SPECIES OF ORNITHOMYIA (DIPTERA: HIPPOBOSCIDAE) FROM THE DUTCH NORTH SEA ISLAND OF VLIELAND

by

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INTRODUCTION

The North Sea island of Vlieland, already famous in ornithologists' circles, is gradually becoming a centre of scientific research on bird populations and bird migration. Several investigators also pay attention to the parasites of their research objects. Mr. C. Swennen (Netherlands Institute for Sea Research, Texel, The Netherlands) first sent us a collection of hippoboscid flies from Vlieland for identification (VAN DEN BROEK, 1965). Later on, a large number of these flies was collected from nests, juvenile birds and migrants, under supervision of the Institute for Ecological Research. Besides, a number of puparia was collected from nest boxes in 1967. Part of these hatched in the laboratory and could be identified, the remaining puparia have been identified by Mr. H. Oldroyd (British Museum, Natural History, London), to whom we are much obliged. That so many nests and birds were available was due to investigations of the Institute for Ecological Research on the island. We are very much indebted to Dr. H. N. Kluyver, former director of this Institute, for his interest in this work and for reading the manuscript.

MATERIAL AND METHODS

During the breeding seasons of 1966, 1967 and 1968, many flies were collected from nest boxes used in an experiment with Great Tits. These boxes were situated in the small wooded areas south of the dunes. The majority of the flies were found on nestlings of the second clutch. In some cases flies from breeding parents were also collected. Occasionally a few other nestlings, mostly pigeons, and wader pulli were examined for flies by means of the method described by CORN-

WALLIS & SMITH (1960), the "modified ether method". Puparia were collected in 1967 only, after the young had left the nests. Juvenile and adult birds of various species were caught in nets for ringing purposes in several places on the island. Some of these were examined by the modified ether method, others were inspected furtively only.

The present paper deals with material collected from 1959 until 1969.

RESULTS

The total number of flies collected from Vlieland, now in the collection of the Institute for Veterinary Parasitology, Utrecht, The Netherlands, is 338. They belong to three species: *Ornithomyia chloropus* Bergroth, 1901 (196 specimens), *Ornithomyia avicularia* (Linnaeus, 1758) (115 specimens), *Ornithomyia fringillina* Curtis, 1836 (27 specimens). These data corroborate the opinion that *O. chloropus* is endemic and common on the island. It was found repeatedly on nestlings, especially in nest boxes inhabited by *Parus major* (see VAN DEN BROEK, 1968) and also on juvenile and adult birds of other species: waders, large and small passerines, but never on Columbidae (see Table I).

Ornithomyia avicularia is also rather common on the island and occurs on hosts belonging to several families.

Compared with the other two species *Ornithomyia fringillina* was found in very small numbers. The hosts were all small passerines. Of this species all specimens collected before 1968 are females. In 1968 males were also caught.

For further examination of the data, it is useful to distinguish between parasites found:

- a, in nests and nest boxes;
- b, on fledgelings and juveniles, and
- c, on migrants.

The division between these categories was made rather arbitrarily. In Table II an infected nest box counts for one positive case, irrespective of the number of its inhabitants, which may include the breeding parent. Pulli from waders were counted as fledgelings. Young birds were counted as juveniles until 1 September, after which date they were considered as migrants.

The inspection of the nests and inhabitants took place regularly from the middle of May onward till the end of the breeding season, according to a scheme set up by the Institute for Ecological Research; the other birds and their flies were trapped entirely by chance. Several flies managed to escape when the hosts were handled. There-

TABLE I

Numbers of hosts infected by species of *Ornithomyia*

Order	Number of hosts Family	Species	Number infected by		
			<i>O.</i> <i>chlo-</i> <i>ropus</i>	<i>O.</i> <i>avi-</i> <i>cularia</i>	<i>O.</i> <i>frin-</i> <i>gillina</i>
Charadriiformes	Haematopodidae	<i>Haematopus ostralegus</i> (4)	4	1	0
	Charadriidae	<i>Pluvialis apricaria</i> (1)	1	0	0
	Scolopacidae	<i>Numenius arcuata</i> (2)	2	0	0
		<i>Tringa totanus</i> (1)	1	0	0
	Laridae	<i>Larus ridibundus</i> (1)*	0	1	0
Columbiformes	Columbidae	<i>Columba palumbus</i> (7)	0	7	0
		<i>Streptopelia decaocto</i> (4)	0	4	0
Passeriformes	Motacillidae	<i>Anthus pratensis</i> (1)	1	0	0
		<i>Motacilla alba</i> (2)	1	0	1
	Turdidae	<i>Turdus philomelos</i> (2)	2	1	0
		<i>Turdus iliacus</i> (1)	1	0	0
		<i>Turdus torquatus</i> (1)	0	1	0
		<i>Turdus merula</i> (9)	5	7	0
		<i>Turdus pilaris</i> (1)	1	0	0
		<i>Phoenicurus phoenicurus</i> (2)	2	0	0
		<i>Erithacus rubecula</i> (1)	1	0	0
	Sylviidae	<i>Sylvia borin</i> (1)	1	0	0
		<i>Sylvia communis</i> (1)	0	0	1
		<i>Regulus regulus</i> (1)	0	0	1
	Muscicapidae	<i>Muscicapa striata</i> (2)	2	0	0
		<i>Ficedula hypoleuca</i> (1)	1	0	0
	Paridae	<i>Parus major</i> (42)	33	16	11
	Fringillidae	<i>Carduelis flammea cabaret</i> (3)	3	1	1
		<i>Loxia curvirostra</i> (1)	1	0	0
		<i>Fringilla coelebs</i> (1)	0	0	1
		<i>Fringilla montifringilla</i> (3)	3	0	0
	Ploceidae	<i>Passer domesticus</i> (3)	2	1	1
	Sturnidae	<i>Sturnus vulgaris</i> (8)	5	3	0
	Total numbers		107	73	43
				17	

* A dying adult host, infection apparently accidental. This case is not included in Table II.

fore no numbers of the non-infected birds are available and no values for infection percentages of any species can be given.

a. Nests

From the data (Table II) it is evident that both *O. chloropus* and *O. avicularia* are common nest parasites on Vlieland. Before 1968,

TABLE II

Infection in various categories

	Number of infected hosts	Infected by			
		<i>O. chloropus</i>	<i>O. avicularia</i>	<i>O. fringillina</i>	More than one species
Nests (nestlings, parents removed from nest)	49	38	25	9	20
Juveniles (fledgelings, first years)	41	26	15	3	3
Migrants	16	9	2	5	0

O. fringillina was found in nests only twice, rather late in the breeding season (hosts: *Parus major*, *Carduelis flammea cabaret*). In 1968 *O. fringillina* occurred regularly in nests of *Parus major*. There was a surprisingly high percentage of mixed infections in this category (40.8%).

b. Juveniles

Data from juvenile birds show about the same trend. The percentage of mixed infections, although much lower than in nests, is still considerable (8.0%). Apparently the division between *O. chloropus* on one side and the other two species on the other, caused by preference for different habitats (HILL, 1962), does not hold on Vlieland.

c. Migrants

Soon after the breeding season, at the end of July and in August, many migrants (waders and small passerines) arrive already from northern and eastern districts, and the origin of the hippoboscids found on Vlieland is no longer certain. The early migrants may well import specimens of *O. fringillina*. Afterwards, autumn migrants from more northern districts probably carry new specimens of *O. chloropus* to the island. The record of a living specimen of *O. fringillina* on a Great Tit on 20-12-1966 is in correspondence with records of HILL *c.s.* (1964) of *O. chloropus* and *O. fringillina* in Fennoscandia in November and December. Generally, migrants harbour only one fly each. No mixed infections were found among them.

SEASONAL OCCURRENCE (Fig. 1)

So far, the search for hippoboscids on Vlieland was determined by activities needed for other research purposes. The data obtained,

Fig. 1. Seasonal occurrence on the island of Vlieland of the species of *Ornithomya*. Abscissa: season, divided into periods of 5 days, starting 31 May. Ordinate: numbers of flies.

therefore, are partly quite haphazard, partly dependent on the time limit of the breeding season of the Great Tit.

However, the number of collected flies is now so large that the data can be pooled in order to construct the histograms which give an impression of the seasonal occurrence of each species. These histograms can be compared with similar ones, also constructed from rather haphazard data pooled in Fennoscandia by HILL *c.s.* (1964, fig. 5). The similarity between the two figures is striking, although those from Vlieland clearly show the influence of a decreased collecting activity towards the end of July. Also, the treatment of one single infected wader fledgeling with ether or chloroform in a few cases yielded 10 or more flies, which fact is reflected by some high peaks in the present

histograms. The general trend, however, is the same on Vlieland as that shown by the Scandinavian data.

O. chloropus is already present in the beginning of June and reaches its maximum at the end of this month. It can be found in small numbers during August and September, perhaps specimens are being imported from northern Europe during that period. *O. avicularia* also appears in the beginning of June. A maximum is reached probably in about the middle of July. The last specimens were found in the middle of September, earlier therefore than those of *O. chloropus*. As regards sex differences both species show the same trend: males generally appear earlier than females, but later the females are more numerous. After 20 July two male *O. chloropus* were caught against 20 females, for *O. avicularia* the numbers were 7 against 22, respectively. This agrees with results obtained by CORBET (1956) and HILL (1963), who conclude that for males the puparium stage is shorter than for females by about two weeks, and that the average life span for females is longer.

As has been stated before, the occasional appearance of *O. fringilina* after the breeding season – from August onwards to late in autumn – can be explained by import on migrants. It was also found in nests, in small numbers, but not before the beginning of July.

A difference between the present histograms and those given by HILL *c.s.* is that in Fennoscandia *O. avicularia* and *O. chloropus* appear earlier, and all species are found later in the season. This can be well explained by climatic conditions: in the vast mainland of Fennoscandia there will be many sheltered places with mild temperatures in early spring, whereas Vlieland has a maritime climate with low temperatures in spring. In autumn the presence of flies is mainly determined by the presence of migrants. Besides, collecting methods and local trapping activities have an unmistakable influence on results like those presented here.

PUPARIA

After the young had left the nests in 1967 the contents of nest boxes, generally inhabited by *Parus major*, were collected and searched for puparia. The first portion, collected in the first half of June, consisted of 38 nests. No puparia were found. Of 21 nests collected between 15 June and 12 July, two were found to be infected and together they yielded 3 puparia. On 9 October, 36 more nests were collected, 15 of which contained 30 puparia all together. The maximal number of puparia in one nest was 7. These results are surprising. CORBET (1956) and HILL (1962) supposed that most puparia are deposited in the vege-

tation, or simply drop on the soil after being laid on the bird's plumage. It seems, therefore, that the nest boxes used by the Institute for Ecological Research for *Parus major* are very attractive for female flies for the deposition of puparia. Other observations (KLUYVER, personal communication, 1968) are in correspondence with this supposition. Perhaps this is the reason why *Parus major* has been found to be a suitable host for any of the three species (VAN DEN BROEK, 1968).

Twelve nest boxes of the last sample were formerly inhabited by *Parus major* and yielded 28 puparia, 12 of which hatched in the laboratory in February or March. Three hatched specimens were identified as *O. fringillina*; no more unhatched puparia of this species were identified. There were 13 puparia of *O. chloropus*, 5 of which hatched, and 12 *O. avicularia* (4 hatched). Mixed infections were found in 3 cases: 2 with both *O. fringillina* and *O. chloropus* and one with both *O. chloropus* and *O. avicularia*.

In the three remaining nest boxes, inhabited by other hosts, 4 more puparia of *O. chloropus* were found. These results show that all three species use nest boxes as overwintering-places. No local differences could be found in the distribution of the puparia of the three species on the island. Considering the size of the island (3258 hectares) and of its woods (all together 292 hectares split up into 5 small wooded areas, data from SPAANS & SWENNEN, 1968) this is understandable. Although the woods are more sheltered than the surrounding open country, the climatic conditions on the island must, on the whole, be rather uniform.

DISCUSSION

As has been mentioned already, the collecting activities were not planned for the specific purpose of investigating the hippoboscids of Vlieland. Choice of hosts, collecting period and methods depended on factors that had no connections with the problems of the present study. The collectors caught as many flies as they could whenever there was an opportunity. Chance, therefore, has greatly influenced the results.

When considering the data more closely, it appears that the relative abundance of the three species is far from constant. Table III illustrates this.

The numbers of *O. fringillina* show a remarkable fluctuation. Those of *O. chloropus* also fluctuate considerably. For those results, especially for the differences between 1967 and 1968, various explanations can be given.

TABLE III

Numbers of parasites caught over certain periods.

	Numbers				Percentages			
	Total	<i>O. chloropus</i>	<i>O. avicularia</i>	<i>O. fringillina</i>	Total	<i>O. chloropus</i>	<i>O. avicularia</i>	<i>O. fringillina</i>
Before 1967	114	62	44	8	100	54	39	7
In 1967	117	84	32	1	100	72	27	0.9
In 1968	107	50	39	18	100	47	36	17

1. Hosts examined.—As one would expect, Charadriiformes are important hosts for *O. chloropus* (see Table I) and juvenile waders sometimes harbour a considerable number of these flies. The three wader pulli examined in 1967 together yielded 23 specimens of *O. chloropus*. In the same way, the number of *O. avicularia* is related to the number of pigeons examined, and that of *O. fringillina* to the number of small passerines and their nests. The numbers of positive cases in the comparable periods are summarized in Table IV.

In 1968 more nests were found to be infected than ever before. This might be an explanation for the comparatively large numbers of *O. fringillina* collected in that year.

TABLE IV

Numbers of infected hosts and their distribution over certain periods.

	Charadriiformes	Columbiformes	Passeriformes	Number of <i>Parus major</i> from last group
Before 1967	5	7	35	7
In 1967	3	1	19	10
In 1968	1	3	39	15

2. Investigation period.—This is determined by the breeding season of the Great Tit. Inspection of nest boxes started in the middle of April, and thorough search of the young birds by means of the modified ether method took place shortly before the young would fly out. When comparing 1967 with 1968 it appears that in 1967 most flies were trapped in the end of June, the last nest being inspected on 3 July. In 1968 the activities were postponed for almost a fortnight, and the last nest was inspected on 26 July. Undoubtedly the breeding season is influenced by weather conditions, but if *O. fringillina* indeed does not appear before July, the chance to find it in nests has been much larger in 1968 than in 1967. The reverse holds for *O. chloropus*, which species usually appears in maximal numbers in the end of June.

3. Escaping activity.—It is not known whether any of the species escapes more easily than the others from hosts that are handled, but the possibility ought to be considered.

4. Annual fluctuations in climatic conditions.—This factor will surely be very important but a real fluctuation in numbers in the various species can hardly be observed, because of the effects of factors 1 and 2.

The summer of 1967 has been rather sunny and warm, and this offered good opportunities for *O. fringillina*, which species prefers a milder climate than is usual on Vlieland. Viable puparia of this species have been discovered in nest boxes in the autumn of 1967, and some of these might actually have hatched on the island. If so, the first adult specimens were found rather late, for *O. fringillina* generally seems to appear earlier (HILL, 1963), but it was striking in this context that males were found in 1968 for the first time. Despite the cold and wet summer of 1968, an unusually high number of *O. fringillina* was found in nest boxes (one in 1966, one in 1967, 17 in 1968), whereas the number of *O. chloropus*, which species actually prefers moderate temperatures, was slightly lower in these boxes (44 in 1967, 38 in 1968). This might be an effect of the climatic conditions during the breeding season of the foregoing year. However, more observations are needed for a better analysis of this effect. On the other hand, the collected numbers of *O. avicularia* are rather constant, but many more specimens were found in nest boxes of the Great Tit in 1968 than in 1967 (27 and 3, respectively). One gets the impression that a competition between the three species must exist in the nest boxes and that the numbers of *O. chloropus* have been influenced by the unusual (?) abundance of the other two species in 1968. More observations on these relations, collected over several years, are necessary.

It is also evident that it is not yet certain whether *O. fringillina* is endemic on Vlieland or not. Apparently the conditions on the island are far from optimal, and it is probable that the species can maintain itself there only during very favourable summers. In this respect it would be very interesting to investigate if the species breeds in the northern part of The Netherlands and on the other Wadden islands, and where it is "replaced" by *O. chloropus*.

In summers that are cool and unfavourable for *O. fringillina*, there must exist a competition between *O. chloropus* and *O. avicularia*, at least in nest boxes but, as the data indicate, probably also on those Passeriformes on which both species occur regularly (*Turdus merula*, *Sturnus vulgaris*). On the small island the different habitats are not strictly separated and therefore a factor for the separation of the two

species is eliminated (see HILL, 1962). Considering this, it would be worth while to continue the observations.

SUMMARY

1. Three species of *Ornithomyia* Latreille have been caught on birds and in birds' nests on the Isle of Vlieland. Two of these, *O. avicularia* L. and *O. chloropus* Bergroth, are common and most probably endemic. *O. fringillina* Curtis, may be endemic under favourable conditions but seems mainly to be imported from the mainland.

2. The three species have been found in nests, on juvenile birds and on migrants. There was no evidence of preference for different parts of the island. Mixed infections in nests were comparatively frequent.

3. Based on data from the past ten years, covering 338 flies, the seasonal distribution of the three species on the island is expressed in histograms. The results generally agree with those presented by other authors for northern Europe.

4. Puparia of the three species have been found in artificial nest boxes after the breeding season of the hosts.

5. It is concluded that competition may exist, at least between the two common species. Under favourable circumstances, *O. fringillina* may also play a part in this competition.

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