Cereal pests among nest parasites – the story of barley thrips, *Limothrips denticornis* Haliday (Thysanoptera: Thripidae)

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Barley thrips, *Limothrips denticornis*, Haliday, 1836 (Thysanoptera: Thripidae), a grass-dwelling Holarctic species represents a model example to study transport mechanisms of Thysanoptera into nests. In samples from more than 1,500 nests, barley thrips were recorded in nests of 20 vertebrate species, both birds and mammals. Applying appropriate statistics (nonparametric methods) clear clustering among nest materials and a strong relationship between presence of thrips and grass as the nest material was found. Occurrence of thrips was not associated with nest size, location or height. To validate our statistical analyses 15 wooden boxes were installed and equipped with sticky traps to record the whole year migration dynamics. Barley thrips infiltrate nests by various ways (e.g. dwelling on bark, landing from atmosphere), however most of them (88%) invade passively on nest material (grass) in spring (1st summer nesting) and autumn (winter nest building).

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1. Introduction

Nests form suitable ecological conditions for a wide variety of invertebrates, particularly ectoparasites and their predators. A small portion of nest-dwelling inhabitants, including thrips, is formed by insects with an uncertain status. Their occurrence in nests is rather more sporadic than regular and challenges entomologists with many questions.

Amongst eighteen orders of Insecta recorded in nests by Hicks (1959), thrips species were found at least at seven fully determined birds, including *Passer montanus montanus* (Boyd 1932, 1935). Since 1960's, only sporadic data on the occurrence of thrips in nests have been published (e.g. Judd 1962, Freitag & Ryder 1973), except the most comprehensive papers by the Pelikán's team (Pelikán *et al.* 2002, Fedor *et al.* 2008, etc.). These authors identified 38 species of Thysanoptera, and their work, with its rich material available, stimulated us to put a particular attention on barley thrips, which appeared to be the most common and dominant species in the nests, but whose frequent occurrence has not been satisfactorily explained yet.

Perhaps one would have guessed without doing this work that it is clear how thrips invade nests, e.g. they are carried into nests as a contaminant on grasses the birds collect to build their nests. But based on more than 30 year long experiences and collecting nest-dwelling Thysanoptera, we have supported the idea that there is a wide spectrum of ways to invade nests, and each species might have its specific and preferred mechanisms to do so.

Collecting Thysanoptera in nests and their surroundings have shown that presence in nests does not always have the only and same origin. It may be accidental, with thrips drifting in on air currents. In Central Europe *Limothrips denticornis*, Haliday, 1836 is a frequent member of the aeroplankton when it disperses from nearby cereal fields particularly via wind currents (Fedor *et al*. 2007b). Maximum densities of more than 140,000 airborne barley thrips specimens per 106 m^3 were recorded during mass flights in southern England (Lewis 1965). Really the most noticeable mass flights are generally produced by cereal and grass thrips when they leave ripening crops (Tansky 1958).

Although living and feeding on grasses, usually in open habitats, barley thrips often occur on trees, where they presumably overwinter under bark (Lewis 1973). Dwelling on bark they were often trapped by many authors (e.g. Jenser 1993, Ulitzka & Funke 1997, Fedor *et al.* 2007a) even in the tree canopy.

And finally there are some papers (e.g. Fedor *et al.* 2008), giving rise to a logical assumption that grass-dwelling thrips, such as *L. denticornis*, *L. cerealium*, Haliday, 1836 and *Chirothrips pallidicornis* Priesner, 1925, will infiltrate the nest-dwelling fauna by being transported on grasses used for nest building.

Some thrips may overwinter in nests or avoid unsuitable weather conditions (Hartwig 1967, Lewis 1973, Fedor *et al.* 2008). And finally there is a disputable presumption of occasional ectoparasitism by these insects that are usually living and feeding on grass (e.g. Southcott 1986, Lane & Crosskey 1995). Although tiny and sometimes easily unnoticed, barley thrips have the ability to travel and survive for long periods in suitable weather (Lewis 1962). Moreover many papers emphasize their strong tolerance to environmental factors (e.g. Post & Colberg 1958).

Simply, there are several alternatives that explain how *L. denticornis* invades nest-dwelling fauna. Their interpretation, however, has never been statistically tested and experimentally approved. Taken together, occurrence of thrips in nests of birds and mammals has encouraged us to analyze transport mechanisms of barley thrips. In particular, the specific objectives were to test a hypothesis that (1) *L. denticornis* applies only one preferred mechanism to infiltrate nests, (2) it predominantly invades nests passively transported on nest material and (3) the role of active looking for a save shelter is not the most significant determinant in distribution of thrips in nests and finally (4) to project seasonal transport dynamics of barley thrips into nests. Before making any conclusion we suggest that studying migration mechanisms of barley thrips, even into nests, may help to understand some of the consequences in spatial distribution and spread of many cereal damaging pests.

2. Material and methods

For studying infiltration of barley thrips into nests we decided to apply two basic approaches: (1) statistical analyses of the existing data and (2) field research to approve our suggestions.

2.1. Analyses of the existing data

In the relatively long period of 1975–2008, the team of zoologists at Comenius University in Bratislava, Slovakia collected valuable samples of diverse nest-dwelling fauna from more than 1,500 nests of birds and mammals throughout Slovakia. Although the basic, rather faunistic, data of these samples were published previously by Pelikán *et al*. (2002) and Fedor *et al*. (2008), the material (probably one of the most complex in the world and reliable for general conclusions) was supposed to be evaluated more in detail as no deeper ecological analyses in this matter have been published yet.

Generally the R software (2008), free environment for statistical computing and graphical display, was chosen for all the statistical analyses ($\alpha = 0.05$). Each partial tool was applied according to a specificity of computation data sets. We tested, if barley thrips predominantly occurred in a certain type of nest (defined by its material, size, location a height) and thus to find conclusions on their preferences.

The sampled 275 nests containing various thrips, including 443 *L. denticornis*, were formerly inhabited by 39 species of birds and mammals. Thus a wide spectrum of material used for building nests could be analyzed. In statistical analyses, 154 nests (with 237 *L. denticornis*) inhabited by only one nester, were taken into account (Table 1). The others correspond with multiple nesting and were not included in the analyses due to a disputable interpretation of the results. All nests positive in thrips, including those without *Limothrips denticornis*, were statistically evaluated. For detailed analysis, 14 material categories were selected (Table 1). In fact we have to underline that in nature nests are composed of their mutual combinations, appropriate and specific for each bird and mammal species. For instance, nests of common blackbirds, *Turdus merula* Linnaeus, 1758, built of stalks, moss, detritus and branches, or those of tree sparrows, *Passer montanus* (Linnaeus, 1758), consisting of feathers and grass, were the two most common nests sampled. The significant ANOVA (Siegel & Castellan 1998) result suggests rejecting the global null hypothesis concerning the relationship between nominal (material) and response binary variables (presence of thrips).

After rejecting the null hypothesis multiple comparison (Siegel & Castellan 1998) procedures (after Friedman's ANOVA in our case) were used to determine differences among means. Comparing K means involves $K(K - 1)/2$ pairwise comparisons. Divisive hierarchical clustering technique (DIANA) (Kaufman & Rousseeuw 1990) was chosen with Gower's General Similarity Coefficient (metric) to measure proximity of mixed data types (material of nests). Advantages of this hierarchical clustering include no difficulties of proximity measure selection and flexibility of received classification. For divisive clustering the known information about inter-relationship may be incorporated into the algorithm.

The strength of the clustering structure found by the algorithm ("measure of effectiveness") is, in case of DIANA, indicated by divisive coefficient (*DC*). The closer *DC* is to 1 the clearer cluster structure algorithm yields. Gower's metric implied natural standardization of variables which helped to get off influence of misleading outliers. In the Gower's metric the contribution of a nominal or binary variable to the total dissimilarity is 0 if both values are different, 1 otherwise. The contribution of other variables is the absolute difference of both values, divided by the total range of that variable.

Scaled as 4 nest size categories (1: 0–9 cm; 2: 9–15 cm; 3: 15–30 cm; 4: more than 30 cm in diameter) we analysed association of thrips occurrence with nest size (137 nests in total). This scaling was applied for the older material that is not available anymore, thus we had to use the same method for the other nests to obtain more data. A contingency table 4×2 was prepared with presence/absence as a dependent and size as an independent variable. Pearson's chi-squared test of the null hypothesis was performed in evaluation of dependency of nest size on the presence/ab-

Table 1. Summary of statistically analysed nests.

	No. of nests analysed	Materials*	No. of *L. denticornis*
1. *Acrocephalus arundinaceus* (Linnaeus, 1758)	4	13, 4, 5, 2	1
2. *Acrocephalus palustris* (Bechstein, 1798)	1	12, 1, 13, 6	0
3. *Acrocephalus scirpaceus* (Hermann, 1804)	1	12, 1, 13, 6	1
4. *Aegithalos caudatus* (Linnaeus, 1758)	1	1, 4	0
5. *Anas platyrhynchos* Linnaeus, 1758	1	5, 2	0
6. *Anthus trivialis* (Linnaeus, 1758)	1	5, 4, 2	1
7. *Arvicola terrestris* (Linnaeus, 1758)	3	12	0
8. *Buteo buteo* (Linnaeus, 1758)	1	7	0
9. *Carduelis carduelis* (Linnaeus, 1758)	1	9, 4, 5, 3	0
10. *Certhia brachydactyla* Brehm, 1820	1	7, 2, 6	0
11. *Certhia familiaris* Linnaeus, 1758	1	1, 9, 2, 6	4
12. *Ficedula albicollis* (Temminck, 1815)	2	1, 5, 4, 2	3
13. *Ficedula parva* (Bechstein, 1794)	1	5, 4, 2	0
14. *Fringilla coelebs* Linnaeus, 1758	1	4, 2, 5	0
15. *Garrulus glandarius* (Linnaeus, 1758)	2	7, 9, 3	0
16. *Hippolais icterina* (Vieillot, 1817)	1	5, 1, 3, 2	2
17. *Chloris chloris* (Linnaeus, 1758)	3	3, 5, 2	2
18. *Lanius collurio* Linnaeus, 1758	9	5, 7	64
19. *Merops apiaster* Linnaeus, 1758	1	–	0
20. *Micromys minutus* (Pallas, 1771)	1	5, 14	59
21. *Microtus arvalis* (Pallas, 1778)	1	–	1
22. *Motacilla alba* Linnaeus, 1758	2	5, 4, 3, 2	0
23. *Muscardinus avellanarius* (Linnaeus, 1758)	9	5, 1, 4	4
24. *Muscicapa striata* (Pallas, 1764)	2	9, 3, 2	5
25. *Nucifraga caryocatactes* (Linnaeus, 1758)	2	7, 5, 4, 2	1
26. *Parus major* Linnaeus, 1758	2	4, 5, 3, 2	0
27. *Passer domesticus* (Linnaeus, 1758)	2	5, 2	4
28. *Passer montanus* (Linnaeus, 1758)	36	5, 2	42
29. *Pica pica* (Linnaeus, 1758)	10	7, 8, 5, 3, 2	1
30. *Remiz pendulinus* (Linnaeus, 1758)	1	14, 9	0
31. *Riparia riparia* (Linnaeus, 1758)	3	5, 2	0
32. *Sciurus vulgaris* Linnaeus, 1758	1	4	0
33. *Sturnus vulgaris* Linnaeus, 1758	1	9, 5, 2	0
34. *Sylvia atricapilla* (Linnaeus, 1758)	1	1, 5, 2, 3	0
35. *Troglodytes troglodytes* (Linnaeus, 1758)	1	5, 1, 2, 4	0
36. *Turdus merula* Linnaeus, 1758	24	9, 4, 7, 10	30
37. *Turdus pilaris* Linnaeus, 1758	8	5, 7, 4, 8	1
38. *Turdus philomelos* Brehm, 1831	6	9, 4, 3, 7, 8	9
39. *Turdus viscivorus* Linnaeus 1758	5	4, 3, 7, 8, 5	2
Totals	154		237

*) 1: leaves, 2: feathers, 3: roots, 4: moss, 5: grass, 6: web, 7: branches, 8: clay, 9: stalks, 10: detritus, 11: fruits, 12: reed, 13: aquatic plants, 14: seeds

sence of thrips.

Scaling within 7 categories (1: free nests, 2: nests in boxes, 3: nests in burrows, 4: nests in hollows, 5: nests on water surface, 6: nests on ground, 7: nests on buildings) the analyses on location of a nest included 124 nests in total. Due to low frequencies of data elements classified according to 2 variables (location, presence/absence) we applied Fisher's exact test, used in the analysis of contingency tables where a sample size is low (Agresti 2002). Multivariate generalization of the hypergeometric probability function and conditional probability were used for the contingency table 7×2 prepared with presence/absence as dependent and location (category) as independent variable.

In contrast with the two former variables, height was used as a continuous variable, defined

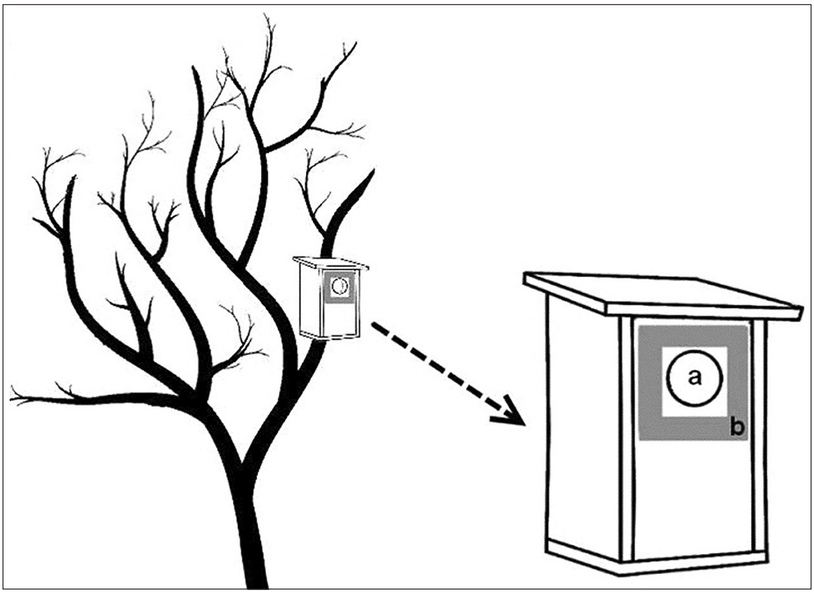

Fig. 1. A sketch of a wooden box with sticky traps (b) installed around the entrance hole (a).

in m above ground or water surface. Kruskal-Wallis rank sum test (Hollander & Wolfe 1973) and Friedman rank sum test as the nonparametric analogies of ANOVAs were applied because of the non-normally distributed data and lower number of observations (43). Kruskal-Wallis (ANOVA) test, using ranks instead of original data, compares the medians of three or more groups and assumes at least an ordinal variable (height of nests), equal population variances and independent groups with simple random samples. *K* as abbreviation for Kruskal chi-squared was used. Friedman's (ANOVA) test is a nonparametric analysis, using ranks instead of original data, performed on data from a randomized block experiment that takes account of known factors affecting an outcome but without primary interest. The test was applied for analysis of material and height of the nests sampled. *F* as abbreviation for Friedman chi-squared was used. Different quantity of nests analysed in the statistical evaluation refers to a lack of available, especially older, data (height, material, location, size).

2.2. Fieldwork research

The fieldwork part of this study was performed to test our hypotheses which were generated based on the analyses of the existing data above. We applied sticky traps just around the wooden box entrance (Fig. 1) despite modeling artificial conditions. In our opinion this is a practical method to sample thrips during the whole year.

For several decades the rare vegetation community of *Carici elongatae –Alnetum glutinosae* determined by alder and elm stands has been established as a suitable site for studying nest-dwelling fauna (Fedor *et al.* 2008). Tree sparrows (*Passer montanus*) appeared as one of the common hosts for thrips in our previous research (Fedor *et al.* 2008). Accordingly, 15 wooden boxes were installed on trunks (2–5 m above ground) of mature trees in Jurský Šúr area just 12 km NE of Bratislava (SW Slovakia, geographically N 48° 42', E 17° 16'). Each well caulking box with 30 mm wide entrance (Luniak 1992) was designed for tree sparrows which nest easily in boxes and also host barley thrips The boxes were equipped with wide brown (to avoid excessive attraction) sticky traps around the entrance hole (Fig. 1) to capture invading (outer margin) as well as escaping (inner margin) thrips. The boxes were installed in autumn immediately after sterilization and the traps changed twice a month in the period of September 2008–August 2009 to record the whole year migration dynamics. The fact that tree sparrows, expected to nest in the boxes, build their smaller winter nests in autumn, enhanced us to start sampling in September.

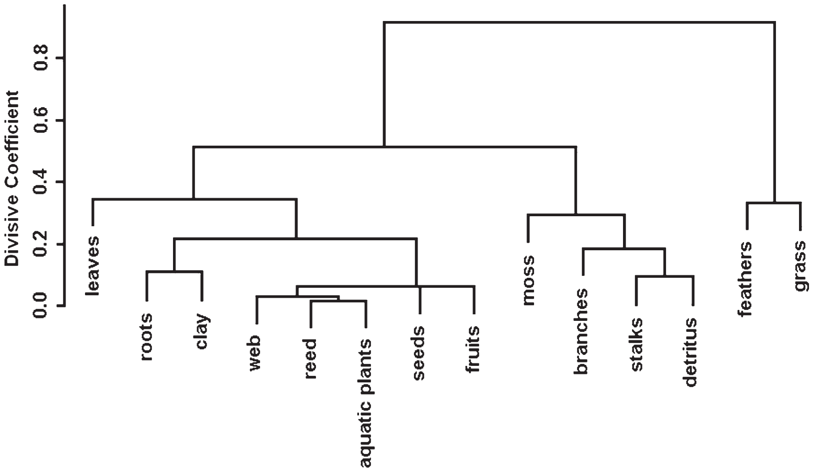

Fig. 2. Cluster analysis on affinity of *Limothrips denticornis* to certain nest materials.

Captured thrips were separated from permanent glue (Chemstop-Ecofix, Fytofarm, ltd.) in benzoline to enable determination. After a 1 year period we took the nests to a plastic bag and separated remained Thysanoptera in the xeroeclectic Tullgren's apparatus (Tullgren 1917). Standard preparatory techniques (e.g. Mound & Kibby 1998) were used for mounting: specimens were collected into AGA (10 units of 60% ethyl alcohol, 1 unit of glycerine and 1 unit of glacial acetic acid), shortly macerated in warm 10% KOH, dehydrated in alcohol and clove oil, and mounted on slides in Canada balsam.

3. Results

3.1. Statistical evaluation of the existing data

From nests inhabited by 17 bird and 3 mammal species, 237 specimens of *L. denticornis*, all of them adult females, were used in the statistical analyses (Table 1). Despite considerable numbers in nests of *Lanius collurio* Linnaeus, 1758, *Micromys minutus* (Pallas, 1771) and *Passer montanus*, it generally occurred frequently in a variety of nests. The numbers of barley thrips varied from 0 to 59 per one nest (*Micromys minutus*).

Our results indicated that if there was no preference for a certain nest type, barley thrips occured in nests relatively equally. But taking the nest material into account, high *DC* (0.84) proved very clear clustering (Fig. 2), probably except for two outliers included (seeds and fruits). There are three observable clusters within the dendrogram (Fig. 2), including the one consisting of grass and feathers which appears the most significant and clearly dissimilar from the others. Two outliers are classified with low values of both presence and abundance of thrips. Leaves as a material are situated between two clusters despite of a relatively high presence which can be ascribed to smaller number of nests analyzed. The clusters reflect general structure on the nests analyzed.

Taken together, barley thrips predominantly occurs in nests built of grass and feathers (Fig. 3), such as those inhabited by songbirds *Turdus viscivorus* Linnaeus, 1758, *T. pilaris* Linnaeus, 1758, *Lanius collurio*, *Acrocephalus arundinaceus* Linnaeus, 1758, *Nucifraga caryocatactes* (Linnaeus, 1758), *Passer montanus*, *Carduelis chloris* (Linnaeus, 1758) or mammals such as *Micromys minutus* (Pallas, 1771). Obviously, it does not mean that their nests are built only of grass and feathers, but this material is simply one of the components. Thus, for example, together with grass and feathers European greenfinch, *Carduelis chloris*, often uses roots to build its nests. Nutcracker, *Nucifraga caryocatactes*, usually searches for small branches and moss in addition to grass and feathers. However, in the main cluster (Fig. 2), feathers do not seem to be a material playing an important role despite its statistical significance. They are often combined together with grass in many nests. Indeed, we did not record a significant presence of barley thrips in nests constructed with no grass such as in *Turdus merula* or *T. philomelos* C. L. Brehm, 1831. Gen-

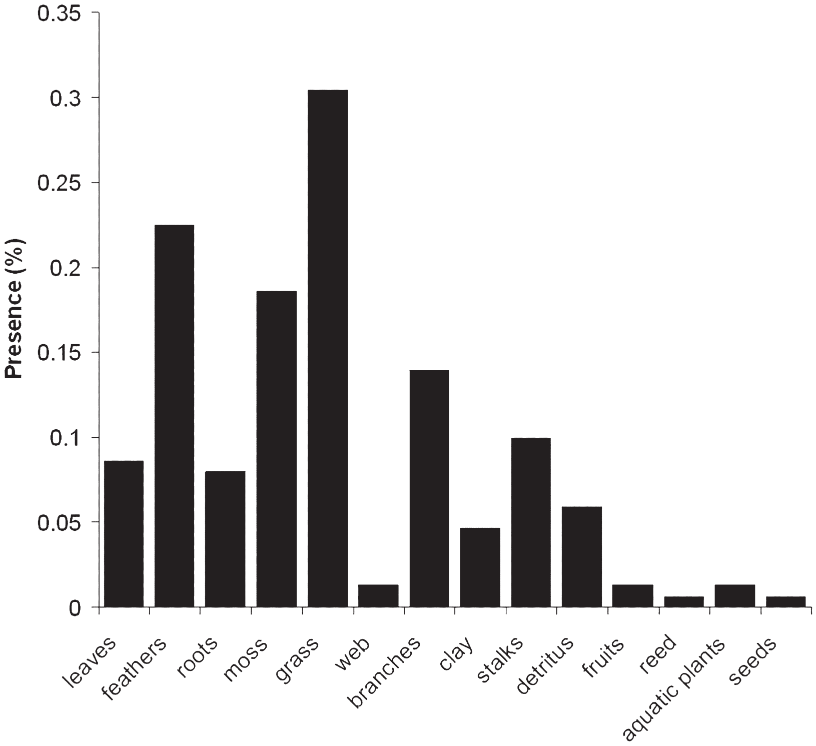

Fig. 3. Presence of *Limothrips denticornis* in nests built of different material.

erally, the presence of grass almost automatically means occurrence of barley thrips. Corresponding with grass-dwelling way of life this fact may declare that *L. denticornis* predominantly invades nest-dwelling fauna passively on grass when birds are building their nests.

In the multi-factor analysis of variance, Friedman chi-squared statistics show strong dependence of presence of a barley thrips on certain materials ($F = 234.03$, $df = 13$, $P < 0.001$). In order to obtain specific differences, 91 pairs of material combinations were compared mutually in post-hoc testing (multiple comparisons adjusted for the number of comparisons) with critical value of 167.3291. Contrary to the cluster analysis, we can deduce a significant difference between the sorts of material analyzed. Among the nest materials, statistical difference of grass versus either reeds (335), fruits (330) or aquatic plants (328), is very high. The test shows no significant difference only for grass and feathers as well as moss, which confirms similarity in the cluster analysis.

Except for the material structure, we did not find any studied factor (size, location and height) to be significant for occurrence of barley thrips in nests, suggesting that thrips do not actively search for a certain nest type. A relatively equal distribution in open and closed nests (e.g., boxes) does not correspond with a commonly underlined active looking for a safe shelter. The results support the idea that this phenomenon is not the most important determinant for distribution of thrips in nests. Statistical tests for nest size ($\chi^2 = 7.0827$ with 3 degrees of freedom and $P = 0.07$), location ($P = 0.40$), height vs. absence of *L. denticornis* ($K = 16.21$, $df = 12$, $P = 0.18$), height vs. abundance of *L. denticornis* ($K = 16.48$, $df = 12$, $P = 0.17$) and height vs. both absence and abundance ($F = 5.87$, $df = 3$, $P = 0.12$) do not allow to reject the null hypothesis about independence towards occurrence of thrips.

3.2. Fieldwork analyses

To approve our hypotheses above, suggested by existing data, we installed 15 wooden boxes, 3 of which were occupied by tree sparrows as expected (Table 2). 45 barley thrips were sampled from applied sticky traps and 4 more specimens

Table 2. Summary of *Limothrips denticornis* captured on sticky traps (inner and outer margin) installed on 3 wooden nest boxes and sampled in the 1st (1st row) and 2nd (2nd row) half of each month. The last row shows the no. of thrips remained in nests.

Month	Nest box 1		Nest box 2		Nest box 3	
	Inside	Outside	Inside	Outside	Inside	Outside
September 08	0	0	0	0	0	0
	0	0	0	0	0	0
October 08	3	0	2	2	0	0
	2	0	0	0	0	0
November 08	0	0	0	0	0	0
	2	0	0	0	0	0
December 08	0	0	0	0	0	0
	0	0	0	0	0	0
January 09	0	0	0	0	0	0
	0	0	0	0	0	0
February 09	0	0	0	0	0	0
	0	0	0	0	0	0
March 09	0	0	0	0	0	0
	0	0	0	0	0	0
April 09	0	0	0	0	0	0
	6	0	5	0	7	0
May 09	2	0	4	0	3	0
	0	0	0	0	2	0
June 09	0	2	1	0	0	0
	0	0	0	1	0	0
July 09	0	0	0	0	0	0
	0	0	0	0	0	0
August 09	0	1	0	0	0	0
	0	0	0	0	0	0
Total	15	3	12	3	12	0
In nest	2		0		2	

separated later from nests dried in laboratory. As predicted before, thrips were predominantly captured in October, when smaller winter nests were built (2 cases) and in April–May during first summer nest building (1 case) or reconstruction (2 cases). During the 2nd and 3rd potential nesting, when a clutch is laid to older nests we did not record any more thrips invaded.

In agreement with the hypotheses 1 and 2, thrips infiltrate nests by various ways (Table 3), e.g. dwelling on bark or landing from aeroplankton. However, most of them (88%), captured on inner margin of sticky traps, invade passively by bird-induced transport on nest material (grass). These insects survive in nests, feeding on still fresh grass, but later continuously leave to find better conditions.

Generally barley thrips may occur in nests during the whole year (Table 2, 3). Although predominantly transported on nest material (in autumn and spring), the population is even supported by specimens actively invading from nearby microhabitats, particularly in summer when overpopulated in cereal fields. These thrips may infiltrate looking for a safe shelter, but most Thysanoptera rather leave than invade. Usually there is a group hibernating during cold months.

4. Discussion

Barley thrips belong to the most common Thysanoptera in Central Europe and adults can be found in a wide spectrum of habitats. However, they breed only on grasses, and may affect the yield and quality of barley crops (Post 1955). Fe-

Table 3. A sketch of *Limothrips denticornis* migration dynamics in nests.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			1st summer nest building		2nd and 3rd summer building			Winter nest nest building			
			Transported on nest material					**Transported on nest material**			
Hibernating thrips			Leaving the nests to find food and better conditions							Hibernating thrips	
					Invading on bark and aeroplankton – usually when overpopulated				Invading to over-winter		

males lay their eggs in the interveinal spaces of the inner surface of cereal leaf sheaths (Bournier 1956). They are generally the stronger sex and invade various habitats more easily than wingless males, which has been shown not only by this study (e.g. Lewis 1973, Fedor *et al*. 2008, etc.).

Some authors (Lewis 1959, 1965) declare that immature females predominate in airborne populations distant from host crops during spring and autumn migrations, whereas gravid females fly more locally among host plants in summer, presumably as they seek oviposition sites. Because we did not record any larvae, the fact mentioned above may correspond with our suggestion that thrips captured on inner sticky trap margin were passively transported on nest material and did not invade flying through the entrance hole. If some specimens infiltrated from aeroplankton, they would probably land close to the entrance to enter walking due to their worse flight skills and would be captured on outer margin of traps. Lewis (1965) recorded the height of 300 m attained by airborne barley thrips swarms. Although the airspeed of individuals probably depends on their size generally, the maximum values recorded were 33.1 cm/s (Lewis 1958). Synergic effects of wind turbulence play an important role in active transport. Kittel (1958) and Kirk (2004) argued that the mass flights were associated with rapidly changing weather factors such as storm.

However if flying, dwelling in canopy, transported via wind currents or on birds and nest material would be equally responsible for infiltrating nest assemblages, the null hypothesis would not be statistically rejected. In our analysis we have underlined a high significance for grass as a nest material, which, corresponding with grass-dwelling *L. denticornis*, hints at passive transport of the species on grass.

We have approved the role of transport on grass material when birds build their nest. It is probably the most frequent alternative for grass-dwelling thrips to invade nest-dwelling fauna. Eventually this may be connected with transport on hosts. Lewis (1973) emphasized the transport of *Aeolothrips* spp. on bird's plumage. *Aptero-thrips secticornis* Trybom, 1896 was observed on the feathers of a migratory lesser whitethroat, *Sylvia curruca* (Linnaeus, 1758), in Great Britain (Morison 1973). But although zoochorous transport by birds may play some role in increasing the diversity of nest-dwelling invertebrates, we have not recorded any barley thrips on caught and checked tree sparrows.

This analysis has encouraged us to think about potential niche of thrips in nests in our future research. We assume that barley thrips mostly leave nests as their food source declines (Fedor *et al.* 2008). Lewis (1973) states, that occasionally *Aeolothrips* species (predaceous) are found in nests of house martins, *Delichon urbica* (Linnaeus, 1758), and although probably blown there by chance, they may feed on the small scavenging dipterous larvae living in the bottom of the nest. Based on the results of this study, we cannot agree with this idea.

In our research we have introduced migration dynamics of usual grass-dwelling thrips. We suggest that other Thysanoptera may apply different mechanisms to invade nests. However, before making any general conclusions we underline a need for further research, including analyses of statistically reliable samples.

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