

Aggressiveness of a *Neomys fodiens* parous female towards conspecific and *N. anomalus* intruders

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Krushinska N. L. and Rychlik L. 1994. Aggressiveness of a *Neomys fodiens* parous female towards conspecific and *N. anomalus* intruders. Acta theriol. 39: 329–332.

Reactions of a *Neomys fodiens* (Pennant, 1771) parous female [FP] to 4 conspecific and 3 *N. anomalus* Cabrera, 1907 intruders were studied quantitatively in enclosure (135 × 135 cm) experiments. Total time of observations was 30 hr. FP initiated 5.6 intraspecific conflicts per 1 hr (1.95/hr of these were pouncings and fightings) with adult males, 0.8 conflicts/hr with a juvenile female, and 4.7 conflicts/hr with a *N. anomalus* adult male. Reactions of *N. fodiens* parous female were several times more aggressive than interactions between non-breeding 'residents' and 'immigrants' of both water shrew species tested under the same conditions in earlier studies.

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Key-words: *Neomys fodiens*, *N. anomalus*, agonistic and maternal behaviour, territoriality, parous female

Introduction

The high aggressiveness of breeding females towards intruders, observed in many mammals, is believed as an adaptation against intra- and interspecific infanticide. It was also observed in some *Soricidae* (e.g. in *Blarina brevicauda* – Platt 1976, *Crocidura flavescens* – Baxter and Meester 1982, *Sorex isodon* – Skarén 1982, *S. araneus* – Churchfield 1990), as well as in *Neomys fodiens* (Michalak 1983). However, no quantitative data were presented in neither of those studies.

The aim of this preliminary note is to communicate quantitatively about agonistic reactions of a *N. fodiens* parous female to intruders of two water shrew species. In previous studies (Krushinska and Rychlik 1993, Krushinska *et al.* 1994) it was found that, among non-breeding animals, *N. fodiens* adult males are the most aggressive intraspecifically, and *N. fodiens* females were the most aggressive towards *N. anomalus* newly introduced into the enclosure. Therefore, we also tried to check if *N. fodiens* parous female is (1) more aggressive intraspecifically than adult males and (2) interspecifically than non-breeding females.

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Subject and methods

Five *Neomys fodiens* (Pennant, 1771) (3 adult males, 1 ad and 1 juvenile females) and three *N. anomalus* Cabrera, 1907 (1 ad and 2 juv males) captured in early summer (June–July) of 1989 in the Białowieża Primeval Forest were used. The *N. fodiens* adult female was captured when pregnant. All animals underwent at least a 2-week acclimatization in individual cages (38 × 30 × 16 cm). They were then weighed and marked by fur-clipping.

The *N. fodiens* adult female (FP) was placed in the separate enclosure (135 × 135 cm) built in a laboratory room located in a basement. The floor was covered with a 5-cm-layer of sand. A small amount of moss for nest-building was put on the sand and changed every 2–3 weeks. The enclosures were also provided with 2 upturned earthenware flower-pots as nest boxes, 2 feeding trays, and 1 water basin (80 × 25 × 15 cm). Meat, milk and water were given *ad libitum*.

After 11 days FP gave birth to 4 pups. On the 5th day after parturition 2 *N. anomalus* juvenile males were introduced into her enclosure, which resulted in an act of infanticide, probably by the mother. On the 6th day the males were removed. Within the next 46 days, 4 *N. fodiens* and 1 *N. anomalus* were successively introduced (each animal for 3 days) to the enclosure. Social behaviour between FP and each of the intruder was observed for 6 hr (2 hr per 3 successive evenings). Agonistic behaviour (threatening postures and/or vocalization, pouncing, chasing and fighting) was analysed. Total time of observation was 30 hr.

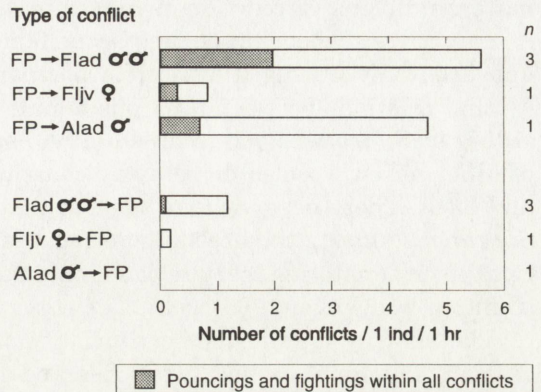
See Krushinska and Rychlik (1993) and Krushinska *et al.* (1994) for more details about methods of animal keeping, sex and age designation, experimental procedure, behavioural pattern definitions, and data organization.

Results and discussion

The mean number of conflicts (all kinds of conflicts combined) initiated by the FP parous female with conspecific adult males during 1 hr was 5.6 (Fig. 1). It was several times higher than the number of conflicts between non-breeding *N. fodiens*-‘residents’ and ‘immigrants’ observed in the same experimental conditions (Krushinska *et al.* 1994; Exp. 2), and many times higher than the number of intraspecific conflicts between *N. fodiens*-‘immigrants’ and members of mixed (*N. fodiens* + *N. anomalus*) ‘resident’ groups (Krushinska *et al.* 1994; Exp. 1). In contrast to it, the *N. fodiens*-‘resident’ adult female from the mixed group (Krushinska *et al.* 1994; Exp. 1) did not attack *N. fodiens*-‘immigrant’ males at all. Moreover, pouncings and fightings (i.e. the most aggressive conflicts) composed more than third part of all conflicts initiated by FP towards adult males (Fig. 1).

The first *N. fodiens* adult male was introduced to the FP female on the 6th day after parturition, i.e. when she was probably in oestrus. One can believe so because 1 hr after introduction this male entered her nest box and within the next 2 hr they spent a long time together inside without any conflicts. It was also observed that the male climbed the female’s back 4 times without irritating her. But as early as on the next day no sexual interactions were noted, and the female again attacked the male and did not let him inside her nest box. The next two *N. fodiens* adult males introduced later were at once subjected to vigorous attacks of FP both in open enclosure and near/in the nest boxes, as well as to persistent chases which become less aggressive on the 3rd day. Neither of the males came into any sexual

Fig. 1. Aggressiveness (mean number of conflicts initiated by 1 individual during 1 hr) between the parous female (FP) and intruders in regard to their species, sex and age. Arrows show animals active in conflicts, i.e. FP→FI means that the parous female attacked conspecific intruder, AI→FP means that *N. anomalus* intruder attacked the parous female, etc. *n* – number of 6-hr observations of a particular type of conflicts.



contact with the female. The reactions of the FP female to the *N. fodiens* young female were comparably milder (Fig. 1).

Thus, the suspension of FP's antagonistic behaviour occurred only during oestrus, after which the female's aggression again intensified, and she defended her nest box against all approaching *N. fodiens* intruders.

Two *N. anomalus* young males, introduced into the enclosure on the 5th day after parturition, were observed entering FP's nest box with the litter. The female chased them away from the nest and made persistent attacks upon them in the enclosure. However, no quantitative data were recorded. The *N. anomalus* adult male, which was introduced to the FP three weeks after parturition, was attacked (mainly frightened away and chased) by the FP female 4.7 times per 1 hr (Fig. 1). For comparison, *N. anomalus* introduced to the mixed groups were attacked as rare as 0.7 times per 1 hr by *N. fodiens*-'residents' (mean for all *N. fodiens*-'residents') and 2.0 times per 1 hr by the *N. fodiens*-'resident' adult female (Krushinska *et al.* 1994; Exp. 1).

The numbers of conflicts initiated by *N. fodiens* intruders with FP were much lower than opposite, and *N. anomalus* intruder did not initiated any conflict with FP (Fig. 1). Among intruders, only *N. fodiens* adult males initiated some pouncings and fightings with FP, but their number was very low (0.1/hr).

Thus, the exceptionally high aggressiveness of the *N. fodiens* parous female in regard to intruders of both water shrew species was evident and it was visible even several weeks after parturition. Besides, the level of intraspecific aggressiveness by FP was the highest towards conspecific adult males and the lowest towards young conspecific female. Probably, all adult breeding females can be more aggressive than adult males, which were found to be the most aggressive among non-breeding *N. fodiens* (Krushinska *et al.* 1994). Similarly, in *S. araneus*, breeding females seem to dominate adult males as well as juveniles (Moraleva 1989).

A very high degree of aggressiveness of lactating *N. fodiens* females towards adult males was underlined by Michalak (1983). This is undoubtedly a natural

maternal defensive reaction as according to Michalak (1983), males can eat pups. A temporary suspension of the parous female's agonistic reactions towards males appeared only during the possible postpartum oestrus. An analogous pattern of mutual relations between a parous female and a male was observed by Crowcroft (1957) in *S. araneus*. Churchfield (1990) suggests that also non-oestrous females of other shrew species drive away courting males by vocal threatening, attacks and bites. These observations suggest that in solitary shrews like *N. fodiens* and *S. araneus*, during the breeding period, males and females do not form permanent couples on territories that are commonly defended as it is in e.g. *Crocidura russula* (Cantoni and Vogel 1989), *Suncus etruscus*, and *S. murinus* (Churchfield 1990).

The sharply manifested territoriality of breeding females is a typical feature of many mammals which was observed both in captured *Soricidae* (e.g. in *B. breviceuda* – Platt 1976, *C. flavescens* – Baxter and Meester 1982, *S. isodon* – Skarén 1982), and under natural conditions (e.g. in *S. coronatus* and *N. fodiens* – Cantoni 1993, *S. vagrans* and *S. obscurus* – Howes 1977). Females of the last-mentioned species actively defend territories over the whole lifetime; within these territories they produce 3–4 litters (Howes 1977). Therefore, the intensified aggressiveness towards immigrants is a natural maternal reaction guaranteeing successful rearing of the offspring by assuring food resources and protection from infanticide and predators.

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