

A CURIOUS CASE OF WALL CLIMBING IN *CARABUS INTRICATUS*: DO THE CARABIDS ORIENT BY ODOUR TRAILS?

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Abstract: An almost five hours lasting climbing of *Carabus intricatus* LINNAEUS, 1761 on a fine plaster façade is described. The beetle was unable to pass over rectangular edges of the facade or decorative grooves. It seemed to mark its path by the protective glands in its abdomen and to be able to recognize its odour traces later. In spite of the fact that fall down could be the easiest way how to escape the façade, the beetle climbed extremely carefully and safely. The observation gives an evidence that just the ability of *C. intricatus* to overcome vertical obstacles is one of the important factors allowing it to survive in the cities. This behaviour is compared by the odour trace orientation in ants.

Key words: *Carabus intricatus*, bionomics, odour traces, ecology, ground beetles

INTRODUCTION

Carabus intricatus LINNAEUS, 1761 is distributed in South, West and Central Europe and, similarly as most *Carabus* species, prefers woodlands. Within its distribution range, it forms small, more or less isolated areas and absents on relatively large territories. It exhibits certain preference for the lime stone substrates, but even in the natural or near-natural habitats it always belongs only to influent or recedent species in the ground beetles communities. It is never so abundant as some of its congeners (e. g. *Carabus nemoralis* O. F. MÜLLER, 1764, or *C. hortensis* LINNAEUS, 1758). On the difference to its congeners, it is known to hunt pray also in the tree crowns. Its ability to climb the vertical surfaces and preference for calcareous substrates enables it to penetrate large cities like Bratislava, Brno or Prague (ŠUSTEK 1984, HŮRKA 1996) and to survive there in those disturbed habitats (family house quarters, some parks, abandoned places with rich secondary vegetation) where other typical forest Carabids do not migrate or survive.

On 14 July 1997, just after a period of strong rains, under clouded sky and high humidity, an individual of *C. intricatus* was occasionally noticed being climbing on the walls of a house on the Staré Zámocké Schody street in Bratislava, on the southern slope of the Hradný Vrch hill (Fig. 1). The considerable height, at which this individual was noticed, motivated me to continue observation and record its movement and behaviour. The beetle probably got on the wall trying overcome the vertical obstacle the wall represented. After many trials to continue its "journey" the beetle found finally a way back and it itself succeeded to escape the wall without fall down.

The aim of this contribution is to describe this curious observation.

RESULTS

The beetle was noticed at 3.30 p. m. (15.30) in the height of ca. 3.5 m (Fig. 2). It climbed a northerly facing fine stucco plaster facade in an almost straight line slightly aslant upwards. Within 25 minutes, it reached the wall edge, tried to overcome it and to continue climbing in the original direction. After several unsuccessful trials, it changed direction and climbed directly upwards along the edge and after about 1 m it turned to the wall centre and continued aslant upwards up to the roof overhang. There it tried to pass on the horizontal downwards facing surface of the overhang, but after several unsuccessful trials it changed direction and within a short time it reached the wall vertical edge and along this continued to descend directly downwards up to a small horizontal decorative groove at the wall lower part. It did not succeed to overcome it but it twice tried to return back upwards along the wall edge or aslant upwards toward the wall middle up to a short distance, but it soon returned to the groove. As late as after several unsuccessful trials the beetle started to climb along the edge up to a height of about 2.5 m and there it changed its direction aslant upwards to the wall centre. After ten minutes it reached to a window ledge. After several trials to overcome it and to continue in the original direction, the beetle turned downwards. In this section the beetle stopped several times and examined the wall surface by means of antennae and palpi. After passing a short distance, it turned again aslant upwards, repeated examination of the wall surface. After eight minutes (Fig. 2) it changed the direction for second time and continued aslant downwards repeating examination of the facade surface. After next 11 minutes, it changed direction for the third time and after next six minutes he started to move slightly aslant downwards, almost in the same path in which he moved at the observation beginning, but in the reverse direction. In this direction it relatively quickly reached the gutter pipe at the right vertical edge of the wall. There it turned directly downward along the pipe, but after one metre it reached the decorative horizontal groove in the facade. It was not able to overcome it. In that place he continued along the groove up to a window, but there it was not again able to overcome the wall vertical edge. After several unsuccessful trials to overcome it, the beetle returned to the gutter pipe and climbed about 1.5 m upwards along the gutter pipe. There it turned just in reverse direction, reached again the decorative groove and along it, for the second time, the window. Similarly as in the preceding trials, it was unsuccessfully trying to overcome the vertical edge and finally returned to the gutter pipe. There the beetle passed until the right edge of the house and climbed a little upwards, but quickly returned downwards and by chance found the narrow interruption of the decorative groove, which was hidden behind the pipe and represented a "bridge", through which it could pass onto the facade bottom part and to return on the ground.

The whole "journey" on the wall lasted from the beginning of observation 5 hours 16 minutes. The beetle frequently changed the movement speed. It carefully searched for suitable points to catch itself at the relatively smooth facade. The beetle many times stopped, especially in the crucial points where it changed direction and touched the facade surface by the abdomen end, where its defensive glands are situated. Therefore, this behaviour suggests that the beetle was marking its path. This hypothesis also supported by the repeated careful examinations of the facade surface, especially when the beetle four times crossed its original path. It seems that it searched for and verified its own traces.

At an obstacle which the beetle was not able to overcome easily, it stayed about five to seven minutes and repeated trials to overcome it. At two places, which were about 1.5 and 1 m respectively above the ground level, it was not able to recognise optically the ground nearness and even in that situation it was not to risk the fall down, which at these two places would be fully secure.

DISCUSSION

Attempts at climbing vertical surfaces (rough façades, wooden construction) were twice observed (1994, 1997) also in other *Carabus* species, *C. hortensis* (ŠUSTEK, unpublished), in autumn in late evening, when the seasonal and diurnal activity of this species in nature culminates. Both attempts were however much less successful than the case described above and the beetles fell down from the height of about 150 cm. In a limited extent, attempts at climbing of vertical surfaces in the *Carabus* species are to be expected in the species using to hibernate also under bark of decaying dead trees or forced to escape from the floods like *Carabus granulatus* LINNAEUS, 1758.

The slow cautious moving on the wall, the frequent careful examination of the wall surface by antennae and palpi and periodical touching it by the anal segments provided by glands producing a sharply smelling defensive secret strongly resemble the behaviour of the ant workers making trail on their path (HANGARTNER 1969) and/or behaviour of ant workers detecting by the antennae the trail made by other members of a colony (HANGARTNER 1967). HANGARTNER (1967) found the workers to tend, under normal conditions, to move out of the line marked by odour trails and when one antenna detected a decreased concentration of pheromone vapours, they corrected their movement on other side. So, they moved along the idealised chemically marked line in a weaving pattern. When one antenna of the experimental ant was cut, the weave amplitude increased considerably on the side of the cut antenna. Crossing of the antennae and their fixing in that position caused a strong disorientation of the ant which was searching for the correct direction with difficulties and made complex loops along the marked line. The groping on both sides of the searching for direction back from the wall observed in *C. intricatus* between 6.30 and 7.16, (Fig. 2) resembles just the behaviour of the disoriented ant in the experiment of HANGARTNER (1967). It suggests that *C. intricatus* had such difficulties even under normal conditions and that the odour orientation is not so developed as in ants (for many examples see. HÖLDOBLER & WILSON 1990).

The observation made in *C. intricatus* puts the question of fade-out time of its odour trails. The experience from collecting the *Carabus* species by hand shows that one can feel the defensive secret of these beetles even after some hours. So, the odour trail can be detected with, possibly, more sensitive beetle sensors after a considerable time. Also in this case there is a good comparison with the ants. The observations by WILLSON (1962) and WILLSON & BOSSERT (1963) showed the odour trails to fade out after 100 seconds on a distance of 20 cm. Contrary to this, the trunk trail and "highways" laid by some ant species can endure some days or longer (HÖLDOBLER 1967). The above examples show that the odour trace orientation can work also in *C. intricatus*. In addition, in this tree climbing species, the odour trace orientation can help to reduce the risk of fall down from relatively large heights.

CONCLUSIONS

The observation confirms the good ability of *C. intricatus* to move on vertical surfaces, which is rather extraordinary within the genus *Carabus*. In addition, the presented observation suggests that the movement of these beetles is not managed only by the external factors and the beetles preference for them. It seems that *C. intricatus* and possibly also some other Carabids beetles, similarly as the ants, actively use chemical orientation and are able to recognize individual, group (recognition of nestmates or particular castes and of injured or dead individuals, territorial or home range signals) or specific (species and sex recognition)

chemical traces or signals. This hypothesis is supported by the analogy of behaviour of ants using the odour trails. This kind of orientation requires, however, a developed memory, which is known so far only in the social insects, like wasps, bees or ants. Existence of such "spatial memory" was also indicated by a general tendency to maintain the principal direction of the movement, in spite of many partial direction changes. On the contrary, the visual orientation played obviously a minor role at the climbing. It was indicated by recognizing of the obstacles as late as in the immediate contact with them. The odour trace orientation in *C. intricatus* is, hypothetically, considered to be an adaptive mechanism reducing in this tree climbing species the risk of fall down from relatively large heights.

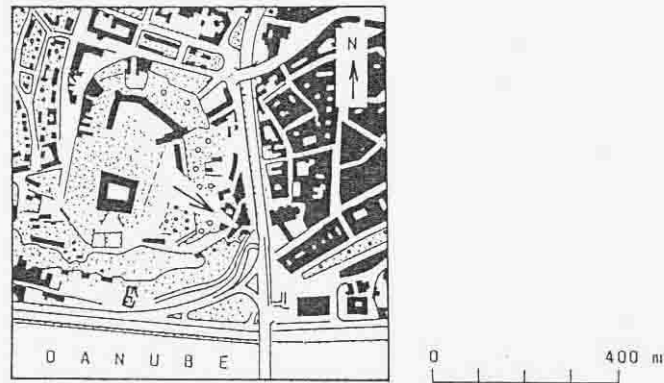


Fig. 1. Position of the observation site on the southern slope of the Hradný Vrch hill in Bratislava.

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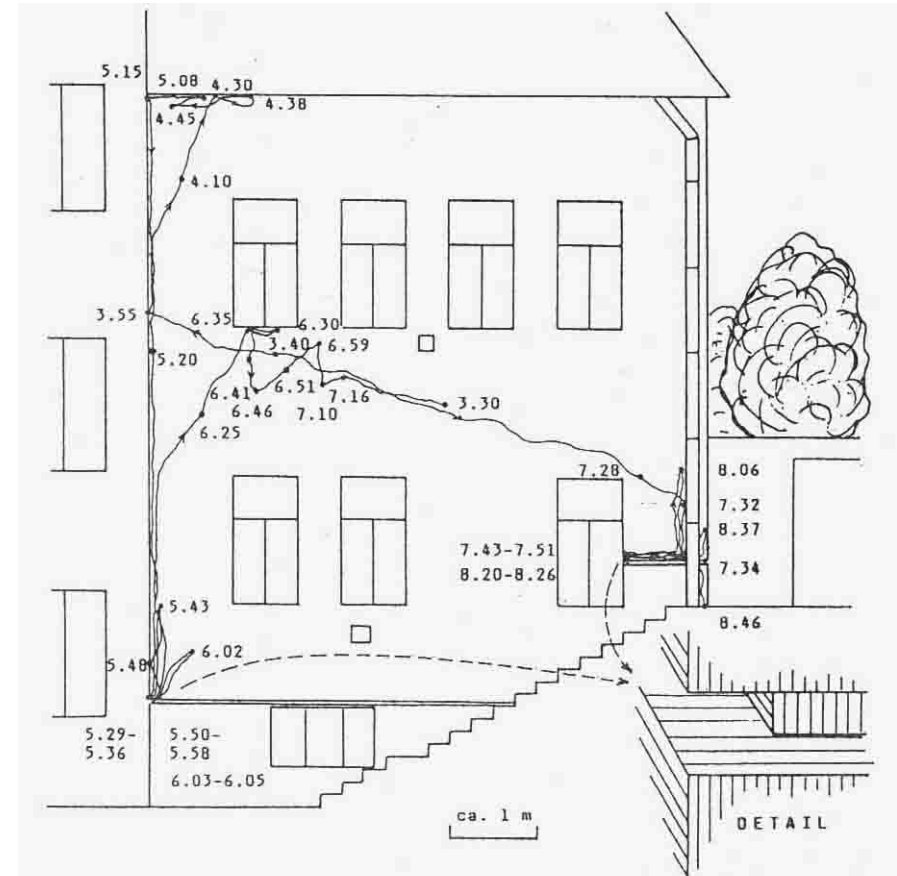


Fig. 2. Path of *C. intricatus* on the wall of a house on the Staré Zámocké Schody street. The observation started at 3.30 p. m. (15.30) and finished at 8.46 p. m. (20.46). The simplified mode of time recording was used due to space lack on the scheme in the places where the beetle often changed direction.