

Quaternary Fossil Frogs from Skull Cave and Devil's Lair in the Extreme South-west of Western Australia

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Abstract

The Quaternary fossil frog faunas of Skull Cave and Devil's Lair include representatives of two families. Extant species identified are *Litoria adelaidensis* (Hylidae), and *Crinia georgiana*, *Limnodynastes dorsalis* and *Pseudophryne guentheri* (Leptodactylidae). The close phylogenetic relationship between *Litoria cyclorhynchus* and *L. moorei*, and between the genera *Heleioporus* and *Neobatrachus* precludes further specific identification of material referred to each of these two groups.

Introduction

Western Australia has a particularly rich frog fauna including at least 70 species (Tyler, Smith and Johnstone 1984). That fauna can be divided into three separate components. The most numerous and diverse is the northern unit occupying the Kimberley; its phylogenetic affinities are with that portion of the Northern Territory at comparable latitudes (Tyler, Watson and Martin 1981). The second unit includes the Pilbara and adjacent arid zone, and is principally an endemic fauna supplemented with a number of species found elsewhere in Australia. Finally in the moist south-west most of the species have more obvious affinities with the fauna of the south-east of the continent than with the adjacent geographic area (Littlejohn 1967, 1981).

The frog fauna of the south-west is by far the best known component in Western Australia and is the subject of a field guide (Main 1965). In the same area frog fossils have been found in rich Holocene and Pleistocene vertebrate assemblages (Balme *et al.* 1978; Porter 1979). Here I provide identifications of some of the fossil frogs and discuss their significance.

Materials and Methods

The specimens examined are lodged in the vertebrate palaeontological collection of the Western Australian Museum. Because of the disarticulated nature of the material, identifications and comparative studies were confined to ilia, following the techniques of examination, measurement and description outlined by Tyler (1976). The study of the surface architecture of the fossils was facilitated by the use of scanning electron microscopy.

Comparative skeletal material from extant specimens used in this study is located in the Department of Zoology, University of Adelaide.

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Results

Family: Hylidae Hallowell, 1857

Litoria adelaidensis (Gray, 1841)

Fig. 1

Material

Skull Cave – 76.1.45(1 right) (used for SEM); 83.5.8(used for SEM); 83.2.30(3 right); 83.2.3(1 right); 83.2.22(1 left); 83.2.19(2 left & 2 right); 83.2.1(1 left & 1 right); 83.2.7(5 left & 1 right); 83.2.71(1 left).

Devil's Lair – 83.2.17(1 left).

Description

Twelve of the 20 ilia located are complete. The length of the specimens ranges from 13.4 to 16.35 mm. The characteristic feature of this species is the way in which the margin of the broad preacetabular zone parallels the anterior margin of the rim to the acetabular fossa (figure 1). The shaft is slightly curved and bears a very shallow lateral groove. The dorsal prominence is rounded and conspicuous. No distinct dorsal crest is present. The dorsal acetabular expansion and ventral acetabular expansion are poorly developed. The acetabulum is prominent and has a markedly elevated rim.

Comparison with Extant Material

The snout to vent lengths of modern *L. adelaidensis* range 34-35 mm (males) and 42-47 mm (females) (Tyler et al. 1984). When ilial length is plotted against snout to vent length, it is apparent that the fossil bones are from large individuals.

Remarks

The form of the preacetabular zone distinguishes the species from other southwestern species, and resembles most closely the condition of *L. ewingi* (Duméril & Bibron) from South Australia (Tyler 1977 Fig. 2).

Litoria sp. cf. *L. cyclorhynchus* (Boulenger, 1882) and *L. moorei* (Copland, 1957)

Fig. 2

Material

Skull Cave – 83.2.12(1 right); 83.5.31(1 left); 76.1.77 (1 right); 76.1.46(1 right); 76.1.148(5 left 1 right); 76.1.203(1 right); 83.5.2(3 right); 83.5.3(1 right); 83.5.5(1 right); 83.5.22(1 left 1 right); 83.5.25(2 left 3 right); 83.5.9(3 left); 83.5.12(2 left 1 right); 83.2.14(1 pair, 2 left 1 right); 83.5.13(1 left); 83.5.6(2 left 2 right); 83.5.17(1 right); 83.5.14(5 left 3 right); 83.5.15(1 right) (used for SEM).

At least 26 individual frogs are included.

Description

The complete ilia range from 20.6 to 29.4 mm in length. These and modern specimens share an elongate shaft and a very slightly sigmoid margin to the preacetabular zone such that the margin is not entirely parallel to the acetabular rim. The dorsal protuberance is small and discrete, and extends superiorly only slightly above the dorsal margin of the ilial shaft, merging anteriorly into a short and slightly developed dorsal crest. The dorsal acetabular expansion is small but rises at an acute angle. The ventral acetabular expansion is moderately developed.

Remarks

Litoria cyclorhynchus (Boulenger) and *L. moorei* (Copland) are closely related species confined to the southwest of Western Australia. Their modern distributions are largely allopatric (Tyler et al. 1984, Figs 41 and 39) with only *L. moorei* recorded in the vicinity of the fossil deposits. The ilia of these two species cannot be distinguished.

Family: Leptodactylidae Berg, 1896

Crinia georgiana Tschudi, 1838

Fig. 3

Material

Skull Cave – 83.5.7(1 right); 83.5.24(1 right); 83.5.26(1 right).

Devil's Lair – 83.5.35(1 left); 83.5.36(1 left); 77.2.247(1 left); 77.3.133(1 right); 77.4.469(1 right).

Description

The ilial shaft is incomplete in all specimens, but straight as far as can be determined. The preacetabular zone is moderately developed with a slightly sigmoid anterior border. The ventral acetabular expansion is moderately developed. The dorsal protuberance is poorly developed and the dorsal prominence small but discrete. The dorsal acetabular expansion is large and anteriorly inclined at 45° to the ilial shaft. *Crinia georgiana* exists in the vicinity of the fossil deposits (Tyler et al. 1984, Fig. 21).

Heleioporus/Neobatrachus spp.

Fig. 4

Material

Skull Cave – 83.2.11(2 left 7 right); 83.2.28(1 right); 83.2.25(3 left 2 right); 76.1.43(1 right) (used for SEM); 83.2.24(1 left); 83.2.13(1 left); 83.2.26(4 left 3 right); 83.2.8(1 left 4 right); 83.2.9(1 left 1 right); 83.2.10(1 left); 83.2.4.(5 left 5 right); 76.10.47(1 left); 76.10.48(1 left); 76.10.49(1 left); 83.2.29(1 right); 83.5.4(1 right); 83.2.21(6 left 14 right); 83.2.20(6 left 12 right); 83.2.23(9 left 11 right); 83.2.15(14 left 18 right); 83.2.2(29 left 15 right); 83.2. (42 left 28 right); 83.2.18(17 left 18 right); 83.2.16(11 left 14 right); 83.2.27(7 left 6 right).

This collection includes a minimum of 163 frogs.

Devil's Lair – 83.2.32(1 right); 73.11.429(1 left); 83.2.35(1 left); 75.5.530(1 right); 83.2.36(1 right); 83.2.33(1 right); 83.2.31(1 left 2 right); 77.6.874(1 right).

This collection includes a minimum of seven frogs.

Description

The ilial shaft is elongate and either straight or very slightly curved ventrally. The preacetabular zone is broad and its anterior margin is uniform and almost a quadrant. The ventral acetabular expansion is large and well developed. The dorsal protuberance is large and extremely variable in form; its highest point is on a level with the margin of the preacetabular zone. The dorsal prominence is small and varies in degree of lateral extension. The dorsal acetabular expansion is large and anteriorly is inclined at 45° to the shaft.

Remarks

These two genera are closely related and *Neobatrachus* was resurrected by Main (1957a) from the synonymy of *Heleioporus* apparently on the basis of differences in breeding biology.

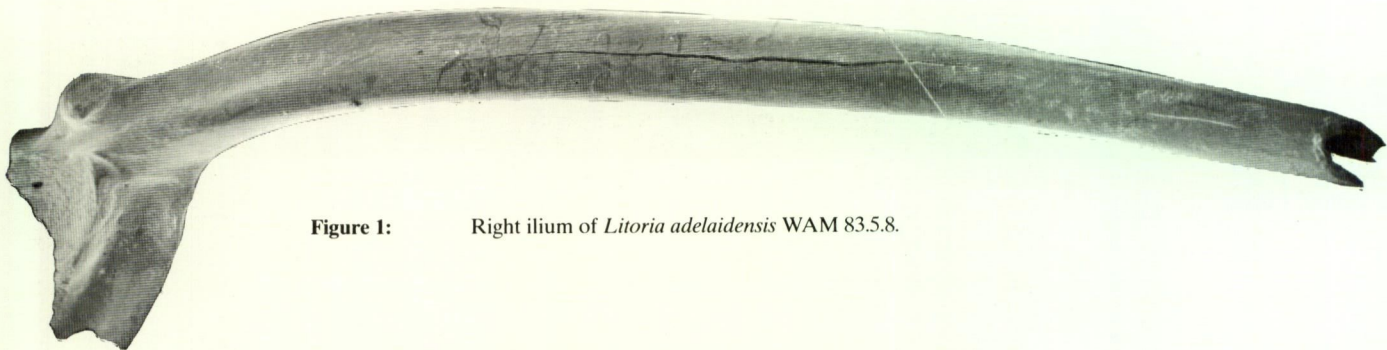


Figure 1: Right ilium of *Litoria adelaidensis* WAM 83.5.8.

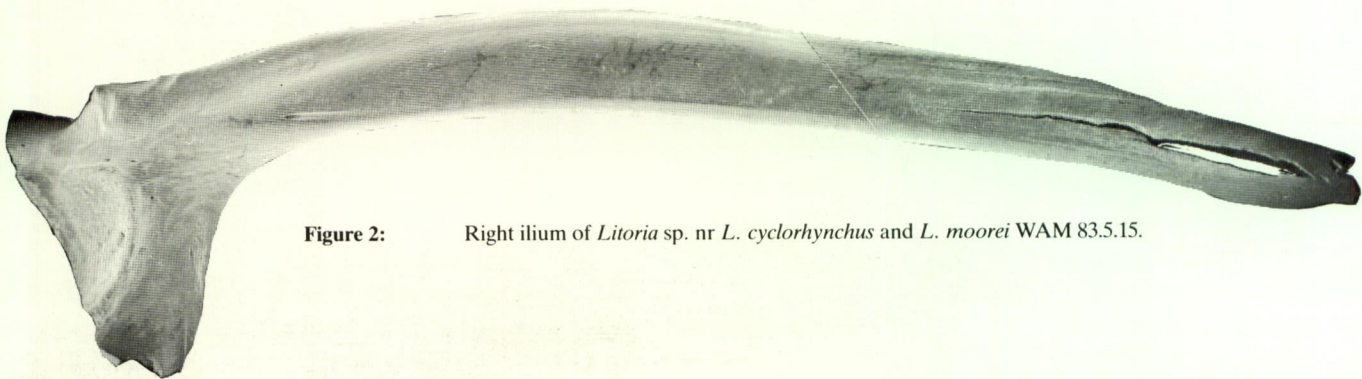


Figure 2: Right ilium of *Litoria* sp. nr *L. cyclorhynchus* and *L. moorei* WAM 83.5.15.

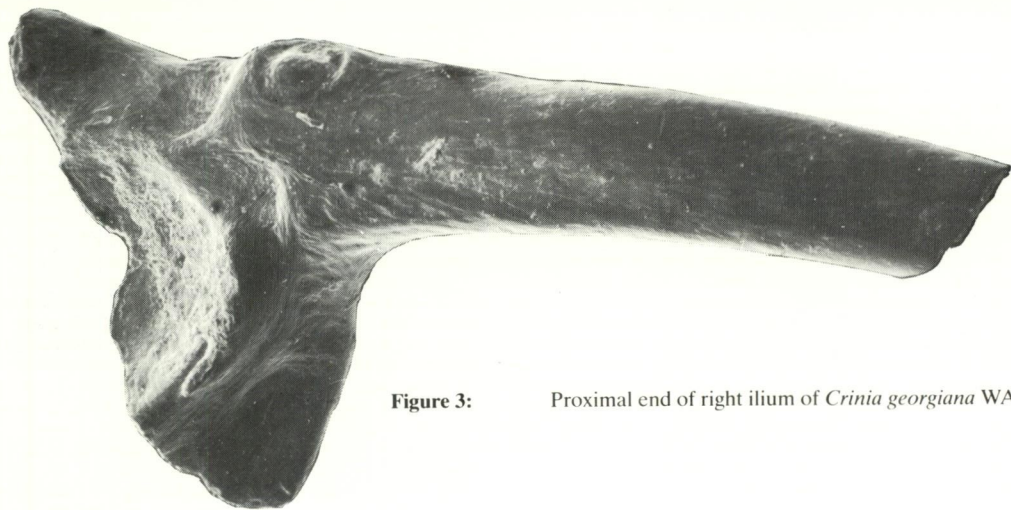


Figure 3: Proximal end of right ilium of *Crinia georgiana* WAM 83.5.33.

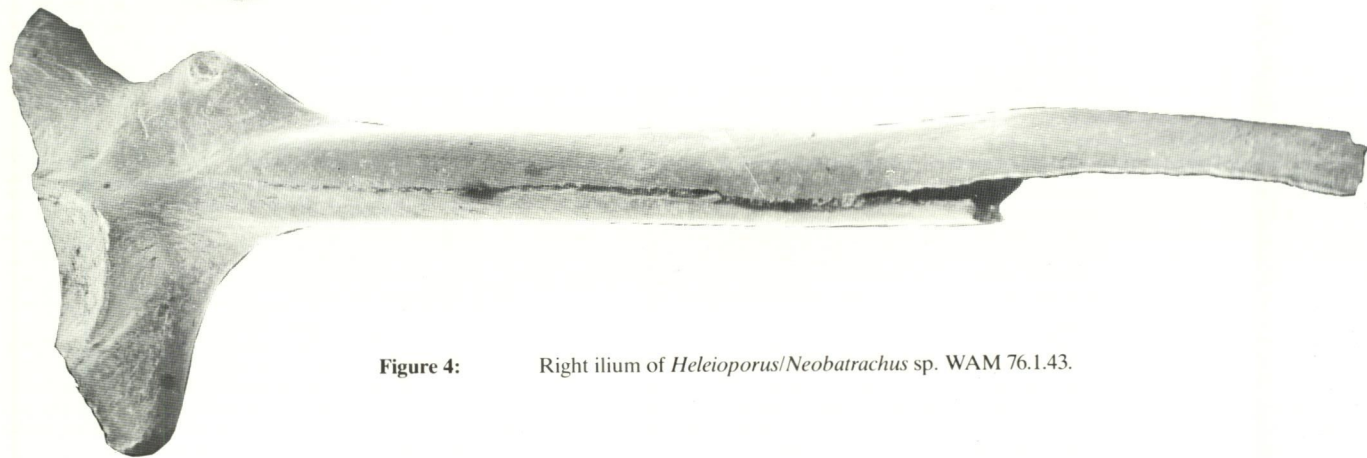


Figure 4: Right ilium of *Heleioporus/Neobatrachus* sp. WAM 76.1.43.

All species are morphologically similar in overall body shape and limb length and as yet no consistent structural characters have been found to permit their separation. Tyler (1976) examined ilia of a single species of each genus, but the separation proposed there cannot be sustained now that representatives of all species in the south-west have been examined in the course of this study. Accordingly these specimens, forming the dominant component of the collections reported upon here, cannot be assigned to genus or species.

***Limnodynastes dorsalis* (Gray, 1841)**

Material

Skull Cave – 76.1.48(1 left); 83.5.23(2 left); 83.5.27(1 right).

Description

The ilial shaft is slightly curved, lacks a dorsal crest and lacks any lateral indentation. The preacetabular zone is very poorly developed, forming only a very narrow border to the acetabular rim. The shape of the preacetabular zone for the shaft, posteriorly forms a quadrant. The dorsal protuberance is concave on its anterior margin but is convex posteriorly. The dorsal prominence is poorly developed, of elongate form and horizontally orientated. The dorsal acetabular expansion is well developed and rises at an angle of approximately 45° to the ilial shaft. The ventral acetabular expansion is large and evenly rounded.

Remarks

Limnodynastes is characterised principally by the shape of the dorsal protuberance which is large and generally has a concave anterior margin and convex posterior margin (Tyler 1976). *Limnodynastes dorsalis* is the only member of the genus occupying the south-west of the continent. Its nearest relatives are distributed in the south-east (Martin 1972).

***Pseudophryne guentheri* Boulenger, 1882**

Material

Devil's Lair – 83.5.34(1 right); 75.4.166(1 left 1 right).

Description

The ilial shaft is only very slightly curved and lacks a lateral groove. The preacetabular zone is poorly developed and slightly curved. The ventral acetabular expansion is small and poorly developed. The dorsal acetabular expansion is slightly inclined. The dorsal protuberance is small but distinctly raised and the dorsal prominence large but poorly demarcated from it. The dorsal acetabular expansion is only slightly raised above the dorsal margin of the ilial shaft.

Discussion

The modern frog fauna of the south-west of Western Australia includes several groups of species which phylogenetically are closely related, and exhibit very slight morphological divergence between member species. For example three of the four species now referred to

Ranidella were considered to represent a single species prior to the contributions of Moore (1954), Main (1957b) and Littlejohn (1957).

The species of *Ranidella* remain more readily distinguished from one another by biological features, such as the nature of the male mating call, than by any morphological attributes. A comparable situation occurs within the genera *Heleioporus* and *Neobatrachus* which were synonymised until the resurrection of *Neobatrachus* by Main (1957a).

The slight differentiation that is exhibited in the external morphology of the species is paralleled by skeletal features. Identification of fossil material of these animals is further complicated by the disarticulated nature of the bones, and the fact that the ilium is the only robust bone from which specific identification can be obtained. In consequence the only specific identifications obtainable in these faunas involves species that are phylogenetically remote from other components of the anuran fauna.

Each of the species reported here from Quaternary deposits now occurs in the same area (Tyler et al. 1984) and, in the case of groups not identifiable to species, comparable forms occur in the area today. The absence of *Ranidella* is probably attributable to the minute size of their ilia: they are unlikely to be retained in any extractive process designed to remove the remains of larger vertebrates.

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