

STATUS OF DORMICE (*MUSCARDINUS AVELLANARIUS*) IN DENMARK

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During 1980–2002, investigations on the habitat types and distribution pattern of the Danish populations of the common dormouse (*Muscardinus avellanarius*) were carried out in Zealand, Funen and selected sites of SE-Jutland. The presence of dormice was investigated directly by observing dormouse visits and nesting activities in nest boxes placed in selected regions and indirectly by searching systematically for summer nests in the vegetation visiting all major woodland areas. A total of 98 forest districts and 248 woods were searched by walking along parallel transects especially after leaf fall. The presence of dormice was confirmed from 31 forest districts, of these 58% in Zealand, 39% on Funen and 3% in SE-Jutland. Typical habitats could be classified as 56% from young woodland growth with scrub, herbs and bushes, 12% from forest regeneration, 26% from marginal areas, 4% in under-storey of high forest and 2% in alternative habitats as fruit-gardens and orchards. The preferred Danish habitat is characterized by permanent stability, high plant diversity, varied groups among trees, a distinctive structure and rich vegetation of herbs and bushes. The regional distribution has been shrinking to few major forest regions or smaller woodland areas too small and isolated from one another for maintaining stable populations. Great effort is now being taken in order to protect the regional Danish dormouse population by means of an action-strategy plan concerning forest management and financial support, a monitoring programme, nest boxes placed to increase the population, genetic analyses and planning faunal bridges by new road and railway constructions.

Key words: *Muscardinus avellanarius*, habitat requirements, conservation programme, Denmark

INTRODUCTION

The common dormouse is the only representative of the rodent family Gliridae, in Denmark. Its postglacial immigration probably occurred c. 10.000 B.C. (AARIS SØRENSEN 1998) with the extension of deciduous forest (including species such as oak, alder, lime and hazel), influenced by a warmer climate. At that time its distribution was more extensive than now, probably due to the fact that it prefers a forest environment of high plant diversity, glades with regeneration, deciduous trees of different age groups and a rich understorey supplying berries and herbs. These conditions favour the dormouse and also provide resting places as well as food and breeding sites. Intensive forestry management, mono-cultures and landscape barriers that obstruct dispersal and re-colonization may be responsible for reduced numbers and distribution.

In Europe, *Muscardinus* distribution reaches its north-western limit in Britain, Sweden and Denmark. Here, as in the main distribution area of central Europe, the populations are small and isolated from one another (BRIGHT & MORRIS 1996, BERG & BERG 1998). In Denmark it is difficult to estimate how the dormouse has managed to cope with changes in the landscape through times as no older surveys are available. However, today the dormouse is one of Denmark's rarest mammals, known only from certain forest areas within a limited region of the central part of the country.

In Denmark the dormouse is totally protected and red-listed (included as "vulnerable") in the national list and has been registered in the IUCN RED List of Threatened Species from 2000. It is also listed in EU Habitats Directive (requiring full protection in its natural areas of distribution) and the Bern Convention (the species must be protected).

In the years 1980–86, 1989–92 and 2001–02, field studies of the distribution of the common dormouse were carried out on Zealand, Funen and in the eastern and the southern parts of Jutland (VILHELMOSEN 1992). The results of these investigations form the basis of present knowledge about the species in Denmark. This paper presents new results from recent searches for dormice, some habitat management proposals and a conservation programme for the species.

MATERIALS AND METHODS

As the dormouse is a nocturnal animal, living and climbing in very dense vegetation, direct observations of dormice in nature are difficult. Characteristic tooth-marks on hazelnuts offer a way of getting indirect information about their distribution pattern (BRIGHT *et al.* 1994). Another useful technique is to search for the characteristic summer nests. These are used for breeding and shelter. They are tightly woven and placed high in the branches, where they may be seen as compact balls if search is carried out after leaf fall in the autumn. Hazelnuts are only used as indications of dormice in a few exceptional, as hazels are rarely found in Danish dormouse habitats. In addition to field searches, dormouse activity in nest boxes placed in dormouse habitats has also been recorded in these studies. These methods of indirect and direct observations complement each another.

Adjacent forest areas (> 50 ha) on Zealand, Funen and parts of Jutland have been examined by walking parallel line transects, 10 metres apart, with at least 2 sample areas examined in each forest area. All parts of the selected forests have been inspected, the impassable areas taking the greatest amount of time. No climbing equipment were used. All localities showing dormouse activity were described, recording forest type, nest characteristics (not presented in this paper), forestry and details of dormice found (not presented in this paper).

RESULTS

A total of 98 forest districts in 7 counties and 248 woods have now been systematically searched. In 58 woods (23.4% of the total investigates) distributed over 31 forest districts (the counties of western Zealand, Storstrøm, Funen and Vejle), nests and living animals have been observed. Of these, 58% were found on Zealand, 39% on Funen and 3% in SE Jutland.

Until 1980, no attempts of systematic and general mapping by means of studies in the field had been made, and knowledge about the distribution was formerly based upon circular letters and museum pieces (WALHOVD 1976). Thus present knowledge of dormice is more detailed and varied. On Funen dormice are now frequent found, but restricted to the southern parts where they occur in smaller woods and hedges connecting woodland areas, as well as in bigger and more continuous woodland areas. On Zealand, the findings were concentrated in three large forest areas, with a few in smaller woodland areas. The findings of dormice from Jutland are unprecedented and concentrated to SE Jutland. In subsequent years, re-examination of the distribution of the Danish dormouse population will be possible.

Typical habitats of the Danish dormouse populations can be classified as:

- young woodland growth age group of 10–15 years (56% of the total investigates);
- deciduous woods (oak, ash, beech) with an almost “scrub” characteristics and many horizontal shoots;
- mixed cultures of deciduous and coniferous woods where bushes have not been cleared, under-storey includes raspberries, blackberries, ferns and high-growing weedy vegetation, besides climbing plants (e.g. honeysuckle, ivy);
- marginal areas in or along coniferous woods with regeneration of ferns, weeds and soft fruits;
- forest regeneration (12% of the total investigates);
- deciduous wood e.g. in glades, clearings, fire breaks, along the edge of high forests and forest paths;
- scrub vegetation surrounding forest bogs, edges of ditches and forest brooks;
- marginal forest areas (26% of the total investigates);
- woods being left without forest management or cultivated by means of very mild thinning;
- thick, well-planted edges of wood with high diversity of light-sensitive trees, especially native, thorny and fruit-carrying bushes (e.g. blackthorn, hawthorn, raspberries, blackberries);
- hedges connecting woodland areas with the above-mentioned characteristics;

- high forest (4% of the total investigates);
- high deciduous woods where thinning allows development of horizontal shoots and glades where under-storey and stratification of trees may be promoted;
- glades in soft-woods with regeneration of deciduous woods, if they are situated near areas of deciduous forest;
- alternative habitats (2% of the total investigates);
- fruit-gardens and orchards near woods containing dormice.

The preferred Danish dormouse habitat seems to be characterized by permanent stability, high plant diversity, varied age groups among trees, a distinctive physical structure (with spreading lateral branches) and plenty of light reaching the under-storey of herbs and bushes, allowing vigorous regeneration, flowering, fruiting and seeding.

DISCUSSION

Mapping the distribution of smaller mammals often depends upon a combination of direct finds (e.g. living individuals caught by trapping, occasional observations of wild animals, dead specimen) and indirect methods (nests, signs of feeding activity, faeces, pellets from owls and birds of prey). Dormice are not easily captured using traditional traps, although Ugglan traps placed high in the vegetation and baited with fruit have been used in Sweden (BERG 1997) or rat traps (BERG & BERG 1999). Nest boxes for resting or breeding have been used for dormice research studies all over Europe, for example in the United Kingdom (BRIGHT & MORRIS 1990a) and in Lithuania (JUŠKAITIS 1999), from which direct evidence of the presence of dormice and other useful biological information may be gained. In Denmark results from nest boxes have been obtained from central Zealand, the south of Funen and the east Jutland (VILHELMOSEN 1992). The common dormouse has generally maintained populations in a number of woods (23,4% of the total investigates of this study) in Denmark. However, in spite of new findings, some of them in hitherto unknown regions and habitat types, the Danish regional distribution of dormice has apparently been shrinking to certain forest regions. Even within woods with well established populations, only few areas are considered as high quality habitats suitable for maintaining stable populations. Many areas of habitat seem to be too small, isolated from one another and lack diversity. Their populations may thus be susceptible to local extinction (BÜCHNER 1997). The most favourable habitat (permanent scrub and bushes, smaller forest cleanings and the botanically diverse fringes of high plant diversity of forest edges)

is vanishing due to intensive forestry. Dormouse populations are further endangered because of the fragmentation of woodland areas due to change of use (BRIGHT & MORRIS 1990*b*).

Fresh initiatives have been brought into effect recently, in order to protect the common dormouse in Denmark and to reduce the decline of the species:

- an action-strategy plan concerning forest management and financial support (ratified by the Ministry of Environment – and Energy, the Danish Nature and Forest Agency 2000);
- a national monitor programme and county registrations of dormice;
- nest-boxes throughout dormouse habitats to safeguard and increase dormouse population;
- genetic analyses in order to study the “bottle-necked” effect caused by fragmentation;
- ministerial acceptance of constructing two 50 m wide fauna passages crossing a highway in a dormouse mosaic landscape.

The action-strategy plan has as its overall object, ensuring a favourable survival status for the common dormouse in order for it to maintain a viable population in its natural areas of distribution in Denmark (Miljø- og Energiministeriet, Skov- og Naturstyrelsen 2000). The realization of this plan is directed towards more suitable forest management for dormice by e.g. having a higher diversity of trees, bushes and herbs, different age groups of woody vegetation, a proper physical structure, ensuring broad corridors connecting habitats and establishing inner/exterior fringes of high diversity. The Plan also suggests possibilities of financial support through co-operation between the Danish Nature and Forest Agency, Danish Forest Society. Better exchange of information between local groups and experts is suggested and also promoting better routes of dispersal in the landscape.

In order to get further information about the distribution and details of the well-known populations, monitoring programmes and local county registration have been instigated. An up-dating of known habitats in the county of Storstrøm from 2001–2002, a registration of the distribution pattern in SE-Jutland, the county of Vejle from 2001–2003, projects for demonstration in the State Forests of Funen and Odsherred (Zealand) and a mapping project in selected areas in the “Danish Atlas Programme” (mapping of all Danish Mammals) from 2000–2003 are examples of current dormouse projects.

In order to safeguard dormice, their breeding activity and habitat qualities, nest-boxes have been put up in selected woodland areas in Jutland (about 200 boxes), Funen (more than 700 boxes) and Zealand (about 200 boxes), primarily in the State forests. Valuable information on the general biology of dormice may be obtained, and the nest-boxes also serve as a management tool, for educational pur-

poses and for attracting public interest. Some of these nest-boxes have been adopted by school classes and nature organisations, and in the future, nest boxes will also be extended among private forest owners too.

The genetic composition of the dormouse population in selected areas will be studied, focussing on DNA-microsatellite variation. Small tissue cultures from the ear lobe (2 × 2 mm) of anaesthetized dormice are being collected. When primers for nuclear and mitochondrial DNA of the common dormouse have been found, it is hoped to get information about genetic relationships in order to study the “bottle-neck” effect caused by habitat fragmentation. Similar studies of other European dormouse populations could be the beginning of co-operative research into immigration history.

Isolation of populations and fragmentation of habitats for instance by means of new road and railway constructions are increasingly a problem for the survival of Danish dormice (RODRIGUEZ *et al.* 1996, VILHELMOSEN 1999). A new four track highway cutting through dormouse landscapes on Funen is contemplated. In order to fulfil directives and protective measures, the alignment of this highway has been modified, saving some woodland edges. In addition, two 50m faunal bridges will be constructed, with new forest plantation, as connecting links between different areas that would otherwise become separated.

In spite of these different strategies, initiatives and new finds, the future status of local populations of dormice in Denmark is still uncertain. Great effort must be made in future to extend studies of dispersal, re-colonisation and the impact of infra-structure development. Monitoring and appropriate forest management will also be needed to maintain a stable dormouse population in Denmark.

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