KYARRANUS MOORE (ANURA, LEPTODACTYLIDAE) FROM THE TERTIARY OF QUEENSLAND

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The first fossil record of the leptodactylid frog *Kyarranus* Moore is from the Tertiary of northwestern Queensland. Sixteen specimens of the new species *K. borealis* have been recovered and described from a series of Oligo–Miocene sites far to the north of the geographic range of the three extant congeners. Ilial characters provide evidence to sustain the recognition of *Philoria* Parker as a distinct genus.

THE LEPTODACTYLID frog genus *Kyarranus* Moore, 1958 was erected to accommodate the species *K. sphagnicolus* Moore, 1958 from northeastern New South Wales, and *Philoria loveridgei* Parker (1940) from the adjacent portion of southeastern Queensland. A third species subsequently was referred to it, *K. kundagungan* Ingram & Corben, 1975.

Kyarranus is most closely related to the genuinely monotypic *Philoria* Spencer of Mt Baw Baw, Victoria. Each of the *Kyarranus* and *Philoria* species is restricted to localised montane habitats. The breeding biology is specialised. In both genera macrolecithal eggs are laid in moist situations out of water. Larval mouthparts are rudimentary and development is accomplished without feeding (Moore 1961, Littlejohn 1963, Anstis 1981).

Kyarranus has not been reported in the fossil record. However, a series of ilia clearly referable to this genus has been recovered recently from a series of Oligo–Miocene sites at Riversleigh Station in northwestern Queensland. In the present paper the specimens are described as a new species, and the geographic and palaeoclimatic significance of the discovery is discussed.

MATERIAL AND METHODS

The fossil material is deposited in the collections of the Queensland Museum, Brisbane (QM) and the South Australian Museum, Adelaide (SAM). Letters following the abbreviations are departmental identifications.

Comparative studies were based on osteological collections of the Department of Zoology, University of Adelaide. Osteological nomenclature follows Tyler (1976). Methods of measurement and orientation of specimens follows the techniques described by Tyler (1989).

Details of sites, stratigraphy, etc. are provided by Archer et al. (1989).

SYSTEMATICS

Family LEPTODACTYLIDAE Werner, 1896
Subfamily LIMNODYNASTINAE Lynch, 1971

Genus **Kyarranus** Moore, 1958

The description of the ilial features of the genus by Tyler (1976) was based on *K. sphagnicolus* and *K. kundagungan* (reported there as "*Kyarranus* sp."). Since that date specimens of *K. loveridgei* have become available, and they do not differ conspicuously from the other species (Fig. 1). In all species the dorsal prominence and dorsal protuberance are particularly well-developed, and commonly project anteriorly as a spine. This feature is unique to *Kyarranus*.

Kyarranus borealis sp. nov.

Fig. 2

Holotype. QM F18167, an almost entire left ilium collected at RSO Site, Riversleigh Station, Queensland.

Description of holotype. Ilial shaft cylindrical and very slightly curved; almost entire. Very shallow grooves on medial surface at proximal and distal extremities.

Acetabular fossa very large, deep and with prominent rim bounding inferior half. Dorsal margin of acetabular fossa situated slightly superior to inferior margin of ilial shaft. Preacetabular zone evenly rounded and moderately

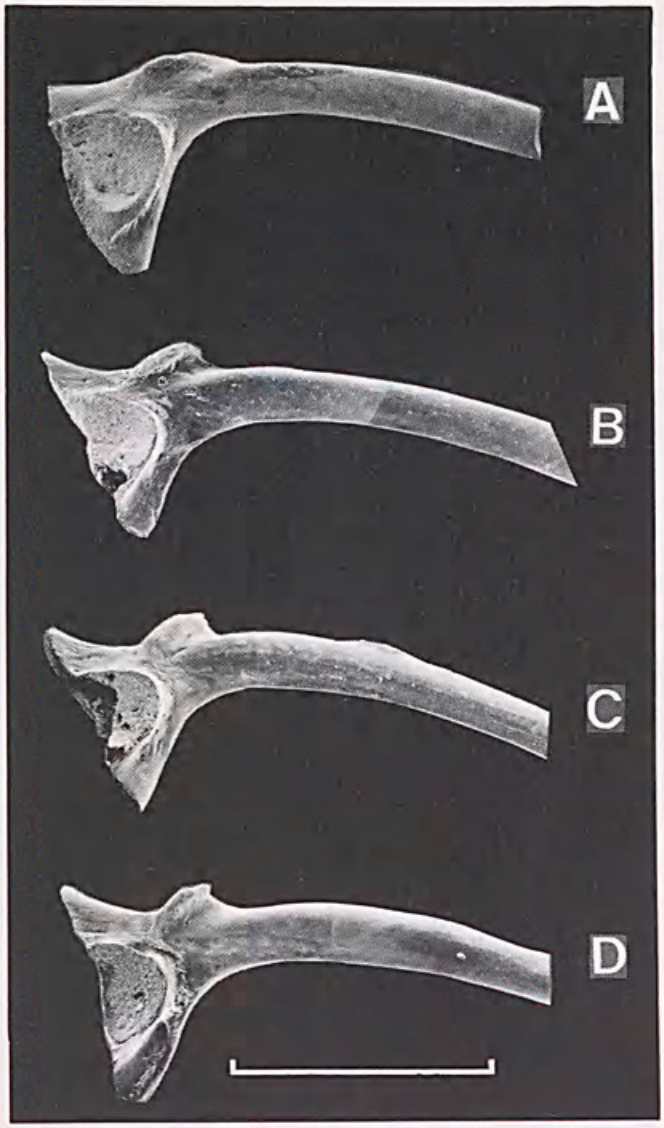

Fig. 1. Comparison of ilia of extant species of *Philoria* and *Kyarranus*. A, *Philoria frosti*; B, *Kyarranus kundagungan*; C, *K. loveridgei*; D, *K. sphagnicolus*. Scale bar = 5 mm.

developed. Ventral acetabular expansion (VAE) missing. Dorsal acetabular expansion (DAE) narrow and incomplete. Dorsal prominence well- developed and conspicuous. Dorsal protuberance projecting laterally and extremely conspicuous. Anterior margin of dorsal prominence extends to position located anterior to anterior margin of acetabulum.

Length of ilium 16.1 mm; DAE/VAE cannot be estimated with any degree of confidence.

Paratypes. There are 15 paratypes: Gag Site QM 18160, 18166, SAM P31237; Last Minute Site QM F18163; Neville's Garden Site QM F18169–70, R.S.O. Site QM F18161, 18165; Camel Sputum Site QM F18162, 18168, 18171,

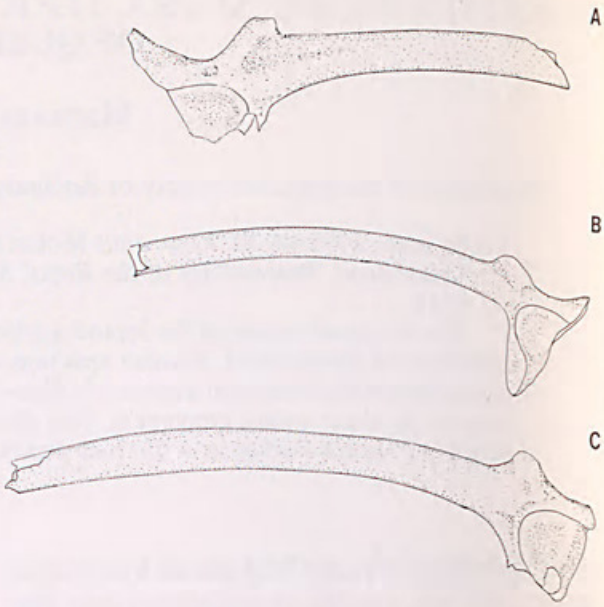

Fig. 2. Ilia of *Kyarranus borealis* sp. nov. A, QM F18169 (paratype); B, SAM P31238 (paratype); C, QM F18167 (holotype).

SAM P31238; Upper Site SAM P31239; Outasite Site QM F18172; Wayne's Wok Site QM F18164.

Variation. Fourteen of the 15 paratypes have an incomplete shaft. The complete specimen (SAM P31238) measures 8.7 mm compared with 16.1 mm for the holotype. No significance is attributed to this difference beyond ontogenetic; comparable variation in size was noted in *Lechriodus intergerivus* at Riversleigh Station (Tyler 1989) and the projected sizes of many of the incomplete ilia approximate the holotype. The proximal portions of each of the ilia, although commonly lacking entire dorsal or ventral acetabular expansions, conform to the shape of the holotype.

Comparison with other species. It is evident that *K. borealis* may have been a slightly larger species than any of the extant congeners. As determined by plotting the regression line of ilial length upon snout to vent length of extant species (Fig. 3), the holotype of *K. borealis* would have had a snout to vent length of 37.9 ± 0.67 mm. This figure compares with upper limits of 31 mm for *K. loveridgei*, 30 mm for *K. kundagungan* and 37 mm for *K. sphagnicolus*.

Etymology. The adoption of *borealis* (L.) or "northern" refers to the far northern position of the type locality compared with the geographic distributions of extant species.

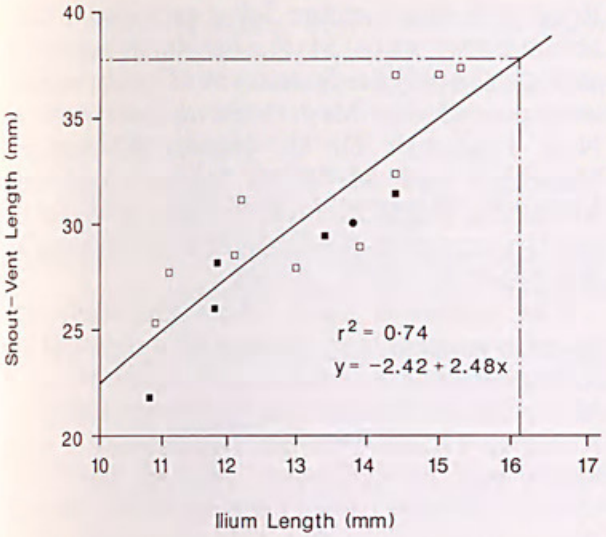

Fig. 3. Length of ilia of *Kyarranus* species plotted against snout to vent length. Assumed snout to vent length of largest specimen of fossil species indicated by broken lines, t- value for slope 6.365, $p < 0.001$. For x = 16.1, y = 37.9 (95% confidence limits = 36.8-38.2). Closed squares = *K. loveridgei*; open squares = *K. sphagnicolus*; closed circle = *K. kundagungan.*

DISCUSSION

Discovery of *Kyarranus* in the Tertiary of northern Queensland is significant in its contribution to an understanding of the origin and dispersal of Australian frogs and the palaeoenvironmental implications. Extant *Kyarranus* are confined to three isolated montane areas which are variously forested, and where there is a carpet of low growing vegetation and decomposing material within which the frogs live and deposit spawn.

The three extant *Kyarranus* species are allopatric and clustered around the eastern extremity of the Queensland–New South Wales border (Fig. 4). The evident close phylogenetic relationship to *Philoria* that has caused the status of *Kyarranus* to be questioned indicates that a shared ancestral stock once extended through New South Wales and eastern Victoria.

The presence of *K. borealis* in the Tertiary of northwestern Queensland indicates a much more widespread geographic distribution than has been appreciated, and emphasises the relict nature of the extant populations. Extinction in the northwest and intermediate areas can be attributed to the first onset of aridity. However, the existence at the Riversleigh sites raises the question of why this genus did not extend its range farther north into New Guinea when opportunities arose.

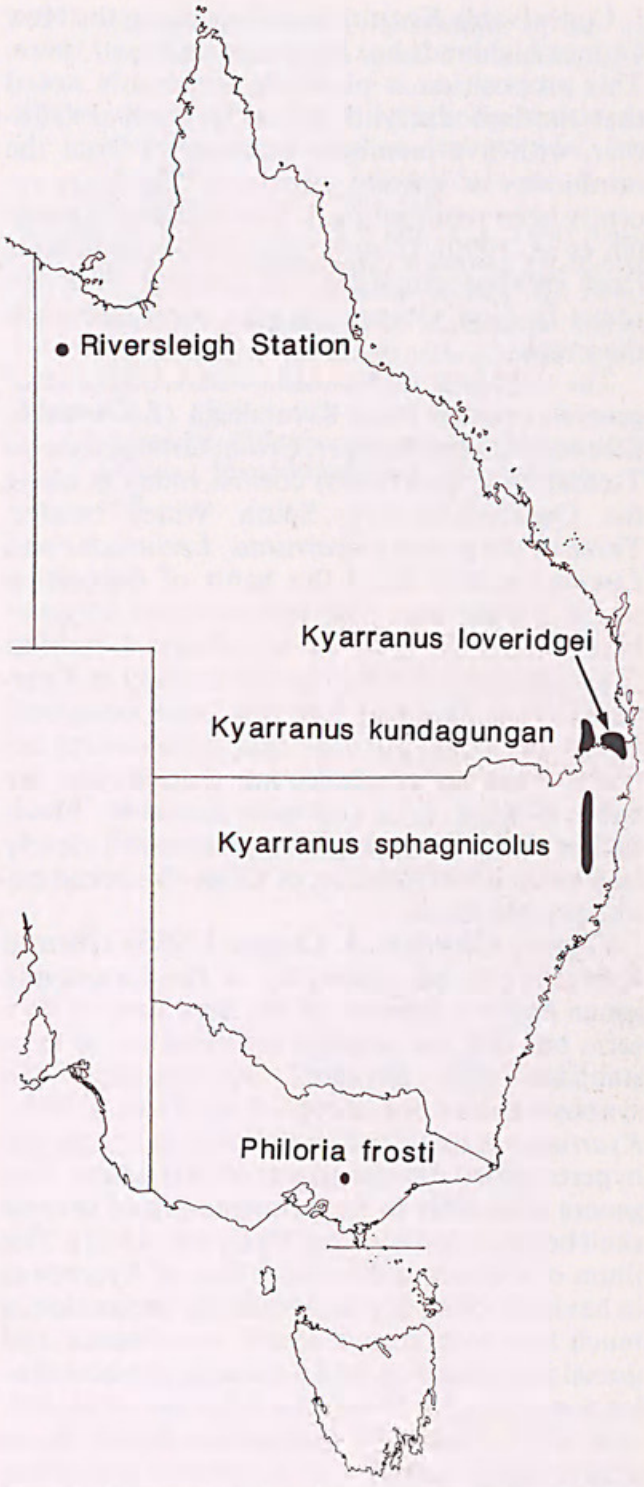

Fig. 4. Geographic distribution of species of *Kyarranus* and *Philoria*. The extent of *K. sphagnicolus* so far south is based on locality records of Webb (1989).

A partial parallel is the distribution of *Lechriodus* Boulenger which is abundant at Riversleigh sites but exhibits a similar gap to the northern limit of the (single) extant species (Tyler 1989, Tyler et al. 1990). However, *Lechriodus* has three extant species in New Guinea.

Conceivably *Kyarranus* does occur in the New Guinea highlands but has yet to be found there. This proposition is plausible when it is noted that the leptodactylid genus *Mixophyes* Günther, with five members well-known from the rainforests of eastern Australia, has only recently been reported from New Guinea (Donellan et al. 1990). If such large and conspicuous frogs escaped attention, the absence of *Kyarranus* in New Guinea may be more apparent than real.

The only area in Australia where the suite of genera reported from Riversleigh (*Lechriodus, Limnodynastes* Fitzinger, *Crinia* Girard, *Litoria* Tschudi and *Kyarranus*) coexist today is along the Queensland–New South Wales border. Three of the genera (*Kyarranus, Lechriodus* and *Limnodynastes*) share the habit of depositing ova in a foam nest. The last two (and *Megistolotis*) create the nest in an identical fashion (Tyler & Davies 1979), but the method in *Kyarranus* (and *Philoria*) has not been observed. Given the complexity of that behavioural activity, concepts of parsimony dictate that the habit evolved in a common ancestor. Elucidation of the Riversleigh frog fauna will clearly lead to an understanding of Oligo–Miocene environments there.

Cogger, Cameron & Cogger (1983) referred *Kyarranus* to the synonymy of the monotypic genus *Philoria* Spencer of Mt Baw Baw in Victoria but did not provide information to substantiate that decision. Accordingly, the synonymy was not accepted by Frost (1985). *Kyarranus* is smaller than *Philoria*, and lacks the hypertrophied dermal glands of that genus. The genera also differ in the arrangement of several skull bones, as pointed out by Lynch (1971). The ilium of *Philoria* differs from that of *Kyarranus* in having a lower dorsal, acetabular expansion, a much less pronounced dorsal prominence and dorsal protuberance, and a reduced pre-acetabular zone (Fig. 1). Given the inherent conservatism of the ilium, the distinctions listed above support the recognition of *Kyarranus* as distinct from *Philoria*.

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