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# Intra and Interspecific Competition in the Water Shrew in the Netherlands

KONKURENCJA WEWNĄTRZGATUNKOWA I MIĘDZYGATUNKOWA U RZĘSORKA RZECZKA W HOLANDII

L.A.C.J. VOESENEK & A.C. van BEMMEL

Voesenek L.A.C.J. & Van Bemmel A.C., 1984: Intra and interspecific competition in the water shrew in the Netherlands. Acta theriol., 29, 25: 297—301 [With 4 Tables V 1 Fig.]

In the Gagelpolder (province of Utrecht) where *Neomys fodiens* and *Sorex araneus/coronatus* live sympatrically a study was carried out into the intraspecific competition in *Neomys fodiens* and the interspecific competition between these two shrew species. The juveniles of the water shrew showed a spatial differentiation which might indicate intraspecific competition. The occurrence of this age class in sub-optimal habitat types confirmed this indication. An indication of interspecific competition between the water shrew and the common shrew was found in a temporal differentiation. The common shrew had a unimodal activity pattern with a peak in the night. *Neomys fodiens*, on the contrary, was captured frequently both by day and by night.

[Nonnenveld 42, 5401 NE Uden (LV); Zwolseweg 405, 7345 AE Wenum-Wiesel (AB), The Netherland]

## 1. INTRODUCTION

Competition occurs when more individuals claim the same limited environmental factors (niche overlap). Pianka (1976) supposed that intraspecific competition is mostly more intense than interspecific competition, the niche overlap being bigger in the former interaction.

Voesenek & Van Bemmel (in preparation) found that the habitat of *Neomys fodiens* was very specific in an area where this species lived in sympatry with *Sorex araneus/coronatus* [1]. On the island of Texel, where *Neomys fodiens* is the only shrew species it occurs in a variety of habitat types (Van Laar, 1981).

When intraspecific competition is strong a species enlarges its biotope and occupies marginal habitats. As soon interspecific competition is strong a species sticks to its optimal habitat (Svardson, 1949).

On that basis there was the impression that *Neomys fodiens* possibly competes with congeners and other shrews. This article describes the

[1]) In central Holland both types occur (Loch, 1977). Exact species determination was not possible.

results of a study in the Netherlands into the intra and interspecific competition in *Neomys fodiens* in spring and early summer.

## 2. MATERIAL AND METHODS

### 2.1. Study Area

The study was made in the period early April—half July 1983 in the Gagelpolder (province of Utrecht; Amersfoort coordinates: 136.6461.2). The study area is dominated by alder groves (alliance: Alnion glutinosae). The characteristic plant species in them are: *Alnus glutinosa*, *Salix* spp., *Rubus* spp., *Carex paniculata* and *Dryopteris carthusiana*. The Gagelpolder is intersected by numerous peatpits, in which the water level is now strictly regulated for agricultural purposes.

Of the five *Soricidae* occuring in the Netherlands only *Neomys fodiens* and *Sorex araneus/coronatus* have been found in the study area.

### 2.2. Captures

The shrews in the Gagelpolder were caught with Longworth live traps (Chitty & Kempson, 1949), filled with fresh pig's heart and minced mealworms (larvae of *Tenebrio molitor*). Before the inlet of the trap another piece of heart was placed. The traps were inspected every five hours night and day. The shrews were individually marked by clipping one or more toes. The following data of every shrew caught were taken: sex, age (adult or juvenile), weight, trap number, time of capture and further particulars.

## 3. RESULTS

### 3.1. Intraspecific Competition

When shrews more or less avoid each other in space and/or time we define that phenomenon as spatial and temporal differentiation.

Table 1

Survey of the number of traps in which one or more individuale of *Neomys fodiens* were captured per period of 19 inspections (A=12 April—25 April; B=26 April—10 May; C=10 May—31 May; D=31May—14 June; E=14 June—24 June; F=24 June—6 July). When $P>0.05$ (ns) there is spatial differentiation.

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| One adult in trap | 13 | 15 | 7 | 16 | 11 | 6 |
| More adults in trap | 6 | 3 | 2 | 4 | 2 | 1 |
| $\chi^2$ | 80.09 | 17.28 | 16.57 | 33.06 | 9.86 | 8.22 |
| $P$ | <0.001 | <0.001 | <0.001 | <0.001 | <0.01 | <0.01 |
| One juvenile in trap | | | | | 16 | 16 |
| More juveniles in trap | | | | | 0 | 1 |
| $\chi^2$ | | | | | 0.31 | 1.66 |
| $P$ | | | | | ns | ns |

Table 1 gives a survey of the number of traps in which only one water shrew was caught and the number of traps in which we caught more. The criterion for spatial differentiation was drawn up arbitrarily: as soon as 98% of the traps in which water shrews were caught trapped only one individual there was spatial differentiation. There were no

indications of changes in spatial differentiation in the course of time (12 April — 6 July) (adults: $\chi^2=1.46$; $P>0.05$, juveniles $\chi^2=0.97$; $P>0.05$).

Table 2 gives a survey of spatial differentiation, if any, between adults and juveniles. In both periods the occurence of juveniles was not associated with the occurence of adults (period E: $\chi^2=0.29$; $P>0.05$, period F: $\chi^2=0.69$; $P>0.05$).

Table 2

Number of traps in which exclusively juveniles, exclusively adults, both or none of these were captured, per period of 19 inspections.

| Period | | Traps without adults | Traps with adults |
|---|---|---|---|
| E (14 June—24 June) | Traps without juveniles | 64 | 10 |
| | Traps with juveniles | 13 | 3 |
| F (24 June—6 July) | Traps without juveniles | 77 | 5 |
| | Traps with juveniles | 15 | 2 |

Table 3

The number of trapped adult and juvenile water shrews per time span in the period 14 June—6 July.

| | Adults | Juveniles |
|---|---|---|
| 7.00—12.00 | 4 | 3 |
| 12.00—17.00 | 5 | 0 |
| 17.00—sunset | 11 | 6 |
| sunset—2.00 | 28 | 21 |
| 2.00—7.00 | 14 | 12 |

Table 3 shows the frequency distribution of daily times of activity of both adults and juveniles. The distribution of adults is not significantly different from that of juveniles ($\chi^2=4.03$; $P>0.05$).

An analysis of the temporal differentiation within both age classes was not possible because of a mostly too limited number of captures per individual.

### 3.2. Interspecific Competition

Table 4 supplies the possible spatial differentiation between *Neomys fodiens* and *Sorex araneus/coronatus*. In the periods A, B, D and F the occurence of the water shrew was not associated with that of the common shrew (respectively $\chi^2=1.34$; $P>0.05$, $\chi^2=0.07$ $P>0.05$, $\chi^2=0.10$; $P>0.05$ and $\chi^2=1.86$; $P>0.05$). In the periods C and E there was a positive association between the occurence of both species (respectively $\chi^2=4.97$; $P<0.05$ and $\chi^2=4.62$; $P<0.05$).

Figure 1 gives a survey of the frequency distribution of daily times of activity of both *Neomys fodiens* and *Sorex araneus/coronatus*. The water shrew was captured significantly more frequently between 7.00

Table 4

Traps in the Gagelpolder in which exclusively *Neomys fodiens*, exclusively *Sorex araneus/coronatus*, both or none of these were captured, per period of 19 inspections (for A — F see Table 1).

| Period | Traps; *N. fodiens* | Traps; *S. araneus/coronatus* Without | With |
|---|---|---|---|
| A | Without | 25 | 10 |
| | With | 10 | 8 |
| B | Without | 54 | 13 |
| | With | 15 | 3 |
| C | Without | 65 | 11 |
| | With | 5 | 4 |
| D | Without | 114 | 8 |
| | With | 20 | 1 |
| E | Without | 59 | 7 |
| | With | 17 | 7 |
| F | Without | 73 | 4 |
| | With | 19 | 3 |

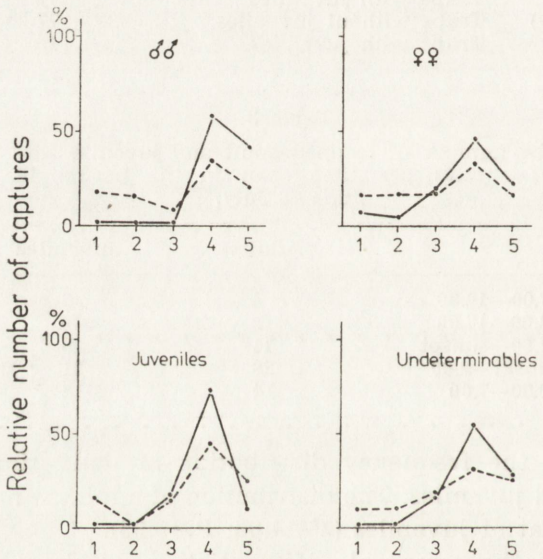


Figure 1. Survey of the relative number of captured per time span of *Neomys fodiens* (dotted line) and *Sorex araneus/coronatus* (fixed line) (1=7.00—12.00; 2=12.00—17.00; 3=17.00—sunset; 4=sunset—2.00; 5=2.00—7.00). Undeterminables are those shrews that could not be sexed in early spring.

and 12.00 hour than the common shrew (Wilcoxon-U=16; $P<0.05$). Between sunset and 2.00 hour the reverse was seen (Wilcoxon-U=16; $P<0.05$).

## 4. DISCUSSION

Only the juveniles of *Neomys fodiens* showed an indication of intraspecific competition. In the Gagelpolder the habitat of juvenile water shrews is different from that of adults. In contradiction with the adults the juveniles were mostly captured on spots where the depth of the neighbouring water was slight (0—25 cm) and where bank crumbling

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was absent (Voesenek & Van Bemmel, in preparation). Because of the indication of intraspecific competition the juvenile water shrews in the Gagelpolder possibly have a relatively wide ecological amplitude and occupy habitats marginal for this species.

Croin Michielsen (1966) found the juveniles of *Sorex araneus* and *Sorex minutus* to be very territorial whereas the sexually grown adults were hardly territorial in the reproductive period. However, in the laboratory Michalak (1983) found that juvenile water shrews were tolerant and non-territorial to each other.

An indication of intraspecific competition was the temporal differentiation between *Neomys fodiens* and *Sorex araneus/coronatus*. In laboratory experiments Crowcroft (1955) saw *Neomys fodiens* immediately attacking *Sorex araneus* when placed in the same cage. The more competition fit water shrew in optimal habitats is likely to "force" the common shrew into a unimodal activity pattern.

In the laboratory Tupikowa (from Buchalczyk, 1972) found that the activity of an isolated shrew increased both by day and by night depending on its size, the smaller, the more active. On this basis one could expect a polymodal frequency distribution of daily times of activity in *Sorex araneus/coronatus* as compared with *Neomys fodiens*. However, the contrary was seen by us. Possibly the activity pattern of both *Soricidae* was changed under the influence of interspecific competition.

To be complete it should be said that spatial and/or temporal differentiation are only indications of competition. Experimental field studies are necessary to come to a definite conclusion (Ellenbroek, 1980).

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