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The effect of pregnancy failure on the onset of reproduction in sympatric populations of *Clethrionomys rutilus* and *Clethrionomys rufocanus*

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A period of sterile ovulations was found to precede the onset of reproduction in sympatric populations of *Clethrionomys rutilus* and *C. rufocanus* studied in northern Norway. A period of sterile ovulations was found in both species. The length of this period appeared to differ both within and between species. An extended period of pregnancy failure in *C. rutilus* caused a great delay in the onset of breeding when *C. rufocanus* was numerous. It is suggested that frequent contacts with the numerically and competitively dominant *C. rufocanus* produce a stress-induced pregnancy blockage in *C. rutilus*.

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1. Introduction

Microtine rodents are considered to be reflex ovulators (Milligan 1975, Andersson & Gustafsson 1979, Westlin 1982, Gustafsson 1985) where matings always precede ovulations. However, sterile ovulations appear to be a normal feature, especially at the beginning of breeding season in the spring: In *Clethrionomys* this has been reported in wild populations of *C. rutilus* (Hoyte 1955), *C. glareolus* (Westlin & Nyholm 1982) and *C. rufocanus* (Westlin 1982).

Sterile ovulation is known to be produced as a response to certain stressfactors (Clulow et al. 1982). It is, however, uncertain whether sterile ovulations is an adaptation. In *C. glareolus* and *C. gapperi* exposure to strange males caused preimplantation pregnancy failure under laboratory conditions (Clarke & Clulow 1973, Clulow et al. 1982). A similar pregnancy blockage in *C. gapperi* was induced by a sudden change in the physical environments during a laboratory test (Clulow et al. 1982). Stress-induced pregnancy blockage seems to occur under natural conditions: Mallory & Clulow (1977), in a field study of *Microtus pennsylvanicus* found a positive relation between population density and frequency of sterile ovulations. Below I present data on pregnancy failure in sympatric populations of *C. rutilus* and *C. rufocanus*.

2. Material and methods

The field work was carried out during the years 1978, 1982 and 1983 in a pine taiga (69°8'N, 29°10'E) in Finnmark, northern Norway. Snap-trapping, according to the small quadrate method (Myllymäki et al. 1971), was performed on permanent quadrates in various habitats in July each year. Additional small quadrate sampling was carried out during the middle of August and late September in 1978. In 1982 a 10×10 grid (2.25 ha) was live-trapped by means of pitfalls (one trap per station) during four periods from early June to late July. During each period the pitfalls were checked at 12-hour intervals for 4-5 days. The individuals were removed and sacrificed in the last trapping-period. Additional samples of snap-trapped animals were obtained from large removal grids at various locations from late May to late July in 1982 and in the latter half of July in 1983.

Small quadrate captures of overwintered individuals per 100 trap-nights in July were used as relative indices of population density (Table 1): since the data derive from several habitats these indices reflect both density and spatial distribution.

Yearborn and overwintered individuals were classified according to pelage characteristics after Kryltsov (1964). Live-trapped animals were toe-clipped for individual identification. Body weight, breeding condition assessed by testes position in males, and state of vaginal opening and size of nipples in females, were recorded at each capture.

In kill-trapped animals the following autopsy data were recorded: testes length, tubular or non-tubular epididymis for males and presence of macroscopically visible corpora lutea and embryos, embryo length, litter size, numbers and number of sets of placental scars for females. Presence of corpora lutea but no placental scars or visible embryos was taken as evidence of pregnancy failure at the time of capture.

3. Results

C. rufocanus was numerous all years of study, but the relative density of overwintered individuals was lower in 1978 than in 1982 and 1983 (Table 1). The densities of overwintered *C. rutilus* were relatively low. In 1978 the catch index was relatively higher than in 1982 (Table 1); this was not due to a higher density, but rather to a wider distribution, i.e. more habitats were occupied. Minimum numbers occurred in 1983.

For all pitfall captures of *C. rutilus*, 40.4% were caught together with *C. rufocanus*. The density of *C. rufocanus* was higher than *C. rutilus* in most habitats, and frequent contacts between the species seemed to occur when density of *C. rufocanus* was high. The corresponding percentage of multiple captures of at least two *C. rutilus* was 3.5%. This suggests that contacts between individuals within the species were few.

By the end of May 1982, all overwintered female *C. rutilus* and 67.7% *C. rufocanus* showed signs of pregnancy failure (Fig. 1A). The remaining part of the female *C. rufocanus* population were pregnant at this time. The proportion of females showing pregnancy failure had decreased by June 20 to 16.0% in *C. rufocanus* and 75.0% in *C. rutilus*. In the last two samples all *C. rufocanus* were in active reproductive state, while still some females in *C. rutilus* (14.3% and 33.3%) had several sets of corpora lutea but no signs of embryos or placental scars.

The time of birth of first litter (Fig. 1B) and the proportion of yearborn individuals in the samples (Fig. 1C), reflect the pattern seen in Fig. 1A. The first litters in *C. rufocanus* were born in early June. The corresponding event in *C. rutilus* took place one month later. The first juvenile *C. rutilus* appeared in the study area on July 20, while yearborn *C. rufocanus* became trappable exactly one month earlier.

Table 1: Relative catch indices (captures/100 trapnights) of overwintered *Clethrionomys rutilus* and *C. rufocanus* from 33 permanent small quadrates in July.

Species	1978	1982	1983
Clethrionomys rutilus	2.0	1.3	0.1
C. rufocanus	4.0	5.4	5.6

By the end of June, 1978, 20.0% of *C. rutilus* was yearborn (Fig. 1C), although 57.2% of the overwintered females showed blocked pregnancy. The corresponding figures for *C. rufocanus* were 39.9% and 35.7% respectively.

4. Discussion

These observations confirm previous records (Gustafsson 1985) of a period with sterile ovulations in both *C. rutilus* and *C. rufocanus* before the onset of reproduction. However, the length of this period appears to differ between individuals both within species and between species. This is reflected in the asynchrony in the timing of birth of the first litter of overwintered females.

The long period of pregnancy failure in *C. rutilus* caused a remarkable late onset of reproduction. Martell & Fuller (1979) and Koshkina & Korotkov (1975) found that the onset of reproduction in *C. rutilus* was related to the timing of disappearance of snow cover. Breeding under snow is recorded in *C. rutilus* in Alaska (Whitney 1976, West 1982) and Russia (Khlebnikov 1970). In 1982, the first female in my study area became pregnant more than a month after the disappearance of snow cover.

Onset of reproduction in *C. rutilus* was found to depend on density by Koshkina & Korotkov (1975) in a non-cyclic population. In a population with non-regular density fluctuations, Cernyavskij & Korolenko (1979) stated that the presence of non-reproducing mature females was typical during the decrease phase, which may be an example of pregnancy blockage.

Since the density of overwintered *C. rutilus* was relatively low during the three years of my study, it seems unlikely that the occurrence of pregnancy failure was density-dependent. The long period of sterile ovulations in *C. rutilus* may be an effect of stress-induced pregnancy blockage due to frequent contacts with a dominant species, since *C. rutilus* is subordinate to

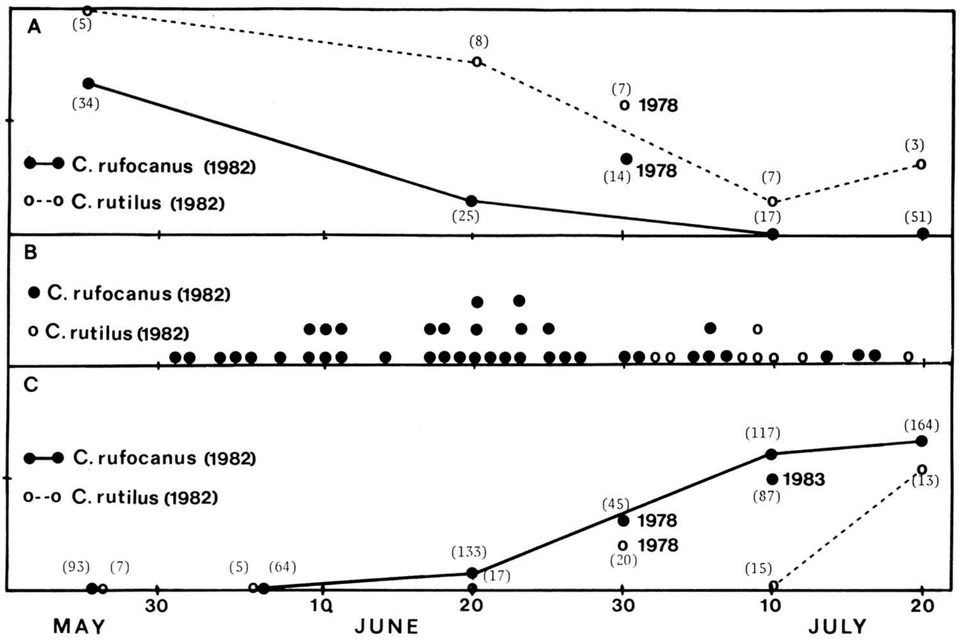

Fig. 1: (A) The proportion of overwintered females (sample size in brackets) with corpora lutea, but without placental scars or embryos. (B) Time of birth of first litter, estimated from length of embryos or observations from live-trapping. (C) The proportion of yearborn individuals (sample size in brackets). Time of loss of snow cover: May 20 in 1978, May 5 in 1982 and May 1 in 1983.

C. rufocanus (Kalela et al. 1971, Henttonen et al. 1977 and pers. obs.). This interpretation may account for the earlier onset of reproduction in *C. rutilus* in 1978 (Fig. 1C), when the density of *C. rufocanus* was relatively lower than during the other two years of this study. An alternative explanation may be that *C. rutilus* was excluded from high quality habitats by high densities of *C. rufocanus,* and that this caused a delay in onset of breeding in *C. rutilus.* Unfortunately, the material is insufficient to permit an evaluation of the effect of habitat quality on reproduction in *C. rutilus.*

Therefore, nothing definite can be said about the exact nature of pregnancy blockage in *C. rutilus* at this stage. Future experimental studies should provide important insight into the underlying mechanism, and in evaluation of whether or not this is an adaptation.

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