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THE STRUCTURE AND DYNAMICS OF COMMON DORMOUSE (*MUSCARDINUS AVELLANARIUS L.*) POPULATIONS IN LITHUANIA

RIMVYDAS JUŠKAITIS

Institute of Ecology, Akademijos 2, 2600 Vilnius, Lithuania

ABSTRACT – During 1984-1993 investigations on the structure and dynamics of two isolated *M. avellanarius* populations were carried out in Lithuania. At site A average population density in spring was 1.0 individuals/ha (0.7 ind/ha at site B); males comprised 50% (47%) of the population. One-year-old, two-year-old, three-year-old and four-year-old dormice comprised 67%, 24%, 8% and 1% (70%, 23%, 5% and 2%) respectively. In autumn average population density was 3.0 individuals/ha at site A (2.4 ind/ha at site B), young made up 69% (74%) of the total population. Fifty five percent (60%) of all females were reproductively active. Males comprised 52% (48%) in the litters. Average mortality during hibernation was 68% (71%). The present paper reviews dynamics and correlation of these indices.

Key words: *Muscardinus avellanarius,* Population structure, Lithuania.

RIASSUNTO – *Struttura e dinamica di popolazione di Moscardino* (Muscardinus avellanarius *L.) in Lituania* – Sono state condotte indagini su struttura e dinamica di due popolazioni di *M. avellanarius* in Lituania nel periodo 1984-1993. Nel sito A la densita media di popolazione in primavera era 1.0 ind/ha (0.7 ind/ha nel sito B), i maschi rappresentavano il 50% (47%); animali di uno, due, tre e quattro anni rappresentavano rispettivamente il 67%, 24%, 8% e 1% (70%, 23%, 5% e 2%). In autunno la densita media di popolazione era 3.0 ind/ha nel sito A (2.4 ind/ha nel sito B), i giovani rappresentavano il 69% (74%) dell'intera popolazione. Il 55% (60%) delle femmine era riproduttivamente attiva, i maschi rappresentavano il 52% (48%) nelle figliate. La mortalita media durante il letargo era 68% (71%). Il presente lavoro riesamina dinamica e correlazione tra questi indici.

Parole chiave: *Muscardinus avellanarius,* Struttura di popolazione, Lituania.

INTRODUCTION

Many publications on *M. avellanarius* biology have appeared in different European countries including data on population structure, but we find very little information on long-term investigations of *M. avellanarius* population structure and dynamics. The longest investigations (7 years) of *M. avellanarius* population structure were carried out by Likhachev (1966b) in the Moscow region. Similar studies by other authors (e.g. Schulze, 1973; Catzeflis, 1984) cover much shorter periods. The present paper aims to present results of investigations of two *M. avellanarius* populations, carried out in Lithuania during 7 and 10 year periods, and to compare them with the results obtained by Likhachev (1966b) in the Moscow region.

MATERIAL AND METHODS

Investigations of the structure and dynamics of two isolated *M. avellanarius* populations in Lithuania were carried out in two locations: in 1984-1990 at site **A** (south-western Lithuania, Sakiai district) and in 1984-1993 at site **B** (eastern Lithuania, Moletai district).

Site **A,** with an area of 60 ha, covers 22% of the whole area occupied by the *M. avellanarius* population: 262 nestboxes were placed in it. Forest here is middle-aged, with a great diversity of species stands. Prevailing tree species are birch *(Betula pendula)*, Norway spruce (*Picea abies*), black alder (*Alnus glutinosa*) and in some places aspen *(Populus tremula*) and ash (*Fraxinus excelsior*). The understorey contains many hazels *(Corylus avellana*) and in some places buckthorn (*Frangula alnus*).

Site B (85 ha) covers approximately 17% of the area occupied by the *M. avellanarius* population; 341 nestboxes were placed there. In most of this site mature oaks (*Quercus robur*) grow with spruce (*Picea abies)* and aspen (*Populus tremula*). The aspen forest dominates in some places. Hazel (*Corylus avellana)* prevails in the understorey.

The methods used to study *M. avellanurius* were based on the following three main principles:

1) even spacing of nestboxes in large forest areas;

2) regular checking of the boxes;

3) marking of all dormice caught.

In both sites, standard wooden nestboxes for small hole nesting birds were placed every 50 metres, at a height of 1.5-2.0 metres. The density was four boxes in 1ha. The boxes were checked once a month from April until October, and twice a month in May and September. **All** dormice caught were marked with aluminium rings (the straightened plate is 2.5 x 8.0 mm). Suckling young weighing less than 10 g were marked by toe amputation, and ringed when caught again subsequently. **All** the animals were weighed and their sex and age determined.

Two seasons have been identified from analyzing population density, sex and age structure: spring (April - June), where there are no independently living young, and autumn (August - October) when young of the year make up a significant part of the population.

The spring population density was determined by the total number of overwintered individuals, caught during the whole active season, in 1ha. The autumn population number (N) at the site was determined by the formula M/N = m/n, where M is the number of dormice marked in autumn, m - the number of over wintered dormice caught in spring, n - the total number of over wintered dormice caught in spring. Then density was calculated.

Four main age groups could be distinguished in the *M. avellanarius* population in spring: one-year-old, two-year-old, three-year-old and four-year-old dormice. It should be noted, that one-year-old dormice are those, who had survived one winter, two-year-old animals - two winters, and so on.

Reproductive performance of *M. uvellanarius* was determined by the percentage of breeding females, found in nestboxes (pregnant, with suckling young, with distinct nipples). However, this index was certainly underestimated in all years, because some females breed in natural shelters where they were not seen.

Territorial distribution of dormice was determined by distribution of occupied nestboxes in the sites. We used Pearson's correlation coefficient r to express relations between population parameters: population density in spring and in autumn, percentage of reproducing females, percentage of young in the autumn population, mortality in winter.

During the whole period of investigation, 627 dormice were marked at site **A,** and 1154 at site B. Out of these, 342 (58.0 %) and 492 (42.6 %) animals respectively were recaptured from 1 to 26 times each.

RESULTS

From the data collected, only population density, demographic structure, reproduction, mortality and their correlation are analyzed here.

POPULATION DENSITY. In the two Lithuanian *M. avellanarius* populations investigated population density was comparatively low (0.4-1.5 individuals/ha in spring and 0.9-3.8 ind/ha in autumn). From year to year it varied slightly (Tables 1 and 2). The highest and the lowest density in autumn differed by a factor of only four times at site B, and even less at site A. A more significant decrease in autumn population density was observed in 1987 at site B. It should be noted, that in all cases average density has been calculated based on large areas (60 and 85 ha respectively).

Tab. 1 – Population dynamics of *M. avellanarius* at site A in 1984-1990.

POPULATION CONDITION INDICES	1984	1985	1986	1987	1988	1989	1990	MEAN NUMBER
Population density in spring. ind/ha		1.5	1.2	1.2	1.0	0.7	0.5	1.0
% of males in spring populations	36	53	60	53	53	40	55	50
% of one-year-old dormice in spring		76	56	71	61	61	80	67
% of reproducing females	68	**24**	46	58	70	65	-	55
% of offsprings. horn in May-July		42	56	54	45	55	-	50
Average number of offspring	3.9	3.8	3 9	4.1	3.9	4.4	-	4.0
% of males in offsprings	49	59	48	59	49	49	-	52
% of youngs in autumn populations	77	57	63	64	69	82	-	69
Population density in autumn. ind/ha	3 7	2.9	2.8	2.7	2.7	3.5	-	3.0
Mortality in winter, %	61	59	58	65	73	90	-	68

SEX RATIO. Secondary sex ratio in offspring and tertiary sex ratio in adult dormice were calculated. In separate litters all possible sex ratios from 5:0 to 0:4 were recorded. Generally the secondary sex ratio in separate years is close to 1:1 (Tables 1 and 2), and deviations from this are statistically insignificant. In 1987 site B was an exception, where, at low population density, females strongly predominated among the young. The sex ratio of adult dormice is also very close to 1:1 almost every year. In certain years males in the population declined to 35% or increased to 60% (Tables 1 and 2).

AGE STRUCTURE. During the whole period of investigation at site A (n = 348 animals) one-year-old animals comprised 67 % of the population, two-year-old - 24 %, three- years-old - 8 % and four-years-old - 1%. At site B (n = 486) the figures were 70 %, 23 %, 5 % and 2% respectively. Two marked animals lived even 5 and 6 years respectively. From year to year, age structure changed (Tables 1 and 2), depending on the previous year's reproductive success and the mortality of different age groups. In autumn, young of the same year almost always predominated. Their proportion varied from 48 % to 85 % (Tables 1 and 2).

Tab. 2 – Population dynamics of *M. avellanarius* at site B in **1984-1993**

POPULATION CONDITION INDICES	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	MEAN NUMBER
Population density in spring. ind/ha	-	1 0	0 8	0 6	0 5	0 8	0 8	0 6	0 6	0 4	0 7
% of males in spring populations	50	45	SO	51	49	52	45	46	49	35	47
% of one-year-old dormice in spring	-	78	73	66	60	71	73	65	57	81	69
% of reproducing females	50	44	72	30	78	83	63	72	48	-	60
% ofoffsprings, born in May-July	-	40	36	57	34	46	52	64	62	-	49
Average **number** of offspring	3 5	3 9	3 9	3 4	3 8	3 9	4 1	3 7	4 4	-	3 8
% of males **in** offsprings	47	55	45	18	53	56	47	57	57	-	48
% ofyoungs in autumn populations	74	76	76	48	85	82	71	68	82	-	74
Population density in autumn, ind/ha	3 8	3 1	2 3	0 9	2 7	3 0	2 1	1 8	2 0	-	2 4
Mortality in winter, %	74	76	76	43	73	75	72	68	84	-	71

REPRODUCTION. The proportion of reproducing females varied between 24 % and 83 % from year to year (Tables 1 and 2). Usually it was inversely proportional to spring population density. For instance, at site **A** in 1985, when population density in spring was 1.5 ind/ha, only 24 % of females were breeding. When population density was below one ind/ha, usually 70-80 % of females bred. A striking exception occurred in 1987 at site B (Table 2). In populations investigated on average 50 % of young were born in May-July, the rest were born in August-September. The modal litter size varied insignificantly from year to year, and had no measurable influence on population dynamics.

MORTALITY. Very high mortality during hibernation was characteristic, on average 70% (Tables 1 and 2). The mortality of young born in August and September was particularly high. The spring population density was very dependent on mortality during the previous winter. At site **A** during the first three years of investigations, overwinter mortality was about 60%, and spring density of the population was comparatively high. When over winter mortality reached 70-75%, the spring density was less than one individual per hectare.

Investigations on the population dynamics of *M. avellanarius* revealed close correlation between different indices of population condition. Winter mortality was correlated with age structure in the autumn, i.e. percentage of young in the population ($r = 0.84$; $p < 0.001$). On the other hand, spring population density was related to winter mortality ($r = -0.41$; N.S.), as well as to population density in the autumn ($r = 0.43$; N.S.). The percentage of breeding females was closely related to spring population density ($r = -0.52$; $p < 0.05$). Reproductive performance may also affect population density in autumn ($r = 0.20$; N.S.) also the age structure, i.e. percentage of young in the population ($r = 0.68$; $p < 0.01$). Sex ratio and territorial distribution change little.

This pattern of *M. avellanarius* population dynamics applied when population density in spring was close to 1 ind/ha. When the density declined to 0.4-0.6 ind/ha, changes occurred in territorial distribution. The population split into separate territorial groups (Juškaitis, 1990). Later, reproductive intensity usually increased, and in 1987 at site B changes in sex ratio also occurred - females were considerably more numerous among the offspring. In general, the year 1987 at site B does not fit pattern described above. First, it is unclear why only a few females took part in reproduction at low spring population density. Perhaps it was due to an unusually prolonged breeding season in 1986, when many females, including that year's young, had offspring in September.

DISCUSSION

Data on these two *M. avellanarius* populations in Lithuania can be compared with the data of Likhachev (1966b). The results are rather similar, probably because both Lithuania and Moscow are situated on the northern edge of *M. avellanarius* distribution. Likhachev (1954) indicated, that population density in the Moscow region in 1953 was 3.5 ind/ha, and in the more southern Tula region in 1950 it was 3.2, and in 1951 - 3.9 ind/ha. Thus, his results are very similar to those in Lithuania. Meanwhile according to Lozan (1970), in Moldavia 'the population density of *M. avellanarius* varies from 3 to 15 ind/ha, and usually is 8-9 ind/ha. Density calculated for Czechoslovakia (Gaisler et al., 1977) was 0.12 ind/ha, but this is an unreliable figure according to the authors themselves.

Unfortunately, Likhachev did not determine population density during investigations of *M. avellanarius* in the Moscow region in 1956-1962. He indicated only total number of adult and young animals caught in different years. The data presented show that the maximum number (508 dormice in 1958) differs from the minimum (66 animals in 1961) by eight times, and low abundance occurred during several successive years (Likhachev, 1966a). As mentioned above, in Lithuania, maximum and minimum population density in autumn differed by four times during the period of investigation. Some changes in abundance of dormice over three years have also been noticed in Switzerland (Catzeflis, 1984).

Sex ratios of the compared populations are also similar. In the Moscow region males were on average 52% of adult dormice, varying in different years from 40% to 64%. A preponderance of females was noted in years with low abundance of dormice. Similar trends have been observed in Lithuania: at site B, in which spring population density was lower than at site A, a slight preponderance of females was observed more frequently. Most other authors (Kahmann & Frisch, 1950; Schulze, 1973; Gaisler et al., 1977; Catzeflis, 1984) indicate that males are usually slightly more abundant than females in trapped samples of dormice.

Age structure in the Moscow region was also very similar. During seven years of investigations one-year-old dormice made up 68% of the population, two-year-old - 23%, three-year-old - 7% and four-year-old ones - 2%. Age structure of this population also varied from year to year, depending on breeding success in the previous year, (one-year-old dormice in spring comprised from 47% to 84%). The percentage of two-year-old individuals changed accordingly.

In autumn, during seven years of investigations, the current year's young averaged only 31%, and in different years their proportion varied from 8% to 59%. **All** these figures are considerably lower than in Lithuania. Such a small percentage of the current year's young in autumn in the Moscow region was directly correlated, with less reproductive success. During seven years, only 38% of females (from 18% to 68% in different years) were breeding each year. It is interesting that **82%** of offspring in this Moscow population were born in May-June, while in Lithuania it was about 50%.

According Likhachev, mortality of adult animals varied from 58% to 80% (an average 71% over seven years). Mortality of young animals **in** their first year was only 60% (with variations from 48% to 81% in different years).

Dormouse populations of Lithuania arid the Moscow region show some differences. The population of the Moscow region had a lower percentage of breeding females and this led to a smaller percentage of young in the autumn. But most young were born at the beginning of summer, and comparatively low mortality during their first year was characteristic for them. Due to this, the age structure in spring was similar to that in Lithuania.

According to Likhachev (1966b), *M. avellanarius* abundance is determined by mortality during hibernation. This in turn is dependent on several factors: feeding conditions in autumn and especially winter climatic conditions. We believe, that the warm and snowless winters of 1987 - 1993 in Lithuania were unfavourable for dormouse hibernation. This could have had an influence on the decline of population density in spring in both investigated populations. **As** mentioned above, besides environmental factors, age structure of the autumn population is also very important for dormouse mortality during hibernation.

Therefore, *M. avellanarius* population dynamics are rather similar in Lithania and in the Moscow region. Probably it is characteristic for populations with low density. In other parts of the species' distributional range, where *M. avellanarius* is more numerous (in Moldavia, for instance), population structure can differ significantly.

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