Introduction
The order Peramelemorpha contains only one superfamily, the Perameloidea, which includes all of the bandicoots and the two recognised species of bilbies. This paper aims to provide a brief overview of biology, anatomy and physiology of these species and to review techniques for restraint, anaesthesia, sample collection and supportive care.

Relevant Biology, Anatomy and Physiology
The order Peramelamorpha evolutionarily represents a high level of separation of the bandicoot group from the Dasyuromorpha and the Diprotodonta. All species are restricted to Australia and New Guinea and belong to one of two families. The family Peroryctidae includes three genera, all of which are found in New Guinea; the Rufous Spiny Bandicoot is the only species in this family found in Australia [1]. The Peramelidae family includes all Australian genera and is divided into two subfamilies: the Thylacomyinae consists of two species of bilby, one of which is thought to be extinct; the Peramelinae consists of the extinct Pig-footed Bandicoot and seven species of non-spiny bandicoots, one of which is presumed extinct and several of which have a restricted distribution or are critically endangered [2]. All species are polyprotodonts, like the dasyurids, but the hindfoot is syndactylous, like the diprotodonts. The maxillae and mandibles are elongated, with 4 - 5 pairs of upper incisors and 3 lower pairs. The canines are well developed. Dentition is designed for an insectivorous diet with some small vertebrates and succulent plants. Bilbies tend to be more carnivorous, regularly consuming small mammals and lizards [1].

Table 1. Bodyweight Ranges of Bandicoots and Bilbies [1]

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Weight - Male (average)</th>
<th>Weight - Female (average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Golden Bandicoot</td>
<td>Isoodon auratus</td>
<td>250 - 670 g</td>
<td>250 - 670 g</td>
</tr>
<tr>
<td>Northern Brown Bandicoot</td>
<td>Isoodon macrourus</td>
<td>500 - 3100 g (2100 g)</td>
<td>500 - 1700 g (1100 g)</td>
</tr>
<tr>
<td>Southern Brown Bandicoot</td>
<td>Isoodon obesulus</td>
<td>500 - 1600 g (850 g)</td>
<td>400 - 1100 g (700 g)</td>
</tr>
<tr>
<td>Western Barred Bandicoot</td>
<td>Perameles bougainville</td>
<td>172 - 286 g</td>
<td>172 - 286 g</td>
</tr>
<tr>
<td>Eastern Barred Bandicoot</td>
<td>Perameles gunnii</td>
<td>Victoria 500 - 1100 g (750 g) Tasmanian 500 - 1450 g (990 g)</td>
<td>Victoria 500 - 1100 g (750 g) Tasmanian 500 - 1450 g (990 g)</td>
</tr>
<tr>
<td>Long-nosed Bandicoot</td>
<td>Perameles nasuta</td>
<td>850 - 1100 g</td>
<td>850 - 1100 g</td>
</tr>
<tr>
<td>Bilby</td>
<td>Macrotis lagotis</td>
<td>1000 - 2500 g</td>
<td>800 - 1100 g</td>
</tr>
<tr>
<td>Rufous Spiny Bandicoot</td>
<td>Echymipera rufescens</td>
<td>500 - 2000 g</td>
<td>500 - 1400 g</td>
</tr>
</tbody>
</table>
The forefeet are used for digging during foraging and are elongate with strong curved claws on digits II, III and IV. Digits I and V are rudimentary and clawless when present. The hindfeet are similar to those of small macropods, with a large strongly clawed fourth digit and joining of digits II and III (syndactyly) [1]. The slow gait resembles a "bunny-hop", whereby the hindlimbs are advanced simultaneously. Most species have 8 teats, but rarely carry more than 4 young in the pouch. Bandicoot embryos are attached to a placenta for a short while. After birth, the young attach to a teat and remain connected to the placenta for a while by tightly stretched umbilical cords [1].

Physical Restraint
Bandicoots are relatively easy to restrain and examine providing that they are restrained within a bag and their eyes are kept covered. An appropriate handling bag can be quickly slipped over them while they are in their nest. Alternatively, they can be flushed from the nest into a net designed from handling bag material with a quick-release velcro attachment over the hoop of the net, or into a conventional net with a draw-string bottom placed inside a handling bag. Free-hold restraint of bandicoots is difficult, due to their strength and tendency to kick, and should be minimised or avoided where possible. If necessary for transfer between a bag to a box or vice versa, the ideal method is to grasp the bandicoot behind the neck with the first two fingers of one hand and support the rump with the palm of the other hand [3] (Fig. 1).

Figure 1. Manual restraint of an Eastern Barred Bandicoot. - To view this image in full size go to the IVIS website at www.ivis.org . -

Bilbies are slightly more difficult to physically restrain due to their greater body weight and strength and increased tendency to struggle. Similar to bandicoots, an appropriate handling bag can be quickly slipped over them while they are nesting or they can be flushed from their nest into a modified net. If free-hold restraint is necessary, the most appropriate method is to grasp the bilby firmly by the tail base and place it quickly into a bag or box.

Recommended Anaesthetic Techniques
Inhalant anaesthesia is the method of choice. The preferred anaesthetic agent is isoflurane in oxygen, delivered via a T-piece using a facemask for induction (Fig. 2 and Fig. 3) and an uncuffed endotracheal tube (2 - 3 mm diameter) for maintenance of anaesthesia [3,4]. Intubation is relatively straightforward and is facilitated by the use of a small-bladed laryngoscope. Induction and recovery are rapid and muscle relaxation excellent. This anaesthetic protocol is ideal for field situations as long as there is access to a portable anaesthetic machine. Injectable anaesthetic agents are rarely used.

Figure 2. Anaesthetic induction of an Eastern Barred Bandicoot. - To view this image in full size go to the IVIS website at www.ivis.org . -

Figure 3. Anaesthetic induction of a bilby. - To view this image in full size go to the IVIS website at www.ivis.org . -

Pre-anaesthetic sedation is rarely required, perhaps with the exception of some fractious bilbies where it may be useful to reduce struggling during induction. Diazepam has been used for sedation at a dose rate of 0.5 - 1.0 mg/kg IM, although in the author’s experience recovery from this can be prolonged even at the lower end of the dose range. More recently midazolam has been used for pre-anaesthetic sedation at a dose rate of 0.1 - 0.2 mg/kg IM, and antagonised with flumazenil at a dose rate of 0.04 mg per mg midazolam IM, IV. Recovery is still prolonged, although not to the same extent as diazepam. The prolonged recovery with benzodiazepine sedation in these species makes these agents unsuitable for use in the field.

Sample Collection
Blood samples are obtained from the femoral, lateral saphenous, jugular or cephalic veins of anaesthetised bandicoots (Fig. 4). The transparent inguinal skin within the pouch of female bandicoots allows visualisation of the femoral vein [3]. If jugular
venipuncture is attempted, it is often useful to angle the needle and approach the vein from a craniodorsal to caudoventral direction. If blood sampling from these three sites is unsuccessful, a small superficial artery coursing along the medial tibia can be accessed using a fine gauge needle. In larger bandicoots and bilbies, the lateral tail vein is often a successful venipuncture site.

![Figure 4. Venipuncture using the lateral saphenous vein. - To view this image in full size go to the IVIS website at www.ivis.org. -](image)

**Injection Sites**
The most commonly used intravenous injection sites are the jugular and cephalic veins and the lateral tail vein in some species. For intramuscular injections, the thigh muscle is the preferred site. Subcutaneous injections can be given in the dorsal neck or just cranial to the thigh; the former is the preferred site for injection of substantial volumes e.g., subcutaneous fluids.

**Supportive Care**
It is imperative to prevent loss of body heat during anaesthesia in these small mammals with a rapid metabolic rate. External heat sources are routinely provided during general anaesthesia. The duration of anaesthesia should be kept to an absolute minimum to prevent unnecessary hypothermia. Administration of warmed fluids, either subcutaneously or intravenously, also assists in maintenance of core body temperature during and immediately after anaesthesia. Fluids of choice include hartmanns (lactated ringers) or equal volumes of hartmanns (or 0.9% saline) and dextrose saline.

**References**


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