

MORPHOLOGICAL CHARACTERISTICS OF THE LONG BONES OF THE PELVIC LIMB IN THE RED-NECKED WALLABY (*MACROPUS RUFOGRISEUS*)

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Abstract

Red-necked wallaby (*Macropus rufogriseus*) belongs to the Diprotodontia order, Marsupialia infraclass, Macropodidae family, and the genus *Macropus*, and is spread particularly on the Australian continental. The Macropodidae family encloses all the marsupial herbivores, from which the kangaroos and the wallabies are the best known. This case study provides a complete description of the long pelvic limb bones in the red-necked wallaby. The morphological features of the skeleton provide valuable data in practice, allowing accurate species identification in case of disputes. The following conclusions emerged: the gluteal line is very high, the ischial tuberosity is rounded and drawn lateral, the iliopubic eminence is very developed, the greater trochanter is large, rectangular and undivided, the tibial intercondylar eminence is very high and elongated, and the articular surfaces relatively equal, the epipubic bones are L-shaped and the cranial extremity is the longer half.

Key words: wallaby, pelvic girdle, femur, tibia.

INTRODUCTION

The red-necked wallabies (*Macropus rufogriseus*) are members of the Macropodidae family, closely related to kangaroos. These species are fascinating marsupials with diverse environmental adaptations, regarding the body shape and unusual hopping locomotion, as well as their ability to be energy efficient (Thornton et al., 2022). Their behaviour is also particular, as in other eutherian species, they may use conflicts and reconciliation to maximise the after-benefits (Cordoni & Norscia, 2014). The skeletal system of marsupials, namely macropodoids, exhibits unique adaptations for characteristic locomotion: the hind limbs are about twice as long as the forelimbs and the tail is strong and sturdy for balance. In this species, the most developed hind limb bone is the tibia. This type of locomotion most likely evolved to enhance predator avoidance (McGowan & Collins, 2018). Some authors have introduced the term 'pentapedal' locomotion, thus describing the tail as a fifth limb to support

weight while the hind limbs are balanced forward (Windsor & Dagg, 1971; Dawson et al., 2015). This pentapedal locomotion does not characterise all members of the family Macropodidae, but it is a habit preference. Most of the species that engage in this type of locomotion inhibit open spaces, like forests, grasslands or woodlands. (Dawson et al., 2015). Another preference of these hoppers is forelimb use; many individuals display lateralisation in limb usage. (Spiezio et al., 2016).

The literature includes studies on locomotion, osteology and musculature in other related species, such as tail anatomy in the western grey kangaroo (*Macropus fuliginosus*) (Dawson et al., 2014), pelvic limb musculature and locomotor apparatus of the curs and leg in the eastern grey kangaroo (*Macropus giganteus*) (Hopwood & Butterfield, 1976; Hopwood & Butterfield, 1990). Research on wallabies, particularly their skeletal structures, offers valuable insights into their evolutionary history, biomechanics, and ecological roles.

MATERIALS AND METHODS

The pelvic limb bones from an adult red-necked wallaby were used for morphological description. The bones belong to the collection of the Anatomy discipline at the Faculty of Veterinary Medicine in Bucharest.

The most captivating aspects were documented and photographed. The description and identification comply with the Nomina Anatomica Veterinaria (N.A.V. 2017).

RESULTS AND DISCUSSIONS

The coxal bone

The ilium presents a very high gluteal line on the lateral surface, which divides this surface into two relatively equal fossae. The iliac crest is convex and tuberos, and both sacral and coxal angles are divided into two spines. Before the acetabular cavity, a preacetabular tubercle is observed at the distal extremity of the gluteal line (Figure 1). The greater ischiatic notch and ischiatic spine are reduced, and the lesser ischiatic notch is very wide.

On the medial surface of the wing, a small groove marks the site of the detachment of the gluteal crest (Figure 3).

The contribution of each pelvic bone is observed on the margin of the acetabular cavity. The acetabular notch is located caudoventrally, the second marginal notch is located cranioventrally, and the last one is dorsal.

The ischiatic tuberosity is rounded and drawn lateral. The ischiatic arch presents, centrally, a tubercle with a ventrocranial orientation.

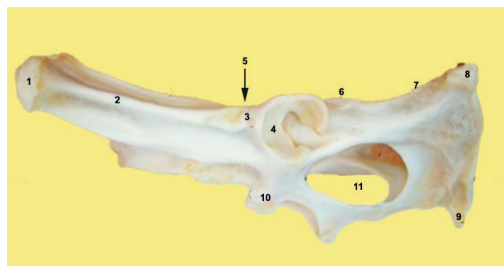


Figure 1. Hip bone of the red-necked wallaby (*Macropus rufogriseus*) - lateroventral view (original):

1. Iliac crest; 2. Gluteal line; 3. Preacetabular tubercle;
4. Acetabular cavity; 5. Greater ischiatic notch;
6. Ischiatic spine; 7. Lesser ischiatic notch; 8. Ischiatic tuberosity; 9. Ischial tubercle; 10. Iliopubic eminence;
11. Obturator foramen

There is an obvious iliopubic eminence on the lateral side of the cranial border of the pubis. At the symphysis level, the bone shows a highly developed pubic tubercle (Figure 1). The obturator foramen has an oval shape (Figure 2). A rough surface for muscle insertion is on the ventral surface of the ischiatic plate.



Figure 2. Pelvic girle of the red-necked wallaby (*Macropus rufogriseus*) - dorsal surface (original):

1. Greater ischiatic notch; 2. Ischiatic tuberosity;
3. Lesser ischiatic notch; 4. Ischiatic spine; 5. Iliopubic eminence; 6. Ischiopubic symphysis; 7. Dorsocranial iliac spine; 8. Dorsocaudal iliac spine; 9. Iliac crest;
10. Obturator foramen



Figure 3. Right coxal bone of the red-necked wallaby (*Macropus rufogriseus*) - dorsomedial side (original):

1. Auricular surface; 2. Iliopubic eminence; 3. Obturator foramen; 4. Ischiatic tuberosity; 5. Ischiatic arch

The femur

The spherical articular head is supported by a very high neck at the femur's proximal end.

The femoral head has a more cranial position, and the fovea is centrally placed. The greater trochanter, relatively rectangular in appearance and undivided, exceeds by far the articular surface of the femoral head (Figure 4).

On the medial face, at the proximal end, the elongated and high second trochanter, with a ridge appearance, is observed. A tubercle for muscular insertion is observed on the caudal face in the central portion of the femoral body.

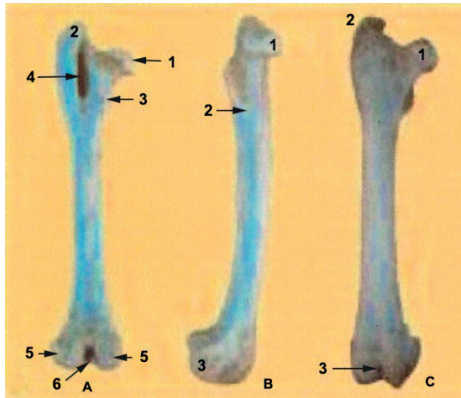


Figure 4. Femur of the red-necked wallaby (*Macropus rufogriseus*) (original):

- A. Caudal surface of the left bone: 1. Femoral head; 2. Greater trochanter; 3. Lesser trochanter; 4. Trochanteric fossa; 5. Femoral condyles; 6. Intercondylar fossa; B. Medial surface of the left bone: 1. Femoral head; 2. Lesser trochanter; 3. Medial condyle; C. Cranial surface of the right bone: 1. Femoral head; 2. Greater trochanter; 3. Femoral trochlea

The distal articular surface is represented by two condyles caudally, separated by an intercondylar fossa, and cranially by a trochlea, with unequal ridges, the lateral one being more developed. Above the lateral condyle is a reduced supracondylar fossa.

The epipubic (marsupial bones) are relatively “L”-shaped, at a wide-open angle, and longer at the cranial end. They are articulated through the caudal end to the ventral face of the pubic bones, almost on the cranial border, immediately near the pubic symphysis (Figure 5).

The cranial margin of the tibia is high, elongated, with a sharp edge, and slightly inclined towards the lateral side (Figure 6).



Figure 5. Epipubic or marsupial bone of the red-necked wallaby (*Macropus rufogriseus*) (original): 1. Caudal extremity; 2. Cranial extremity

The thin, sharp lateral border is ridge-like and reaches the body's middle third.

The distal third of the body of the tibia is cylindroid. Reduced muscle insertion lines are observed on the caudal surface, and a first-order vascular foramen is observed in the upper third of this face.

The tibia has an elongated, high intercondylar eminence and relatively equal condylar surfaces.



Figure 6. Right tibia and fibula of the red-necked wallaby (*Macropus rufogriseus*) (original):

- A. Tibia: 1. Tibial crest; 2. Lateral border; 3. Medial malleolus; B. Fibula: 1. Proximal extremity; 2. Distal extremity; 3. Vascular groove

Distally, the tarsal articular surface is divided by a low median relief into two unequal parts, the medial one elongated and deep, the lateral one wide and relatively shallow. The medial malleolus is evident. Laterally, there is an articular surface for the fibula.

The slightly flexible fibula has a flattened body with a prominent groove on the medial side, which starts from its middle third and ends at the distal end. The distal end of the fibula completes the distal articular surface of the tibia on the lateral side (Figure 6).

CONCLUSIONS

The gluteal crest is very high and divides the iliac wing into two relatively equal fossae. On the medial surface of the wing, a small groove marks the site of the detachment of the gluteal crest. The contribution of each pelvic bone is observed on the margin of the acetabular cavity.

The ischial tuberosity is rounded and drawn laterally. The iliopubic eminence is significantly developed.

The femur presents the relatively rectangular undivided greater trochanter far exceeding the femoral head's articular surface. On the medial surface is the elongated, high, ridge-like second trochanter.

The epipubic or marsupial bones are relatively “L”-shaped and wide open, and the cranial extremity is the longer half.

The tibia has an elongated, high intercondylar eminence and relatively equal condylar surfaces. A first-order vascular foramen is observed on the caudal surface of the body's upper third. Distally, the tarsal articulation surface is divided by a low median relief into two unequal parts, the medial one elongated and deep, the lateral one wide and relatively wide.

The slightly flexible fibula has a flattened body, with an obvious groove on the medial side, which starts from its middle third and ends at the distal extremity.

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