Mothering an Australian dynasty: brood provisioning in *Haploscapanes barbarossa* (Fabricius, 1775) (Coleoptera: Scarabaeidae: Dynastinae: Dynastini)

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ABSTRACT

Females of the Australian dynastine beetle *Haploscapanes barbarossa* (Fabricius, 1775) excavate burrows and provision them with food for young larvae. Larvae consume that food, but not enough is provided for the larva to complete development. In northern Queensland, some of the partially developed larvae move to adjacent burrows of the cockroach *Macropanesthia rhinoceros* Saussure, 1895, where they feed on the considerable organic material, including leaf material and cockroach frass, that builds up in these chambers up to 1 m below the surface. In other areas of northern Australia, there are no burrowing cockroaches, so the larvae must find other food sources after the early stages.

Animals employ a wide range of strategies to ensure that some of their offspring survive to reproduce. Many species of scarabaeoid beetles are well known for their brood care, and substantial literature exists on this phenomenon (Ritcher 1958; Halffter and Edmonds 1982; Hanski and Cambefort 1991). Brood care often involves food gathering and stocking a prepared nest (usually a subterranean burrow) by one or both parents prior to egg laying. This behaviour is conspicuous and almost universal in some scarabaeoid groups (Scarabaeinae, Aphodiinae, Hybosoridae, Geotrupidae), while in others it is practically unknown (Lucanidae, Rutelinae, Melolonthinae, Dynastinae, Cetoniinae).

Typically, in the Dynastinae (rhinoceros beetles; over 2000 species worldwide), the female searches for a suitable larval food source, lays her eggs in or near it and then abandons the eggs and hatching larvae to their fate. Larvae generally develop freely in substrates such as soil, humus, compost, decaying wood or even living plant material. Some work as loose family colonies in decaying wood (Neita M. et al. 2006), and there are several inconclusive references to dynastines of the tribe Oryctini from the Americas digging burrows and stocking them with food material.

Manee (1908) described single males and pairs of *Strategus antaeus* (Drury, 1773) digging vertical burrows in sandy soils in South Carolina. The burrows were 15–20 cm deep with between one and three horizontal chambers 3–12 cm long at the bottom. These horizontal chambers were filled with decaying oak leaves from the surface and an egg was deposited in each. Ritcher (1966) described 20–45 cm burrows for the same species that were stocked with surface litter. Howden (pers. comm.) saw a male *S. antaeus* in Faison, North Carolina packing a sloping burrow 60 cm long with surface litter and found an egg about every 20 cm along the packed burrow. Knaus (1916, 1924) reported males of *Strategus mormon* Burmeister, 1847 in Medon, Kansas excavating burrows in sandy soil that females stock with old horse or cattle dung as larval brood material. Ratcliffe (1976) drew attention to the remarkable nature of these observations, but was unable to confirm this behaviour at the site where Knaus described it and suggested that more observations are needed. Morón and Ratcliffe (1990) described larvae of *S. mormon* that had been 'dug from burrow' and eggs 'from food plug deposited by female in burrow'.

Howden and Campbell (1974) observed males of *Heterogomphus dilaticollis* Burmeister, 1847 in short burrows in the soil of the Sierra Nevada, northern Colombia. Howden later excavated a burrow of the same species in the Ecuadorian Andes and found grass with large larvae in side chambers and a female (Howden et al. 2014).

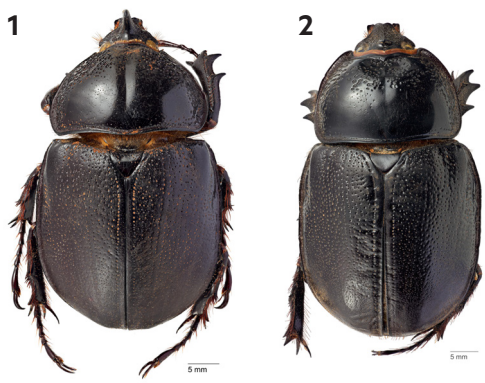
Jacobs et al. (2012) described burrows made by *Enema pan* (Fabricius, 1775) in Peru, finding only male beetles in those they excavated. An inhabited burrow with the longest tunnel had several offshoots from the main tunnel, with one of the offshoots ending at a pile of wet, crushed leaves and sticks. Behind this pile of organic debris was a small scarab larva that they presumed was *E. pan*. The organic material was clearly from the surface, but no females were found in the burrows. They hypothesised that female beetles find male burrows, mate with the males, and lay eggs inside the burrow where the larvae then develop. An adult beetle will provision the larvae with macerated leaves and sticks, although which sex provides this care was unknown.

Here, we report on brood provisioning by the Australian dynastine beetle *Haploscapanes barbarossa* (Fabricius, 1775) where the female provides enough food for young larvae to begin development. However, the story does not stop there — the giant burrowing cockroach *Macropanesthia rhinoceros* Saussure, 1895 (Blaberidae) can be involved in successful development of the beetle.

THE BEETLE

Haploscapanes barbarossa was the first insect described from Australia (Cassis and Weir 1992). It was presumably collected by Joseph Banks and fellow naturalists at Cooktown (15.480°S, 145.256°E), in tropical Queensland, during the seven weeks spent there from 17 June 1770 during James Cook's voyage to eastern Australia and was described as *Scarabaeus barbarossa* by Fabricius (1775) soon after he visited Banks' collection in London. A male and a female syntype are in the Natural History

Museum, London (Arrow 1908; Cassis and Weir 1992). Males have a large cephalic horn without a median tooth and two short pronotal teeth set close together (Fig. 1), while the female has a small cephalic tubercle and no pronotal teeth (Fig. 2). The species is variable in size; the holotype of a synonym, *H. b. similis* (Prell, 1934), is a small male. Large individuals reach over 60 mm in length and are one of the bulkiest beetles known from Australia. Third-instar larvae can be up to 15 cm long; Blackburn (1899) gave a general description of a 90 mm long larva collected in northern Australia that he attributed to this species. Carne (1957), in his landmark revision of the Australian Dynastinae, recorded it from across northern Australia; this was largely repeated by Endrődi (1976, 1985), Dechambre and Drumont (2004), Dechambre (2005), and Hwang (2011). Adults have been collected at light during January–March (Carne 1957; Naumann et al. 1993), but despite these distinctions, it has remained a poorly known species.



Figures 1–2. *Haploscapanes barbarossa*. **Figure 1.** Adult male from Cairns. **Figure 2.** Adult female from Strathleven Station found excavating a brood burrow. Images by Geoff Thompson, QM.

As scarab classification matured from the original Linnean/Fabrician concepts, the species was moved from *Scarabaeus* Linnaeus, 1758 to *Geotrupes* Latreille, 1796 then *Oryctes* Illiger, 1798 and eventually became the type species of Arrow's (1908) genus *Haploscapanes* within the tribe Dynastini MacLeay, 1819. More recently, Rowland and Miller (2012) provided a phylogenetic analysis and taxonomic structure for the Dynastini based on morphological, biogeographical and molecular data. They proposed three subtribes: of these, the Xylotrupina Hope, 1845 (*Xylotrupes* Hope, 1837) and Chalcosomina Rowland and Miller, 2012 (*Haploscapanes*) occur in Australia.

Endrődi (1976) synonymised *Liteupatorus* Prell, 1911 with *Haploscapanes*, allying *H. barbarossa* with the other large species *H. australicus* (Arrow, 1908) that occurs to the south of *H. barbarossa* in eastern Australia (Carne 1957; Dechambre and Drumont 2004; Dechambre 2005). Also included is *H. inermis* (Prell, 1911), currently unrecognisable in collections but maintained as a valid species by Endrődi (1985), Dechambre and Drumont (2004) and Dechambre (2005). These three species of *Haploscapanes* are restricted to Australia, except for a purported specimen of *H. barbarossa* recorded by Paulian (1991) from New Caledonia that may be mislabelled and requires confirmation. Dechambre and Drumont (2004) added a fourth species, *H. papuanus* Dechambre and Drumont, 2004 from Papua New Guinea.

THE COCKROACH

Macropanesthia rhinoceros is the largest of the burrowing cockroaches endemic to Australia and occurs on sandy to sandy loam soils across north-eastern Queensland (Rugg and Rose 1991; Walker et al. 1994; Rentz 2014). Single adults dig deep burrows in the soil and then drag dead leaves down to the end chamber, where they become soft and mouldy and become the cockroach's food source (Rugg and Rose 1991). Females also provide leaves as food for broods of live-born nymphs that remain in the burrow with the adult for a year and contribute frass to the end chamber. Burrows occasionally descend directly, but usually meander just below the soil surface for up to 1 m before sloping steeply downwards without following any apparent pattern or direction. At about 15 cm below the soil surface, the burrows widen considerably (up to 12 cm) and extend for up to 1 m before continuing deeper, where they finish in a short and narrow dead end at a depth of up to 1 m. Rugg and Rose (1991) recorded a maximum density of burrows of 2 m^{-2} but this averaged 0.33 m^{-2}, with the smallest group of burrows covering at least 1 ha.

The widened portion of the burrow usually contains distinctive cockroach frass as well as surface plant debris (leaves, twigs and occasionally grass): usually old dry litter with fresh material rarely found.

OBSERVATIONS

May 1997, February 1998 and March 2001 inquiries

Queensland Museum received a large female *H. barbarossa* (Fig. 2) for identification from Strathleven Station (15.904°S, 143.384°E) in May 1997 with the note 'it digs a hole about 6 cm in diameter and about 30–40 cm deep, then collects grass and leaves and fills a cavity about 30 cm in diameter at the bottom'. Similar observations were made at Wonga Beach (16.334°S, 145.416°E) in February 1998 and near Cooktown in March 2001 from Queensland Museum inquiries.

Station Creek observations

Field observations spanning a full year were made by GBM at Upper Station Creek (16.599°S, 145.206°E) about midway between Mount Molloy and Mount Carbine in northern Queensland. The vegetation is open eucalypt woodland with an understorey of quinine trees (*Petalostigma*) and a groundcover of tall grass. The soil is a deep, coarse sand derived from weathered granite. The area has a monsoonal climate with a pronounced wet season from January to May and little rain for the rest of the year. The grass is burnt off early in the dry season (winter–spring) each year. A dense population of *M. rhinoceros* occurs there, and the site was visited occasionally to dig specimens of the cockroach for live display at the Queensland Museum.

February 1998. Normally the site was visited in the dry season (usually November) when only the oval, sloping, burrow entrances of *M. rhinoceros* were evident. However, in February 1998, a brief visit was made in the middle of the wet season. On this occasion, several different burrows were noticed. These were circular, about 3–4 cm diameter, and went vertically downwards. They were neatly formed with a precise heap of excavated sand situated 3–5 cm to one side of the entrance (similar to Figs 3–5). Some showed marks like a runway between the entrance and the sand pile, clearly made by the inhabitant during burrow excavation. Some had leaves and grass partly filling the entrance hole and apparently pulled in by the inhabitant. It was assumed that these were the work of a small vertebrate, such as a lizard or a mouse-sized rodent, although there was a dead *H. barbarossa* beside one burrow. One burrow was shovelled open to reveal a female *H. barbarossa* in the burrow about 8 cm below the surface, but at the time it was thought unlikely that this beetle was responsible for the burrow and there was not time to investigate further.

May 1998. The burrows were not immediately evident but careful searching revealed that the remains of the distinctive sand piles were evident, although they had been weathered down by rain and partly covered by leaf fall (Fig. 5). There had been no recent burrow-making activity. When excavated, the burrow was tightly stuffed full of leaf litter and humus (Figs 6–7). The litter-filled burrow continued to a depth of 30 cm, where its gradient flattened slightly then widened into a small terminal chamber (Fig. 6). There, sitting on a pile of faecal pellets, was a fat dynastine larva about 3–4 cm long. Five identical burrows were excavated, except one had two larvae (Fig. 8). However, the amount of litter stored in each burrow appeared too little to feed the larva to maturity.

Larvae were brought to Brisbane for rearing out in compost. Initially, one weighed 3.09 g, but this had increased to 15.69 g by the following April. This larva pupated in September 1999 and emerged as a small *H. barbarossa* male in mid-October 1999 (specimen in Queensland Museum Kurilpa).

December 1998. The habitat was very dry with the surrounding grass having been burnt. Burrows with weathered entrances were as easy to find as in May, but no larvae were present and most stored food reserves had been consumed. Burrows continued on with dynastine faecal pellets becoming larger (Fig. 8) and some of the dynastine burrows went into residues of *M. rhinoceros* burrows.

February 1999. With the return of the wet season, there were many fresh, active burrows (Fig. 3). Two each contained an adult female *H. barbarossa* and a large amount of coarse leaf material, and some had

Figures 3-8. Burrows formed by *Haploscapanes barbarossa* at Station Creek study site. **Figure 3.** Newly formed burrow with excavated soil placed to one side of entrance and entrance still open, February 1999. **Figure 4.** Newly formed burrow already refilled with humus and leaf litter. Arrow indicates the entrance. February 1999. **Figure 5.** Older burrow in May 1998, showing weathered entrance area and excavated sand pile. **Figure 6.** Burrow excavated in May 1998 showing longitudinal section of burrow filled with humus and litter. **Figure 7.** Same as in Figure 6 but showing circular cross section of burrow. **Figure 8.** End of excavated burrow with humus and litter consumed and two larvae (each 4 cm in length) resting on layer of their own frass pellets, May 1998.

1 or 2 eggs or hatchling larvae with the burrow filled with litter to the ground surface. One burrow had no litter but an adult female apparently still excavating. Fully formed eggs dissected from one female were 4.5 x 3 mm and a first-instar larva weighed 0.14 g and had a head capsule width of 4.2 mm.

Sugarbag Station observations

Mr Jack Hasenpusch, proprietor of an insect supply business, used to regularly dig live *M. rhinoceros* from a dense population at Sugarbag Station (17.920°S, 145.001°E). He (pers. comm.) occasionally found large dynastine larvae in the terminal chambers, some of which he reared to adult *H. barbarossa* using frass and decaying litter from the burrows as food. In February 2008, he photographed a female *H. barbarossa* dragging leaves and pieces of soft wood into her burrow soon after dawn (Fig. 9) and noted a newly emerged male (Fig. 10) and a newly made burrow, similar to those described at Station Creek with the excavated sand deposited to one side of the entrance.

Isabella Falls observations

A known population of *M. rhinoceros* occurs in deep sand near Isabella Falls (15.200°S, 145.005°E). A burrow excavated by GBM in June 2008 had been vacated by cockroaches and its terminal chamber contained numerous large dynastine frass pellets up to 15 mm by 10 mm in size (Fig. 11) and no residual frass debris from the cockroach occupancy. Based on size, these pellets could only have come from *H. barbarossa*. There was no sign of dynastine pupation, and it is assumed that the larva had consumed the available frass and moved on through the substrate.

Figures 9-11. *Haploscapanes barbarossa*. **Figure 9.** Female at dawn at Sugarbag Station, February 2008, dragging dead leaves and small pieces of soft wood into a newly excavated burrow. **Figure 10.** Freshly emerged male, same locality and date as Figure 9. **Figure 11.** Large faecal pellets of *Haploscapanes barbarossa* (upper) from Isabella Falls in June 2008, and of *Macropanesthia rhinoceros* (lower). Images 9-10 by Jack Hasenpusch, image 11 by Jessa Thurman.

DISCUSSION

These observations clearly show that female *H. barbarossa* excavate burrows and provision them with humus, litter and wood fragments as food for young larvae that hatch from eggs she deposits in the burrows. Larvae consume that food, leaving behind larval faecal pellets that are larger towards the end of the burrow. Not enough food is provided for the larvae to complete development, so they then burrow further through the soil. Some at Station Creek were observed to end up in burrows of *M. rhinoceros* where considerable organic material, including leaf material and cockroach frass, builds up in these subterranean chambers, which can be up to 1 m below the surface (Rugg and Rose 1991). The density and shape of the cockroach burrows increase the chances of the larvae encountering a burrow. Occasionally, females of *H. barbarossa* had been found in the burrows of *M. rhinoceros* (H.A. Rose and G.B. Monteith, pers. obs.), but no special significance has been attached to this previously. Other insects are known to live in these cockroach burrows, some of them almost commensal. The small (18–23 mm long) dynastine *Dasygnathus blattocomes* Carne, 1978 was described as living exclusively in these nest chambers (Carne, 1978), and its larvae have since been reared on the cockroach's stored leaf material and frass (J. Hasenpusch, pers. comm.).

While an apparent feeding relationship has been noted between the larger migrating larvae of *H. barbarossa*, after they leave the initial brood burrow stocked by the maternal female, and the subterranean humus-filled brood chambers of the burrowing cockroach (*M. rhinoceros*), this cannot be a mandatory relationship. Burrowing cockroaches (*M. rhinoceros* and 18 other species in the Geoscapheinae with similar biology) occur throughout the range of *H. barbarossa* in Queensland, but none occur in the Northern Territory and Western Australia (Walker et al. 1994) where the dynastine also occurs. Since the larvae clearly have the capacity to move freely through the sandy soils they live in, it is probable that they exploit other resources such as the underside of embedded logs or deep accumulations of surface litter to reach maturity.

This behaviour differs from *H. australicus*, where larvae develop in the hollow cores of very old eucalypt trees that are filled with decomposing termite nests and take 2–3 years to develop (Zietek 2020). Colonies can exist for over 12 years. A critical factor in these colonies is the layer of faecal pellets found below the larvae that are recycled as food by very young larvae.

Further observations of *H. barbarossa* should concentrate on the life history of late-instar larvae, particularly in areas other than north-eastern Queensland, where burrowing cockroaches do not occur.

These Australian brood care observations for *H. barbarossa* are the first to be made in a dynastine outside the Americas and closely parallel the incomplete American observations (summarised in the Introduction) by involving a parent beetle digging a burrow in the soil, stocking it with plant material brought down from the surface and then depositing eggs in the brood material. Since the American genera that show this behaviour belong to the tribe Oryctini, while *H. barbarossa* belongs to the Dynastini, this may indicate separate evolutionary origins for the behaviour on different continents. It also suggests that the behaviour may exist in other dynastine taxa and on other landmasses, a possibility to which field biologists should be alert.

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LITERATURE CITED

Arrow, G.J. (1908). A contribution to the classification of the coleopterous family Dynastidae. *Transactions of the Entomological Society of London*, **56**(2), 321–358. https://doi.org/10.1111/j.1365-2311.1908.tb02151.x

Blackburn, T. (1899). Further notes on Australian Coleoptera with descriptions of new genera and species. XXV. *Transactions of the Royal Society of South Australia*, **23**, 22–101.

Carne, P.B. (1957). *A systematic revision of the Australian Dynastinae (Coleoptera: Scarabaeidae)*. CSIRO Publishing.

Carne, P.B. (1978). *Dasygnathus blattocomes* sp. n. (Coleoptera: Scarabaeidae: Dynastinae). *Journal of the Australian Entomological Society*, **17**(1), 91–93. https://doi.org/10.1111/j.1440-6055.1978.tb01749.x

Cassis, G. and Weir, T.A. (1992c). 'Dynastinae' in Houston, W.W.K. (ed.). *Zoological Catalogue of Australia. Coleoptera: Scarabaeoidea. Volume 9*, 383–425. Australian Government Publishing Service.

Dechambre, R.-P. (2005). *Les Coléoptères du Monde. Volume 30: Dynastidae australiens et océaniens*. Hillside Books.

Dechambre, R.-P. and Drumont, A. (2004). Le genre *Haploscapanes* Arrow, 1908 (Coleoptera, Dynastidae). *Coléoptères*, **10**(16), 197–203. https://www.researchgate.net/publication/344349049_Le_genre_Haploscapanes_Arrow1908_Coleoptera_Dynastidae

Endrődi, S. (1976). Monographie der Dynastinae (Coleoptera) 6. Tribus: Dynastini. *Acta Zoologica Academiae Scientiarum Hungaricae*, **22**(3-4), 217–269.

Endrődi, S. (1985). *The Dynastinae of the world*. Junk.

Fabricius, J.C. (1775). *Systema Entomologiae, Sistens Insectorum Classes, Ordines, Genera, Species, Adiectis Synonymis, Locis, Descriptionibus, Observationibus*. Korte. https://doi.org/10.5962/bhl.title.36510

Halffter, G. and Edmonds, W.D. (1982). *The nesting behavior of dung beetles (Scarabaeinae) — An ecological and evolutive approach*. Instituto de Ecología.

Hanski, I. and Cambefort, Y. (eds). (1991). *Dung beetle ecology*. Princeton University Press. https://doi.org/10.1515/9781400862092

Howden, H.F. and Campbell, J.M. (1974). Observations on some Scarabaeoidea in the Colombian Sierra Nevada de Santa Marta. *The Coleopterists Bulletin*, **28**(3), 109–114. https://www.jstor.org/stable/3999737

Howden, H.F., Howden, A.T. and Gill, B.D. (2014). *Collecting memories: a sixty year chronicle of a pair of beetle collectors*. Blurb Publishing.

Hwang, S. (2011). *The Dynastini of the world. Coleoptera: Scarabaeidae: Dynastinae*. Nature & Ecology.

Jacobs, J.M., von May, R. and Ratcliffe, B.C. (2012). Observations on the life history of *Enema pan* (F.) (Coleoptera: Scarabaeidae: Dynastinae) and its association with bamboo, *Guadua* Kunth (Poaceae: Bambusoideae), in southwestern Amazonia. *The Coleopterists Bulletin*, **66**(3), 253–260.

Knaus, W. (1916). Notes on *Strategus mormon*. *Bulletin of the Brooklyn Entomological Society*, **11**, 79–81.

Knaus, W. (1924). 1923 collection and life history notes on *Strategus mormon*. *Journal of the New York Entomological Society*, **32**, 124–125.

Manee, A.H. (1908). Some observations at Southern Pines, N. Carolina. *Entomological News*, **19**, 286–289.

Morón, M.A. and Ratcliffe, B.C. (1990). Descriptions of *Strategus* larvae with a new key to species based on the larvae (Coleoptera: Scarabaeidae: Dynastinae). *Elytron*, **4**, 53–66.

Naumann, I.D., Edwards, E.D., Weir, T.A. and Rentz, D.C.F. (1993). 'Insects of the Heathlands area, Cape York Peninsula, Queensland' in *Cape York Peninsula Scientific Expedition Report*, **2**, 173–203. The Royal Geographic Society of Queensland Inc.

Neita M., J.C, Orozco, J. and Ratcliffe, B. (2006). Escarabajos (Scarabaeidae: Pleurosticti) de la selva baja del bosque pluvial tropical «BP-T», Chocó, Colombia. *Acta Zoológica Mexicana (n.s.)*, **22**(2), 1–32. https://doi.org/10.21829/azm.2006.2222012

Paulian, R. (1991). Les Coléopteres Scarabaeoidea de Nouvelle-Calédonie. *Collection Faune Tropicale*, **29**, 1–163.

Ratcliffe, B.C. (1976). A revision of the genus *Strategus* (Coleoptera: Scarabaeidae). *Bulletin of the University of Nebraska State Museum*, **10**, 93–204.

Rentz, D. (2014). *A guide to the cockroaches of Australia*. CSIRO Publishing. https://doi.org/10.1071/9781486300372

Ritcher, P.O. (1958). Biology of Scarabaeidae. *Annual Review of Entomology*, **3**, 311–334. https://doi.org/10.1146/annurev.en.03.010158.001523

Ritcher, P.O. (1966). *White grubs and their allies*. Oregon State University Press.

Rowland, J.M. and Miller, K.B. (2012). Phylogeny and systematics of the giant rhinoceros beetles (Scarabaeidae: Dynastini). *Insecta Mundi*, **263**, 1–15.

Rugg, D. and Rose, H.A. (1991). Biology of *Macropanesthia rhinoceros* Saussure (Dictyoptera: Blaberidae). *Annals of the Entomological Society of America*, **84**(6), 575–582. https://doi.org/10.1093/aesa/84.6.575

Walker, J.A., Rugg, D. and Rose, H.A. (1994). Nine new species of Geoscapheinae (Blattodea: Blaberidae) from Australia. *Memoirs of the Queensland Museum*, **35**(1), 263–284. https://www.biodiversitylibrary.org/partpdf/50726

Zietek, R. (2020). Observation notes on *Haploscapanes australicus* (Arrow 1908). *Metamorphosis Australia*, **97**, 10–13.