Typhloceras poppei (Siphonaptera) and other fleas from small mammals on the Dutch North Sea Island of Terschelling

by

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INTRODUCTION

During the period between 1966 and 1972, an investigation of the productivity of small mammals was undertaken on the Dutch North Sea island of Terschelling. This project was part of the International Biological Program in the Netherlands, and was carried out by the junior author of the present publication.

The investigation involved the trapping of a large number of small mammals, especially long-tailed field mice. This offered a good opportunity to collect and study the ectoparasites of the field mouse on Terschelling in all seasons during a period covering several years. In the present publication, only the fleas of this host are considered, and some additional data are given on the fleas found on shrews in the same localities.

One of our main objects in this study was the flea *Typhloceras poppei* Wagner, 1903, which is found almost exclusively on the long-tailed field mouse. It has generally been reported to occur in very small numbers, but on Terschelling it appeared to be rather common. As samples were taken during all seasons, we were able to obtain a picture of the seasonal occurrence of this species.

THE ISLAND OF TERSCHELLING

Terschelling is an elongate island. Part of it is cultivated land, but more than half consists of sand dunes, dune valleys and sandy shoals, partly covered with vegetation and generally much exposed to the influence of the North Sea. The investigation area was on the eastern part of the island while most of the localities are in the nature reserve „De Boschplaat".

A limited number of wild mammals now occur on the Island of Terschelling. Van Wijngaarden (1964) listed the following species: *Erinaceus europaeus, Sorex araneus, Sorex minutus, Apodemus sylvaticus, Rattus norvegicus, Mus musculus, Oryctolagus cuniculus, Mustela erminea.* Of these, *Rattus norvegicus* has been exterminated since at least thirty years. *Mus musculus* occurs mainly in small numbers near houses, but a few specimens have been found in the nature reserve De Boschplaat, far from human dwellings. The increasing activity of tourists on the island will favour further distribution of this species. The other mammals mentioned can be found regularly on Terschelling, mainly in places covered by vegetation.

As regards vegetation and climatological factors, the area under investigation showed a wide variation. Many collections were made behind the sandy dyke which protects the nature reserve against the North Sea, many others along a smaller dyke and in complexes of sand dunes on De Boschplaat as well as in the dunes and meadows surrounding the Biological Station on the edge of the reserve. On a few occasions traps were placed near the village of Midsland, in the western part of the island. The latter locality was rather dry old pasture land with several hedges of *Alnus glutinosa.* The localities around the Biological Station, covered with short grass or with *Ammophila arenaria,* are also rather dry. Those on the Boschplaat varied very much in humidity. This variation is related to type and density of the vegetation, and to the time of the year. Generally speaking, the soil on the Boschplaat is wet from September up to April, and dry during the summer. Nothing, however, is known about the conditions deeper in the soil or in the nests of the hosts, where the fleas develop.

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Smit (1954) listened the fleas caught by him on Terschelling in June 1950. On *Sorex araneus* he found *Palaeopsylla s. soricis* and *Doratopsylla d. dasycnema.* On *Apodemus sylvaticus,* only *Ctenophtalmus a. agyrtes* was found, but Smit suggested that two more species might occur here on this host: *Megabothris turbidus* and *Nosopsyllus fasciatus.* The latter species was indeed found in 1967 on the field mouse by Dr. M. J. Cotton (Dundee), together with *Typhloceras poppei* (identified by F. Smit). *Megabothris turbidus* has, however, not been found on Terschelling.

MATERIAL

The fleas have been identified by the senior author. Many of the males of *Ctenophthalmus agyrtes* were considered to be intermediate between the subspecies *Ct. a. agyrtes* and *Ct. a. smitianus.* No attempt therefore has been made to identify the specimens on subspecies level. Some of these are now in the collection of the British Museum (Natural History), London. The rest of the material will be kept in the collection of the Department of Entomology, Institute for Taxonomic Zoology, Amsterdam.

TRAPPING METHODS

The mice were caught at night in breakback traps. Because the study of ectoparasites was of secondary importance, no attempts were made to collect with regular intervals. Mammals caught in one locality and belonging to one species were put together in one polythene bag. The contents of each bag were placed on a wire gauze over a dish containing alcohol 70% and a few drops of ether. The majority of the fleas was found in the dish after one hour, the remaining ones were collected from the hosts' skins. The content of one bag will in the following be indicated as a "sample". As the numbers of mice per sample varied between one and 50, no data can be given on the infection of each individual host, but the average numbers of fleas per mouse could be calculated.

Fleas had ample opportunity to escape in the period between the moments of capture and of collection of the host. As has been done in similar studies, our results are presented here under the presumption that the percentages of fleas lost in each sample are about equal.

In a few cases, life traps were used. There are no indications that this influenced the results very much, although of field mice caught in these traps more cases of straggling occurred than on mice caught in break-back traps.

RESULTS

Because data on numbers of fleas on individual hosts are lacking, the results cannot be compared directly with those of other authors. As regards general occurrence and seasonal distribution of the various flea species, the numbers are suggestive enough to permit some conclusions. Howover, our methods of sampling have not been suitable for a statistical treatment of the results.

FLEAS FROM *Apodemus sylvaticus.*

Table I: Collections of *Apodemus sylvaticus.*

	1967	1968	1969	1970	1971
total nr. of mice caught	75	169	106	189	308
total nr. of samples	14	17	11	22	10
nr. samples containing fleas	14	16	9	19	10
total nr. of fleas (stragglers excluded)	195	181	110	473	270

The mean numbers of fleas per host in positive samples vary from 0.20 tot 60.0 (one single host found dead). In 44 out of 67 cases this number is 1.0 or larger.

The six negative samples consisted of 2, 1, 6, 1, 2, 1 hosts respectively. Three of these are from one locality (Midsland) and were taken within a period of 35 days.

1. *Typhloceras poppei* Wagner, 1903.

This species appears to be closely associated with *Apodemus sylvaticus,* and it is but rarely found on other species of the genus *Apodemus* (Peus, 1970; Smit, 1962). It is generally considered to be a "winter flea". As shown in Table II, only a few *T. poppei* specimens were caught during the warmer months May-August: 20 host samples taken during that period yielded only four female *T. poppei.* Its numbers increase rapidly in September, and in October and November it is abundant, occurring in 100% of the samples. Both numbers and frequency decrease but slightly during winter and early spring, but in May the species disappears almost entirely from the host.

Table II: Seasonal fluctuations of *Typhloceras poppei* from *Apodemus sylvaticus* on Terschelling (pooled data 1967-1971).

month	number of samples	nr. with *T. poppei*	nr. with ≧ 1 *T. poppei* per host	nr. of *T poppei* ♂	♀	% males
I	5	4	3	18	25	42
II	5	4	1	11	12	48
III	9	7	2	21	23	48
IV	7	6	1	14	25	36
V	5	0				
VI	5	2	0	0	3	0
VII	4	0				
VIII	6	1	0	0	1	0
IX	6	4	2	15	15	50
X	9	9	3	36	48	43
XI	7	7	3	44	49	47
XII	6	4	2	16	15	52

Table IIII: Seasonal fluctuations of *Typhloceras poppei* from *Apodemus sylvaticus* in Western and Eastern Germany, based on data in Peus (1970).

month	number of samples	nr. with *T. poppei*	nr. with ≧ 1 *T. poppei* per host	nr. of *T poppei* total	♂	♀
I	4	1	0	1	0	1
II	7	1	0	1	0	1
III	13	1	0	1	1	0
IV	6	2	0	6	2	4
V	7	1	0	1	1	0
VI	2	0				
VII	2	0				
VIII	20	2	0	4	1	3
IX	25	11	1	34	7	27
X	13	5	0	9	3	6
XI	13	4	0	6	3	3
XII	8	0				

It is interesting to compare these data on seasonal distribution to those obtained by Peus (1970). During a period of about 20 years, Peus made collecting trips throughout Western and Eastern Germany, and his data on *T. poppei* from *A. sylvaticus* have been tabulated by us in Table III.

In 17 out of 48 positive samples (i.e. about one in three) from Terschelling, one flea or more per host have been collected, against one out of 28 in the German samples. In a suitable area, therefore, *T. poppei* can be regularly found on the body of its host during the colder part of the year.

As regards the flea's sex ratio on the host, there seems to be a slight preponderance of females throughout the year on Terschelling.

It has been suggested (Smit, 1962) that *T. poppei* is a typical nest flea. If so, it woud occur far more frequently and during a greater part of the year in the nests of *Apodemus sylvaticus,* than on the body of this host. These nests are dug out very deeply into the soil and seem to have a characteristic structure. Not many attempts have been made to examine their flea fauna. Peus (1970) inspected five nests in different parts of Germany, in the months of August, September and October. In only one of these *T. poppei* was present with 23 specimens, alle nests contained *Ct. agyrtes.*

Kaczmarska (1963) in an interesting study of the flea fauna of nests of *A. sylvaticus* in various regions in Poland, found *T. poppei* in 22 out of 50 nests, the maximal number of specimens in one nest being 43. The largest numbers were found during autumn: with averages of 8.0 fleas per nest in October and 5.7 fleas per nest in November. The adult fleas were not found during the summer months (1 May - 1 September), but only five nests were inspected during that period. The numbers of examined nests were distributed very unequally over the months of the year (see Table IV), and therefore this investigation is not necessarily conclusive regarding the seasonal distribution of *T. poppei.*

Table IV: Fleas collected in nests of *Apodemus sylvaticus* in Poland, in 1959-1960. Summarized from tables 1 en 2 of Kaczmarska, 1963.

period	number of nests	*T. poppei* found in	total nr. of fleas	total nr. of *T. poppei*
I - II	1	1	108	25 (+ 4)
III - IV	11	3	459	9
V - VI	3	0	58	0
VII - VIII	2	0	18	0
IX - X	11	8	788	88 (+ 35)
XI - XII	22	10	1441	101 (+ 15)

During the present study no natural nests have been examined, but the nests of captive field mice have been inspected at irregular intervals. A few specimens of *T. poppei* were collected from these nests in October and November (24 and 1 respectively), but none in March, April and May.

What causes the striking disappearance of *T. poppei* in spring is not yet known. The change might coincide with a change of behaviour of the host. On Terschelling, the host's breeding period is from April up to September. During this time, nests are occupied either by solitary males or by females with young. In autumn, when the food becomes scarce, there is an enormous migration from the dunes into the cultivated land, and the mice may also enter human dwellings. Later on, they settle down again in territories and more specimens may now occupy one nest. It is in this period (from late autumn up to the start of a new breeding period) that *T. poppei* is found in the largest numbers, in nests as well as on hosts. Physiological changes in the hosts, the presence of more hosts in one nest or a combination of both factors, might influence the life cycle of *T. poppei,* such in contrast to what is found regarding the two other flea species that occur on the same host on the Island of Terschelling.

2. *Ctenophthalmus agyrtes* (Heller, 1896).

This species is very common, and apparently well adapted to its main host on the island. The present data on this species are mainly of interest when compared to those of *T. poppei. Ct. agyrtes* is present in every positive sample collected between May and October, and in about 80% of the samples taken during the rest of the year. There is an indication that the intensity of the infection is lower in the period between 1 August and 1 January than otherwise, but the collected numbers are very variable. Generally speaking, *Ct. agyrtes* is far more numerous than *T. poppei,* except

during late autumn (October-December), when *T. poppei* often surpasses it regarding numbers as well as percentage of infection. In 34 out of 64 positive samples, one flea or more per host has been collected.

Table V: Seasonal fluctuations of *Ctenophthalmus agyrtes* from *Apodemus sylvaticus* on Terschelling (pooled data 1967-1971).

month	number of samples	nr. with *Ct. agyrtes*	nr. with ≧ 1 *Ct. agyrtes* per host	nr. of *Ct. agyrtes* ♂	♀	% males
I	5	4	4	54	50	52
II	5	4	3	18	28	39
III	9	7	6	46	75	38
IV	7	6	4	48	55	47
V	5	5	4	15	27	36
VI	5	5	3	41	42	49
VII	4	4	3	26	19	58
VIII	6	6	3	38	41	48
IX	6	6	0	7	14	33
X	9	7	2	23	41	36
XI	7	7	2	24	47	34
XII	6	3	0	4	6	40

From the data presented in Table V it appears that more females than males of *Ct. agyrtes* are found. There is an indication that during midsummer the numbers are about equal, which would be in agreement with observations by Ulmanen and Myllymäki (1971) on *Ct. agyrtes fennicus* in Southern Finland.

Ct. agyrtes was also present in all five samples of straw etc. from artificial nests. When these nests were finally discarded, over 300 specimens were collected from the straw and from the 52 field mice then inhabiting the nests. Peus (1970) found the species in each of five examined nests of *Apodemus sylvaticus,* whereas Kaczmarska (1963) found it in 26 out of 55 nests.

Table VI: Seasonal fluctuations of *Nosopsyllus fasciatus* from *Apodemus sylvaticus* on Terschelling (pooleddata 1967-1971).

month	number of samples	nr. with *N. fasciatus*	nr. of *N. fasciatus* ♂	♀	total
I	5	1	1	0	1
II	5	1	0	2	2
III	9	2	2	3	5
IV	7	4	14	9	23
V	5	3	0	1	1
VI	5	3	4	2	6
VII	4	2	2	1	3
VIII	6	2	3	1	4
IX	6	1	0	1	1
X	9	1	0	1	1
XI	7	2	1	1	2
XII	6	0			

3. *Nosopsyllus fasciatus* (Bosc, 1800).

Although the main hosts of this flea, *Rattus norvegicus* and *Rattus rattus,* have been exterminated on Terschelling, the flea can be found regularly, but in smaller numbers than the other two species. The tabulated data (see Table VI) suggest that the periodical fluctuations in numbers are not in the first place caused by seasonal influences. During the total investigation period *N. fasciatus* was found in 20 out of 74 samples, but between January 1st and December 31st 1970 in 13 out of 22 samples. During that

year, circumstances seemed to be favourable for the other two species as well. It is possible that the house mouse, *Mus musculus,* also acts as a host of *N. fasciatus* on Terschelling.

Excluding one sample collected in April 1970, when no less than 15 specimens were found on 21 field mice, the average number of specimens per positive sample was 1.9. The intensity of infection was rather low: only in one case (22-VI-1967) one flea per host was recorded. When all numbers for males and females collected during the investigation period are added up, the sex ratio does not deviate much from 50% (27 males - 22 females).

4. Stragglers.

a) from shrews.

Doratopsylla dasycnema was found in five samples, *Palaeopsylla soricis* in four. Generally, only one straggler was found in one sample. There was one exception: one sample yielded five *D. dasycnema* and two *P. soricis,* and circumstances in this case were such that a shrew may have entered and left the trap unnoticed.

b) from birds.

Ceratophyllus garei Rothschild, 1902, a flea which is said to occur in rather damp bird nests near the ground, was found on the long-tailed field mouse in three instances. Each time one female flea was collected. *C. garei* is common on the Frisian island of Vlieland (Van den Broek, 1970) and will most probably be so on Terschelling. This species has not been reported from Terschelling by Smit (1954).

Considering the numbers of collected field mice (about 850), the numbers of flea stragglers found on them are very low (18 specimens).

FLEAS FROM *Sorex* spp.

The total number of shrews caught from 1967 up to 1971 was 30 (respectively: 14, 4, 10, 2, 0). One of these had no fleas, the parasites of a second one were lost. One specimen was a pygmy shrew, *Sorex minutus,* the others all were common shrews, *Sorex araneus.* On both host species, *Doratopsylla d. dasycnema* (Rothschild, 1897) and *Palaeopsylla s. soricis* (Dale, 1878) were found. The collected numbers of *D. dasycnema* illustrate once more the surplus of males in this species: 38 males and 24 females were found in 11 positive samples. For *P. soricis* the numbers are: 13 males and 19 females in 12 samples. The number of collected samples was 16. Mahnert (1971) has shown that seasonal fluctuations in numbers of both these species exist in the subalpine and alpine zones in Austria. Our data are too meagre to permit a comparison with those of Mahnert.

Sorex araneus also harboured as stragglers two flea species from the long-tailed field mouse: *Ctenophthalmus agyrtes* (5 ♂♂, 3 ♀♀) and *Typhloceras poppei* (2 ♂♂, 1 ♀). Of these, two and three specimens respectively were found on a shrew caught in a life trap. Most probably, these specimens had been left behind when the trap was visited by field mice before it was actually working. *Ct. agyrtes,* moreover, was the only species found in a nest of *S. araneus* built under the floor of a shed (1 ♂, 8 ♀).

SUMMARY

Fleas were collected from the bodies of about 850 long-tailed field mice, *Apodemus sylvaticus,* caught in traps on the Dutch island of Terschelling between May 1967 and October 1971. *Ctenophthalmus agyrtes* was very common while *Typhloceras poppei* was found in rather high numbers when compared with data from elsewhere in Europe.

In order to demonstrate seasonal fluctuations, the numbers of fleas caught per month have been tabulated.

In addition, there are a few records of fleas from *Sorex* spp.

ACKNOWLEDGEMENTS

Our thanks are due to Mr. F. G. A. M. Smit (London) who gave valuable advice. Dr. J. Pacenovsky (Košice, C.S.S.R.) kindly translated the most important fragments of Kaczmarska's publication from the Polish.

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MICROLEPIDOPTERA PALAEARCTICA, herausgegeben von Dr. H. G. Amsel (Karlsruhe), Dr. F. Gregor (Brno) und H. Reisser (Wien). 4. Band, Phycitinae Trifine Acrobasiina. 1. Teilband der Phycitinae von R. U. Roesler (Karlsruhe), Textteil : 1—XVI en 1—752, Tafelband, pl. 1—170, daarvan 1—38 gekleurd, 15.XII.1973. Verlag Georg Fromme & Co., Wien. Prijs voor twee delen bij subscriptie öS 4775,—.

Voor een uitvoerig algemeen verslag van deze prachtige serie van monografieën over de Palaearctische Microlepidoptera moge kortheidshalve verwezen worden naar mijn besprekingen in deel 26 : 37 (1966) en in deel 29 : 20 (1969) van dit tijdschrift. Sindsdien is de serie aanzienlijk gevorderd : thans ziet het monumentale vierde volume het licht, terwijl enkele volgende delen bij verschillende specialisten in gevorderde staat van bewerking zijn. Dit vierde deel is het dikste, al behandelt het slechts een onderdeel van de zeer soortenrijke onderfamilie der Phycitinae (Pyralidae), een aanwijzing hoe uitvoerig en minitieus deze behandeling geschiedt. Overigens is de opzet van het deel conform de voorgaande delen, zodat ook voor de beschrijving van de opmaak van het boek naar mijn bovengenoemde besprekingen mag worden verwezen. Ook dit volume is een geheel origineel werk, waarbij alle bestaande typen geraadpleegd zijn en afbeeldingen worden gegeven van de genitalia van beide sexen. De eerste 38 platen zijn in kleur naar de meesterlijke aquarellen van Dr. Gregor en stellen alle palaearctische soorten en vele ondersoorten en formae voor in bewonderenswaardig detail. Een bijzonder moeilijk werk, als wij bedenken, hoe weinig vaak de soorten van deze groep uitwendig onderling verschillen.

Vergeleken met de vorige delen heeft volume 4 enkele verbeteringen ondergaan. Zo is een aparte lijst van gebezigde periodieken gegeven, terwijl alle literatuur volgens de afkortingen van de „World List" wordt geciteerd. De soorten van één enkel genus zijn nauwkeurig op schaal afgebeeld, om onderlinge vergelijking te vergemakkelijken. Prettig is een „faunistisch register", een tabel-achtige voorstelling van het voorkomen van de soorten (in het tweede deel). Een zeer uitvoerige behandeling van de fylogenie der Phycitinae is zeer interessant. Het werk wordt besloten met een indrukwekkende literatuurlijst van 35 bladzijden.

Wederom een prachtige monografie, product van een enorme arbeid en een nieuw pronkjuweel voor de literatuur van Microlepidoptera. Hulde aan de auteur, de uitgevers en niet in het minst — aan de financiers van dit waardevolle wetenschappelijke werk. — A. D.