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Two new skinks (Scincidae: *Glaphyromorphus*) from rainforest habitats in north-eastern Australia

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Abstract

Tropical rainforest is largely restricted in Australia to the fairly continuous Wet Tropics region and disconnected patches to the north on Cape York. The Wet Tropics is relatively well explored and studied, whereas the rainforests of Cape York have received less attention due to their remoteness. Here we describe two new species of *Glaphyromorphus* skinks from rainforest areas on Cape York. The two new species are most similar to each other and to *G. fuscicaudis* and *G. nigricaudis*, but both are readily diagnosed on numerous traits. *Glaphyromorphus othelarrni* **sp. nov.** is diagnosed from all similar species by its supralabial count (typically 8 *vs* 7), high number of subdigital lamellae beneath the 4th finger (14–15 *vs* < 14), and its relatively longer limbs. *Glaphyromorphus nyanchupinta* **sp. nov.** is diagnosed from all similar species by its small body size (max SVL = ~ 54 mm *vs* > 85 mm) and slender body shape, low number of subdigital lamellae beneath the 4th toe (17–20 *vs* generally 20 or more), and head and body pattern. Both species also differ from each other and similar congeners in other aspects of body shape, scalation and colour pattern. *Glaphyromorphus othelarrni* **sp. nov.** is restricted to boulder-strewn rainforest of the Melville Range, whilst *Glaphyromorphus nyanchupinta* **sp. nov.** is known only from upland rainforest in the McIlwraith Range. We discuss patterns of rainforest vertebrate endemism on Cape York, and the importance of lithorefugia in generating these.

Key words: *Glaphyromorphus othelarrni*, *Glaphyromorphus nyanchupinta*, Cape York, rainforest, boulder-field, lithorefugia, Queensland

Introduction

Until recently, *Glaphyromorphus* Wells & Wellington, 1984 contained 18 species distributed in northern and south-western Australia, New Guinea and the Lesser Sundas. However, morphological and genetic data strongly suggested that the genus was polyphyletic (Greer 1989; Reeder 2003; Rabosky *et al.* 2007; Skinner 2007). Mecke *et al.* (2009) added to this data and reassigned 8 of the species to *Eremiascincus* Greer, 1979a or *Hemiergis* Wagler, 1830. This included five of the Australian species, four of which were reassigned to *Eremiascincus* and one to *Hemiergis*. This was supported by a more thorough genetic analysis by Skinner *et al.* (2013). *Glaphyromorphus* now contains nine Australian species: *G. cracens* (Greer, 1985), *G. darwiniensis* (Storr, 1967), *G. pumilus* (Boulenger, 1887), *G. crassicaudus* (Duméril & Duméril, 1851), *G. mjobergi* (Lönnberg & Andersson, 1915), *G. punctulatus* Peters, 1871), *G. fuscicaudis* (Greer, 1979b), *G. nigricaudis* Macleay, 1877 and *G. clandestinus* Hoskin & Couper, 2004. Most of these species occur in north-eastern Queensland (Wilson & Swan 2013). While most *Glaphyromorphus* are slender-bodied and short-limbed, *G. nigricaudis* and *G. fuscicaudis* are more robust and longer limbed (Greer 1979b). Genetic analyses have revealed these to be sister-species (Mecke *et al.* 2009; Skinner *et al.* 2013). *Glaphyromorphus nigricaudis* is widespread in moister habitats in north Queensland, north-eastern Arnhem Land and southern New Guinea, while *G. fuscicaudis* is restricted to rainforests of the Wet Tropics.

In Australia, tropical rainforest is largely restricted to a fairly continuous 430 km strip along the mountains and associated lowlands between Townsville and Cooktown (termed the 'Wet Tropics'), and smaller and more disjunct patches to the north of Cooktown on Cape York Peninsula. The Wet Tropics has been explored in detail and has

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been the subject of intensive biodiversity research (e.g., Yeates *et al.* 2002; Williams *et al.* 2010; Moritz *et al.* 2009). The rainforests of Cape York, in contrast, have not received this level of attention and much of this has focused on the larger and more accessible rainforest areas (e.g., Iron Range). Continued exploration of Cape York and assessment of material in collections has led to the recent discovery of many new species (Hoskin & Aland 2011; Shea *et al.* 2011; Hoskin 2013a, 2013b; Hoskin & Couper 2013). In particular, it has become clear that Cape Melville and McIlwraith Range are centres of vertebrate endemism on Cape York, having 6 and 4 endemic vertebrates, respectively, described to date.

Herein we describe two new *Glaphyromorphus* lizards with highly localized distributions at Cape Melville and McIlwraith Range. We also discuss patterns of rainforest vertebrate endemism on Cape York, and the importance of rock association in generating these.

Methods

All specimens examined are held in the Queensland Museum (QMJ codes). Specimens examined were the type series of each new species and the specimens of *G. fuscicaudis* (N = 14) and *G. nigricaudis* (N = 10) listed in the Appendix. All measurements were taken using Mitutoyo electronic calipers and rounded to the nearest 0.1 mm. The following characters were measured: snout to vent length (SVL), tip of snout to posterior margin of precloacal (anal) scale, with body straightened; axilla to groin length (AG), measured from axilla to groin with body straightened; original tail length (TL), from posterior margin of anal scale to tip of tail (original *vs* regenerated tails determined by eye); length of forelimb (L1) and hindlimb (L2), in both cases measured from insertion to tip of longest digit (claw included) with limb stretched straight perpendicular to body; head length (HL), anterior margin of ear to tip of snout; head width (HW), widest point across back of skull; neck length (NL), posterior margin of ear to axilla. Specimen weight (WT) was taken using an electronic balance, and was used as a measure of how gracile or robust (i.e., mass/SVL) each species is. The following scale counts and definitions apply: subdigital lamellae, counts of the obviously enlarged transverse series beneath 4th finger and 4th toe and including claw sheath (count for 4th finger extends basally below the junction of the 3rd and 4th finger); midbody scale rows counted at a point midway between axilla and groin; paravertebrals, number of scales from anterior-most nuchal to a point in line with posterior margin of hindlimb; nuchals, the enlarged paravertebral rows posterior to parietal shields (nuchal count includes any scales contacting the parietals and lying between the upper secondary temporals and the first paravertebrals). All specimens of the new species from the McIlwraith Range were relatively small but these were determined to be adult through dissection, with the male defined as mature due to the presence of turgid opaque testes, and the females defined as mature due to the presence of developing ovarian follicles or well-developed eggs.

Systematics

Hedges & Conn (2012) proposed splitting Scincidae into seven families (in which case the new species here would fall in Sphenomorphidae), but we follow the more detailed genetic analysis of Pyron *et al.* (2013) in not splitting Scincidae. The assignment of our two new species to *Glaphyromorphus* is based largely on the generic definition provided by Cogger (2014). It is assigned on the basis of the following morphological traits: pentadactyl limbs; smooth scales; anterior ear lobules absent; lower eyelid movable, scaly; parietal scales in contact behind the interparietal; 4th toe markedly longer than 3rd; lower surfaces of rump and tail not flushed with red or pink; hindlimbs moderate, generally less than 40% of SVL. *Glaphyromorphus* can be separated into two morphotypes: (i) slender, short-limbed species (adpressed limbs widely separated), and (ii) more robust species with longer limbs (adpressed limbs separated at most by the length of the forelimb). The species described below fall within this second morphotype, which presently contains two closely related species, *G. nigricaudis* and *G. fuscicaudis* (Greer 1979b; Mecke *et al.* 2009; Skinner *et al.* 2013), and is herein referred to as the '*G. nigricaudis*' species group. Our assignment of the new species to this species group is supported by molecular data, with the two new species both being highly divergent lineages allied to *G. fuscicaudis* (Moritz *et. al.* unpublished data).

***Glaphyromorphus othelarrni* sp. nov.**
Cape Melville Bar-lipped Skink
(Figs 1, 2, 3A, 4A, 5A)

Material examined: Holotype: QMJ93341, Melville Range (14°16'33" S, 144°29'32" E, elevation 460 m a.s.l.), Cape Melville, north-east Queensland, C. J. Hoskin & H. B. Hines, 13 December 2013. **Paratypes:** QMJ93339, QMJ93340, collection details as for holotype; QMJ92570, QMJ92571, Melville Range (14°16'33" S, 144°29'32" E, elevation 460 m a.s.l), C. J. Hoskin, 20 March 2013; QMJ92553, QMJ92554, Melville Range (14°18'55" S, 144°29'50" E, 110 m a.s.l.), C. J. Hoskin & K. Aland, 9 February 2013.

Diagnosis. *Glaphyromorphus othelarrni* **sp. nov.** is diagnosed from all congeners in having: adpressed limbs in contact; more than 27 midbody scale rows; the prefontal separated from the preocular; large body size (max SVL ~ 93mm); usually eight supralabials (with 6th below centre of eye); more than 13 subdigital lamellae beneath 4th finger; more than 21 lamellae beneath 4th toe.

Etymology. Othelarrni means 'He Listens' and this was a name given to Bob Flinders, who was born in the Cape Melville area and who passed on much of the knowledge and responsibility for that country to the current generation of its Traditional Owners. The species was named by the *bubu gudjin* of Cape Melville, the Traditional Owners who have the responsibility to speak for the land where the species live.

Measurements and scale counts of holotype QMJ93341 (Figs 1, 2, 3A, 4A)**.** SVL = 75.4 mm, AG = 37.3 mm, TL = 140 mm, L1 = 19.9 mm, L2 = 29.6 mm, HL = 14.5 mm, HW = 11.4 mm, NL = 13.5 mm, midbody scale rows = 28, paravertebrals = 58, lamellae 4th toe = 25, lamellae 4th finger = 15, supralabials = 8, supralabial below centre of eye = 6th infralabials = 7, supraciliaries = 7.

FIGURE 1. *Glaphyromorphus othelarrni* **sp. nov.** in life (holotype, QMJ93341). Photo: Conrad Hoskin.

FIGURE 2. *Glaphyromorphus othelarrni* **sp. nov.**, dorsal view of holotype in life (QMJ93341). Photo: Conrad Hoskin.

FIGURE 3. Comparison of specimens of: (A) *G. othelarrni* **sp. nov.** (holotype, QMJ93341), (B) *G. nyanchupinta* **sp. nov.** (holotype, QMJ85244), (C) *G. fuscicaudis* (QMJ89915, Kuranda region), and (D) *G. nigricaudis* (QMJ47100, Cairns). Photo: Conrad Hoskin.

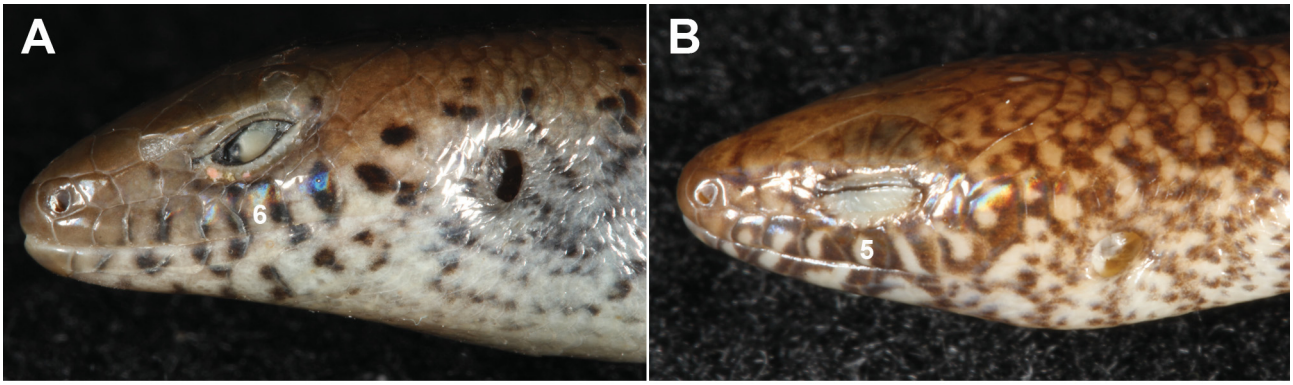

FIGURE 4. Heads of the holotypes of (A) *G. othelarrni* **sp. nov.** (QMJ93341) and (B) *G. nyanchupinta* **sp. nov.** (QMJ85244), with the supralabial positioned below the center of the eye numbered. Photos: Conrad Hoskin.

Description of type series. Data presented as range followed by mean in brackets (n = 7, unless stated otherwise). ***Adult measurements*** (mm): SVL = 75.4–92.9 (85.3), AG = 37.3–49.6 (43.9), Tail = 140.0–144.0 (142.0), L1 = 18.3–20.7 (19.7), L2 = 29.6–32.9 (30.8), HL = 14.5–17.0 (16.0), HW = 11.4–13.1 (12.1), NL = 12.5–15.5 (13.9) (Table 1). ***Adult proportions*** (as % SVL): AG = 49–53 (51), Tail = 147–186 (173), L1 = 22–26 (24), L2 = 33–41 (38), HL = 18–20 (19), HW = 13–15 (14), NL = 14–18 (16) (Table 1). ***Body:*** elongate. Neck broad and not well differentiated from back of head. Snout rounded in profile. Limbs moderate, pentadactyl, and overlapping when adpressed. ***Scalation:*** Scales smooth, with rounded posterior margins; 28–30 (mean = 28.3) rows at midbody; paravertebral scales only slightly enlarged (except enlarged nuchals) and numbering 55–61(mean = 58.9) in a line between the parietals and the posterior margin of the hindlimb. Nasals moderate, well-spaced with a relatively large external naris; rostral and frontonasal in moderate contact; prefrontals large, moderately to narrowly separated and not contacting 1st preocular; frontal contacting frontonasal, prefrontals, first two supraoculars, frontoparietals and narrowly separated or in point contact with 1st supraciliary; supraoculars 4, second the largest; supraciliaries 7–8 (mean = 7.3), first the largest; frontoparietals paired and distinct from interparietal; parietals in contact behind interparietal; 7–9 (mean = 7.9) nuchal scales; primary temporals 1; secondary temporals 2, upper largest and overlapping lower; loreals 2; preoculars 2; presuboculars 2; an enlarged subocular scale penetrating the suture between the 5th and 6th supralabials; supralabials 8, 6th below centre of eye (except QMJ93339, which has 9 on the left side, with 7th below centre of eye); infralabials 6–7 (mean = 6.7); postmental contacting 2 infralabials on each side; lower eyelid scaly; ear opening round or vertically oval, without lobules and with tympanum moderately recessed; lamellae under 4th finger 14–15 (mean = 14.3); lamellae under 4th toe 22–25 (mean = 23.3). **Colour pattern in preservative** (Figs 3A, 4A): Dorsal ground colour light to dark brown, immaculate (QMJ92570) or with black spots (QMJ93339) or transverse bars anteriorly (QMJ93341). Lateral surfaces with longitudinally aligned flecks or vertical wavy bars, which are most prominent on the neck but extend to forebody before breaking up into a series of black flecks that extend to the groin and base of tail. The upper labials are predominantly light with dark vertical bars along sutures. Venter immaculate cream except for a grey tinge on the belly and chest of some individuals. Dark grey flecking present along edge of jaw and lower neck.

Colour pattern in life (Figs 1, 2, 5A). As for preserved specimens but colours richer and appearance generally more glossy. The dorsum is distinctly copper-coloured on lighter individuals.

Comparison with similar species. *Glaphyromorphus othelarrni* **sp. nov.** can only be confused with *G. fuscicaudis*, *G. nigricaudis* and *G. nyanchupinta* **sp. nov.** It is readily distinguished from all three species by its supralabial count (typically 8 with 6th below centre of eye *vs* typically 7 with 5th below centre of eye) (Fig. 4A), the number of subdigital lamellae beneath the 4th finger (14–15 *vs* < 14) and 4th toe (mean 23 *vs* means of 18–21), and its relatively longer limbs (L1/SVL: 0.22–0.26 *vs* ≤ 0.22; L2/SVL: 0.33–0.41 *vs* ≤ 0.34) (Table 1). It is further distinguished from *G. fuscicaudis* in having a proportionately larger head (HW/SVL: 0.13–0.15 *vs* 0.12–0.13; HL/SVL: 0.18–20 *vs* 0.16–0.17); shorter interlimb length (AG/SVL 0.49–0.53 *vs* 0.52–0.58); and generally fewer paravertebral scales (mean 59 *vs* 64) (Table 1). It also lacks the series of yellow dorsolateral blotches that are prominent in *G. fuscicaudis* (Figs 5A, 5C). *Glaphyromorphus othelarrni* **sp. nov.** is further distinguished from *G. nigricaudis* in having a proportionately shorter interlimb length (AG/SVL 0.49–0.53 *vs* 0.52–0.60); a more robust

form (WT/SVL 0.17–0.22 *vs* 0.09–0.17); more midbody scale rows (28–0.30 *vs* 24–28); and more paravertebral scales (55–61 *vs* 51–56) (Table 1). It is further distinguished from *G. nyanchupinta* **sp. nov.** in being larger in all measures (e.g., SVL 74.5–92.9 *vs* 49.2–53.6); in having a proportionately longer tail (TL/SVL 1.47–1.86 *vs* 1.00); a more robust form (WT/SVL 0.17–0.22 *vs* 0.04–0.06); more midbody scale rows (28–30 *vs* 25–27) (Table 1); and a less patterned dorsum (dorsal pattern breaks up beyond midbody *vs* pattern present to hindlimbs) (Figs 5A, 5B), and less patterned upper labials (upper labials predominantly pale with dark sutures *vs* upper labials predominantly dark with a central pale dot) (Fig. 4A, 4B).

FIGURE 5. Comparison of species in life: (A) *G. othelarrni* **sp. nov.** (QMJ92570), (B) *G. nyanchupinta* **sp. nov.**, (C) *G. fuscicaudis* (Walter Hill Ra.), and (D) *G. nigricaudis* (Shiptons Flat). Photo credits: (A) Conrad Hoskin, (B) Harry Hines, (C) Steve Wilson, (D) Stephen Zozaya.

TABLE 1. Comparison of morphology and scale traits. Data is shown as mean (range). Measurements are in mm. Sample sizes for the majority of traits are listed after the species names. Original tail length was measured on fewer specimens (4, 1, 6 and 5, respectively). Specimen weight is a crude comparison of size due to large variation within species associated with loss of part or all of the tail in some specimens. Superscript numbers mark the species (by column number) with which each of the new species differs in that trait (non-overlapping or near non–overlapping ranges, or large difference in means).

Trait	**1.** *G. othelarrni* **sp. nov.** (N = 7)	**2.** *G. nyanchupinta* **sp. nov.** (N = 4)	**3.** *G. fuscicaudis* (N = 14)	**4.** *G. nigricaudis* (N = 10)
Adult SVL	85.3 (75.4–92.9) [2]	51.8 (49.2–53.6) [1,3,4]	83.7 (72.8–91.2)	75.4 (64.1–85.7)
Original tail length (TL)	142.0 (140.0–144.0) [2,3,4]	51.8 (51.8–51.8) [1,3,4]	115.3 (86.6–136.0)	98.7 (72.0–128.0)
Interlimb length (AG)	43.9 (37.3–49.6) [2]	27.3 (25.4–29.5) [1,3,4]	46.4 (40.9–52.0)	41.7 (33.9–46.9)
Forelimb length (L1)	19.7 (18.3–20.7) [2,3,4]	10.7 (10.1–11.3) [1,3,4]	16.6 (14.2–17.9)	15.0 (12.4–16.8)
Hindlimb length (L2)	30.8 (29.6–32.9) [2,3,4]	15.5 (14.3–17.0) [1,3,4]	25.9 (21.0–28.3)	23.4 (20.7–25.9)
Head width (HW)	12.1 (11.4–13.1) [2,3,4]	6.9 (6.6–7.4) [1,3,4]	10.4 (9.2–11.5)	10.1 (8.6–11.9)
Head length (HL)	16.0 (14.5–17.0) [2]	9.5 (9.2–10.2) [1,3,4]	14.1 (12.7–15.3)	13.5 (12.0–15.5)
Neck length (NL)	13.9 (12.5–15.5) [2]	8.5 (7.8–9.8) [1,3,4]	13.1 (11.3–15.1)	12.0 (8.6–13.8)
Specimen weight (grams)	16.0 (12.6–18.2) [2]	2.7 (2.2–3.0) [1,3,4]	12.9 (8.5–18.7)	10.2 (6.6–13.6)
Tail/SVL	1.73 (1.47–1.86) [2]	1.00 (1.00–1.00) [1]	1.43 (0.96–1.68)	1.39 (1.05–1.69)
AG/SVL	0.51 (0.49–0.53) [3,4]	0.53 (0.50–0.55)	0.55 (0.52–0.58)	0.55 (0.52–0.60)
L1/SVL	0.24 (0.22–0.26) [2,3,4]	0.21 (0.20–0.21) [1]	0.20 (0.18–0.22)	0.20 (0.17–0.22)
L2/SVL	0.38 (0.33–0.41) [2,3,4]	0.30 (0.28–0.32) [1]	0.31 (0.28–0.34)	0.31 (0.28–0.34)
HW/SVL	0.14 (0.13–0.15) [3]	0.13 (0.13–0.14) [3]	0.12 (0.12–0.13)	0.13 (0.12–0.15)
HL/SVL	0.19 (0.18–0.20) [3]	0.18 (0.18–0.19) [3]	0.17 (0.16–0.17)	0.18 (0.16–0.19)
NL/SVL	0.16 (0.14–0.18)	0.16 (0.15–0.18)	0.16 (0.13–0.19)	0.16 (0.12–0.18)
Weight/SVL	0.19 (0.17–0.22) [2,4]	0.05 (0.04–0.06) [1,3,4]	0.15 (0.12–0.21)	0.13 (0.09–0.17)
Midbody scale rows	28.3 (28–30) [2,4]	26.5 (25–27) [1,3]	28.1 (28–30)	26.6 (24–28)
Paravertebral scales	58.9 (55–61) [3,4]	58.5 (56–60) [3,4]	64.2 (59–68)	54.3 (51–56)
Subdig. lamellae 4th finger	14.3 (14–15) [2,3,4]	10.8 (10–11) [1]	11.6 (11–12)	11.4 (11–13)
Subdig. lamellae 4th toe	23.3 (22–25) [2,3,4]	17.8 (17–20) [1,3,4]	21.2 (20–23)	20.6 (19–22)
Supraciliaries	7.3 (7–8)	6.5 (6–7)	7.0 (6–8)	6.9 (6–7)
Infralabials	6.7 (6–7)	6.0 (6–6)	6.3 (6–7)	6.4 (6–7)
Supralabials	8.1 (8–9) [2,3,4]	7.0 (7–7) [1]	7.1 (7–8)	7.1 (7–8)
Supralabial below eye	6.1 (6–7) [2,3,4]	5.0 (5–5) [1]	5.1 (5–6)	5.0 (5–5)
Nuchals	7.9 (7–9)	6.3 (6–7)	6.8 (5–9)	7.6 (4–9)

Distribution. Known only from the Melville Range, Cape Melville, north-eastern Australia (Fig. 6). *Glaphyromorphus othelarrni* **sp. nov.** has been recorded in three areas: in the vicinity of the type locality in the western uplands (14°16'33" S, 144°29'32" E, 450–520 m a.s.l.), around the highest peak in the Melville Ra.(14°16'59" S, 144°29'59" E, 600 m a.s.l.), and in the lowlands at the south of the range (14°18'55" S, 144°29'50" E, 110 m a.s.l.).

Habitat and habits. Found in rocky areas in rainforest (Fig. 7). All individuals were found where thick leaf-litter had accumulated at the base of boulders or amongst boulders (e.g., Fig. 7B). Skinks were observed active in the leaf-litter, on adjacent rock surfaces, and amongst crevices between the boulders. When pursued the skinks retreated deep into the leaf-litter or into rock crevices. Activity was greatest in the couple of hours before dusk, and during this period the skink was commonly encountered wherever there were boulders in the rainforest. Most individuals were missing at least one digit (e.g., the 5th toe on the right hindfoot in Figure 2), and some individuals were missing all fingers or toes on a foot. The reason for this was not resolved. The other skinks found in sympatry at *G. othelarrni* **sp. nov.** sites were *Eulamprus brachysoma* (Lönnberg & Andersson, 1915), *Bellatorias frerei* (Günther, 1897), *Saproscincus saltus* Hoskin, 2013, an undescribed species of *Carlia* (Hoskin, in press), and a species of *Lygisaurus* (Hoskin & Hines, under investigation).

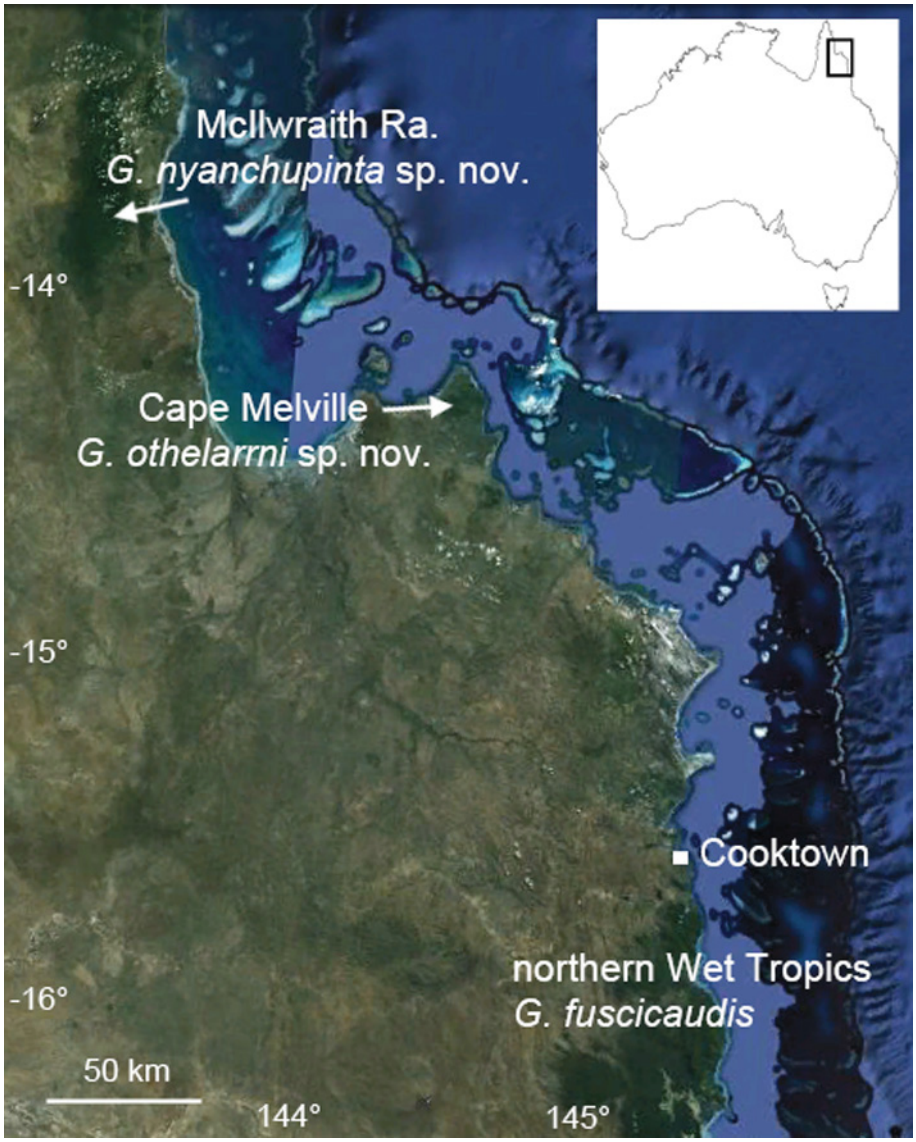

FIGURE 6. Map of north-east Queensland, showing Cape Melville, McIlwraith Range and the northern Wet Tropics region, and the rainforest *Glaphyromorphus* present in each of these areas. *Glaphyromorphus nigricaudis* occurs in vine scrubs, gallery forests and moister woodlands throughout the area shown in this map. The inset shows Australia. Background image is from Google Maps (Imagery 2013 NASA, Map data 2013 GBRMPA, Google).

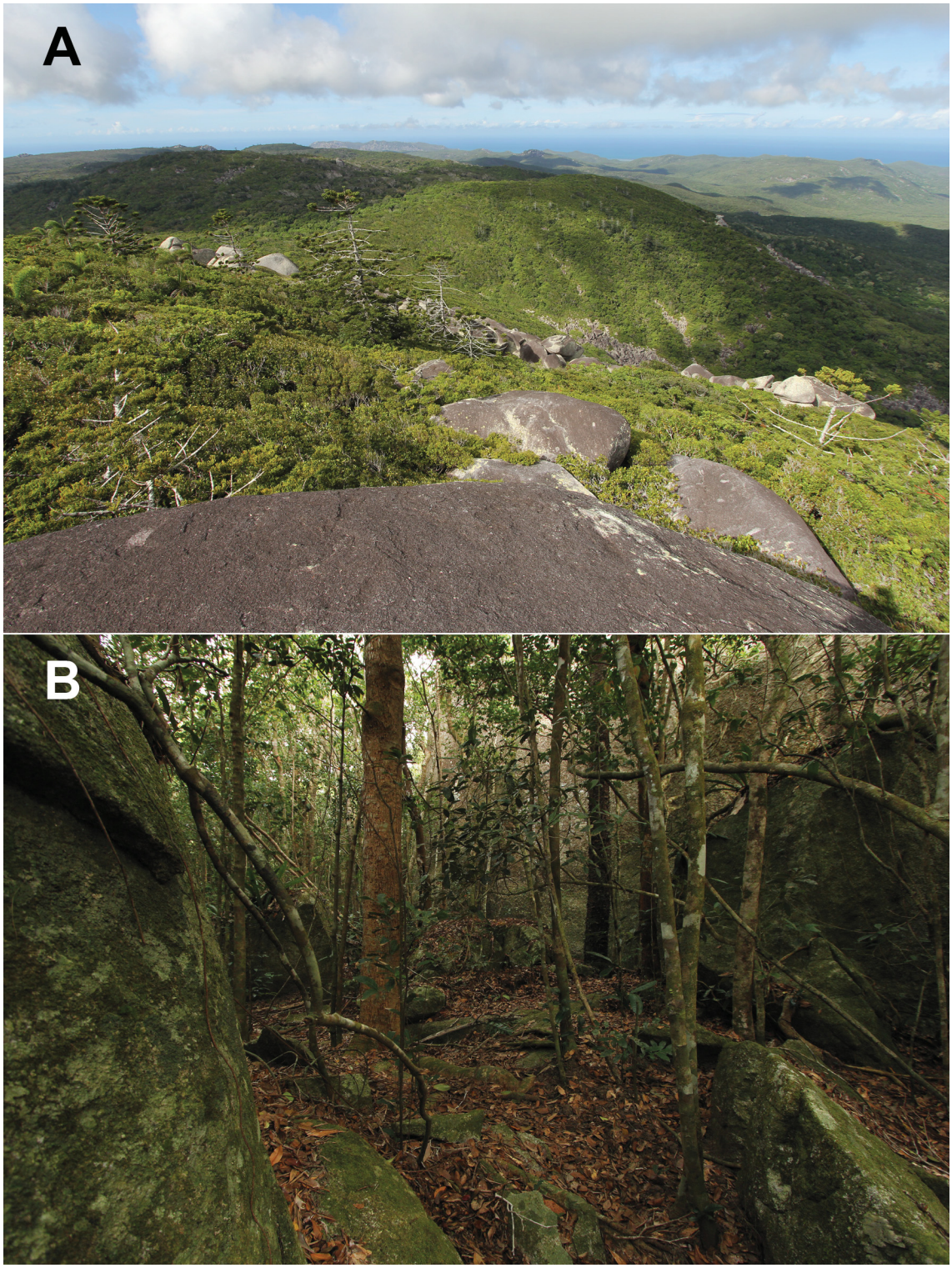

FIGURE 7. Habitat of *G. othelarrni* **sp. nov.**, Melville Range: (A) shows rainforest and boulder-field in the uplands; (B) shows boulder-strewn rainforest at the type locality. Photos: Conrad Hoskin.

***Glaphyromorphus nyanchupinta* sp. nov.**
McIlwraith Bar-lipped Skink
(Figs 3B, 4B, 5B, 8, 9)

Material examined. Holotype: QMJ85244, mature male with turgid opaque testes, Peach Creek (13°44'12" S, 143°19'47" E, elevation 530 m a.s.l.), McIlwraith Range, north-east Queensland, collected 20 July 2007 by S. Williams & C. Moritz. **Paratypes:** QMJ38195, adult female with developing follicles, 17 km ENE of Mt Croll (13°46' S, 143°19' E), McIlwraith Range, collected 2 June 1979, J. W. Winter & R. G. Atherton; QMJ66642, adult female with developing follicles, Peach Creek headwaters (13°44'15", S 143°20'20" E, 530 m a.s.l.), McIlwraith Range, collected 25 August 1998 by K. McDonald & J. Covacevich; QMJ70609, gravid adult female, McIlwraith Range (13°44'01" S, 143°20'09" E, 530 m a.s.l.), collected 16 August 1999, K. McDonald, A. Freeman & H. Hines.

Diagnosis. *Glaphyromorphus nyanchupinta* **sp. nov.** is diagnosed from all congeners in having: narrowly separated adpressed limbs (not separated by more than the length of the forelimb); more than 24 midbody scale rows; the prefontal separated from the preocular; small body size (max SVL ~ 54 mm); seven supralabials (with 5th below centre of eye); fewer than 21 lamellae beneath 4th toe; a strong barred body pattern extending to hindlimbs; dark supralabial scales with a central white dot; dark streaks typically present on throat.

Etymology. Nyanchupinta translates as: 'nyanchu' for 'dead leaves or mulch' and 'pinta' for 'covered', referring to the lizard being hidden in the leaf-litter. The species was named by Elders of the Kaantju clan, traditional owners of the McIlwraith Range where the species lives.

Measurements and scale counts of holotype QMJ85244 (Figs 3B, 4B, 8, 9)**.** Mature male with turgid, opaque testes. SVL = 53.0 mm, AG = 26.4 mm, TL not measured due to partial tail loss, L1 = 10.5 mm, L2 = 17.0 mm, HL = 10.2 mm, HW = 7.4 mm, NL = 7.9 mm, midbody scale rows = 27, paravertebrals = 60, lamellae 4th toe = 17, lamellae 4th finger = 11, supralabials = 7 with 5th below centre of eye, infralabials = 6, supraciliaries = 6 left/7 right.

Description of type series. Data presented as range followed by mean in brackets (n = 4, unless stated otherwise). ***Adult measurements*** (mm): SVL = 49.2–53.6 (51.8), AG = 25.4–29.5 (27.3), TL = 51.8 (n = 1), L1 = 10.1–11.3 (10.7), L2 = 14.3–17.0 (15.5), HL = 9.2–10.2 (9.5), HW = 6.6–7.4 (6.9), NL = 7.8–9.8 (8.5) (Table 1). ***Adult proportions*** (as % SVL): AG = 50–55 (53), TL = 100 (n = 1), L1 = 20–21 (21), L2 = 28–32 (30), HL = 18–19 (18), HW = 13–14 (13), NL = 15–18 (16) (Table 1). ***Body:*** elongate, tubiform. Neck broad and not well differentiated from back of head. Snout rounded in profile. Limbs short, pentadactyl, and separated by the about the length of the forelimb when adpressed. ***Scalation:*** Scales smooth with rounded posterior margins; 25–27 (mean = 26.5) rows at midbody; paravertebrals not transversely enlarged (except enlarged nuchals) and numbering 56–60 (mean = 58.5) in a line between the parietals and the posterior margin of the hindlimb. Nasals moderate, well-spaced, with a relatively large external naris; rostral and frontonasal in moderate contact; prefrontals large, moderately to very narrowly separated, and not contacting 1st preocular; frontal contacting frontonasal, prefrontals, first two supraoculars, frontoparietals and usually in point contact with 1st supraciliary; supraoculars 4, second the largest; supraciliaries 6–7 (mean = 6.5), first the largest; frontoparietals paired and distinct from interparietal; parietals in contact behind interparietal; 6–7 (mean = 6.3) nuchal scales; primary temporals 1; secondary temporals 2, upper largest and overlapping lower; loreals 2; preoculars 2; presuboculars 2; an enlarged subocular scale penetrating the suture between the 4th and 5th supralabials; supralabials 7, 5th below centre of eye; infralabials 6; postmental contacting two infralabials on each side; lower eyelid scaly; ear opening round or vertically oval, without lobules and with tympanum moderately recessed; lamellae under 4th finger 10–11 (mean = 10.8); lamellae under 4th toe 17–20 (mean = 17.8); medial pair of preanal scales greatly enlarged. **Colour pattern in preservative** (Fig. 3B, 4B, 9): Dorsal ground colour mid brown with narrow, dark brown or dark grey wavy bars extending from vertebral zone to lower flanks. Pattern extends to hindlimbs but generally more prominent on anterior half of dorsum. Laterally the pattern breaks up, becoming increasingly mottled on the posterior third of the body and sides of tail. The temporal region and sides of neck marked with dark reticulations, where dark bars merge together, and the upper labials are predominantly dark, each bearing a pale central dot. Venter immaculate cream except at edge of jawline and chin, where there are dark markings around the scale edges. These are least prominent in QMJ66642 but extend to the throat in the rest of the type series. Limbs pale brown with a dark reticulated pattern.

Colour pattern in life (Figs 5B, 8). As for spirit specimens but colours richer, particularly on body bars and face, and appearance generally more glossy.

Comparison with similar species. *Glaphyromorphus nyanchupinta* **sp. nov.** can only be confused with *G.*

othelarrni **sp. nov.**, *G. fuscicaudis* and *G. nigricaudis*. It is readily distinguished from all three species by its small body size (max SVL = ~ 54 mm *vs* > 85 mm), less robust form (WT/SVL 0.04–0.06 *vs* > 0.09); number of subdigital lamellae beneath the 4th toe (17–20 *vs* generally 20 or more) (Table 1); labial pattern (supralabials predominantly dark, enclosing a central white dot *vs* supralabials pale with dark barring along sutures) (Fig. 4B), lateral head and neck pattern (dark reticulations *vs* dark bars or spots) (Figs 3B, 5B); the extent of the body pattern (dark dorsal and lateral bars extend posteriorly to hindlimb *vs* pattern generally strongest on anterior half of body and breaking up or absent beyond midbody) (Figs 3B, 5B); and dark streaks typically present on the throat (Fig. 9) *vs* throat typically unmarked. *Glaphyromorphus nyanchupinta* **sp. nov.** is further distinguished from *G. othelarrni* **sp. nov.** in having a proportionately shorter tail (TL/SVL 1.00 *vs* 1.47–1.86); shorter limbs (L1/SVL: 0.20–0.21 *vs* 0.22–0.26; L2/SVL: 0.28–0.32 *vs* 0.33–0.41); fewer midbody scale rows (25–27 *vs* 28–30); fewer subdigital lamellae beneath the 4th finger (10–11 *vs* 14–15); and fewer supralabial scales (7 with 5th below centre of eye *vs* typically 8 with 6th below centre of eye) (Table 1). It is further distinguished from *G. fuscicaudis* in having a proportionately larger head (HW/SVL: 0.13–0.14 *vs* 0.12–0.13; HL/SVL: 0.18–0.19 *vs* 0.16–0.17); fewer midbody scale rows (25–27 *vs* 28–30); and generally fewer paravertebral scales (mean 59 *vs* 64) (Table 1). It also lacks the series of yellow dorsolateral blotches that are prominent in *G. fuscicaudis* (Figs 5B, 5C). It is further distinguished from *G. nigricaudis* in having fewer paravertebral scales (56–60 *vs* 51–56) (Table 1).

Distribution. Known only from the uplands of McIlwraith Range, north-east Australia (Fig. 6). All individuals have been collected in the same area, at about 530 m elevation in the headwaters of Peach Ck. The McIlwraith Range is poorly explored and it is likely the species is more widespread in the uplands.

Habitat and habits. Found in upland rainforest (Fig. 10). Individuals have been collected from under logs in rainforest. A gravid female (QMJ70609), with two fully-developed eggs, was collected in mid August.

FIGURE 8. *Glaphyromorphus nyanchupinta* **sp. nov.** in life (holotype, QMJ85244). Photo: Stephen Williams.

FIGURE 9. Ventral surface of the holotype of *G. nyanchupinta* **sp. nov.** (QMJ85244). Photo: Conrad Hoskin.

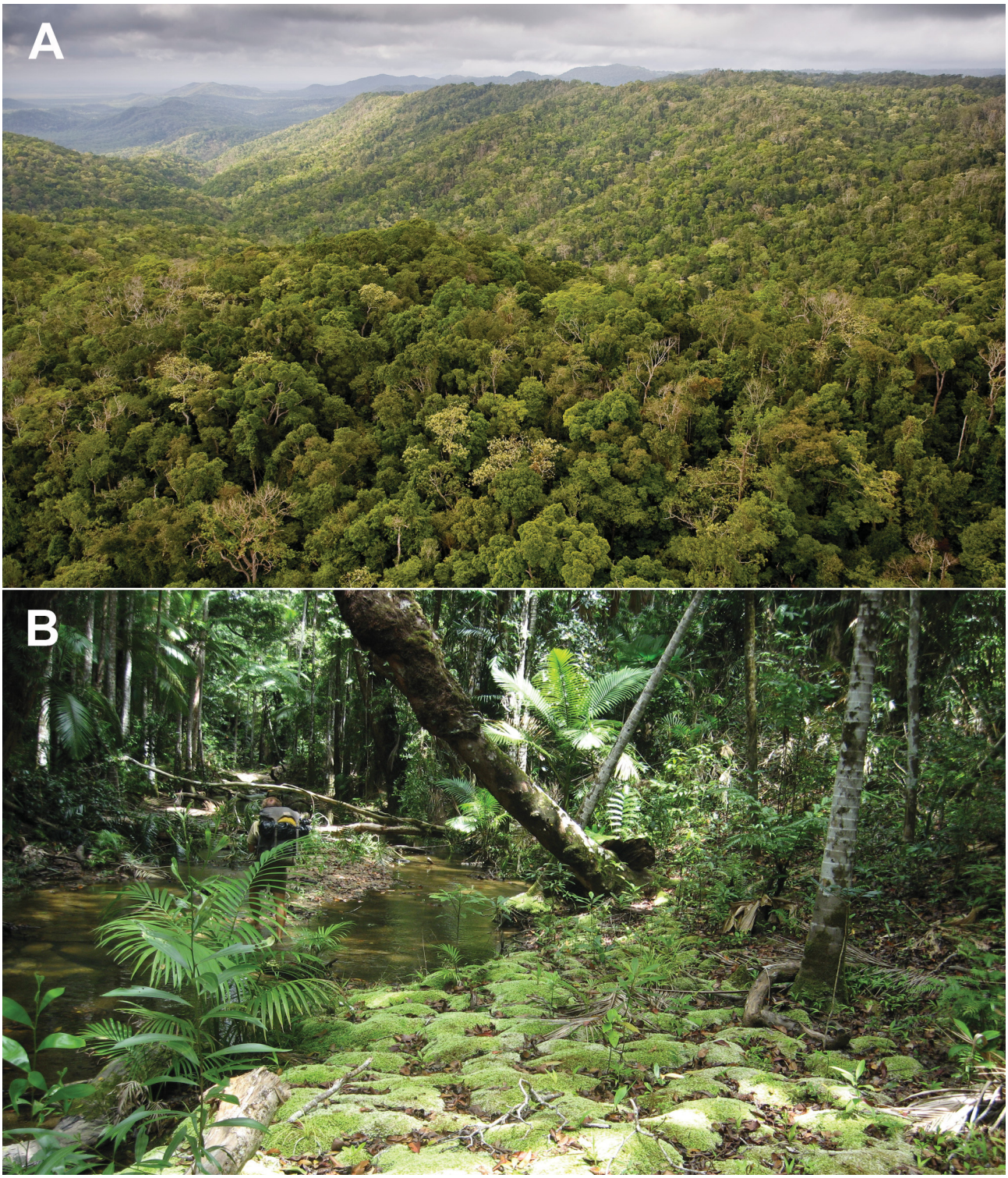

FIGURE 10. Habitat of *G. nyanchupinta* **sp. nov.**, McIlwraith Range: (A) shows the rainforest uplands; (B) shows rainforest in the vicinity of the type locality. Photo credits: (A) Adam Creed (QPWS), (B) Patrick Couper.

Discussion

The description of these two species brings the number of Australian *Glaphyromorphus* to 11 species, four of which are in the '*G. nigricaudis* group'. Individuals of *G. othelarrni* **sp. nov.** and *G. nyanchupinta* **sp. nov.** were not included in Greer's (1979b) study of *G. nigricaudis*-like skinks in north Queensland because these populations had

not been discovered at the time. Greer (1979b) separated *G. fuscicaudis* from *G. nigricaudis* based primarily on non-overlapping paravertebral counts of 60–70 and 52–58, respectively. Our additional data for these species reduces the lower limit of the count for both species by one scale row (Table 1). The paravertebral counts remain non-overlapping between these two species: *G. nigricaudis* 51–58 *vs G. fuscicaudis* 59–70. These two species are otherwise very similar in morphology and scalation (Greer 1979b; Table 1). They do, however, differ obviously in pattern, with *G. fuscicaudis* having a prominent dorsolateral series of yellowish blotches on the shoulders. They also differ ecologically. In the Wet Tropics region, where they co-occur, *G. fuscicaudis* occupies the core rainforest areas whereas *G. nigricaudis* is generally found in peripheral areas, in moist woodlands, vine thickets and gallery forests.

The Wet Tropics has many endemic rainforest species, including 10 mammals, 12 birds, 21 reptiles and 28 frogs (a total of 71 rainforest-associated vertebrate endemics). The rainforests of Cape York have 21 identified rainforest-associated endemic vertebrates, consisting of 2 mammals, 11 reptiles and 8 frogs (Table 2). These species are generally highly localized and nearly 50% have been described in the last decade (Table 2). The majority of the rainforest-associated vertebrates endemic to Cape York are restricted to Cape Melville or McIlwraith Range (Table 2). These areas have 7 and 5 endemic rainforest-associated species, respectively (*Cryptoblepharus fuhni* Covacevich & Ingram, 1978 is also endemic to Cape Melville but is not considered rainforest-associated). The remaining endemics are found in smaller rainforest areas (e.g., Stanley Hills area), are shared between rainforest areas (McIlwraith Range–Iron Range area), or are widespread across rainforests of Cape York (*Melomys capensis* Tate, 1951) (Table 2).

TABLE 2. The rainforest-associated endemic vertebrates of Cape York; listed approximately north to south. These species are considered rainforest-associated because they predominately occur in rainforest or are members of a genus that is always associated with rainforest. The latter category refers to the *Cophixalus* frogs—14 Australian species are rainforest-restricted and 5 species occur in boulder-fields associated with rainforest.

Area	Group	Species	Description
widespread	mammal	*Melomys capensis*	Tate, 1951
Stanley Hills area	reptile	*Cyrtodactylus adorus*	Shea *et al.*, 2011
Stanley Hills	frog	*Cophixalus pakayakulangun*	Hoskin & Aland, 2011
Stanley Hills–McIlwraith Ra.	reptile	*Carlia rimula*	Ingram & Covacevich, 1980
Mt Tozer area	frog	*Cophixalus kulakula*	Hoskin & Aland, 2011
Iron–McIlwraith Ra.	mammal	*Antechinus leo*	Van Dyck, 1980
Iron–McIlwraith Ra.	reptile	*Varanus keithhornei*	Wells & Wellington, 1985
Mt Carter–McIlwraith Ra.	frog	*Litoria longirostris*	Tyler & Davies, 1977
McIlwraith Ra.	reptile	*Cyrtodactylus pronarus*	Shea *et al.*, 2011
McIlwraith Ra.	reptile	*Glaphyromorphus nyanchupinta*	This paper
McIlwraith Ra.	reptile	*Orraya occultus*	(Couper *et al.*, 1993)
McIlwraith Ra.	frog	*Cophixalus crepitans*	Zweifel, 1985
McIlwraith Ra.	frog	*Cophixalus peninsularis*	Zweifel, 1985
Cape Melville	reptile	*Carlia* sp.	Hoskin, in press
Cape Melville	reptile	*Glaphyromorphus othelarrni*	This paper
Cape Melville	reptile	*Saltuarius eximius*	Hoskin & Couper, 2013
Cape Melville	reptile	*Saproscincus saltus*	Hoskin, 2013a
Cape Melville	frog	*Cophixalus petrophilus*	Hoskin, 2013b
Cape Melville	frog	*Cophixalus zweifeli*	Davies & McDonald, 1998
Cape Melville	frog	*Litoria andirrmalin*	McDonald, 1997
Cooktown–Starcke area	reptile	*Lygisaurus tanneri*	Ingram & Covacevich, 1988

Glaphyromorphus othelarrni **sp. nov.** does not live on exposed rock surfaces but it was always found living amongst boulders. Although its limbs aren't long as seen in true boulder-adapted lizards at Cape Melville (Covacevich & Ingram 1978; Hoskin 2013a; Hoskin & Couper 2013), it nonetheless conforms to the predicted pattern of relatively long legs compared to sister species (Table 1). As for most other Cape Melville vertebrate endemics (Davies & McDonald 1998; Hoskin 2013a, 2013b; Hoskin & Couper 2013), this suggests a long history of association with rock and highlights the importance of rock landscapes for the persistence of rainforest lineages (Couper & Hoskin 2008). While rainforest refugia of substantial size persisted in the Wet Tropics through the cool, dry glacial maxima (e.g., VanDerWal *et al.* 2009), it is likely that rainforest and associated biota contracted to tiny areas on Cape York during restrictive climatic periods. While the large upland area of McIlwraith Range is likely to have retained small rainforest refugia (and rainforest lineages like *Cophixalus crepitans* Zweifel 1985 and *G. nyanchupinta* **sp. nov.** that are not rock-associated), in other areas (e.g., Cape Melville) persistence would have been reliant on the cool, moist conditions offered by deeply layered rock environments—lithorefugia (Couper & Hoskin 2008). Over extended periods in these rocky environments, the fauna adapted to a largely rock-associated morphology and lifestyle, such that even under more expansive current climatic conditions many of these species remain restricted to rock habitats and absent from the surrounding rainforest lacking rocks.

A key to the *Glaphyromorphus nigricaudis* group of north-eastern Australia

Group defined as having: adpressed limbs overlapping or separated by at most the length of forelimb, 24 or more midbody scale rows, and prefrontal not contacting first preocular scale.

1. Body size small (SVL ~ 50 mm); dark barred pattern on dorsal and lateral surfaces of the body, extending posteriorly to groin; supralabials predominantly dark . . . . . *nyanchupinta*
- Body size large (SVL ~ 70–90 mm); dark barred pattern not extending to groin; supralabials predominantly pale with dark sutures 2
2. Eight supralabial scales with 6th below centre of eye, and more than 14 subdigital lamellae beneath 4th finger . . . . . *othelarrni*
- Seven supralabial scales with 5th below centre of eye, and less than 14 subdigital lamellae beneath 4th finger. 3
3. 59–70 paravertebral scale rows; a series of pale or yellowish dorsolateral blotches present on shoulders . . . . . *fuscicaudis*
- 51–58 paravertebral scale rows; no series of yellowish dorsolateral blotches on shoulders . . . . . *nigricaudis*

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APPENDIX. Additional material examined.

Glaphyromorphus fuscicaudis: QMJ25218, Mt Finnigan summit (15°49'10" S, 145°17'05" E); QMJ29074–075, Danbulla SF, 'A' Rd (17°07' S, 145°38' E); QMJ29076–077, Lake Eacham NP (17°16'57" S, 145°37'46" E); QMJ48700, Gadgarra SF, Bull Ck (17°17'30" S, 145°41'30" E); QMJ51995, Mt Molloy (16°41' S, 145°20' E); QMJ58119, Mt Pieter Botte (16°04' S, 145°25' E); QMJ60638, Mt Boolbun South, via Cooktown (15°56' S, 145°09' E); QMJ60739, Windsor Tableland (16°17'30" S, 145°05'30" E); QMJ61842, Stagers Rd, base of Mt Bartle Frere (17°23' S, 145°46' E); QMJ75147, Mt Lewis SF, SW slope of Mt. Lewis (16°35'25" S, 145°16'15" E); QMJ89914, Black Mountain Rd, N of Kuranda (16°47' S, 145° 37'54" E); QMJ89915, Black Mtn Rd, south of Forestry Hut (16°45'58" S, 145°37' E). ***Glaphyromorphus nigricaudis:*** QMJ47100, Cairns (16°55' S, 145°46' E); QMJ63520, Cape Melville NP (14°17'03" S, 144°27'31" E); QMJ69394, Haggerstone Is. (12°02' S; 143°18' E); QMJ86368, Masig Is., Yorke Islands (09°45' S, 143°24' E); QMJ87578, Muck River (14°18'45" S, 144°26'22" E); QMJ87881, Bluebottle Spring, Steve Irwin Wildlife Reserve (12°20' S, 142°14'14" E); QMJ87921, Oasis Spring, Steve Irwin Wildlife Reserve (12°20'24" S, 142°15'05" E); QMJ87973, Ling Ck, Steve Irwin Wildlife Reserve (12°18'01" S, 142°15'15" E); QMJ89482, Kennedy Hills, north of Pascoe R. (12°28' S, 143°16'12" E); QMJ92549, Altanmoui Range (14°31'27" S, 144°37'17" E).