

## WINTER SURVIVAL OF *APODEMUS FLAVICOLLIS* IN CRABAPPLE ISLAND

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Until now, three papers considering winter survival of the yellow-necked mouse have been published, and all of them are based on the same data set sampled in Białowieża Forest, NE Poland. This paper is an attempt to analyse factors affecting winter survival of *Apodemus flavicollis* (Melchior 1823) inhabiting Crabapple Island.

The sampling site was Crabapple Island on Bełdany Lake (NE Poland), covered with mixed deciduous forest. The entire 4 ha area of the island was sampled using a grid of 159 evenly distributed trap sites. The traps were inspected twice daily, at 7:00 a.m. and 7:00 p.m., in each of 5 trapping series, lasting 7 days and conducted in 6 weeks intervals from April through October. Trapped rodents were weighed, sexed and had their identification marks as well as location in the grid recorded before releasing.

During 9 consecutive winters (1994-2003) the numbers of marked mice present in October (i.e., after completion of the breeding season) were compared with the numbers that remained till April. Among all females, mature (i.e., either pregnant or having open vaginal orifice) were distinguished from sexually immature ones, and among males mature (scrotal testes) and immature (abdominal testes) were the two distinct categories. Unmarked mice, born earlier in spring (e.g., in March), were excluded from calculations, though they appeared in April occasionally.

Three age groups among the individuals present in October were distinguished: i) overwintered individuals (born in the previous year) which were excluded from estimates of winter survival because they do not survive 2 winters, ii) individuals caught for the 1<sup>st</sup> time in June or July trapping series (called spring generation), and iii) individuals born in the 2<sup>nd</sup> part of the season (caught for the 1<sup>st</sup> time in September or October trapping series), called autumn generation.

Winter weather was assessed using data provided by a meteorological station located some 20 km north of Crabapple Island: Amount of atmospheric fall, temperature at 5 cm above ground level (mean values for months October through April), number of days with snow cover (November through April), total number of days from snow appearance to snow melt, and also maximum snow cover thickness during winter. Estimates of herb layer biomass were based on randomly taken samples (18 to 24) of 0.1 m<sup>2</sup>.

The total number of current year born individuals present in October was 311 females and 268 males. Survival percentages varied much between winters: from 5.3% (4 out of 75 in winter 2002-2003) to 51.1% (23 out of 45 in winter 2001-2002). No correlation was found between numbers of the current year mice present in October and the percentages of such mice that survived till April ( $r=0.173$ ,  $P>0.6$ ). Neither any single weather factor correlated with the percentages of winter survivors. To answer the question whether or not similar winters result in similar survival percentages, a cluster analysis based on 22 variables describing winter weather was performed. Low values of Euclidean distance were found in the pair of winters: 1 (1994-1995) and 6 (1999-2000). Thus, these winters were similar each

to the other. In spite of that similarity, winter survival of yellow-necked mice was different (11.1% and 42.1%, respectively). In another pair of similar winters, i.e., 5 and 7, the percentages of survivors were almost identical (9.2% and 12.8%, respectively). In the 3rd pair of similar winters: 2 and 3, the percentages of survivors (9.8% and 32.4%) were again different. Winters 8 and 9 were relatively cold: differed much from those above mentioned, and the most different and most severe was the latter one, with mean temperature at 5 cm above ground in December, January and February dropping below minus 20° C. Of the mice present in October in the 1<sup>st</sup> of those winters as much as 51% survived, while in the latter one only 5.3% did. No correlation was found between the standing crop of herb layer biomass in April and the number of survivors and percentage of survivors.

Apart from survival rate of the entire population present in October, individual features were also considered. Yellow-necked mice of the spring generation, survived winter in higher percentages than those belonging to autumn generation: mean values equal to 25.1% and 17.5%, respectively ( $P < 0.05$ ). It has appeared that in spring generation as well as in autumn generation mature yellow-necked mice survive better than their sexually immature sisters and brothers of the same age: mature females survive winter in higher percentages than any of the remaining categories ( $P < 0.05$ ). Mature males survive winter better than immature males. Because percentage of adult individuals is significantly higher ( $P < 0.001$ ) in spring generation (88.0%) than in the autumn generation (11.8%), the former one survives winter better than the latter generation.

Body mass of *A. flavicollis* assessed in October was the highest in mature males, and the lowest body mass showed immature females. Comparison of body mass between individuals of the same category that next survived winter and those that died during winter shows that there is no significant difference. On the other hand body mass of survived immature females of *A. flavicollis* in October was slightly lower than that of died ones, and body mass of survived immature males was higher than that of the died immature males.

Variation of winter survival in small rodents was interpreted in terms of relation to autumn population density, predation, and also to food resources. Also winter weather conditions were taken into regard, with a conclusion that thick snow cover may favour winter survival rates.

In the present paper we have found neither correlation between the percentage of survivors in April and population numbers in October nor survival rate and winter weather conditions. It cannot, however, be excluded that extremely severe winters affect survival rate. Yellow-necked mice in Crabapple Island provided evidence that sexual maturity enhances winter survival, which denies the belief that young rodents “postpone” reproduction in order to survive to the next breeding season.

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