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Bionomics of a typical necrophagous beetle, *Thanatophilus rugosus* (Linnaeus) (Coleoptera Silphidae)

ABSTRACT

Both adults and larvae of this beetle have been repeatedly collected on mammalian remains in a locality of Southern Italy. Details of its behaviour and life-cycle were acquired through both field and laboratory observations. Adults were fed in terrariums with pig meat, and females released after 2-4 days some masses of eggs, which hatched 4-5 days later. Larvae carried out their feeding activity on the decaying meat for about 10-12 days and moulted twice in the meanwhile; then, they buried deeply in the ground and built a pupal cell. New adults emerged less than 30 days after oviposition. Because literature reports *Thanatophilus* adults to be attracted by carrions in gassy decaying phase, presence of larvae of this genus on remains would indicate that mammalian death happened at least 14 days before. This may be useful to evaluate the forensic parameter PMI_{min} referred of members of the genus *Thanatophilus*.

Key words: oviposition, larval morphology, adult emergence, carrion updating.

INTRODUCTION

The recent review of AMENDT *et al.* (2010) states about the interest of specialists of forensic investigations towards the Silphidae of the genus *Thanatophilus*, which is occurring in Italy with three species: *T. dispar* (Herbst), *T. rugosus* (Linnaeus) and *T. sinuatus* (Fabricius) (ANGELINI *et al.*, 1989). One of them is the subject of the present contribution, in which its usefulness in updating carrions is discussed on the basis of new observations.

Species has been identified thanks to the courtesy of Dr. Roberto Poggi (Civic Museum of Natural History, Genova).

MATERIAL AND METHODS

Several adults of *Thanatophilus rugosus* (Linnaeus) have been collected in both spring and summer of two subsequent years in a locality of Southern Italy. Field data are: Puglia, Bari province, Gioia del Colle, April 2008 on ox bones; same locality, April and July 2009 on calf carrions. Many larvae of the onisciform type were collected in the above substrates and fed in the laboratory to obtain the corresponding adults.

Observations in the laboratory were carry out in terrariums of the figured type (Fig.

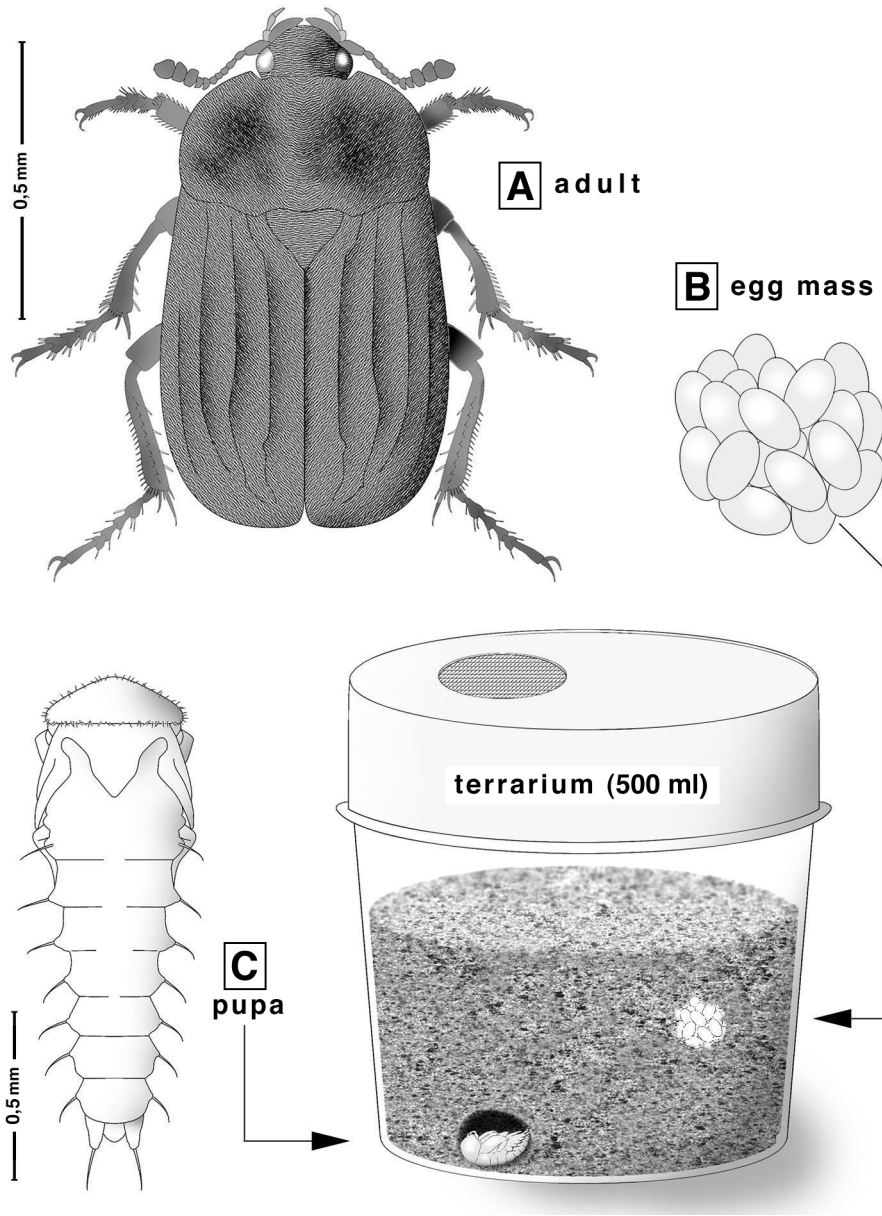


Fig. 1 - *Thanatophilus rugosus* (Linnaeus): adult, egg mass, pupa and technical features of the terrarium used in the laboratory.

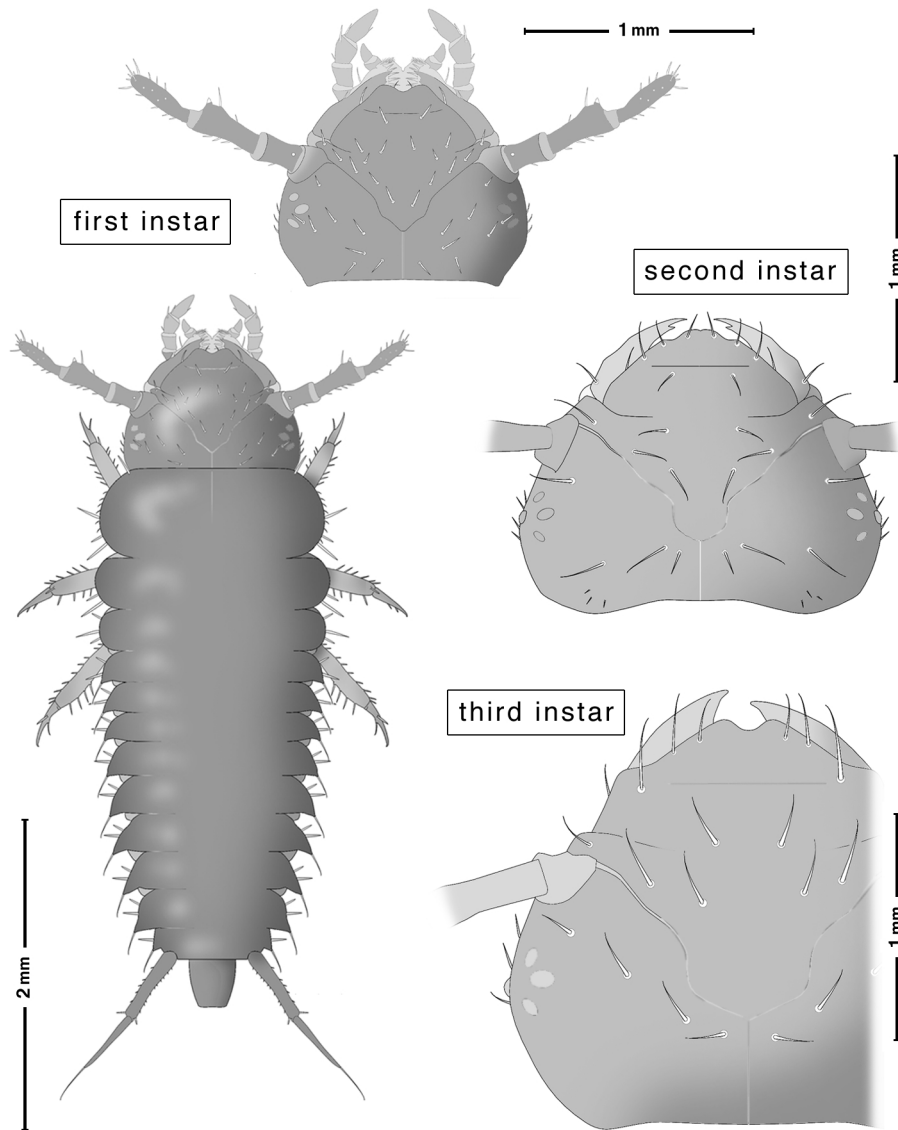


Fig. 2 - *Thanatophilus rugosus* (Linnaeus): diagram of the preimaginal development according to data acquired in the laboratory.

1), which included a piece of pig sausage. Three terrariums of this type (one in April and two in July) were installed starting from 4 adults of undetermined sex; they were stored at the room-temperature ($=18\pm 2^{\circ}\text{C}$ in April-May and $26\pm 2^{\circ}\text{C}$ in July) and inspected twice a day. Both oviposition and egg eclosion were registered through the transparent walls, whereas larval activities were observed at the terrarium surface. The time of the pupal development was evaluate on a sample of 8 larvae extracted from their pupal cell.

Morphological observations were carried out on a sample of 15 larvae collected in the field and preserved in ethanol 70%. Head size and body length were measured on specimens mounted on slides in glycerol.

RESULTS

Oviposition in the laboratory was observed in both April and July, starting from 4 and 2 days respectively after terrariums had been installed. Eggs were released in groups of 15-20 units, which were buried at 2-3 cm from the surface (Fig. 1.B). Egg eclosion lasted 4-5 days and occurred synchronically in each mass. Larvae stayed strictly aggregated in their eclosion pit for not more than 12 hours; then, they gained the surface and soon began in feeding on meat; they persevered in feeding activity for 10-12 days and moulted twice without synchronism in the meanwhile. Afterward, each larva deeply hid in the ground and got to build a 10-15 mm large pupal cell at the terrarium bottom. Pupation time was 4-5 days long in both April and July.

Events observed in the laboratory are reported in the following diagram (Fig. 2) and allow to outline the life-cycle of *Thanatophilus rugosus* as follows: (a) oviposition does occur at soil, not directly into the decaying matter; (b) females are able to discharge egg even 2 days after they have reached the decaying substrate; (c) egg eclosion lasts 4-5 days in both spring and summer; (d) larvae are engaged in feeding for 10-12 days, (e) then, they bury deeply in the soil and built their pupal cell; (f) the new adults emerge within 30 days from oviposition. Moreover, the observations in the field did provide the evidence that the larvae of this species are able to develop on both large bones and entire bodies of mammalians.

The morphological larval type of *Thanatophilus rugosus* (Fig. 3) is “onisciform” as in most Silphidae. Development includes three larval instars, which were easy to recognize by evaluating their head width. This was: 1,1-1,2 mm in the first instar (n=6), 1,6-1,7 mm in the second instar (n=6) and 2,0 mm in the third instar (n=3). Body length in each instar was evaluated in specimens with fully extended intersegmental membranes; it was: 0,5 mm in the first instar (n=5), 1,0 mm in the second instar (n=3) and 1,3 mm in the third instar (n=3).

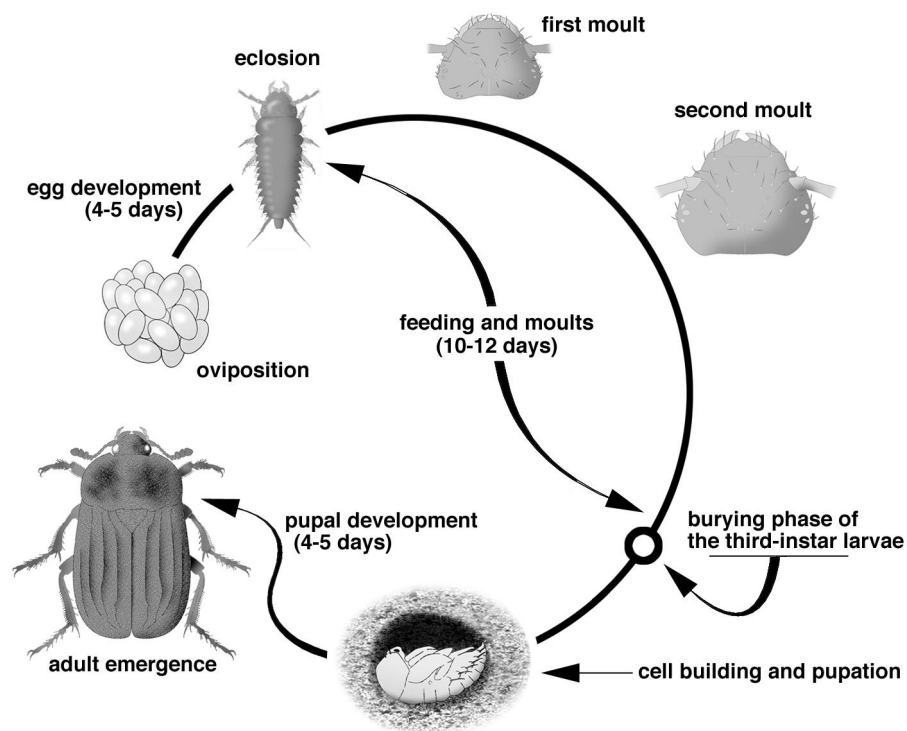


Fig. 3 - *Thanatophilus rugosus* (Linnaeus): habitus of the first-instar larva and head in larvae of the three instars.

DISCUSSION

All the *Thanatophilus* species occurring in Italy are reported as “necrophagous” in the ecological catalogue of KOCH (1989); anyhow, according to the terminology of BINAGHI (1960), they must be properly classified as “zoosaprophagous beetles” because, as far as we know, they feed directly on the decaying animal matter.

Members of this genus are mentioned in two chapters of the review of AMENDT *et al.* (l.c.). In the Chapter 4, MIDGLEY *et al.* (2010) deal with *T. micans* (Fabricius) and do regard this species as a reliable forensic indicator, because of its attitude to locate corpses within 24 h of death (as well as flies do); moreover, they discuss about its possible usefulness to evaluate the forensic parameter PMI_{min} (= Minimum Post Mortem Interval). In the Chapter 9, DE CARVALHO (2010) deals with *T. sinuatus* (Fabricius) and judges this *Thanatophilus* as an interesting source of data for

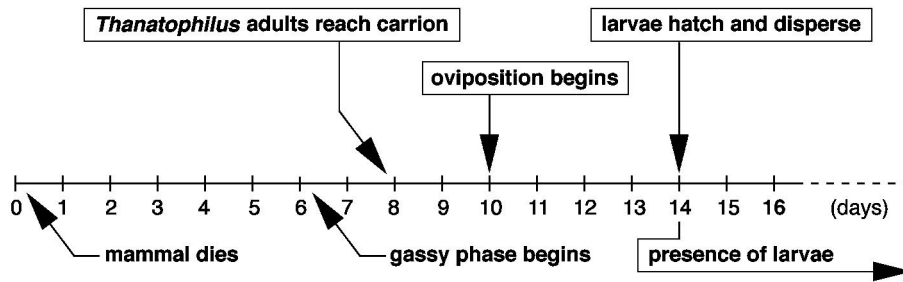


Fig. 4 – *Thanatophilus* spp.: supposed chronological events after carrion has been released in the field. This diagram co-ordinates the new observations on *T. rugosus* with those reported by DEFILIPPO *et al.* (2009) for *T. dispar*.

toxicological studies on corpses.

Another *Thanatophilus* species of forensic interest, *T. dispar* (Herbst), is reported in a recent contribution of DEFILIPPO *et al.* (2009). These authors have studied by pitfall traps the faunal succession of insects on pig carrions exposed in the field (see Table A); they have realized that adults of the above *Thanatophilus* do colonize a carrion when this has reached the gassy decaying phase.

CONCLUSIVE REMARKS

Because of their onisciform habitus, the larvae of *Thanatophilus* can be easily

Table A – Necrophagous Diptera and Coleoptera caught by pitfall traps on pig carrions intentionally released in the field, as reported by DEFILIPPO *et al.* (2009).

decaying stage	taxa
early	Diptera: Calliphoridae, Fanniidae, Muscidae
gassy phase at 6 days	<i>Aleochara curtula</i> (Staphylinidae-Aleocharinae) <i>Creophilus maxillosus</i> (Staphylinidae-Staphylininae)
gassy phase at 8 days	<i>Dermestes frischii</i> (Dermestidae) <i>Saprinus subnitescens</i> (Histeridae) <i>Thanatophilus dispar</i> (Silphidae)

distinguished from those of other necrophagous beetles of the families Histeridae, Staphylinidae and Dermestidae; moreover, because of their comparatively small size, they can't be mistaken for the larvae of other Silphidae occurring on carrions, such as *Nicrophorus* spp., *Silpha* spp. and *Necrodes littoralis* (Linnaeus). Their

Because, according to DEFILIPPO *et al.* (l.c.), adults do reach carrions in gassy decaying phase, larval presence of *Thanatophilus* on remains might suggest that mammalian death did happen at least 14 days before, as reported in the following diagram (Fig. 4). Therefore, 14 days is the value of the forensic parameter PMIm in referred to *Thanatophilus*.

RIASSUNTO

APPUNTI DI STORIA NATURALE SU UN TIPICO COLEOTTERO NECROFAGO, *THANATOPHILUS RUGOSUS* (LINNAEUS)
(COLEOPTERA SILPHIDAE)

Recenti contributi indicano l'interesse degli studiosi di Entomologia forense per i silfidi del genere *Thanatophilus*, ai fini della datazione dei resti di mammiferi. Il presente contributo riporta alcuni dati di campo e di laboratorio su *Thanatophilus rugosus*, di cui è stata ripetutamente riscontrata la presenza su resti di bovini in una località del Sud Italia.

Osservazioni etologiche sono state effettuate in laboratorio a partire da adulti cibati con carne di maiale. Le uova sono state deposte nel terreno a distanza di 2-4 giorni dalla installazione dei terrari e sono schiuse dopo 4-5 giorni. Le larve hanno raggiunto la superficie entro qualche ora e hanno iniziato subito a cibarsi; esse hanno perseverato nell'attività trofica per 10-12 giorni, effettuando nel contempo due mute; a maturità, hanno raggiunto il fondo del terrario e si sono allestita una propria cella pupale. I nuovi adulti sono sfarfallati a distanza di circa 30 giorni dall'ovideposizione. Poiché la letteratura riporta che i *Thanatophilus* afferiscono ai resti dei mammiferi quando questi sono nella fase gassosa di decomposizione, la presenza di larve starebbe ad indicare che tali resti si trovano in campo da non meno di 14 giorni dalla morte del soggetto. Ciò sostiene l'idea, già espressa dalla letteratura, riguardo all'utilità dei *Thanatophilus* nella valutazione del parametro forense PMIm.

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