

On the Life-History and Habits of *Rhizophagus depressus*, Fowler.

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With Figures 15-17.

In addition to the family Nitulidae to which our beetle belongs, there are several related families which number amongst them species which live below the bark of trees in the galleries made by the bark-boring beetles. The members of these families, so found, prey upon the insect enemies of the trees.

Professor Nitsche¹ mentions the families and some of the useful forestal species which have been noticed by different observers. Following Nitsche, and noting others from the literature, I summarise the families in tabular form, adding the name of the tree and the name of the pest infesting it.

[TABLE

[Notes, R.B.G., Edin. No. III., 1900.]

Family.	Name of Carnivorous Species.	Name of the Enemy of the Tree in whose Tunnels the Carnivorous Beetle was found.	Tree Infested.
Nitidulidæ	<i>Rhizophagus depressus</i>	<i>Hylesinus</i> and <i>Bostri-chus</i> species	Various conifers
	<i>Rhizophagus grandis</i>	<i>Hylesinus micans</i>	Spruce
	<i>Rhizophagus dispar</i>	<i>Pissodes piceæ</i>	Silver fir
	<i>Ips ferrugineus</i>		Scots pine
	<i>Ips quadripustulatus</i>		
Trogositidæ	<i>Nemosoma elongatum</i>	<i>Hylesinus vittatus</i>	Elm
		<i>Lymexylon dermes-toides</i>	Beech ; some-times birch, alder, rarely silver fir
		<i>Tomicus domesticus</i>	Birch, alder, beech, oak
		<i>Tomicus Saxesenii</i>	Oak, beech, birch, lime, poplar, fruit trees, pine, spruce
		<i>Hylesinus oleæ</i>	Olive
		<i>Tomicus bicolor</i>	Beech ; rarely hornbeam and walnut
Colydiidæ	<i>Colydium filiforme</i> and <i>Oxylaemus variolosus</i>	<i>Tomicus mono-graphus</i>	Oak
	<i>Colydium elongatum</i>	<i>Platypus cylindrus</i>	Oak
Cucujidæ	<i>Læmophloeus ferru-gineus</i>	<i>Tomicus micro-graphus</i>	Pine, spruce, silver fir
	<i>Læmophloeus ater</i>	<i>Hylesinus rhodo-dactylus</i>	Spruce
	<i>Læmophloeus clematides</i>	<i>Tomicus bispinus</i>	<i>Clematis vitalba</i>

The widely-distributed family Nitidulidæ includes very diverse forms, and the species also vary in habit. Some are

found in flowers: for example, *Meligethes aeneus*, the tiny shining green beetle so abundant in the flower-heads of the Cruciferae and other plants where the larvæ feed, interfering with the production of seed; others live in putrefying organic matter, and others still, like *Rhizophagus*, are insectivorous.

The genus *Rhizophagus*, which Sharp³ would refer to the Cucujidæ rather than the Nitulidæ, numbers in Britain some ten species, which live below the bark of trees, where they make war on the Bostrichidæ or bark-beetles.

I quote Fowler's³ description of the imago, and his translation of Perris'⁴ description of the larva, of *R. depressus*.

IMAGO.—Bright rust red, with suture of elytra generally darker; body depressed; head of male large, about as broad as thorax, of female, narrowed, thorax longer than broad, widest in front, thickly and very finely punctured; elytra with very finely punctured striae, first interstice with a row of widely-separated fine punctures; second interstice widened and irregularly punctured at base.



Fig. 15.

Rhizophagus depressus. Imago magnified. From nature.

Length, $2\frac{1}{2}$ – $3\frac{1}{4}$ mm.

LARVA.—Length, 6 mm., rather depressed, and in the form of an elongated oval; head narrower than the prothorax; head and prothorax reddish, the base of the latter being whitish, and all the succeeding segments except the last are reddish for their basal half and whitish for their apical half; the head is long, almost elliptical, with two long impressions; the prothorax longer than the meso- or meta-thorax, and is rounded and narrowed in front; the last segment of the body is entirely ferruginous, and is furnished on its upper surface with two distinct tubercles; this segment behind is divided into two lobes, each of which terminates in three strong teeth, on the under side is a small anal appendage which is used for progression.



Fig. 16.

Larva of *Rhizophagus depressus*. After Perris.



Fig. 17.
Rhizophagus de-
pressus. Pupa
magnified. From
nature.

PUPA.—The pupa is whitish in colour, and the last segment is cleft. There are long silky hairs down the sides and very small spines over the body. Length, 4 to 5 mm.

HABITS AND METAMORPHOSIS.—There is no doubt whatever that *R. depressus* is of great service to the forester in assisting to hold in check the increase of those most troublesome enemies of woods, the bark- and wood-boring Coleoptera.

Two years ago I determined the beetle for a forester in charge of extensive woods in Aberdeenshire, and asked him—in connection with certain trap trees which had been felled and allowed to lie here and there in the pine wood as lures for *Hylesinus piniperda*, the pine beetle—to make frequent examination of the trees for *Rhizophagus depressus*. The trap-trees were very successful in attracting for their egg-laying numbers of *Hylesinus piniperda*, and the forester has just written me to say that in such trees where *Rh. depressus* was plentiful nearly one-half of the *Hylesinus* larvæ were destroyed.

I have taken *Rh. depressus*, imago and larva, from under the bark of Pine and Spruce; the imago moving about the borings and the *Rhizophagus* larva (also capable of active movement) lying alongside the larva or pupa of the injurious species; e.g., recently on removal of bark I got two *Rhizophagus* larvæ lying in the bed of, and attached to, a *Hylesinus palliatus* pupa. The head of one of the larvæ was sunk deep in the *H. palliatus* pupa.

In June 1898, under the bark of some pine (*Pinus sylvestris*) branches I found a number of *Hylesinus palliatus* at work, the mother galleries having been partly made. Each *H. palliatus* mother tunnel held two *Rh. depressus* imagines.

In other two cases of grown pine and spruce, the bark in each case infested by *Hylesinus palliatus* and the wood by *Bostrichus lineatus*, I got numbers of *Rhizophagus* larvæ. In October 1898 and February 1899, in the galleries of *Hylesinus piniperda* which held larvæ and pupa and dead beetles, I also found *Rh. depressus* at work.

Again, in February and March 1898, on an Austrian Pine

(*Pinus Austriaca*) infested with a *Bostrichus*, I found *Rh. depressus* larvæ, which, on being placed on the outside of the Pine and watched, entered by the holes the *Bostrichus* had made, and hid there.

In October 1898, on a Scots Pine attacked by a *Bostrichus*, I got in the mother galleries of the latter, *Rhizophagus* larvæ.

On April 15, 1898, there came into my possession a section, measuring a yard, of a well-grown Scots Pine. This was found on examination to contain below the bark hundreds of *Hylesinus palliatus* larvæ. To prevent the beetles, when these had attained maturity, from escaping into the open, the section of stem was placed in a sack made of strong cotton. On July 12th I found on the floor of the sack about one hundred larvæ, which, observed through their later stages, proved to be larvæ of *Rh. depressus*. These larvæ, on being touched, coiled themselves up; on being laid on a piece of paper or glass or board they crawled actively away in all directions. As the number was far in excess of what might have accidentally tumbled out of the bark, the natural conclusion was that they had voluntarily left the pine stem in order to undergo pupation in the ground. To make certain of this—I have since found in the literature that Perris² had previously recorded that the *Rhizophagus* larvæ became pupæ in the soil—I covered a large circular transparent glass plate with an inch and a half of soil, and dropped here and there over the surface of the soil fifty larvæ. In one minute all without exception had disappeared into the soil. Into a glass tumbler half-filled with pressed-down soil I also dropped twenty larvæ, and these, too, rapidly buried themselves.

Towards the end of July I found that a larva had pupated; the pupa was lying a little below the surface of the soil against the glass of the tumbler. On some of the soil being emptied from the tumbler, more pupæ were found, and also larvæ as yet unchanged. With the glass plate I also had success, as on holding it overhead and looking through the under surface the tracks of the larvæ, as these had moved along the plate after burying themselves, were plainly seen, and a number of pupæ were found lying on the plate at the bottom of the soil. As August went on these pupæ were noticed to be "browning,"

and later, on removing the soil from above two of them, *Rhizophagus depressus* walked out. On turning over more of the soil other two *Rhizophagus* beetles started to walk away, but on being touched they remained quite motionless, with their legs and antennæ drawn in. Others in the turned-out earth, not quite mature, had their heads and under surface quite red-brown, while their wing covers still remained whitish.

WHEN RHIZOPHAGUS MAY BE FOUND.—Without professing to discuss this question, Perris incidentally records that the adult beetles may be found flying in the evenings in February, and also got below the bark in May and June. He notes also that the larvæ may be got even in January, and the pupa in May and June.

As I have because of its practical importance recorded times of appearance and finding of the different stages of other Coleoptera, I give here in tabular form from my notes the months of the year in which I have taken *Rh. depressus* in any of its stages.

MONTH.	STAGE.
January . . .	(Larva. Perris.)
February . . .	Adult and Larva.
March . . .	Larva.
April . . .	Larva.
May . . .	Larva. (Pupa and Adult. Perris.)
June . . .	Larva and Adult. (Pupa. Perris.)
July . . .	Larva and Pupa.
August . . .	Larva, Pupa, and Adult.
September . . .	Adult.
October . . .	Adult and Larva.
November . . .	
December . . .	

In one case the larvæ of February and March were from a Pine log that I had kept under cover in a sack, and it is reasonable to suppose that the larvæ were present at the end of the previous October when I placed the Pine log in the sack.

The fact of the finding of different stages in the life-history

at one and the same time throughout the year seems to emphasise what I have argued strongly for in Papers on other Coleoptera—viz., that the flight-times of adult beetles are not necessarily as brief as the general teaching would make us believe, and that immediate or a comparatively quick-following death is not certainly the "nemesis for reproduction."

LITERATURE.

1. Nitsche. Lehrbuch der Mitteleuropäischen Forstinsektenkunde, Vol. II., p. 292.
2. Sharp. Insects, Part II., p. 232. The Cambridge Natural History.
3. Fowler. British Coleoptera, Vol. II.
4. Perris. Annales de la Société Entomologique de France, Sér. III. Vol. I., p. 599.
5. Perris, *loc. cit.*, p. 602.