

Table II. Proportional measurements of selected type specimens of *Melanotaenia rubrivittata* expressed as percentage of the standard length.

	Holotype MZB 22261	Paratype WAM P.31454	Paratype WAM P.31454	Paratype USNM 432453	Paratype USNM 432453	Paratype MZB 22262	Paratype WAM P.31454	Paratype MZB 22262	Paratype WAM P.31454
Sex	male	male	female	female	male	female	male	female	male
Standard length (mm)	48.7	42.2	40.8	39.9	39.6	33.2	32.8	33.2	28.4
Body depth	37.0	38.3	34.1	34.6	37.6	35.2	39.7	35.2	35.4
Body width	12.6	12.1	13.9	13.9	12.9	15.0	12.8	15.0	10.9
Head length	25.3	26.3	26.5	27.4	27.2	28.2	28.2	28.2	29.9
Snout length	8.0	8.1	7.3	8.1	7.7	7.8	7.6	7.8	7.0
Maxillary length	8.4	8.3	8.4	8.4	8.2	9.1	7.8	9.1	8.7
Eye diameter	7.7	8.9	8.4	8.5	9.1	9.6	9.5	9.6	10.7
Bony interorbital width	10.4	11.2	10.1	11.9	10.8	10.9	10.9	10.9	11.3
Depth of caudal peduncle	11.0	11.7	10.3	10.3	11.6	10.7	12.5	10.7	10.9
Length of caudal peduncle	16.0	15.7	15.9	16.0	13.6	15.7	15.5	15.7	18.2
Predorsal distance	46.8	49.5	49.7	47.3	47.8	50.6	46.6	50.6	50.2
Preanal distance	49.3	49.8	50.0	52.6	48.7	54.2	48.2	54.2	53.0
Prepelvic distance	36.9	36.8	37.0	38.6	38.6	40.1	35.9	40.1	40.2
2nd dorsal-fin base	21.4	23.6	18.9	22.2	26.2	21.5	24.6	21.5	22.7
Anal-fin base	38.0	40.3	34.2	33.5	39.1	32.1	39.8	32.1	31.5
Pectoral-fin length	17.8	18.5	17.7	17.0	17.6	20.2	19.5	20.2	20.6
Pelvic-fin length	13.3	15.2	13.8	13.2	13.3	15.6	13.4	15.6	16.4
Longest ray 1st dorsal fin	13.9	16.1	12.6	12.9	15.9	12.7	16.7	12.7	16.9
Second dorsal-fin spine	11.2	9.8	11.6	11.5	11.0	11.8	12.5	11.8	12.2
Longest ray 2nd dorsal-fin	11.8	11.0	12.4	11.3	12.2	12.8	13.9	12.8	17.2
Anal-fin spine	7.1	6.9	7.9	7.2	7.5	7.7	7.9	7.7	7.0
Longest anal ray	10.5	11.5	12.7	10.8	12.8	11.5	11.7	11.5	15.1
Caudal-fin length	19.0	23.5	22.7	21.9	20.9	23.7	19.7	23.7	21.3
Caudal concavity	3.8	9.9	6.8	7.5	9.0	6.5	4.4	6.5	6.8

Table III. Summary of dorsal, anal, and pectoral fin-ray, predorsal scale, and cheek scale counts for *Melanotaenia rubrivittata*. Pectoral-ray counts were taken on both sides of each individual.

First Dorsal-fin spines			Soft Dorsal-fin rays				Soft Anal-fin rays				
IV	**V**	**VI**	**9**	**10**	**11**	**12**	**17**	**18**	**19**	**20**	**21**
4	15	4	1	7	11	4	2	5	9	6	1

Pectoral-fin rays				Predorsal scales				Cheek scales					
10	**11**	**12**	**13**	**13**	**14**	**15**	**16**	**6**	**7**	**8**	**9**	**10**	**11**
1	27	17	1	3	10	9	1	1	3	1	11	5	2

of second dorsal fin to the base of last ray of second dorsal fin; *length of anal-fin base* – measured from the origin of anal fin to base of last ray of anal fin; *pectoral, pelvic, and caudal-fin lengths* – measured from base of fin to distal tip of longest ray; *caudal peduncle depth* is least depth and *caudal peduncle length* is measured between two vertical lines, one passing through base of last anal ray and the other through caudal-fin base; *caudal concavity* –horizontal distance between verticals at tips of shortest and longest rays.

All of the rainbowfish DNA sequences from the monophyletic "Chilatherina" group and several from the "Glossolepis" group sequenced by Unmack et al. (2013) were phylogenetically analysed, plus new additional sequences obtained from a larger number of individuals from *C. alleni*, *M. praecox*, and the new species described here from the Wapoga River system (Table I). We sequenced the complete mitochondrial cytochrome *b* (cyt*b*) gene and a portion of the S7 nuclear gene (part of exons 1 and 3 and complete exon 2 and introns 1 and 2) and used GARLI 2.0 (Zwickl 2006) to obtain the best maximum likelihood trees and 1000 bootstrap replicates. Methods for obtaining DNA sequence data and their analyses follows Allen & Unmack (2012), Unmack et al. (2013) and Allen et al. (2014) except where noted as follows: S7 sequences were manually phased for only *M. praecox* and the new species, of those, seven individuals had a single heterozygous position, while one (*M. praecox* Pagai 2) had six (phased individuals have the letters a and b to designate each allele); S7 sequences were then aligned using the online version of MAFFT 7.205 (Katoh and Standley, 2013) using the slow iterative refinement G-INS-i algorithm with the scoring matrix for nucleotide sequences set to 1PAM/K=2, a gap opening penalty of 1.53 and an offset value of 0.1; the model of sequence evolution GTR+I+G and GTR+G were the best ones identified by ModelTest 3.7 (Posada & Crandall, 1998) for cyt*b* and S7 respectively; we used attachmentspertaxon = 66 and trees were rooted with species from the "Glossolepis" group. GenBank accession numbers are provided in Table I for all sequences examined in this study.

Melanotaenia rubrivittata n. sp.

Laser Red Rainbowfish

Holotype. MZB 22261, male, 48.7 mm SL, small pond beside Tirawiwa River, 3° 01.970'S, 136° 22.231' E, Wapoga River system, Papua Province, Indonesia**,** 0.3 m, seine net, G. Allen & S. Renyaan, 5 April 1998.

Paratypes (collected with holotype unless stated otherwise): MZB 22262, 6 specimens, 23.2–43.5 mm SL; USNM 427072, 5 specimens, 26.0–39.3 mm SL; WAM P. 31449-001, 6 specimens: 18.0–42.2 mm SL; WAM P.31454-001, 8 specimens, 28.4–41.9 mm SL, small pond beside Tirawiwa River, 3° 01.399'S, 136° 21.892' E, Wapoga River system, Papua Province, Indonesia**,** 0.3 m, seine net, G. Allen & D. Polhemus, 9 April 1998.

Fig. 3. Male specimens of *Melanotaenia rubrivittata* raised in captivity, approximately 45 mm SL. The nuptial display is shown in the upper photograph. G.L.

Diagnosis: A species of melanotaeniid rainbowfish distinguished by the following combination of characters: dorsal rays IV–VI-I,9–12 (usually V-I,10–11); anal rays I,17–21 (usually I,18–20); pectoral rays 10–13 (usually 11–12); lateral scales 32–33, predorsal scales 13–16 (usually 14–15); circumpeduncular scales 12; total gill rakers on first arch 12–14; total scales covering cheek (preopercle) 6-11 (average 8.9); snout length 3.2 (3.0–4.3) in HL; average body depth of adult males 37.7 % SL; colour in life brilliant neon blue on upper two-thirds of body with five red stripes (one between each scale row); ventral portion of head and body silvery white to blue with slight pinkish hue; first dorsal fin blue; second dorsal fin blue with red basal stripe and broad red zone encompassing outer margin and posterior portion of fin; anal

fin bluish with red basal stripe and red outer margin; caudal fin red, grading to bluish or translucent along posterior margin.

Description (morphometrics based on 17 specimens, 28.4–48.7 mm SL and counts on 23 specimens, 26.0-48.7 mm SL; *see* also Tables II and III)**:** Dorsal rays V-I,10 (IV–VI-I,9–12); anal rays I,19 (I,17–21); pectoral rays 11 (10–13); pelvic rays I,5; branched caudal rays 13 (15); principal caudal rays 15 (17); upper and lower procurrent caudal rays 5 (5–6); lateral scales 33 (32–33); transverse scales 10; predorsal scales 15 (13–16); prepelvic scales 16 (13–17); cheek scales 9 (6–11); circumpeduncular scales 12; gill rakers on first branchial arch 1 + 12 (1–2 + 11–13), total gill rakers on first arch 13 (12–14).

Body depth 2.7 (2.5–3.3) in SL, head length 3.9 (3.3–3.9) in SL; greatest width of body 2.9 (2.2–3.2) in greatest body depth; snout length 3.2 (3.0–4.3) in HL; *eye* diameter 3.3 (2.8–3.2) in HL; interorbital width 2.4 (2.4–3.0) in HL; depth of caudal peduncle 2.3 (2.2–2.7) in HL; length of caudal peduncle 1.6 (1.6–2.0) in HL.

Jaws about equal, oblique, premaxilla with an abrupt, ventrally-directed bend between the anterior horizontal portion and lateral part; maxilla ends below about anterior edge of *eye*; maxillary length 3.0 (2.9–3.7) in HL; lips thin; teeth conical with slightly curved tips, extending on to outer surface of lips; teeth of upper jaw in about five irregular rows anteriorly with largest in outer row, reduced to single row posteriorly, where exposed when mouth closed; teeth in lower jaw in about 4–6 irregular rows anteriorly, reduced to 1 or 2 rows posteriorly; narrow row containing small, conical teeth on vomer and palatines (usually embedded in congealed mucous).

Cephalic sensory pores well developed, consisting of six large pores along margin of preopercle, five pores on maxilla, four pores on preorbital, five pores on interorbital/supraocular, and five pores along infraorbital (postocular) canal.

Scales of body cycloid, relatively large, and arranged in regular horizontal rows; scale margins weakly crenulate; predorsal scales extending forward to about middle of interorbital space; preopercle with 1-2 scale rows between its posterior angle and *eye*.

Predorsal length 2.1 (2.0–2.1) in SL; preanal length 2.0 (1.8–2.1) in SL; prepelvic length 2.7 (2.5–2.9) in SL; length of second-dorsal fin base 4.7 (3.8–5.3) in SL; length of anal-fin base 2.6 (2.5–3.2).

First dorsal fin-origin about level with anal fin-origin; longest spine (usually second or third) of first dorsal fin 1.8 (1.5–2.5) in HL, its depressed tip reaching base of spine of second dorsal

Fig. 4. *Melanotaenia rubrivittata*, preserved male holotype, 48.7 mm SL.. G.R.A.

fin in females and reaching to about base of first soft ray in mature males; second dorsal-fin spine 2.3 (1.7–2.7) in HL; longest (generally anteriormost in females and penultimate in adult males) rays of second dorsal fin 2.1 (1.8–2.4) in HL, depressed posterior rays extending less than one-half length of caudal peduncle in females and about one-half to two-thirds length of caudal peduncle in mature males; anal-fin spine 3.6 (2.9–4.3) in HL; longest (more or less subequal in adult males and females) anal rays 2.4 (1.9–2.5) in HL; pelvic-fin tips when depressed reaching to base of anal spine or first soft anal ray in mature adults; length of pelvic fins 1.9 (1.7–2.1); length of pectoral fins 1.4 (1.3–1.8) in HL; length of caudal fin 1.3 (1.2–1.4) in HL; caudal fin moderately forked, caudal concavity 6.7 (2.7–6.4) in head length.

Colour of freshly captured male in life (Fig. 2): head greyish dorsally, silvery blue on cheek and operculum; brilliant neon blue on upper two-thirds of body with five red stripes; ventral portion of head and body silvery white to blue with slight pinkish hue; first dorsal fin blue; second dorsal fin blue with red basal stripe and broad red zone encompassing outer margin and posterior portion of fin; anal fin bluish with red basal stripe and red outer margin; caudal fin red, grading to bluish or translucent along posterior margin; pelvic fins bluish to translucent with red anterior margin and reddish posterior tip; pectoral fins translucent. Illustrations of captive aquarium specimens are presented in Fig. 3. Nuptial males are capable of "switching on" a golden-orange mid-dorsal stripe, extending from the dorsal-fin origin to the snout tip (Fig. 3, upper fish).

Colour pattern of freshly captured female in life (Fig. 2, lower): generally similar to that of male except overall pattern is much duller and lacks brilliant red markings on fins; second dorsal and anal fins with blue outer margin.

Colour of holotype in alcohol (Fig. 4): snout and dorsal surface of head bluish-grey, grading to tan on propercle and opercle; upper half of body brown with red stripes (see live description above) replaced by tan markings; longitudinal scale row at eye level slightly darker brown; lower half of body with large brown area below pectoral fin, gradually fading to tan posteriorly; fins mainly translucent. Female paratypes greyish on snout and dorsal surface of head, tan on preopercle and opercle; upper half of body brown with darker brown scale margins; lower half of body mainly tan; fins translucent.

Sexual dimorphism: Typical of most *Melanotaenia*, males have a deeper body and longer dorsal and anal fin-rays. The longest soft dorsal-fin rays of males are located in the posterior portion of the fin, in contrast to that of females, which are situated anteriorly. In addition, the depressed first dorsal fin of adult males extends to the base of the first soft ray of the second dorsal fin, compared with the origin of the fin in females.

Body depth generally increases, especially in males, with increased growth and is therefore most useful as a distinguishing character when assessed on the basis of sex and size range as follows: *males* – 40–50 mm SL, 37.0–40.2 % SL (average 38.4, n = 4); *males* – under 30 mm SL, 35.2–39.7% SL (average 37.0, n = 4); *all males combined* 28.4–48.7 mm SL, 35.2–40.2% SL (average 37.7, n = 8); *females* 40–45 mm SL – 30.0–34.1% SL (average 32.1, n = 2); *females* – under 40 mm SL, 27.5–35.4% SL (average 30.5, n = 12); *all females combined* – 30.2–42.6 mm SL, 27.5–35.4% SL (average 30.7, n = 14) This species reaches sexual maturity at a relatively small size as indicated by the presence of ripe gonads, approximately 28.5 mm SL in males and 30.0 mm SL in females.

Remarks: The new species is most similar in appearance to *Melanotaenia praecox* (Fig. 5) from the Mamberamo River system, lying approximately 100 km to the east. The two species share a number of similarities including a neon-blue ground colour, brilliant red markings on the median fins, relatively small maximum size (less than about 50 mm SL), overlapping counts for dorsal rays, anal rays, pectoral rays, predorsal scales, and cheek scales, and most morpho-

Fig. 5. Aquarium photographs of *Melanotaenia praecox*, males, approximately 45 mm SL, vicinity of Dabra, Mamberamo River system, Papua Province. G.R.A.

metric proportions. Genetic results (Fig. 6) reveal the two species are clearly separable. In addition, *M. praecox* lacks the characteristic red body stripes of male *M. rubrivittata*. The males of *M. praecox* also tend to be deeper bodied (average depth 41.0% SL, n = 14) than males of *M. rubrivittata* (average depth 37.7% SL, n = 8). There is also a slight difference in snout length with *M. praecox* generally having a shorter snout (average length 7.2% SL, n = 15 versus 7.7% SL, n = 15 for *M. rubrivittata*). Lastly, *M. praecox* has fewer lateral scales (usually 29–30 versus 32–33) and frequently has 11 transverse scales (always 10 in *M. rubrivittata*).

Genetic results and discussion: A total of 44 individuals were sequenced for cyt*b* and 36 for S7 which was reduced to 33 sequences in both datasets once identical samples were removed. Analysis of the 33 sequences yielded 863/895 invariant characters, 83/40 variable but parsimony uninformative characters, and 195/67 parsimony informative characters for cyt*b* and S7 respectively. Maximum likelihood analysis recovered one tree for each dataset with likelihood scores of -4253.549833 and -2260.786885 respectively (Fig. 6). The relationships recovered from cyt*b* were broadly congruent with the larger sequence dataset in Unmack et al.

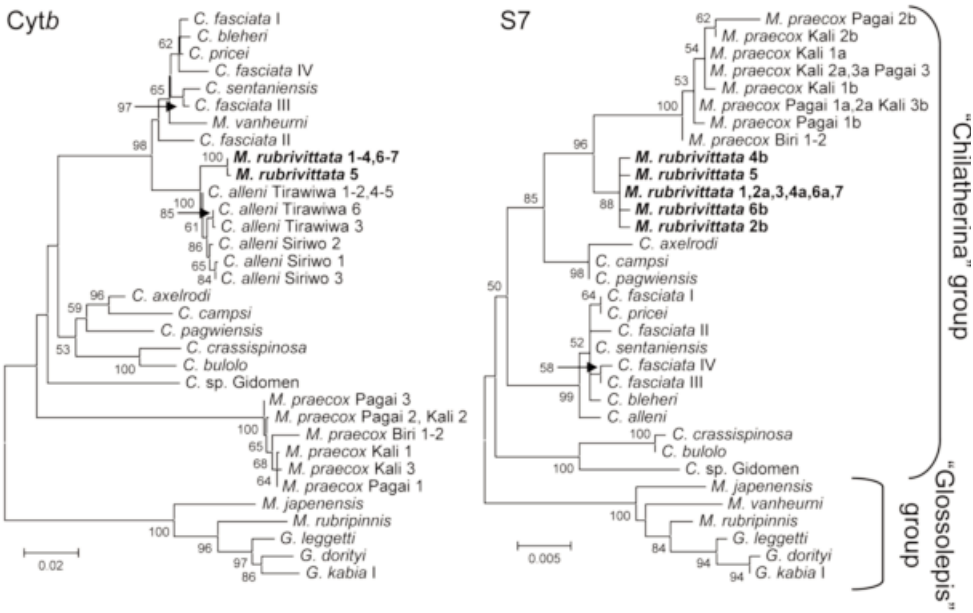

Fig. 6. Maximum likelihood trees for selected rainbowfish species based on analysis of mitochondrial cytochrome *b* sequences (left) and nuclear S7 sequences (right). Bootstrap values were obtained from 1,000 replicates. Numbers after species names represent the individual within that population, Roman numerals match those used in Unmack et al. (2013). For S7, the letter a or b indicates different phased alleles for heterozygous individuals.

(2013), albeit with reduced support for some nodes and slightly different relationships due to fewer characters versus the 6827 combined base pairs in Unmack et al. (2013). The S7 results are overall quite similar to cyt*b* (except in the cases of two introgressed species, see below), but with reduced resolution between some closely related species (which is typical for nuclear sequence data with this gene). The S7 results differ slightly from those in Unmack et al. (2013) in that *Melanotaenia praecox* is nested more deeply within the "Chilatherina" group and the position of the lineage containing *C. fasciata* is slightly different. This difference is likely due to the larger number and type of genes included in Unmack et al. (2013).

We found evidence for mitochondrial introgression between *Melanotaenia rubrivittata* and *Chilatherina alleni*, based on their sister group relationship for cyt*b* (Fig 6). Introgression is a result of an initial hybridisation event followed by an extensive backcrossing of the hybrids only into one of the parental species (usually), such that over time genetic material from one of the species becomes incorporated into the other (essentially via horizontal transfer rather than via common descent). This can arise under various scenarios, such as where one species is substantially more abundant than the other and thus limited in their choice of conspecific mates. Mitochondrial DNA can provide very strong evidence for this as it is only maternally inherited and is passed along clonally (meaning there is no recombination, which is quite different to nuclear DNA). Introgression has been recorded between a number of rainbowfish species, usually between those with sympatric distributions (Unmack et al. 2013). Clearly this introgression is not recent given there is a pairwise p-distance of between 1.0–1.6% for cyt*b* between individuals within both species. As with the morphological evidence presented above, nuclear sequence data clearly place *M. praecox* and *M. rubrivittata* as sister species well


Fig. 7. Floodplain habitat of Tirawiwa River new Siewa, West Papua Province and type locality (right) of *Melanotaenia rubrivittata*. G.R.A.

separated from each other by a greater sequence divergence than most sister species shown in Fig. 6. Note that *C. alleni* is placed in the same location for both cyt*b* and S7 relative to other *Chilatherina* species, but quite distant from *M. rubrivittata* for the nuclear gene (Fig. 6). The same patterns of relatedness can be see with *Melanotaenia vanheurni* which has experienced introgression with an ancestor to *Chilatherina fasciata* and its closely related sister species (which they would have been sympatric with), but is clearly placed very differently with nuclear sequence data in the "Glossolepis" group (Fig. 6).

The phylogenetic position of *M. praecox* and *M. rubrivittata* within the "Chilatherina" group is one of the more interesting relationships within rainbowfishes. Neither species shares much resemblance to *Chilatherina* species (or any other melanotaeniid for that matter) based on general appearance. Molecular clock estimates place the divergence of the ancestor to *M. praecox* and *M. rubrivittata* and its sister group at a mean age of 9.9 million years (Unmack et al. 2013). Even if only approximately accurate, this leaves a long time for divergence especially given how quickly rainbowfishes can evolve differences.

Distribution, habitat and zoogeography: The new species is known only from the Wapoga River system in the vicinity of Siewa, former site of a Freeport Mining Company exploration camp. This location (Fig. 1) is approximately 100 km northeast of Nabire, a relatively large town lying on the edge of Cenderawasih Bay. The type locality (Fig. 7) is situated about 130 km upstream in the Wapoga system at an elevation of approximately 70 m on the edge of a broad floodplain adjacent to nearby foothills. At the time of collection (April 1998) it consisted of a small pond, resulting from previous flooding of the nearby Tirawiwa (sometimes spelt Tiawiwa) River. The pond was fully shaded and about 12 m in diameter with an average depth of only 30 cm. The substratum was composed of soft mud covered with a layer of organic debris, mainly dead leaves. Additional paratypes were collected in a small (2–5 m width), closed-canopy rainforest stream 1.3 km northwest from the type locality. The new species and *Mogurnda wapoga* Allen et al. 1999 (Eleotridae) were the only fishes collected at both sites, although a few juvenile *Glossolepis leggetti* Allen & Renyaan 1998 (Melanotaeniidae) were obtained from the pond habitat. Temperature and pH values of 27.0°C/6.6 and 28.7°C/8.0 were recorded for the respective pond and stream habitats. Specimens obtained for genetic analysis in 2012 from the same general area were found in a small (about

1.5–2 m wide) rainforest stream that was also inhabited by *Melanotaenia rubripinnis* Allen & Renyaan 1998 and *Chilatherina alleni* Price 1997. The Wapoga system is an important location for freshwater fish endemism with all the previously mentioned melanotaeniids known thus far only from this region, except *C. alleni*, which ranges to the Siriwo River drainage, approximately 70 km to the southwest. In addition, *Mogurnda wapoga* and *Sicyopterus erythropterus* Keith et al. 2012 (Gobiidae) are known only from this area.

Etymology: The new species is named *rubrivittata* (Latin: red-stripes) with reference to the distinctive markings that distinguish it from the similar appearing *M. praecox*.

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Were Those Red Laser "Stripes" Really Worth It? – The Hunt for the Wapoga Red Laser Rainbowfish

Gary Lange, Johannes Graf and Dan Dority

Can you remember when you had a close call in your car and almost crashed, cheating injury maybe by inches? How about as a youngster jumping off of a tall cliff into the lake then second guessing yourself after it was too late to turn back, hoping things didn't end badly. "I shouldn't have been following that other car so closely" and "How did I let my friend Randy talk me into such a stupid decision as jumping off this cliff" were the thoughts racing through my mind in those moments. And here I was in a pathless jungle, up the creek without a paddle. Actually without the boat, because they had abandoned us and now we were several hours into a very long hike. Those thoughts were again running through my mind that I had indeed made a questionable decision.

But let's back up a few months to January of 2012. It's time to plan another trip with Johannes Graf and Dan Dority. Where should we go for new fish and adventure? We didn't have to look any further than the cover of Aqualog's "All Rainbowfish". Let's go to the Siewa airfield (Figure 1), home of *Glossolepis leggetti* and *Melanotaenia rubripinnis*. This was also home to the Aqualog cover fish *Chilatherina alleni* and of course that super electric blue "*M. praecox*" with the striking red laser stripes thru its body. These were fish that Dr. Gerry Allen had photographed from a 1998 expedition but none were brought back alive. It was easy to say you want to go there but now much harder to actually get there. The Siewa airstrip built for mining exploration was no longer in use and overgrown, the jungle had taken it back. The only way would be to take a small boat from Nabire travelling on the ocean for five hours and then up Sungai Wapoga and its tributary, Sungai Tirawiwa, for another eight hours to get as close to the Siewa airstrip as possible. We badly wanted to collect the wonderfully yellow *Chilatherina alleni* and especially that electric blue "striped praecox". We have had more than a few conversations with aquarists wondering out loud whether that cover picture was "doctored" because the blue and the red stripes were so intense. Hopefully we would find out for ourselves.