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POPULATION DYNAMICS OF THE ROE DEER, *CAPREOLUS CAPREOLUS,* AND THE RED DEER, *CERVUS ELAPHUS* (ARTIODACTYLA, CERVIDAE), IN THE MOUNTAIN CRIMEA

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Population Dynamics of the Roe Deer, *Capreolus capreolus,* and the Red Deer, *Cervus elaphus* (Artiodactyla, Cervidae), in the Mountain Crimea. Smagol, V. M., Yarysh, V. L. — Results of the investigations of changes in the number of hoof-animals in the Mountain Crimea in the period from 1980 to 2014 are presented in the article. It is found that the period of the animal numbers change is 7.5 years for red deer and 4.6 years for roe deer. The shortening of the period of the animal numbers change as compared with other populations is a defence mechanism under conditions of a continuous anthropogenic pressure.
Key words: red deer, roe deer, population dynamics, Mountain Crimea.

Introduction

It is well-known that the number of most species varies from year to year. The cause of these fluctuations is the variability in the intensity of reproduction and mortality rate of populations, which, in its turn, depends on the variability of the environmental conditions (Macfadyen, 1965; Odum, 1975). The amount of food, the number of predators, propagation of parasites, weather conditions, etc. change annually. Under certain conditions, a substantial role is assigned to the intra-population mechanisms of regulation of population size, moreover, at present, powerful influence of anthropogenic factors is observed.

Fluctuations in the number of mammals occur with certain regularity. Almost for each known species, an alternation of rises and declines in their number of wave-like and cyclical nature is noticeable (Severtsov, 1941; Polyakov, 1949; Maksimov, 1984).

Autochthonous populations of the red deer and the European roe deer have existed in the mountain-forest part of the Crimean Peninsula in isolation for a long time (Kryzhanovsky, 1965; Volokh, 2004), and it is natural to assume that fluctuation in their population size have obtained its own periodicity (Yarysh, 2005, 2007).

Material and methods

It is known that the counting of animals on large territories has obvious flaws (Dyozhkin, 1985), however, their results adequately reflect the basic characteristics of the population dynamics. Thus, for the analysis of global processes within the mountain–forest zone of Crimea, we used materials of the State Committee of Statistics of Ukraine (Form No. 2-tp (Okhota (Hunting)) for the 1980–2014 period, and also the data from the "Designs of Organization and Development of hunting" for hunting and forest–hunting enterprises, as well as the data from the "Designs of Organization of Territory, protection, reproduction and recreational use of natural complexes and objects" for the protected area institutions (fig. 1).

The analyzed time segment (1980–2014) is of interest in the historical aspect because it shows the level of hunting management in the last years of the Soviet times, when the Crimean forests were the special land assigned to hunting for the Communist Party elite, as well as the time of Ukrainian statehood formation with permanent political instability and economic confusions when poaching often contributed to the survival of its impoverished population.

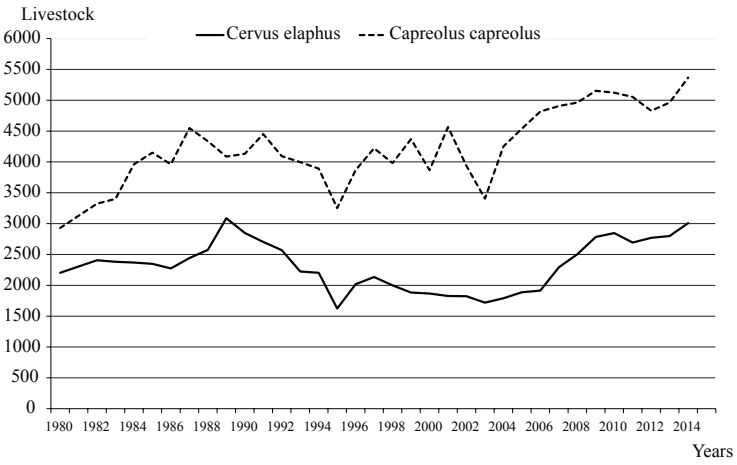

Fig. 1. Quantity dynamics of the Cervidae в Mountain Crimea.

Results of the research

The statistical analysis shows that the number of ungulates in the Crimean Peninsula from 1980 to 2014 changed significantly. In particular, the number of the red deer changed from 2,203 individuals in 1980 to 3,009 individuals in 2014, demonstrating the highest number in 1989 — 3,087 individuals. During the research time, four, as minimum, complete cycles of fluctuations in the population number of this species, which are characterized by different amplitude and duration, are identified:

1) 1980–1986. The number of the red deer varied between 2,203 and 2,273 individuals with the peak of the population number in 1982 (2,406 individuals); it is characterized by the lowest rates of growth (8.4 %) and mortality (5.5 %);

2) 1986–1995. The number of these animals varied between 2,273 and 1,623 individuals with the highest rate in 1989 (3,087 individuals); the rates of growth and mortality increased by several times — 26.4% and 47.4 %, accordingly;

3) 1995–2003. The number of the red deer was characterized by the lowest absolute figures — 1,623–1,719 individuals (maximum in 1997 — 2,134 individuals), as well as relatively rapid (during 2 years) growth (23.4 %) and gradual (during 5 years) reduction (19.5 %);

4) 2003–2011. The number of the red deer increased considerably: from 1,719 to 2,692 individuals with the peak in 2010 (2,846 individuals). The growth took a considerable period of time (7 years) with the highest increase 39.6 %. The reduction in the number was small (5.4 %) and short in time.

5) The cycle of 2011–2014, most probably, was not completed and did not achieve the maximum number. In 2014, we estimated 3,099 red deer individuals with an increase in the population by 13.1 %.

Thus, the average time of fluctuation in the number of Crimean red deer is 7.5 years (6–9 years). The cyclic character of populations is characterized by diverse rates of growth (2 to 7 years) and decline (1 to 6 years).

The number of the roe deer in the forests of Mountain Crimea during 1980–2014 was characterized by much higher absolute figures as compared to the red deer (2,930–5,367 individuals), and this fact points to a significant level of its adaptation to the environment. Currently, the population size has reached its peak. During this time, we distinguished seven full periods of the population number fluctuations, and each of these periods had different amplitude and duration.

1) 1980–1986. The number of the roe deer varied between 2,930 and 3,962 individuals with the highest absolute figure in 1985 (4,150 individuals). The rate of increasing was 29.4 %, the rate of mortality was 4.5 %;

2) 1986–1989. The number ranged between 3,962 and 4,085 individuals with the highest figure in 1987 (4,548 individuals). The rate of increasing was 12.9 %, the rate of mortality was 10.2 %;

3) 1989–1995. The number ranged between 4,085 and 3,251 individuals with the highest figure in 1991 (4,452 individuals). The growth of population was 8.2 %, and mortality — 27.0 %;

4) 1995–1998. The number ranged between 3,251 and 3,982 individuals with the highest figure in 1997 (4.221 individuals). The growth of population was 23.0 %, and mortality — 16.96 %;

5) 1998-2000. The number ranged between 3,982 and 3,866 individuals with the highest figure in 1999 (4,368 individuals). The growth of population was 8.8 %, and mortality — 11.5 %;

6) 2000-2003. The number ranged between 3,866 and 3,405 individuals with the highest figure in 2001 (4,566 individuals). The growth of population was 15.3 %, and mortality — 25.4 %;

7) The period from 2003 to 2012 (3,405–4,829 individuals) did not fit the overall scheme of the long-term cycle of population dynamics concerning both duration and the amplitude configuration. In particular, gradual increase in the number of the roe deer up to 5,152 individuals in 2009 (33.9 %) is clearly inconsistent with its short-term and minor decreasing (6.3 %).

8) A new cycle of the population dynamics started in 2012, and the actual number of roe deer as many as 5,367 individuals in 2014 was the highest for the entire history of the 35-year observations of the dynamics of the species numbers.

Thus, the average rate of dynamics of the number of the Crimean roe deer is 4.6 years (2–9 years). The cyclic nature of its population was characterized by relatively small fluctuations and more or less periodical intervals (2–6 years) until the early 2000s. Then there has been a trend towards an increase in the population numbers without any regularity.

Discussion

It is known that ungulates, which are characterized by large size, long lifespan, late sexual maturation and low fecundity, have the so-called *stable type* of population dynamics (K-strategy) (Severtsov, 1941; Naumov, 1963; Shilov, 1998), which, in turn, is characterized by small amplitude and a long period (10–20 years) of the numbers fluctuations.

In this case of study, the periods of the population fluctuations of the Crimean mountain the red deer and roe deer populations, are 7.5 and 4.6 years, respectively, which corresponds to the *labile type* of population dynamics (r-strategy), which is typical of smaller animals with short lifespan and high fecundity. Let us mark that the labile type mentioned above is characterized by a large amplitude, when the number is changed by dozens of times. But in our case the maximum range of changes in the number of the red deer reaches 47.4 %, and in the number of the roe deer — 33.9 %.

Thus, "island" populations of the Crimean red deer and the European roe deer have the following peculiarities: the amplitude of fluctuation of the population number is characterized by their natural stable type of population dynamics; however, to a greater extent the periodicity matches the labile type. The reason for this paradox we see in the incomplete accordance of the study populations of ungulates with the k-strategy because in the "classical" case natural animal populations are not subject to significant influence from the human (Wynne-Edwards, 1964). It should be noted that the stable type of population dynamics is characterized by low level of natural mortality.

In our case, we consider groups of species that during the entire long period of time were the object of constant and regular use by humans (Volokh, 2004), and in recent years, we have observed the improvement of protection measures and the expansion of the natural reserve areas. The latter circumstances, probably, gave rise to intensive succession processes. Thus, in the conditions of the Crimean Mountains, the classical types of population dynamics manifest themselves in a somewhat modified form, and, in particular, cannot be

expressed in the form of typical "waves of life". In such conditions, the process of prolonged growth or decline in the number of individual species can be observed up to the beginning of the climax stage, that is, for decades.

At the time, Mac Arthur and Wilson (1967) developed the so-called *strategy of ecological concepts;* its essence is that successful survival and reproduction of the species is possible by enhancement the adaptability and competitiveness of organisms, or intensifying the breeding ability which compensates for the increased death of animals, and in critical situations allows restoring their numbers quickly. The first way is more commonly used by large forms with long lifespan; the second one is inherent for small animals with significant mortality and high fecundity.

It is easy to notice that the types of environmental strategies are positively correlated with the above-mentioned types of population dynamics. However, I. A. Shilov (1998) insists that these options are not discrete and between them there are a number of transitions. Thus, each species in its adaptation to the conditions of existence unites the principles of different strategies in a variety of combinations.

Conclusions

Animals, whose evolution was influenced for a long time by humans, in particular, with consideration with their economic activities (primarily, hunting species are concerned), developed a number of protective mechanisms that allowed them to resist the influence of anthropogenic pressure. We mean the so-called ecological reserve (population homeostasis) (Folitarek, 1980), which is inherent in any healthy population and is determined by the possibility of compensation for mortality (natural or human-caused activities) by intensifying the reproduction.

References

Volokh, A. M. 2004. *Large mammals of southern Ukraine in the twentieth century (habitat dynamics, population, conservation, and management)*. Ph.D thesis, Institute of Zoology of NAS of Ukraine. Kiev, 1–35 [In Ukrainian].

Dyozhkin, V. V. 1985. Management of populations of wild ungulates. *Results of science and technology. Vertebrate Zoology*. VINITI, Moscow, 13, 66–138 [In Russian].

Kryzhanovsky, V. I. 1965. *The red deer and the European roe deer in Ukraine, their ecology and perspective for economic use*. Ph.D thesis, Institute of Zoology of NAS of Ukraine. Kiev, 1–18 [In Russian].

Macfadyen, A. 1965. *Animal ecology. Aims and methods*. Mir, Moscow. 1–375 [In Russian].

Maksimov, A. A. 1984. *Long-term fluctuations of animal numbers, their causes and prognosis*. Novosibirsk, 1–249 [In Russian].

Naumov, N. P. 1963. *Animal ecology*. Vysshaya Shkola, Moscow, 1–618 [In Russian].

Naumov, S. P. 1973. *Vertebrate Zoology: tutorial for students of biol. Specialities for pedagogical institutes.* Prosveshchenie. Moscow, 1–421 [In Russian].

Odum, Eu. 1975. *Fundamentals of Ecology*. Mir, Moscow, 1–740 [In Russian].

Polyakov, I. Y. 1949. The Theoretical essence of the doctrine of periodicity of mass reproductions of voles and mice. *Journal of General Biol.*, **10**, 3, 249–260 [In Russian].

Severtsov, S. A. 1941. *Population dynamics and adaptive evolution of animals*. Publishing House of the Academy of Sciences of the USSR, Moscow, Leningrad, 1–316 [In Russian].

Folitarek, S. S. 1980. Theoretical bases of biotechnics and survey of works of the Karasukskaya Biotechnical Station. *Proceedings of the Biol. Institute of the Siberian Branch of the Academy of Sciences of the USSR*, 37, 8–81 [In Russian].

Shilov, I. A. 1998. *Ecology: tutorial for biological and medical specialties for higher education institutions*. Vysshaya Shkola, Moscow, 1–512 [In Russian].

Yarysh, V. L. 2005. Dynamics of abundance of red deer and roe deer in forest biocenoses of the Mountain Crimea. *A Preventive Affair in Ukraine*, 11, 1, 29–31[In Ukrainian].

Yarysh, V. L. 2007. *Regularities of the dynamics of hoof-animals (Artiodactyla) populations in the forest biocenosis of the Mountain Crimea.* Ph.D thesis, National Agricultural University. Kiev, 1–19 [In Ukrainian].

MacArthur, R. N., Wilson, E. D. 1967. *The theory of Island biogeography*. Prinston Univ. Press, Prinston, N. Y., 1–203.

Wynne-Edwards, V. C. 1964. Population control in animals. *Scient. Amer.*, **211**, 2, 68–74.

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