



**Elżbieta
Jancewicz,
PhD, DSc**

is an Assistant Professor at the Department of Forest Zoology and Wildlife Management at the Institute of Forest Sciences of the Warsaw University of Life Sciences (SGGW). Her work focuses on small mammals – rodents and shrews. She studies the spatial behavior of rodents and the environmental conditions of their distribution at the micro- and macro-scale.
elzbieta_jancewicz
@sggw.edu.pl

HOME, HOME ON THE RANGE

There are currently more than 5,800 species of mammals in the world. They exhibit complex patterns of spatial organization in how they function in their habitats and in how they relate to other individuals of the same species.

Elżbieta Jancewicz

Warsaw University of Life Sciences (SGGW)
Institute of Forest Sciences
Department of Forest Zoology
and Wildlife Management

All animals compete for space. How much space they need depends on many factors: their body size, season, lifestyle, the type and availability of food, the intensity of reproduction, their method of raising young, and the quality of the environment. If we decide to study the influence of just one of these factors (e.g., body weight), we must remember that in wild land mammals – of which we have more than 100 species in Poland – the variation in body weight is quite large: from a few grams up to several hundred kilograms. And despite what you might expect, it's by no means true that the smallest species require the least room.

Each individual animal functions within a specific space, in a specific part of the environment. There it finds shelter, acquires food, reproduces, interacts with other individuals. This space, referred to as an individual's "home range," has a certain size and shape, and is related to the sex of the individual and the season. In some mammals or some individuals of a certain sex (which varies by species), the space is actively defended against other individuals, then we speak of territory. The distribution of the ranges/territories of males and females in the environment and the spatial interrelationships between individuals of different sexes tell us about the spatial organization of the population. This organization changes to some extent, not only depending on the abundance of

food in a given year, but also depending on the population density, predator pressure, and competition. In more abundant ecosystems, home ranges tend to be smaller, providing sufficient food and shelter sites for animals. Wherever food is less abundant, where resources are not very renewable, and where food must be sought over a larger area, the home ranges maintained by individuals of the same species must be larger.

Spaces

Large herbivorous ungulates need a lot of room. Poland's largest mammals, the bison, roam over a large area. In the Białowieża Forest, the individual ranges of adult female bison (known as cows) – which were therefore also the home ranges of the mixed groups in which these females lived from spring to autumn – have been found to vary in size from 45 to as much as 100 km². Such a large variation had to do with the type of environment. Smaller home ranges were maintained by bison residing in meadows and feeding glades, while larger ranges were maintained by bison residing in forests. Male bison (known as bulls, living alone or in small groups) occupied home ranges slightly larger than cows, varying from 29 to 152 km². Before winter, the spatial distribution of bison shifts to a different mode: they join together to form large mixed groupings, numbering of dozens of individuals. Adult males live alone or form small groups, only periodically joining such mixed groups.

Unlike bison, red deer show a wide sex-based variation in the size of their individual ranges. Over the course of the year, family groups of does (female deer), together with this year's and the previous year's young, moved around home ranges of up to 13 km². On the other hand, much larger and heavier males, living alone or in small groups of 2-5 individuals,

maintained home ranges as large as 38 km². Such large differences in the size of the home ranges of does vs. bulls have to do with their reproductive strategy. The individual ranges of bulls overlap to a large extent with those of doe belonging to different groups.

Roe deer (Poland's smallest ungulates), in turn, have small individual territories: from less than 1 km² up to several square kilometers. Starting in early spring, roebucks (male roe deer) intensively mark their territory and actively defend it against other males. The territories of roebucks remain separate and overlap with the territories of many females. In spring and summer, females (doe) raise their young alone, while males live alone. Larger groupings (of up to seven individuals) are found only in late autumn and winter.

Small world

Small herbivorous mammals, usually weighing less than 50 grams, are characterized by strong fluctuations in population numbers and intensive reproduction usually lasting from spring to autumn. Small rodents living in open areas have at their disposal almost exclusively herbaceous vegetation. The bio-

mass of undergrowth plants is high, so such areas offer high food availability. Small rodents living in temperate forests with the same climate conditions, on the other hand, rely on two main food sources: undergrowth vegetation and seeds (especially heavy tree seeds). However, to the low availability of light in forests, the undergrowth vegetation is much poorer, and the abundance of seeds is cyclic – and so the availability of plant food in the forest is lower than in open areas. Only in deciduous forests with a highly varied species composition of heavy-seeded trees can the availability of seed food autumn and winter seed food persist more stably over time and change less abruptly. Regular fluctuations in rodent population numbers of a seasonal and perennial nature, occur on the one hand due to the abundance of food, easy access to it, the associated increased reproduction rate of rodents, higher survival rates, lower mortality, and on the other due to competition and predation cause. This is reflected in the spatial organization of the population of small mammals.

In well-studied root vole populations, the size of individual home ranges has been found to be related not only to the sex of individuals, but also to population density. Telemetric data supported by live-catching



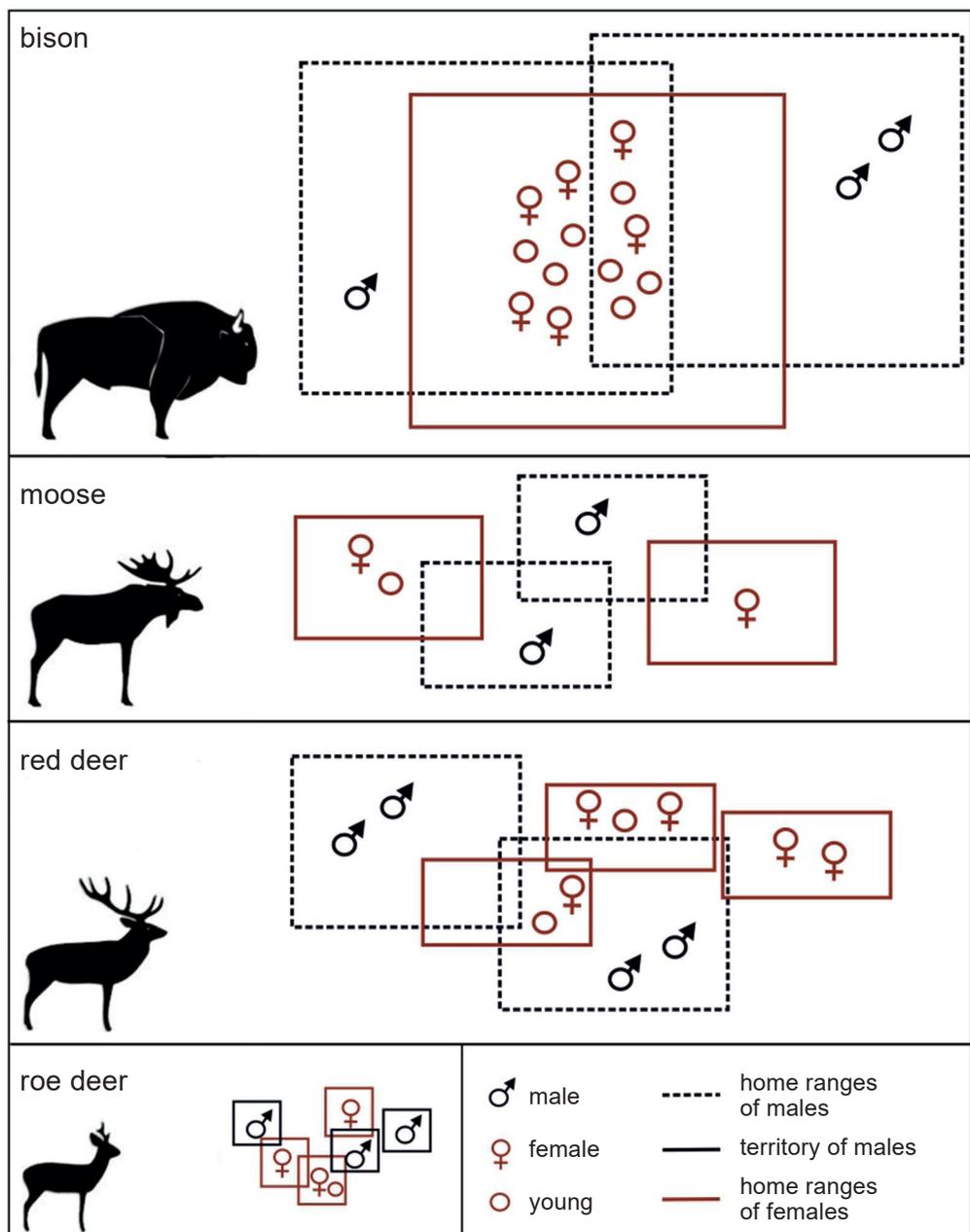
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data has shown that at low and medium densities, females of this species are territorial, with their territories located in the best available sites. However, the situation changed as population densities increased. At high densities, not all females were able to settle in the best sites and were forced to occupy slightly inferior sites as well. In such a situation, all the females had smaller home ranges and allowed for close proximity to related females, and even partial overlap with neighboring home ranges of other females.

Studies done on voles have confirmed an important hypothesis in ecology: that the spatial distribution of females depends on the distribution of resources, whereas that of males depends on the distribution of females. Females raising offspring are forced to ensure

the best possible access to food for themselves and for their young. Round-the-clock telemetric observations have shown that females leave their burrows only briefly and do not venture far, foraging near the burrow and repeatedly returning to it, presumably to feed their young. Males, on the other hand, are interested in mating with as many females as possible, so their ranges are sometimes as much as three times larger than those of females. In autumn, when the breeding season ends, female root voles cease to be territorial. Their individual ranges become larger, more similar in size and shape to those of males. Juvenile females tend to settle near their mothers and sisters, while males look for free places to settle and may undertake slightly further migrations.

Schematic of the social organization of ungulate mammals.
 Source: Daleszczyk K., *Systemy rozrodcze ssaków kopytnych* [Reproductive Systems of Ungulates], in: Jędrzejewska & Wojcik (eds.) 2004



Although some researchers have questioned the persistence of small rodents' home ranges over time, voles have been found to be quite attached to their locations. Extensive catching work, documenting the specific life histories of the individuals, as well as intensive telemetric studies and analysis of daily ranges have confirmed that voles persistently occupy the same locations. This makes spatial relationships in the population orderly and the spatial arrangement stable.

Small rodents and large ungulates are important links in the food chain, and are important sources of food for predators. It is known that, to some extent, the presence of predators modifies the behavior of prey, irrespective of their size, and affects their activity and movement patterns. However, the population densities and availability of prey also modify the spatial behavior of mammalian predators.

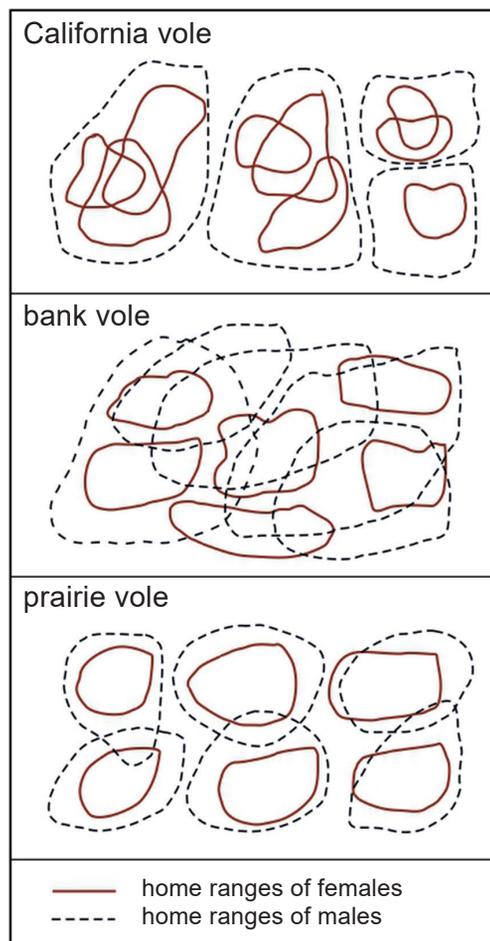
Carnivorous mammals

Much like in herbivores, seasonal changes in the size of individual home ranges of mammalian carnivores are also related to the reproductive cycle, to the availability of food, and to the quality of the environment in general.

Wolves live in packs made up of a breeding pair plus their pups from this year and earlier years. The size of wolf packs ranges from two to usually 4-5 individuals, but much larger groups can also sometimes be encountered. In the Białowieża Forest, the annual ranges of the wolf packs were found to cover 140-320 km², varying seasonally. The smallest home ranges of wolf packs are observed in spring, when newly born pups remain in the burrows. The pack's range increases in the subsequent weeks, to reach its maximum size in winter. Wolves make use of their home range on a rotating basis, hunting in the same place every few days. This limits the extent to which they disturb their prey, mainly ungulates. When prey become scarce, wolves have to hunt over a larger area, so during periods of low food availability, each pack's home range becomes much larger.

Poland's largest felines, lynxes, on the other hand, are loners, maintaining very large territories. The average size of the individual territories of males in the Białowieża Forest varies up to 250 km². The ranges of reproducing females are about half that size, while those of juvenile individuals smaller still. During the period of caring for cubs, adult females limit their activity to 7-14 km² in the immediate vicinity of the burrow. Over time, to meet the food needs of their own and their offspring, females hunt over a much larger area.

The mammals in the shrews family, which are extremely voracious and predatory, despite weighing just a few grams to tens of grams need to maintain truly large ranges to ensure that they get enough food.



Schematic representation of modes of spatial organization in different species of voles. Adapted from: Ostfeld R.S., The ecology of territoriality in small mammals, *Tree* 1990, 5(12)

Their high energy requirements and associated food demands force shrews to intensively defend their territories against intruders. In the abundant habitats of the Białowieża Forest, the largest shrews in this group, the water shrews, require as much as 430 m², more than other rodents of similar body mass. The territory of the much smaller common shrews is even larger, at around 790 m². In poor environments, the territories of these mammals must be still larger. All available space gets divided up between individuals and is constantly patrolled by the owners of territories, seeking food.

As these examples serve to show, every ecosystem is a spatially complex structure in which every organism must find its own place. In this network of dependencies, the living space of some organisms is very often determined by others. Through the successive periods of the year, the individual factors of predation and competition for food, shelter, and reproductive partners variously shape the spatial relations between individuals of the same species.

In the complex food chain, successive links and relationships between species are formed. In this seemingly chaotic system, spatial relationships are in fact often strictly ordered and governed by specific laws. ■

Further reading:

Jędrzejewska B., Jędrzejewski W., *Ekologia zwierząt drapieżnych Puszczy Białowieżskiej* [Ecology of Predatory Animals of the Białowieża Forest], 2001.

Jędrzejewska B., Wójcik J.M., (eds.) *Eseje o ssakach Puszczy Białowieżskiej* [Essays on the Mammals of the Białowieża Forest], 2004.