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NOCTURNAL ACTIVITY OF *TROCHOSA RURICOLA* (DEGEER) AND *T. TERRICOLA* THORELL (LYCOSIDAE, ARANEAE) SAMPLED BY THE TIME-SORTING PITFALL TRAP

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ABSTRACT

In this study, diel activity of *Trochosa ruricola* (Degeer) and *T. terricola* Thorell (Lycosidae Araneae) was determined using the time-sorting pitfall trap in grasslands and fields in northeast England. In spite of capture of *Trochosa ruricola* and *T. terricola* during day-time and night, most were caught during the dark periods. The ratio of adults of *T. ruricola* caught during the dark periods to the light periods was 1 / 0.28 in the field, and 1 / 0.23 in the grassland. For *T. terricola*, the same ratio was 1 / 0.17 in the field, and it was 1 / 0.26 lycosid in the grassland. Among the dark periods, much activity was recorded during the sunset and evening periods for the species. Little activity was recorded during the sunrise and morning periods. While the adults were nocturnal, the immatures of *Trochosa* were found as diurnal. In addition, *T. ruricola* was more active in the field while *T. terricola* was more active in the grassland.

INTRODUCTION

Wolf spiders are important predators of insects and some other arthropods in agricultural environments such as crop fields and grasslands. In many ecological studies, wolf spiders formed a very important proportion of the fauna (Yeargan et al. 1974, 1975; Whitcomb et al. 1963, Nyffeler 1982, 1988; Bayram et al. 1993 a,b; Bayram 1993, 1994; Heong et al. 1989, Wu et al. 1988). In recent years a great deal of research has been undertaken to establish life cycle, habitat selection, seasonal and diurnal activity, feeding ecology and reproduction of this group of animals. Twentyfour hour rhythms of activity are widespread in the animal kingdom (Harker, 1958). Some ecologists tried to determine the nature of the "clock" in wolf spiders under experimental and field conditions. In these works, in order to measure diel rhythms of locomotory activity, aktograph apparatus has been used by some ecologists (Buchli 1961, Herrero et al. 1983, Minch 1978). Time-sorting pitfall traps were another apparatus in activity works (Williams 1958,

1959; Houston 1971, Luff 1978). Subjects such as daily activity patterns, relationships between locomotion and ambient temperature and other climatic factors (Abraham 1983, Carnel 1980, Horn 1969), the relationship between activity of spider and that of its prey species (Yeargan, 1975), seasonal variation in activity, and immigration have been studied by means of these apparati.

Most species of spiders are noctural. Many web makers such as araneids, theridiids and tetragnathids build silk-lined retreats in which they spend their days. At night, most of these spiders come out on to the structure of the web. Nocturnal hunting spiders shelter under stones, dead leaves or in grass tussocks during the day. Also, many desert species tend to be nocturnal and active at night while tropical forest and woodland spiders are mostly diurnal (Cloudsley-Thompson, 1981). Among the studies on *Trochosa* lycosids, the following works can be counted: seasonal and diurnal activity of some spiders including *Trochosa ruricola* and *T. terricola* (Williams, 1962), phenology of some spiders inc luding *T. terricola* (Merrett, 1968), ecology of *T. ruricola* (Hackman, 1957), and life cycle and population dynamics of *T. terricola* (Workman, 1978).

This study describes the results obtained from an hourly time-sorting pitfall trap during two periods to explain nocturnal activity of *T. ruricola* and *T. terricola* in a filed and grassland in northeast England.

MATERIAL and METHOD

The study was conducted in two different sites. A fallow field and a grassland in a cultivated area at Close House (Hedd-on-the Wall, Northumberland, NGR N2131660, England). The field (about 600 m2) was surrounded by wheat fields, some small medaow plots and woodland. The ground vegetation was including *Taraxacum officinale* Weber, *Agrostis stolonifera* Linneaus, *Lolium prenne* L., and *Stellaria media* (L.). The grassland was a south-facing slope (150×20 m overall) between two winter wheat fields bordered by two woodlands. Some trees and shrubs (*Prumus avium* (L.), *Rubus sp.*, *Ulex europaeus* L.) were scattered throughout and in the surroundings. The general grass species were *Dactylis glomerata* L., *Deschampsia caespitosa* (L.), *Holcus lanatus* L., and *Festuca rubra* L. *Dactylis glomerata* was the dominant species.

To determine the diel activity of *Trochosa* spiders a collection was made for a period of twenty one days in each of the field (F) and grass-

land (GR) which contained most lycosids in some other studies (Bayram et al. 1993 a,b; Bayram 1993, 1994). The first collection was in F between 11 May and 31 May 1992, and the second was in GR between 1 June and 21 June 1992. The collection was made by means of the timesorting pitfall trap as used by Ludd (1978) for ground living beetles based on the design of Houston (1971). This apparatus consisted of an annular container (25 cm in diam. and 10 cm deep, and divided into 24 small compartments) and a (1 rev / 24 h) clock. The clock was located in the centre of the container and was carried a turning metal pitfall trap (Figure 1). Antifreeze was poured into the compartments (is about 4 cm depth), and the container was placed into a bigger and cylindrical drum made of tinplate (in 29 cm diam., 34 cm diam., 34 cm deepness). A pit of about 50 cm deep and 40 cm diameter was dug in a suitable place in the site, and the tin container with a lid was placed into it. Above this, a long plastic gutter pitfall (192×11×7cm) was fixed to the mouth of the drum in order to collect many more spiders. The rim of the gutter was flush with the ground surface, and there was a mesh covered hole at the bottom of the far end to allow rain weter into the ground. Also, the end with this hole was a bit lower than the other end

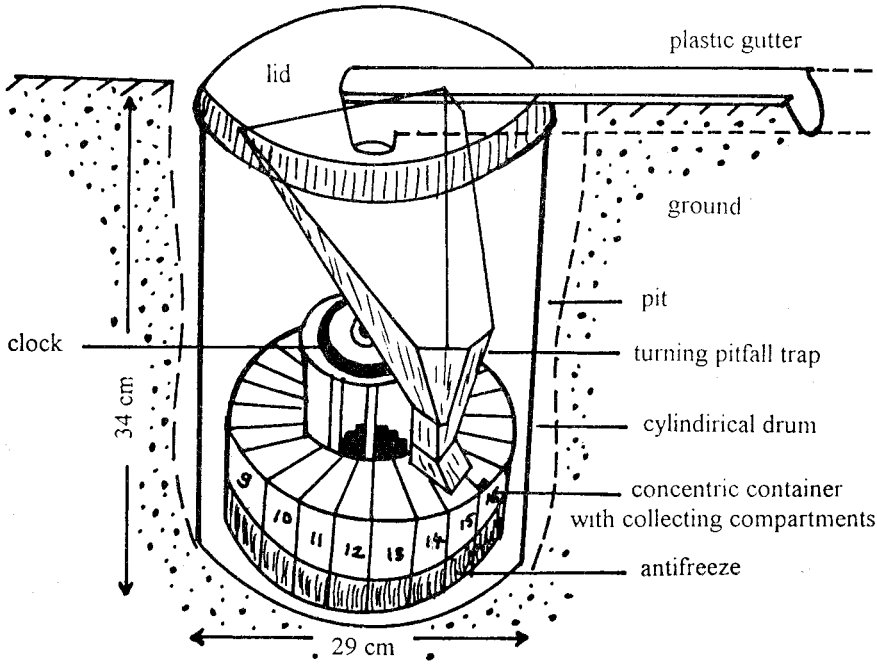

Figure 1. The position of a time-sorting pitfall trap in the ground.

in order to preserve rain water from running into the drum. The top of the container was covered with grasses, and a piece of galvenized wire mesh fixed to the mouth to prevent small vertebrates blocking the mouth of the funnel below. The clock was checked and reset at five day intervals. At the end of the period the trap was carried to the laboratory, the collected spiders identified and kept in 70 % alcohol in small containers.

To establish the distribution of activity throughout the days in May and June, the 24 pots were divided into six periods in the climatic conditions of northeast England, namely;

1. **Midnight:** From midnight to one hour before sunrise (01 to 05, 4 hrs)

2. **Sunrise:** From one hour before sunrise to one hour after sunrise (05 to 07, 2hrs)

3. **Morning:** From one hour after sunrise to noon (07 to 13, 6 hrs)

4. **Afternoon:** From noon to one hour before sunset (13 to 19, 6 hrs)

5. **Sunset:** From one hour before sunset to one hour after sunset (19 to 21, 2 hrs)

6. **Evening:** From one hour after sunset to midnight (21 to 01, 4 hrs).

RESULTS AND DISCUSSION

In this study, *Trochosa ruricola*, *T. terricocola*, *Arctosa perita*, *Alopecosa pulverulenta*, *Pardosa amentata*, *P. pullata*, *P. palustris* and *P. nigriceps* were recorded from the sites. Among these species, *T. ruricola* and *T. terricola* were found about in all periods in both sites. However, they were remarkably more active in the sunset, evening and midnight periods than the sunrise, morning and afternoon. Table 1 gives the lycosid numbers caught per hour per collection in the dark and light periods. In the field (F), *T. ruricola* was collected mainly in the evening period (4.75 lycosid per hour per collection), and followed by the sunset and midnight periods. *T. ruricola* could also found in the afternoon and morning periods but in less numbers (Figure 2). No *T. ruricola* was caught in the sunrise period. In the grassland (GR), this wolf spider exhibited a similar activity pattern. It was more active in the sunset (4 *ruricola* per hr. per coll.). Followed by the evening and midnight periods. It was less active in the morning and afternoon periods (0.33 *ruricola* per hr. per coll. in the morning, 0.83 *ruricola* per hr. per coll. in the afternoon).

Table I. The numbers of individuals of *Trochosa ruricola* and *T. terricola* caught per hour per collection by the time-sorting pitfall trap in the sites.

Field:

	P	E	R	I	O	D		
Species	Midnight	Sunrise	Morning	Afternoon	Sunset	Evening	Total	n
T. ruricola	2.75	0	0.33	2.16	4	4.75	2.2	53
T. terricola	3	0	0.16	1.33	4.5	3.75	1.87	45
Tot. adult	5.75	0	0.5	3.5	8.5	4.08	4.08	98
Tot. imm.	0.5	2	1.16	2.83	1.5	1	1.54	34

Grassland:

T. ruricola	1.25	1	0.33	0.83	4	3.5	1.5	36
T. terricola	6	0.5	0.83	3.16	7.5	6.75	3.79	91
Tot. adult	7.25	1.5	1.16	4	11.5	10.25	5.25	127
Tot. imm.	2.75	2.5	3.33	6	3	3.5	3.83	92

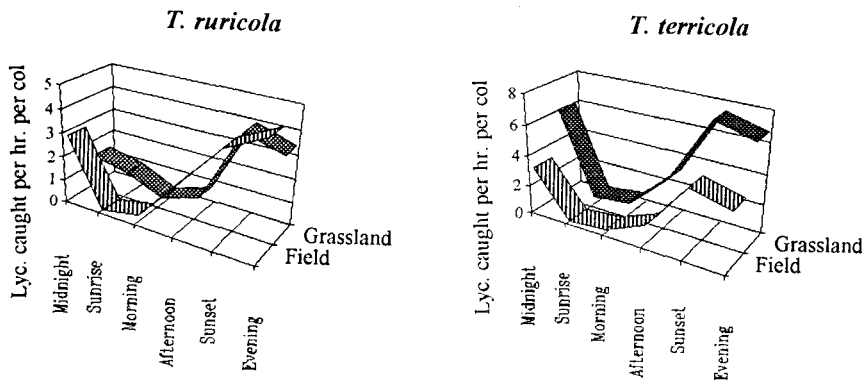

Figure 2. The diel activity of *Trochosa ruricola* and *T. terricola* in the sites studied.

Like *T. terricola* much activity was recorded during the dark periods for *T. terricola*. This species was found mainly in the sunset period (4.5 *terricola* per hour in the field, 7.5 *terricola* per hour in the grassland, Table 1). Followed by the evening and midnight. Among the light periods, more *T. terricola* were collected in the afternoon while it collected in limited numbers in the sunrise period (Figure 2). In general, in F, the ratio of the dark periods to the light periods was 1 / 0.28 lyc. per hour for *T. ruricola*, and was 1 / 0.16 lyc. per hour for *T. terricola*. Similarly, in the grassland, the ratio was 1 / 0.22 lyc. per hour for *T. ruricola*, and was 1 / 0.27 lyc. per hr. for *T. terricola*. Clearly, more *T. ruricola* and *T. terricola* were collected during the dark periods. So, in both locations *Trochosa* species were nocturnal.

Also, in the field, the number of *T. ruricola* caught per hour in the periods was higher than that of *T. terricola*. The ratio of *T. ruricola* to *T. terricola* was 1 / 0.85 lycosid per hour. In contrast, in the grassland, *T. terricola* was collected more than *T. ruricola* (1 / 0.39 lyc. per hour, Figure 2). Meanwhile, *T. ruricola* preferred the fallow field with short grasses while *T. terricola* showed affinity to long grasses.

Total number of adults was higher in F than that found in GR for *T.* ruricola. But much activity was recorded for the males of *T. ruricola* in F and GR. The ratio of the males of F to GR was 1 / 0.67 lyc. per hr. while it was 1 / 0.68 lyc. per hr. for the females. Moreover, both sexes were more active in the dark periods. They did not prefer the light periods or they found in limited numbers (Table 2, Figure 3). Furthermore, similarly, the males and females of *T. terricola* were caught mainly in the sunset, evening and midnight periods in both locations. Among the light periods, *T. terricola* was more active in the afternoon, and it was less active in the sunrise period (Figure 3). However, the total catch of the males in GR was higher than that caught in F (1.66 / 1.25 *terricola* per hr.). Also, more females of *T. terricola* were collected in GR (2.12 terricola per hr. in GR, and 0.62 *terricola* per hr. in F). On the other hand, the males were more active than the females for both sites. However, in *T. terricola* while the males were more active than the females in F, they were less active in GR.

No females with egg sac (cocoon) of *T. ruricola* were found during the work. Only ten females with egg sacs of *T. terricola* were caught in

Table 2. The numbers of the males and females of *Trochosa ruricola* and *T. terricola* caught by the time-sorting pitfall trap during the collections in the sites. M: male, F: female.

Field:

		P	E	R	I	O	D	
		Midnight	Sunrise	Morning	Afternoon	Sunset	Evening	
Species	Sex	4 hrs	2 hrs	6 hrs	6 hrs	2 hrs	4h rs	Total
	M	8	0	2	8	4	12	34
T. ruricola	F	3	0	0	5	4	7	19
	M	10	0	1	5	8	6	30
T. terricola	F	2	0	0	3	1	9	15

Grassland:

	M	5	0	2	2	5	9	23
T. ruricola	F	0	2	0	3	3	5	13
	M	9	1	3	8	7	12	40
T. terricola	F	15	0	2	11	8	15	51

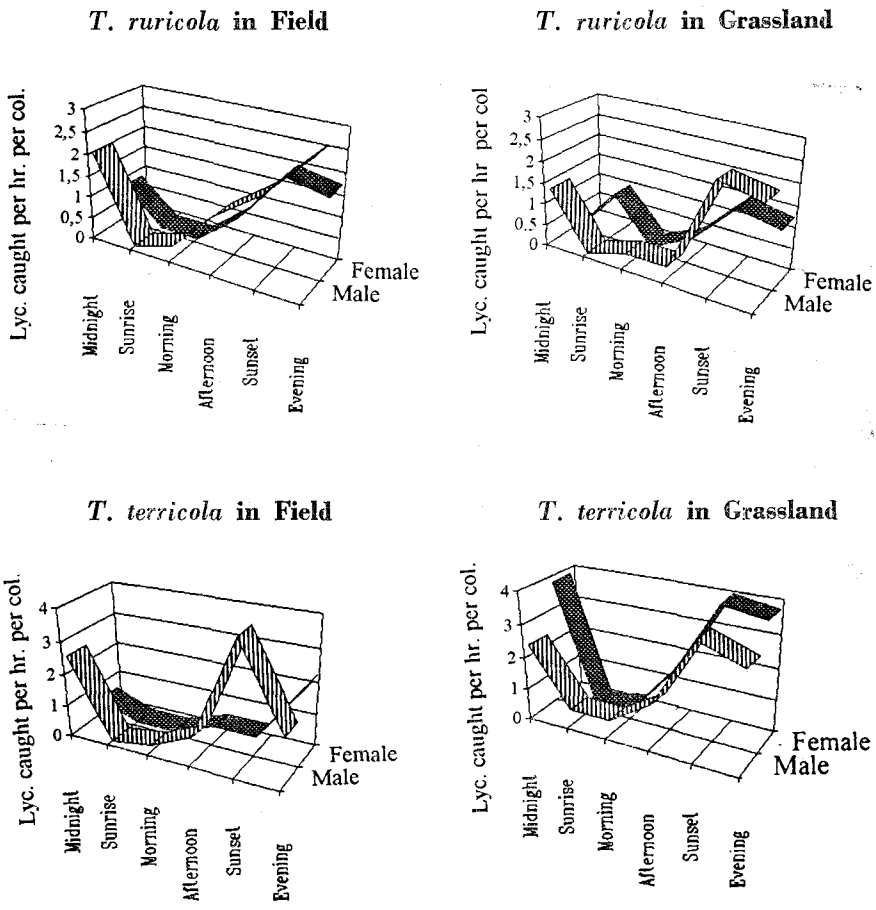

Figure 3. The activity of the males and females of *T. ruricola* and *T. terricola* in the sites

the grassland. In these females, five were collected during the afternoon (0.83 cocoon per hour), two during the sunset (1 coc. per hr.), and three during the evening period (0.75 coc. per hr). Thus, the females with egg sac of *T. terricola* could be found in light and dark periods. The values of the light and dark periods were equal (0.83 / 0.83 coc. per hr.).

In this work, while the adults of *T. ruricola* and *T. terricola* were more active in the dark periods, the immatures of these species showed a tendency to be day-time active spiders (Figure 4). The ratio of the light periods to the dark periods was 1 / 0.45 immature per hour in F, and it was 1 / 0.7 imm. per hr. in GR. Among the light periods, the af-

ternoon contained more immatures (Table 1). Followed by the morning or sunrise period. On the other hand, the midnight and evening periods were contained limited numbers of immatures. So, in contrast to the adults, the immatures of *Trochosa ruricola* and *T. terricola* were found as day-time active. Namely they were diurnal.

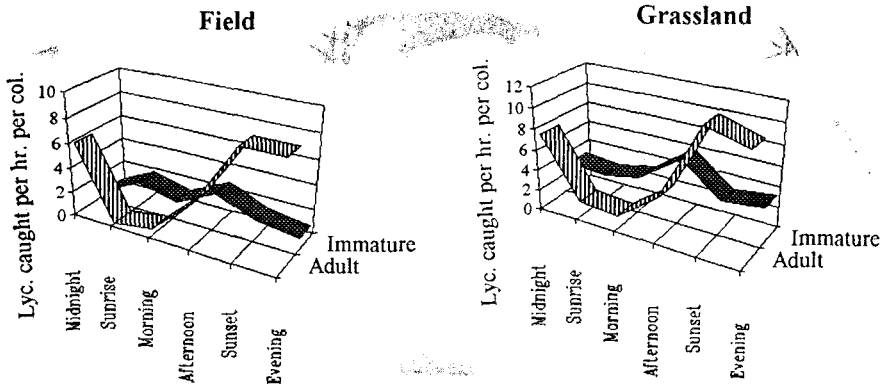

Figure 4. The activity of the adults and immatures of *T. ruricola* and *T. terricola*.

Hackman (1957) recorded that *T. ruricola* was generally found in habitats near the water, and they hit under stones when they alarmed. In this study, arround the field there were some water canals, marshy places and small ponds. Therefore, more *T. ruricola* was occurred in the field. On the other hand, according to Workman (1978) *T. terricola* showed an affinity to found in locations with moisty *Festuca spp.* tussocks. In my study, *Festuca rubra* was one of the grass species formed tussocks in the grassland. Also, this site was moisty with long and thiny grases. Perhaps that is why, more *T. terricola* was collected from this site.

Trochosa spiders show biennial life cycle, and therefore, they become active earlier than some other lycosids such as *Pardosa*, *Alopecosa* and *Pirata* (Williams 1962, Hackman 1957, Bayram 1993). Some adults of *Trochosa* hibernate with immatures, and begin to occure in early March while the adults of the other genera occur in early April. There is a remarkable decrease especially in male population of *Trochosa* species in June. The males dissappear earlier than the females. A few females are found in July and August. At the end of August of beginning of September a second increase is seen in adult population but this belong to the new generation. In this study, the ratio of the males to the females was 1:0.56 lycosid for *T. ruricola* (in May), and it was 1:0.94

lycosid for *T. terricola* (in June). So, the data agrees with the records of Williams (1962), Hackman (1957) and Merrett (1968).

Nocturnal activity of *T. terricola* and *T. ruricola* was emphasized also by Workman (1978), Engelhardt (1964) and Locket & Millidge (1953). According to the authors adults of *T. terricola* and *T. ruricola* are nocturnal but juveniles of these species are diurnal, and much more activity was recorded at night (between 23 and 06 hrs) for the adults. In addition, according to the experiments of Norgaard (1945) and Backlund (1945) on the light reaction of *T. ruricola*, the specimens perferred "dark" to "light" in 90 % of the cases.

No females with egg sacs of *T. ruricola* were recorded during this work. Only ten females with egg sacs of *T. terricola* were caught in the grassland. These females were collected during both light and dark periods. This amount of egg sacs is not enough to analyse the light perferences of the females with egg sacs. For this, a longer collection period by the time-sorting pitfall trap is needed. Workman (1978) recorded that females of *T. terricola* started to produce egg sac in June in the field conditions. But unfortunately there is no record on diel activity of the females with egg sacs of *T. terricola* or *T. ruricula*.

During the experiment a long gutter was added to the time-sorting pitfall trap in order to collect more specimens. This device is more suitable for some ground livings insects such as Carabidae (Houston 1971, Luff 1978). I observed that lycosid spiders certainly can climb out of the gutter. Also, being curved inside at the rims of the gutter did not matter for spiders. In spite of this, this device and method was found to be effective to collect spiders. Especially in the grassland, more specimens were collected than I expected, even though the galvanized wire mesh can also prevent the pitfall capture of spiders.

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