

## SCIENTIFIC NOTE

### REVERSAL TO A TWO-OVARIES STATE IN SCARABAEINAE (COLEOPTERA: SCARABAEIDAE)

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The Scarabaeinae, typically dung beetles, forms a monophyletic group according to the criteria agreed upon by all authors. Perhaps the character that most strongly supports this unique origin is the reduction of the female gonads to a single ovary (the left one) with a single ovariole; a true synapomorphy. The first to note this reduction as a distinctive characteristic of Scarabaeinae was Heymons (1929, 1930). E. Willimzik (1930), a student of Richard Heymons, confirmed it in several other species. As a basic and distinguishing character of Scarabaeinae, ovarian reduction has been amply discussed and illustrated by Halffter and Edmonds (1982), and more recently by Scholtz (2009). All other authors who have examined a scarabaeine specimen in general studies of the ovaries in Scarabaeoidea mention an ovary with a single ovariole. The only equivalent case (one ovary, one ovariole) that we know of in Insecta occurs in the aphid family Pemphigidae (Woodward *et al.* 1970). Furthermore, although Scarabaeinae and Aphodiinae (the closest subfamily) share other synapomorphies, such as membranous incisive areas in their maxillae and mandibles, the Aphodiinae do not have the ovarian reduction found in the Scarabaeinae.

The first case of a scarabaeine female with two ovaries was published by Heymons (1930), who found the character state in a specimen of *Scarabaeus sacer* L., which, in addition to a normal left ovary, also had a right ovary with a nonfunctioning ovariole. Pluot (1979) published on a second species, *Onthophagus lecontei* Harold, with this same condition. This author, in addition to describing the relictual gonad, did a detailed study of organogenesis in the female genital apparatus in two species of Scarabaeinae. To summarize Pluot (1979), in the larva there were two ovarian precursors, although the right one was considerably atrophied compared to the left one. The left ovary had six ovarioles, of which only one developed normally, the others were strongly atrophied. In the larva, the right ovarian precursor,

like the atrophied ovarioles of the left ovary, disappeared, leaving a single ovariole in the left ovary.

In the female *O. lecontei* studied by Pluot (1979), the left ovary (functional) had one ovariole. The right ovary, which was smaller, had an ovariole with some oocytes among the trophocytes. The joined ovaries (as in the other cases studied) had two pedicels (one per ovary) which joined at the common oviduct.

The third published case (Martínez and Cruz 1998) was of a female *Canthon cyanellus cyanellus* LeConte. In this specimen, the left ovary was normal and the right ovary had a much reduced ovariole, but with some oocytes (five in total). In this case, the right ovariole, though reduced in size, appeared functional.

The fourth case was reported for *Onthophagus hirculus* Mannerheim (Martínez *et al.* 1999), which had two ovaries, each with its lateral oviduct and an ovariole. The two ovarioles had six oocytes, with those of the left ovariole more developed. Histological study revealed that the ovaries (including the ovarioles) were functional.

We report a fifth case, a female *Onthophagus rhinolophus* Harold collected in Coatepec, Veracruz, Mexico, with a relictual ovary. In this case, the left ovariole measured 4.57 mm, while the right one was only 2.57 mm (Fig. 1). The left ovariole had five oocytes in vitellogenesis and a totally functional structure (Fig. 1). Although the right ovariole had three oocytes, its structure did not appear to be functional.

The presence in larvae of Scarabaeinae of two ovaries, each with six rudimentary ovarioles (Pluot 1979) is, in our opinion, an indication that the phyletic ancestor of the Scarabaeinae had two ovaries, each with six ovarioles. This would be the plesiomorphic condition for the gonads in Scarabaeinae. It must be emphasized that this is the more generalized type of ovary in the families of Scarabaeoidea (Ritcher and Baker 1974).

The drastic reduction to a single ovary with one ovariole can be considered a synapomorphy that,