



Eco-cinegetic Management in Romania's Maramureş Forest District

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Authors' contributions

This work was carried out in collaboration between both authors. Author BVC designed the study, performed the literature searches, and wrote the first draft of the manuscript. Author ANH managed the analyses of the entire study. Both authors read and approved the final manuscript.

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ABSTRACT

Hunting has been one of the first major concerns of humans since their appearance on this earth for many thousands of years. For the civilized world, however, the hunting activity made huge leaps of content, manifestation, and attitude, eventually reaching to be defined as a cultural, educational, recreational, sports, and even art activity. The present paper has as a subject the national hunting fund, having as a case study, the hunting fund of Maramureş county, specifically, the Vişeu district. We presented the national situation regarding the hunting fund, and only later, after reviewing the definition and characteristics of hunting, we started to present the data for Vişeu district hunting fund, noting that it has a significant hunting potential supported by sustainable management that may still involve adjustment, improvements, and assignment of methodologies, strategies and good environmental practices.

Keywords: Biodiversity; hunting management; forest resources; sustainable development.

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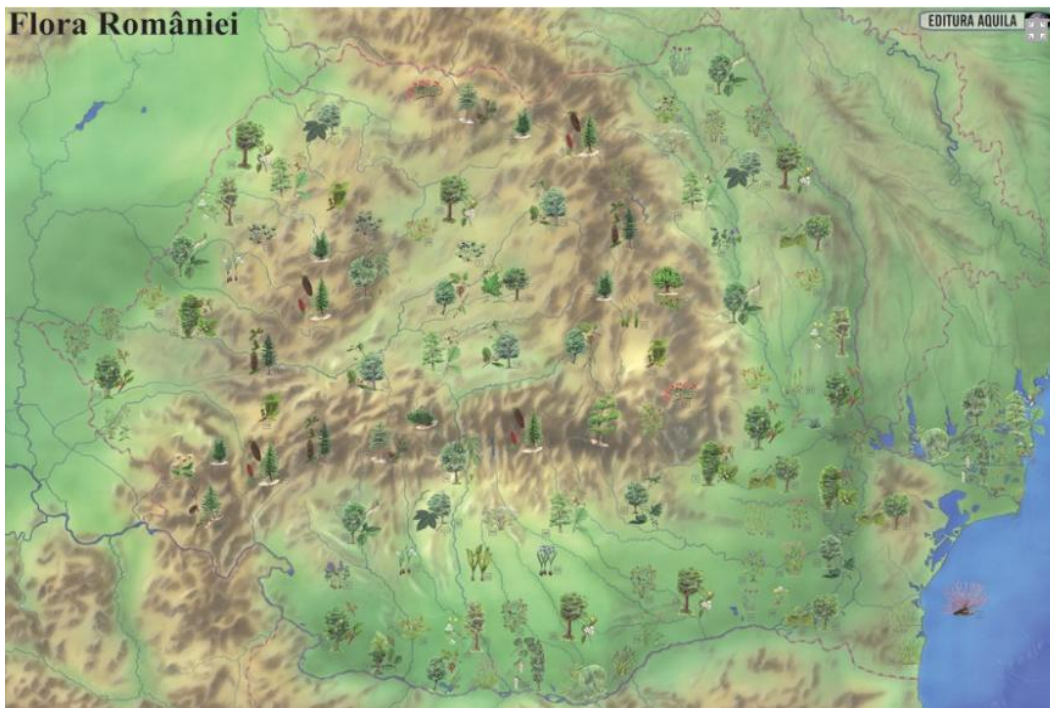
1. INTRODUCTION

Hunting has been one of the first major concerns of humans for many thousands of years. For the civilized world, however, the hunting activity made huge leaps of content, manifestation, and attitude, eventually reaching to be defined as a cultural, educational, recreational, sports, and even art activity [1]. This concept has been imposed since the current balance of nature is no more a natural balance in the true sense of the word; but it remains as a balance in a state of relative stability, by wise intervention, environmental and economic reasons, and human factors [2].

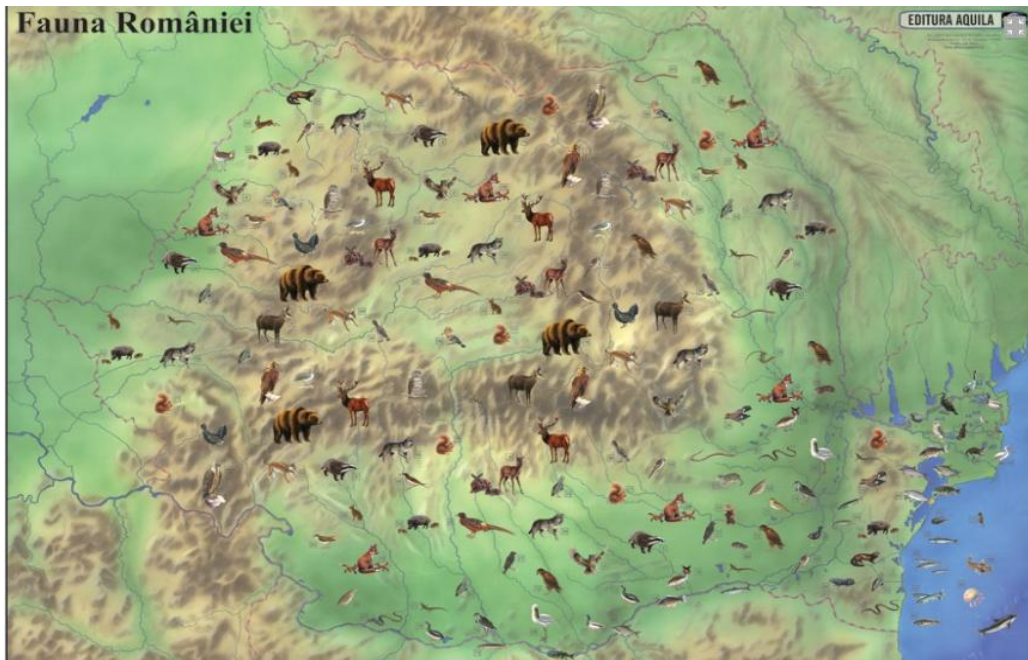
Romania, through its geographical location and the relief with which it was endowed by mother nature, was a chosen land, richly adorned with gifts of nature, including forests and wildlife. Romania's wildlife - well represented numerically, as a diversity of species and as a value of trophies, has been a subject of passion and hunting activity for all social categories, from crowned heads to ordinary people, remaining each time, from one generation to another, enough and richly hunted to this day. As it is known, Romania is a country with great biodiversity and a high percentage of intact

natural ecosystems [3]. Furthermore, in our country, there is still the largest area of natural forest in Europe, and on its territory, there are many colors of biodiversity migration. The high level of ecosystem diversity and geographical location is reflected in the floristic richness (over 3,500 different species) and fauna (over 30,000 species) [4,5], as shown in Fig. 1 [6]. In Romania, there are 2,147 hunting funds. The average surface of a hunting ground is approx. 10,000 ha. In any hunting ground, there is a species of game that has a higher value from a hunting point of view.

This species is called the main game or main hunting resource. Viewed in this respect, the hunting fund of Romania is divided as follows: rabbit - 15,200,000 ha, deer - 3,900,000 ha, red roe - 2,800,000 ha, chamois - 220,000 ha and 545,000 ha for the secondary game [7,8]. The hunt is reunited in centrally managed hunting funds in a hierarchical order by the relevant ministry. Of all hunting reservations, a small number have protected areas and a special regime. The main game in Romania is the hare, spread over about 15.2 million hectares, practically on the entire area between the alpine gaps and the coast.



(a) Representation for the Romanian flora



(b) Representation for the Romanian fauna

Fig. 1. Distribution of flora and fauna species in Romania

2. MATERIALS AND METHODS

The research methodology started from going through specialized literature, to be able to identify the particularities of the area under study. Only in this way was it possible to describe the area, the ecological framework, and implicitly the biodiversity and the hunting potential. In addition to the documentation regarding the two aspects, the documentation regarding the history of the hunting activity, respectively the regional and local hunting potential was also targeted.

After outlining some peculiarities that the biodiversity of the area presents, a series of maps were exhibited based on the hunting quotas and the eco-hunting regime. The latter attests to the area of the hunting species considered, with the positioning of the forest schools, the last remnants that function according to the principles of sustainable exploitation of resources.

3. RESULTS AND DISCUSSION

3.1 The Ecological Framework from the Vișeu Forest District

The forest fund managed by the Maramureș Forestry Department is located in Maramureș

county, a county located at the northwestern limit of Romania, with an area of 145,518 ha, owned by the state. It is rounded as follows: 14 forest districts with areas between 4,344 ha (Șomcuta Mare) and 25,717 ha (Poienile de sub-Munte), 44 forest districts, 254 forest cantons and trout [9].

With a variation of the relief elements with great amplitude, the forest fund is distributed in the low area of the banks of the Someș, up to the alpine hollow of Pietrosului Rodnei (2303m). In the northern part, the Eastern Carpathians are divided into two branches inside the county: Rodna together with the Northern Volcanic Carpathians and the Maramureș Mountains, which close the depression of the same name.

On the south lies an area connecting the Eastern Carpathians and the Apuseni considered a strip of the "Hidden Mountains" of Transylvania, from which rise the crystalline massifs Preluca, Prisaca and Codru. At the foot of the volcanic mountains lies the depression corridor Baia Mare - Copalnic - Lăpuș [9]. The eastern limit stretches from the top of Preluca Căței to the Bistrița Aurie river. To the west, it stretches from the top of Pietroasa (1200 m) of the Oaș Mountains, along the rivers Someș, Tisa, and Crasna to the northwestern border of Romania with Hungary.

The Maramureș Forestry Department is set up as a resource manager within the group set up in order to obtain the FSC certificate. The group consists of several forest districts with an area of 60,755 ha of forest, as follows [9]: Firiza - 10,332 ha, Groșii Țiblesului - 11,798 ha, Mara - 18,029 ha, Strâmbu Băiuț - 12,710 ha, Tăuții Magherăuș - 8,908 ha, Vișeu - 32,441 ha, Baia Sprie - 11,012 ha, Dragomirești - 18,240 ha, Poieni - 30,366 ha, Sighet - 9,277 ha, Șomcuta Mare - 9,584 ha, Târgu Lăpuș - 13,088 ha, Ulmeni 9,388 ha.

The surface of the state forest fund - 23,685 ha, managed by management contracts 2,023 ha and 787 ha with forestry services, is rounded in several districts, 22 cantons, and 2 hunting funds. The initial surface of the Vișeu forest fund was 35,695 ha, of which 12,010 ha have been returned, according to the land fund laws, until now 12,010 ha [10].

The afforestation percentage of the Vișeu Forest District is 98.6% (the afforested area is 23,372 ha, and 313 ha represent other lands such as nurseries, lands serving production needs, lands serving forest management needs, lands affected by afforestation, unproductive land). The composition of main species is: 75% MO, 2% BR, 19% FA, 1% PAM, 1% DT and 1% DM. The structure of age classes is as follows: 12% I (1-20 years), 20% II (21-40 years), 21% III (41-60 years), 14% IV (61-80 years) 10% V (81-100 years) and 23% (101-120 and over) [10].

The share of the two functional groups is 97% group I and 3% group II. The remaining possibility for the last year of arrangement is 56.5 thousand m³, of which 30.3 thousand m³ main products, 13.2 thousand m³ by-products (mainly from thinning), and 13 thousand m³ hygiene. Care work: clearing 151.2 ha/year, cleaning 108 ha/year, thinning 550 ha/year. The main access road to Vișeu is the forest railway with a total length of 42 km, which represents the accessibility of the area of 24%, and the forest roads make the area accessible in a proportion of 60%.

3.2 The Biodiversity and Potential of Hunting in Vișeu Forest District

As peculiarities of the hunting fund, significant in terms of trophies and the number of individuals, were identified in the Vișeu district as follows [10]: chamois (*Rupicapra rupicapra*), roebuck (*Capreolus capreolus*), deer (*Cervus elaphus*),

birch rooster (*Lyrurus tetrix*), mountain rooster (*Tetrao urogalus*), pheasant (*Phasianus colchicus*), hare (*Lepus europaeus*), wolf (*Canis lupus*), wild boar (*Sus scrofa*), lynx (*Lynx lynx*), Carpathian bear (*Ursus arctos*), and fox (*Vulpes vulpes*).

The chamois (*Rupicapra rupicapra*) - as shown in Fig. 2a - has an estimated longevity of 18-23 years, although research on short specimens has not established ages older than 15 years. Regarding the biotope, we can say that originally the chamois seems to have been a forest animal, stationed towards the limit of the alpine hollow [11]. Later, driven by the uneasiness caused by human activity, he adapted to life in rocks inaccessible to man, located above the upper limit of the forest; and some forested rocks have proved suitable for the species. Through periodic movements towards the forest, when it snows, and towards the mountain hollow, where the snow is quickly scattered, especially when in the forest the snow layer prevents its movement, it manages to choose, permanently, the most favorable conditions for feeding and living. For these reasons, complementary feeding to the black goat is not necessary, although it readily accepts human-administered food. The world record trophy was hunted in the autumn of 1934 in the Făgăraș Mountains, on Răutățile Gârdomanului.

The roebuck (*Capreolus capreolus*) - as shown in Fig. 2b - has an estimated longevity of 12-15 years; from the age of 8, the male trophy regresses due to aging. The age is easily assessed after the wear of the teeth in the shot specimens, and in the living ones, depending on the external appearance and the trophy [11]. The deer prefers forests and groves from the mountains to the plains, as well as the vast agricultural area in the plains area. It is also found in the forests, in the ridges, and agriculturally cultivated enclosures of the Danube Delta. However, the small forest bodies, located in the middle of the agriculturally cultivated lands, from the plains and on the hills, are very favorable for the species.

The common deer (*Cervus elaphus*) - as shown in Fig. 2c - has longevity appreciated in the wild, at a maximum of 18-20 years, but in nature, this age can rarely be reached. Between the ages of 12 and 14, the deer are at their peak, after which they gradually enter decrepitude. The age of the living specimens were assessed according to the external appearance and the trophy, and that of

the animals shot after the wear of the teeth and certain elements of the trophy [11]. The deer, which was originally a low-altitude animal, was gradually pushed by civilization to mountain areas. Now the deer is perfectly adapted to mountain areas with large forests, which include parquets and enclaves, as well as water springs, so the areas that provide them, at the same time, the necessary conditions of peace, shelter, and food.

The birch rooster (*Lyrurus tetrix*) - as shown in Fig. 2d - is widespread in northern Europe and Asia. It is sedentary, being found in some places in the north of the Eastern Carpathians and the Maramureș mountains (Cârlibaba Forest District, Vișeu Forest District, Borșa Forest District, etc.). It prefers rare birch forests or junipers in the area bordering the forest [11].

The mountain rooster (*Tetrao urogalus*) - as shown in Fig. 3a - has an estimated longevity of

18 years, which seems exaggerated. The age category of the live mountain rooster is assessed only by the way the tail fan opens, by the length of the tail in proportion to the body and by the way it "sings" [11]. In the shot rooster, the age is estimated with some approximation by the shape of the beak, by the shape of the connection to the beak of the head, by the groove on the beak, by the size of the "chin", by the clarity of the white spots on the tail, which fades with age. safer, depending on the length and terminal shape of the tail feathers. It prefers pure coniferous forests and the lower limit of the alpine hollow, but it is also found at the upper limit of mixed forests throughout the Carpathian chain, being present in greater numbers in the Eastern Carpathians. In the glandular stomach of roosters and mountain, hens are found swallowing pebbles to aid digestion (grinding and crushing food), known as "gastroliths".

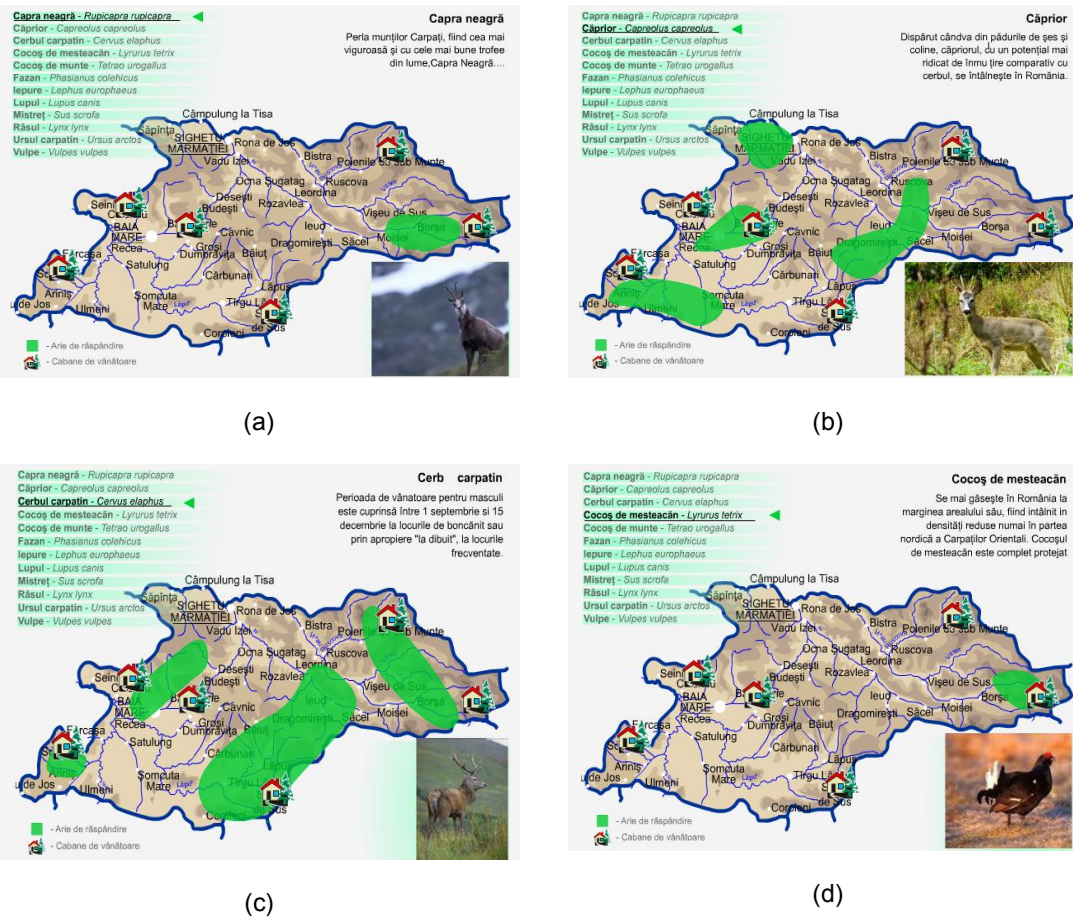


Fig. 2. Distribution maps of chamois, roebuck, common deer and birch rooster within the Vișeu forest district

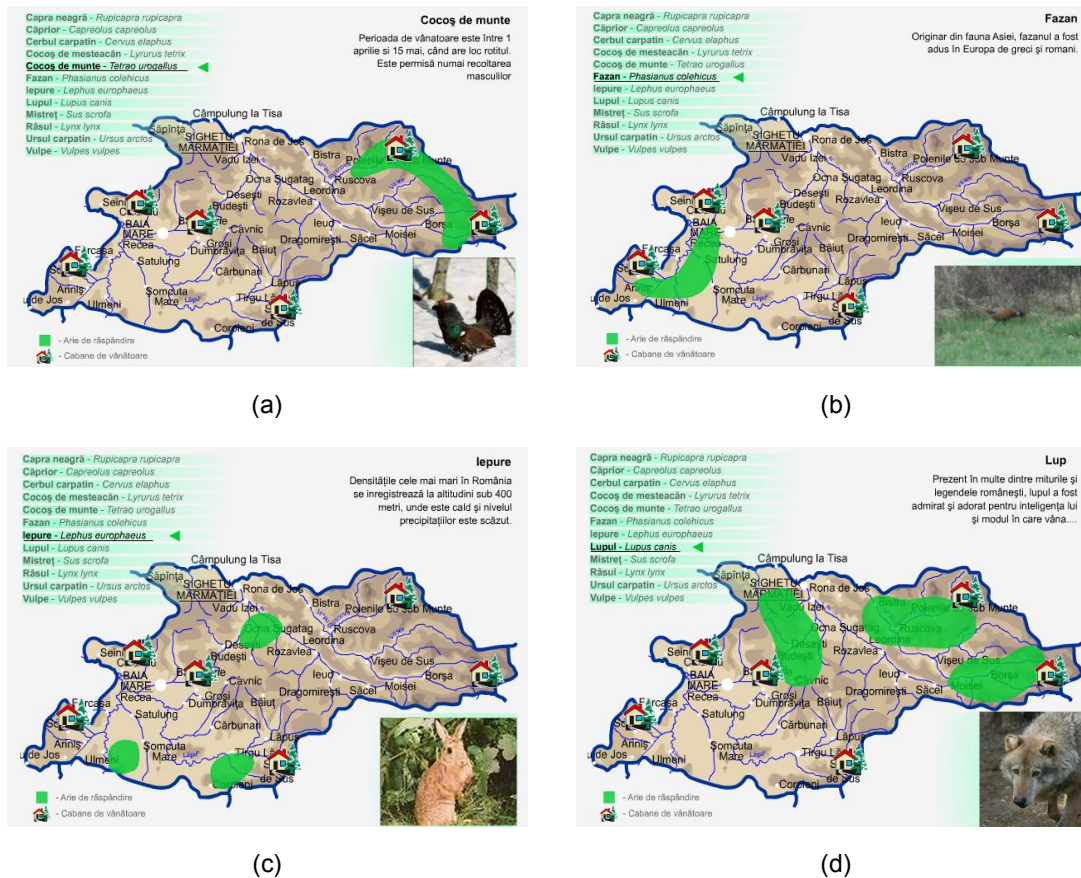


Fig. 3. Distribution maps of mountain rooster, pheasant, hare and wolf within the Vișeu forest district

The pheasant (*Phaseinus colchicus*) - as shown in Fig. 3b - has an age appreciated only by the size and shape of the spur, which grows, sharpens, and curves over the years. It is estimated that, in the wild, pheasants cannot survive more than 4-5 years. It prefers small, thickly forested forests, groves, and ridges on hills or streams, especially if they are difficult to penetrate and surrounded by agricultural land [11]. To a greater extent, it is looking for large reeds, swamps, especially those that have springs and do not freeze, as well as agricultural fields that remain dormant. In these biotopes, the pheasant is located mainly due to the good and diverse conditions of shelter and food.

The hare (*Lepus europaeus*) - as shown in Fig. 3c - lives a maximum of 10-12 years. However, the specimens from the first 3 years of life are predominant. Only wadding can be easily distinguished from older specimens by the characteristic protrusion of the foreleg, the appendage of the orbit, or the fragility of the

forelegs [11]. The method of determining age is based on the weighing of the lens. We meet it from the alpine hollow to the seashore, in almost all types of biotopes. It avoids only swamps and aquatic biotopes to some extent. Shows preference for agricultural land in lowland areas, hills, and low hills, where small forest bodies are scattered.

The wolf (*Canis lupus*) - as shown in Fig. 3d - lives up to 15-16 years. Like the bear, he prefers the vast mountain forests. It often descends in the region of high hills, settling in extensive and frequent forest regeneration, or in deep ravines covered with thorns that are difficult to pierce. It is also accidentally found in the plain area [11]. Sometimes it also appears in the south of Dobrogea, certainly coming from Bulgaria. Although attached to the occupied territory, the wolf is not stationary, changing its place of residence daily. In the vast territory he masters, he travels up to 30-40 km, and even more, in a single night, when the feeding needs impose it.

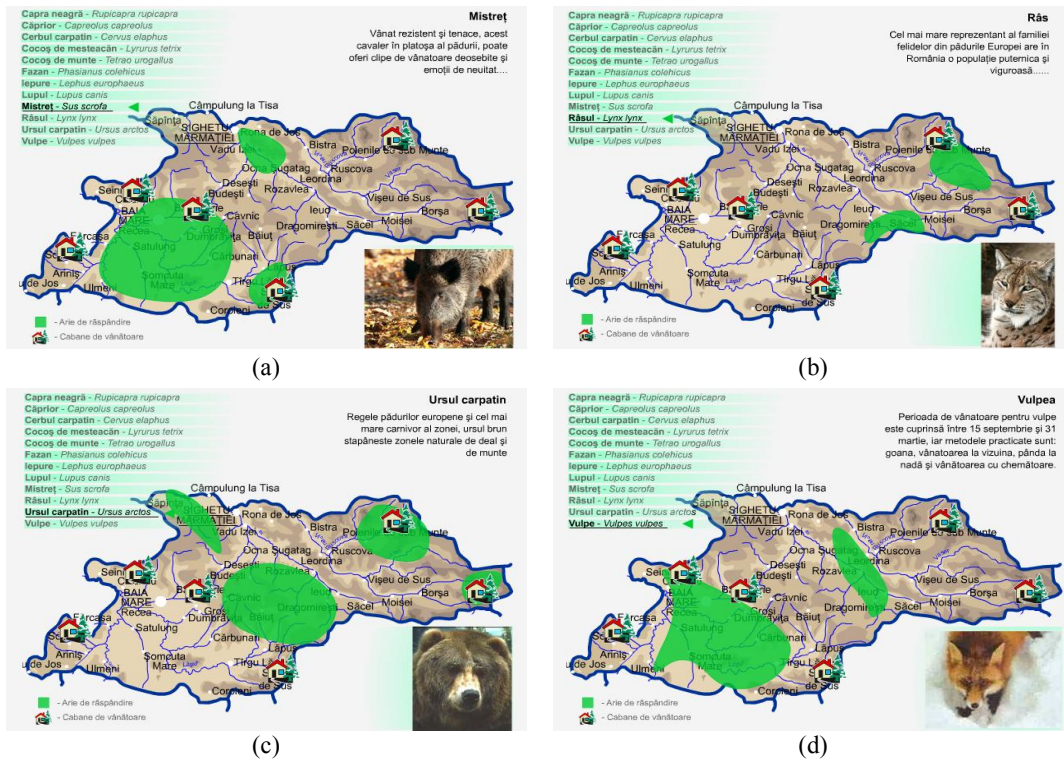


Fig. 4. Distribution maps of wild boar, lynx, Carpathian bear and fox within the Vișeu forest district

The wild boar (*Sus scrofa*) - as shown in Error! Reference source not found.a - in conditions of freedom, reaches 18-20 years; In captivity, however, this age is frequently exceeded, being cited in the literature longevity of 30 years in zoos. It prefers large deciduous and mixed forests but is also frequently found in small forest bodies if they are dense, as well as in reeds and meadows [11]. It is sometimes found in summer even in large cereal fields in agricultural fields. Due to the very high ecological amplitude, the wild boar area practically extends from under the mountain hollow to the seashore. It is attached to the place of living only insofar as it provides the necessary conditions for living (food, peace, and shelter). In situations where these conditions do not satisfy him, he travels up to 30-40 km and even more, in search of more favorable places.

The lynx (*Lynx lynx*) - as shown in Error! Reference source not found.b - lives 12-14, a maximum of 18 years. It prefers large and quiet forests located at high altitudes. But it also descends in areas of high hills. It is generally attached to its habitat, but in the absence of food,

it makes relatively long journeys of up to 40-50 km [11].

The Carpathian bear (*Ursus arctos*) - as shown in Error! Reference source not found.c - has an estimated longevity of 25-30 years. Some authors believe that the bear can reach older ages, up to 40 years. The age of living specimens is estimated only by shape and size, and of specimens shot by dentition, which turns yellow and at which blunting begins after 6-7 years [11]. At the age of 10-12 years, the canines become almost brown and the blunting is visible, and at the age of 15, the blunting of the incisors and masses affects about 1/2 of the initial length. After 20-25 years, the incisors are blunted at the gums, only abutments remain in the canines, and the masses from the center are almost finished. Its territory, very wide, usually includes rocks, fellings, or thickets where the bear can arrange its lair, hut, or, as the case may be the bed for wintering. In search of food, he makes very long periodic trips from the sub-alpine area to an altitude of 500 m, sometimes covering distances greater than 100 km. Despite all the long journeys it makes, the bear is considered an

animal attached to its native place, where it returns periodically for winter. In the den, he falls into deep drowsiness, slowing down his biological rhythm, but at the slightest noise, he awakens and returns, instantly to the fullness of the vital faculties. It does not hibernate but spends the winter in this state of drowsiness, during which time the body feeds on the fat reserves accumulated in the previous summer and autumn.

The fox (*Vulpes vulpes*) - as shown in Error! Reference source not found.d - lives between 12-14 years. It is found from the alpine hollow to the seashore, in forests, in bushes, in reeds, or in the open field [11]. The burrow, which it digs by itself, usually has several exits and is located on sunny slopes, in dikes, on the banks of streams, in elevations of earth, but also the flat field. It can be dug in places covered by vegetation, but also in absolutely open ground. In many cases, it occupies the burrows dug by the beetle, which can even share with it or with the wild cat. The difference between the burrows dug by the fox, which are narrower and start horizontally, than the ones dug by the foxes, which are wider and start pointing obliquely downwards, is obvious.

3.3 The Hunting and Eco-hunting Management in Vișeu Forest District

As already anticipated, hunting is a rational activity, through which a renewable natural resource is valued in the long run. To sustainably exploit the forest resources, in the interest of society and hunters who are directly interested in ensuring the permanence of the activity, taking a certain share of it is done strictly within the limits of the population surplus, established by methods and with scientific claims [12]. However, this is not done by hunters - who would be tempted to be subjective, either out of a desire to hunt more for a moment or out of a desire to leave an exaggerated number of breeders in the wild - but by the managers of the hunting activity.

In conclusion, hunting activity is useful for the conservation and even the rational multiplication of the hunting herds, and the hunter, far from being a cruel man, fulfills the role of harvesting the game with moderation and the human spirit. The modern hunter is called, unlike the old one, to maintain the agroforestry - hunting balance with the weapon, as well as the vigor and health of the game [13].

Finally, the calculations and proposals for annual harvest quotas, performed professionally by

these managers for each hunting population, from each hunting fund, are approved by the Central Public Authority responsible for the activity, after obtaining any necessary approvals from the central public authority responsible for the environment, by neutral civil servants, becoming mandatory to be performed by managers. This mechanism for correctly establishing the harvest quotas is complemented, to preserve the balance in kind, by the provisions of the law which considers it a contravention not to achieve these quotas and a crime to exceed them by the managers.

So, things are as clear and judiciously regulated as possible. However, how are population surpluses determined in such a way that, by taking them, the hunting populations are not endangered, neither by exaggerated extractions nor by undersized extractions that lead to overpopulation, degeneration, or damage to society? The problem scientifically initiated more than 50 years ago, has been solved by establishing optimal numbers for the main sedentary game species, on each hunting area.

These optimal numbers were subsequently recalculated periodically, usually every 10 years, to take into account changes in the hunting fund landscape. Such optimal herds are now established in Romania for red deer, fallow deer, deer, black goat, wild boar, rabbit, rooster, pheasant, partridge, bear, and lynx. Therefore, these optimal numbers are established for each hunting fund. They are also established for some of these species and optimal structures, by sex for the time being.

Both the managers of the hunting fund and the hunters know the optimal numbers and structures, as well as their obligation to permanently aim, through hunting towards them. The real hunting herds, existing in the hunting funds, are reviewed annually, the work being finalized in the spring, at the end of each hunting year. The remaining breeding stock after the hunting season and after the passage of the critical winter period is reviewed, without taking into account the offspring from that year.

It is worth mentioning that the managers of the hunting funds must deduct from the harvest quota, the hunting resources found dead in the hunting ground, the wounded and unrecovered hunting resources, and the hunting resources that died due to road accidents.

From the difference of the two categories of herds, according to some calculation formulas and some computer programs meant to eliminate possible census errors, the annual harvest quotas are established, of course taking into account certain annual natural increases, different from species to species and from one altitudinal zone to another.

The steps presented above, concise and simple for easier understanding, hide behind years of research on the level of optimal numbers, natural increases, and effective evaluation methods, as well as 50 years of experience in what we now call "hunting durable".

For all other sedentary game species for which optimal herds are not established, only the evolution of their herds, a certain density of them considered normal, and the experience gained over time regarding the level are taken into account when establishing the annual harvest quotas. hunting opportunities. Finally, for migratory species, only the evolution of their numbers is considered, including in the world, and, of course, the experience of the harvest quotas achieved in previous years.

All these works and stages necessary to establish the harvest quotas are carefully monitored by the central public authorities responsible for hunting and environmental protection, then approved by the former, with the approval of the latter. For strictly protected game species and for those in the area of protected areas, not in strictly protected areas where they are not hunted, the approval of the Academy of Agricultural and Forestry Sciences is also required. Thus here are the "Caudine forks" that ensure sustainable management, in the interest of the permanence of hunters in Romania.

The research strategies called "diagnostic keys" are used on all hunting funds in our country, which are used for each species of game. Depending on the score obtained, the main hunting resource of the hunting fund is established, as well as the optimal number of each species. Hunting planning involves the integration of biological and ecological knowledge and the application of appropriate techniques. Sustainable use must be a way to practice modern hunting planning. The International Union for Conservation of Nature defines as sustainably usable species those that meet the following conditions: the potential for future exploitation of populations is not reduced,

they must be compatible with the maintenance and long-term stability of the ecosystem where these species live. reduced future potential and threatened the long-term viability of other species.

4. CONCLUSION

Over time, to meet the ever-increasing and diversifying needs, people have engaged in a multitude of occupations. Regardless of the nature of activities, they made a certain physical and/or intellectual effort, using tools and means specific to a certain period in the history of society. The immediate political and economic interests led to the change of land ownership and implicitly to the change and excessive fragmentation of their use in a socio-economic environment marked by rapid and contradictory legislative changes, without central public authorities being able to exercise authority through specific levers. Because of this, natural ecosystems have been severely affected, with long-term repercussions on biodiversity, in this case on sedentary game populations existing in the territory.

Lately, in increasingly political and economic circles, hunting is perceived as a quick and easy source of income, but we must also take into account the fact that a significant increase of some hunting species over the optimal numbers can lead to damage, in agricultural and forestry crops (e.g. wild boars in crops as well as in forest nurseries, deer and rabbits in orchards, pigeons and turtledoves in sunflower crops and of course large carnivores in our country that attack households bordering the forest). Of course, we must also take into account the fact that a significant increase in the number of specimens on the hunting grounds can lead to the appearance and spread of diseases (e.g., swine fever that is transmitted from wild boar to domestic pigs, bird flu).

Unfortunately, this vision can lead to the depletion of an extremely valuable national natural resource (qualitative and quantitative) that other countries have already depleted. For this reason, the only solution we propose for the conservation of this resource, the value of which cannot be fully quantified, is the unitary, state-level approach to hunting management in compliance with current legislation and the application of methodologies, strategies, plans, and policies of good practice in the field of biodiversity conservation and protection.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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