A beetle (Carabidae: *Chlaenius (Epomis)* spp.) that eats frogs

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The large size of most vertebrates compared to that of insects makes it difficult for predatory insects to utilise them as prey and, consequently, very few insects are capable of doing so. The few records of such interactions are usually incidental occurrences limited to young nesting birds or small lizards on land, or small fish and tadpoles in aquatic habitats.

Amongst the more common examples of large insects preying on smaller vertebrates are those of certain aquatic Heteroptera (*e.g.* Nepidae and Belostomatidae), Odonata and Coleoptera that feed on tadpoles and small fish. Fewer terrestrial insect groups are known to include vertebrates in their diet – one such is the Mantodea in which the few records available suggest the phenomenon is mainly incidental such as when large mantids capture and feed on small lizards. Aggressive ant species have also been recorded to use worker numbers to overwhelm, kill and dismember sedentary nesting birds and rodents.

Here we report on an obligatory association between an insect that is smaller than its vertebrate prey; a terrestrial ground beetle (Carabidae) that feeds on frogs. In this complete role-reversal the frog and beetle exchange their positions as predator/prey in the food chain; the frog from being a generalist insect predator that eats insects similar to its predator, to becoming the prey of a specialist, frog-eating beetle in what is undoubtedly one of the most unusual and bizarre examples of insect feeding yet recorded in southern Africa.

The beetle concerned is one of two species of the genus *Chlaenius* (Licininae: Chlaeniini), a very large genus (about 1000 species) distributed across the Holarctic and Afrotropical regions. The genus is divided into about 60 subgenera of which one, *Chlaenius (Epomis)* concerns us here. The subgenus has about 20 species recorded from the Palearctic and Afrotropical regions, two of which, (*C. (E.) circumscriptus* Duftschmid and *C. (E.) simba* Alluaud) are known from South Africa. *Chlaenius (E.) circumscriptus* is widespread in the southern Palearctic Region including Europe and the Near East, and across Africa to the Cape. *Chlaenius (E.) simba* is restricted to southern Africa. They are large beetles, measuring between 16–25 mm in length (all from Kirschchenhofer 2010).

The interactions recorded here were observed by one of us (C.D.R.) in the vicinity of George on the southern Cape coast of South Africa.

Larvae were observed attached to painted reed frogs (*Hyperolius marmoratus verrucosus*) on three daytime occasions between late December 2015 and late January 2016. On one occasion a larva was attached below a frog’s eye, on another to the belly and, on the third, to the front femur (Fig. 1). In the first example, the frog hopped away when disturbed, with the larva still attached, although the frog showed signs of discomfort. In the second case, the larva detached from the host when it was handled and was retained – the frog appeared unharmed but the larva died a day later. In the second case, the larva detached from the host when it was handled and was retained – the frog appeared unharmed but the larva died a day later. The third host–parasite interaction was first observed with a frog sitting quietly in the normal, vertical, position with the larva attached. Other than occasional flexing of its body and the excretion of a milky substance, the larva appeared immobile. After about three hours the frog began to move and was

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