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Long-term population dynamics of the red deer and European roe deer at the protected and not-protected areas in Mountain Crimea

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The long-term population dynamics of the red deer (*Cervus elaphus* L.) and European roe deer (*Capreolus capreolus* L.) at the mountain and forest zone of Crimea during 1980-2017 is presented. Fluctuations in numbers of both species are cyclical and partly synchronous. Period of oscillations in the population of red deer is about 25 years, the average duration of the oscillation period of number of roe deer is 12.3 years. During the fluctuations in the number the increasing and fall in population number of the red deer had been as 26-47 %, and roe deer – as 22-34 %. Basing on the dada obtained we have assumed that together with large-scale cycles of fluctuations in population number of both red deer and roe deer the short cycles of fluctuations in the number of these species with period from 3.5 to 7.5 years take place. Significant differences of the parameters of cyclical fluctuations in the number of roe deer at some sites of the Mountainous Crimea: breaches of synchronicity, as well as significant differences in the duration of cycles are revealed. The greatest deviations from the average values of parameters of long-term dynamics of the number of roe deer in Crimea are noted for groups of this species at two protected areas. At the Crimean Nature Reserve the cycle time of fluctuations of the numbers of roe deer was 18 years. At the Karadag Nature Reserve since 1976 we can see an exponential growth in number of roe deer that is continued up to the present time. By 2016 the number of roe deer reached 750 individuals at a density of 437 animals per 1 thousand ha. Peculiarity of dynamics of number of roe deer at some sites proves the existence in the mountain forest of Crimea several relatively isolated groups of deer. We assumed that "island" location of the Crimean populations of red deer and European roe deer, their relatively little number and influence of permanent extreme factors of both natural and anthropogenic origination have contributed to a mechanism of survival of these populations. The elements of such a mechanism include the following features of long-term dynamics of the population: the reduction in the period of cyclic population fluctuations, while maintaining their amplitude and the appearance of additional small cycles, providing more flexible response of the population to the impact of both negative and positive environmental factors. From the totality of the weather conditions for the Crimean population of roe deer the recurring periods of increases and downs in the annual precipitation amount may have relevance. There was a trend of increase in the roe deer population during periods of increasing annual precipitation.
Key words: European roe deer; Red deer; long-term dynamics of population; Crimea

Introduction

The change in number of individuals in a successive sequence of generations or seasons is a characteristic feature of populations of most animal species. The reason for these fluctuations is the variation of the rate of reproduction and death of individuals, which in turn depends on variability of habitat conditions (Macfadyen, 1965; Odum, 1975). Availability of feed, the level of pressure by predators and parasites, weather conditions are changed annually. Intrapopulation mechanisms providing the compensation of the negative environmental factors or making positive factors asymmetric can impact significantly on the regulation of animal number. Last time anthropogenic factors make a great impact on the change of numbers of many animal species.

Fluctuations in the number of mammals, as a rule, are of logical character. Almost all species show alternating of increases and downs in the number of different duration and amplitude (Severtsov, 1941; Polyakov, 1949; Maksimov, 1984). The cyclical increases and downs of the number are typical for ungulates as well. Duration of the cycle as well as the rate of change of the number of each specific populations are the result of a complex interaction of various multidirectional factors of different nature (Forchhammer et al., 1998; Mysterud et al., 2007).

The autochthonous population of the red deer (*Cervus elaphus* L., 1758) and European roe deer (*Capreolus capreolus* L., 1758) at the mountain and forest zone of the Crimean Peninsula are developed in isolation for a long time, and that is reflected in the peculiarities of their morphology (Kryzhanovsky, 1965; Volokh, 2004). It is natural to assume that the specific inhabitancy conditions for ungulates in Crimea have impact the characteristic of the dynamics of their populations.

The aim of this research is to identify features of the long-term dynamics of numbers of red deer and European roe deer in the Mountainous Crimea and assess the factors that determine its nature.

Material and methods

It is known that the methods of animal counting at large territories have obvious disadvantages, and the choice of method the most suitable for these studies is not an easy task (Dezhkin, 1985; Mysterud et al., 2007; Meriggi et al., 2008). However, under proper selection methods, the representativeness of the sample and sufficiency of its scope, the research results can adequately reflect the nature of changes in number of studied population.

In our case the material for the study was the data of the State Committee for Statistics of Ukraine (Form № 2-tp-(Hunting)) for the period of 1980-2017, data from the "Designs of organization and development of hunting" for hunting and forest-hunting farms in Crimea, data from the "Designs for organization of territory, protection, reproduction and recreational use of natural complexes and objects" for the protected area organizations in Crimea, as well as data on number of ungulates in Crimea presented in some previous publications by the authors (Ivanov et al., 2004; Yarysh, 2005, 2007; Smagol, Yarysh, 2006; Yarysh et al., 2014; Yarysh, Ivanov, 2015). Final numbers of red deer and roe deer in Crimea for certain years are obtained during the processing of the data of regular counts of hunting animals at 18 sites in the Mountain Crimea.

Despite the different affiliations of forest lands (forest and hunting farms, hunting associations, nature reserves etc.), count of populations at all sites has been held annually in winter at the same time all over the Crimea on one of the days assigned considering weather conditions of the current year. The basic method of accounting is the animal expelling from account sites toward a chain of checkers with following extrapolation of the obtained data on the entire territory of the certain farm or nature reserve.

It should be noted that from 1990 to 2000 there was the political instability in the Crimea (so-called "shocking" 90-ies), which was accompanied by economic chaos, impoverishment of significant part of population and, consequently, enlargement of poaching significantly influenced the number of ungulates at certain hunting farms and even nature reserves. In early 90th during some seasons there were cases of a sharp fall in number of roe deer. Such a sharp fall in numbers might be not relevant to natural fluctuations of ungulates, but, nevertheless, we did not consider it possible to exclude its data from the total dataset because of the difficulty to identify factors of poaching and objectively assess the level of its influence (Khoyetskyy, 2013, pp. 83-96).

Among other factors may have a direct or indirect impact on the number of ungulates in Crimea we have considered only one – the amount of precipitation during the year or series of years. The choice of this factor was due to the substantial value of precipitation for forest vegetation that in Crimea located on the border of its climatic optimum. The influence of other weather factors was not considered for various reasons, in most cases, due to the lack of possibility to collect objective data, their small values or irregularity of impact. The importance of snow cover for the survival of ungulates is well-known (Forchhammer et al., 1998), but in Crimea it is negligible due to the overall scarcity of precipitations and extremely short periods of existence of snow cover at the Crimean Mountains. Information concerning precipitations we obtained from the Ai-Petri Weather Station located at the centre of the Mountainous Crimea.

To confirm the presence of periodic oscillations in number of the European roe deer and red deer in Crimea it was used one of the biometric indicators – the Wald-Wolfowitz series criterion (Runyon, 1987).

Results

Statistics indicates that the number of the red deer and roe deer at the Crimean Peninsula during 37 years from 1980 to 2017 changed in a wide range (Fig. 1). In general, during this period the number of the red deer increased from 2203 individuals to 3397, and the number of the roe deer – from 2930 to 5540 individuals. The maximum number of the roe deer was observed in 2016 (3397 individuals), the lowest number was 1610 individuals in 1995. The maximum and minimum numbers of the roe deer are observed in the first and final year of observations. Certain synchronism of oscillations of two species is clearly visible at the figure.

Population dynamics of the red deer.

Population dynamics of the red deer in Crimea during 1980-2017 is presented at Fig. 1. Repetitive rises and downs in numbers of these species are well visible at the figure. During the studied period, there are two long (large-scale) cycles of changes in number of the red deer and five short cycles that are of smaller amplitude and duration can be recognized.

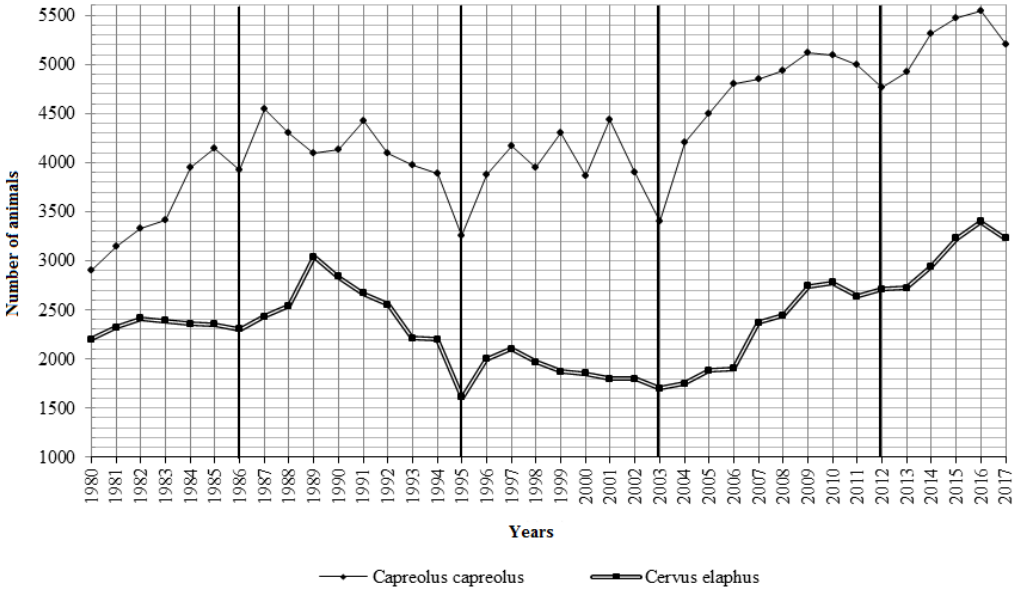

Fig.1. Population dynamics of the red deer and European roe deer at the forests of the Mountainous Crimea.

Large-scale fluctuations in number of the red deer during the time of investigation – large cycles – can be described as follows. Rise of the population number lasted from the first year of observations (1980) to 1989, then this declined until 2003 and rise until 2016 took place. So, we observe two periods of the rise of population and a period of decline. The start time of the first rise of population is still unknown. Thus, we have one full cycle lasting 27 years. Rises in population number was accompanied by an increasing of population number by 26 and 50 %. The only period of decline was also as significant as 47 %. Evaluation of the reliability of the presence of periodical increasing and declines in the number according to the series criterion (Wald-Wolfowitz criterion) showed significant decline and rise of population during 1989-2016.

Short cycles of fluctuations in the number of the red deer are within the following intervals:

1) 1980–1986. 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). This period is characterized by the lowest rates of number growth (8.4 %) and elimination (5.5 %);

2) 1986–1995. 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. 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 (for 2 years) number growth (23.9 %) and gradual (for 5 years) reduction (19.5 %);

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

5) The cycle of 2011–2017, most probably, was not completed. In 2016, we estimated 3,397 red deer individuals with an increase in the population by 14 %.

Thus, the average period of small-scale fluctuations in number of the Crimean red deer is 7.5 years with a range of this indicator from 6 to 9 years. The cyclical change in the population is characterized by a different duration of the periods of growth of the population (2 to 7 years) and decline (1 to 6 years). Evaluation of the reliability of the presence of periodic fluctuations in population number within small cycles showed reliability of only one of them during 1986-1955.

Population dynamics of the roe deer. Number of the roe deer at the forests of the Mountainous Crimea during the time of observation, as noted above, was higher than number of the red deer, and this difference increased and reached maximum in 2016, when the number of the roe deer exceeded the number of red deer 1.6 times.

Figure 1 shows that for the curve of changes in number of the roe deer, as well as for the curve of changes in number of the red deer is characterized by periodic rises and downs in number. The whole observation period can be divided into three long and several short cycles of changes in number of the roe deer.

Large cycles of fluctuations in number of the Crimean population of roe deer during the time of investigation represented by the rise and decline of the population number during 1980-1995 (the first large cycle), a further rise and the following decline up to 2003 (the second large cycle), the third rise in number that was finished in 2009, and a decline until 2012 (the third cycle). The recent rise of population from 2012 to 2016, apparently, is the first half of the fourth incomplete cycle. During the first cycle, the increase in number of the roe deer by 33.3 % lasted 7 years, and further reduction by 22.2 % lasted 8 years. Total cycle time is 15 years. The increase and decrease in number of the second large cycle is almost the same – it is about 22 % each. Duration of rise and fall in number in this case is difficult to determine because of big fluctuations of population during the time of maximum values of number of the roe deer, perhaps, because of temporary strengthening of the factor of poaching during this time at the separate areas. The duration of the second cycle is 8 years. The third great cycle (2003-2012), is characterized by a significant rise of population (34 %) and a relatively small decline (9%). Its duration is 9 years. The fourth cycle is represented by the rise from 2010 to 2016 by 14 %, the length of this half cycle is 4 years.

We distinguished seven full short cycles of the roe deer number fluctuations, and one unfinished:
1) 1980–1986. 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 elimination was 4.5 %;
2) 1986–1989. Number ranged between 3,962 and 4,085 individuals with the highest figure in 1987 (4,548 individuals). The rate of growth was 12.9 %, the rate of elimination was 10.2 %;
3) 1989–1995. Number ranged between 4,085 and 3,251 individuals with the highest figure in 1991 (4,452 individuals). Growth of population was 8.2 %, and elimination – 27.0 %;
4) 1995–1998. Number ranged between 3,251 and 3,982 individuals with the highest figure in 1997 (4.221 individuals). Growth of population was 23.0 %, and elimination – 16.96 %;
5) 1998-2000. 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 elimination – 11.5 %;
6) 2000-2003. 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 elimination – 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. Gradual increase in number of the roe deer up to 5,152 individuals in 2009 (33.9 %) is clearly inconsistent with its short-term and insignificant decreasing (6.3 %). Probably these deviations were provoked by the above-mentioned increase of poaching level at Crimean forests during this period.
8) Cycle that started in 2012 probably up to 2016 reached its maximum both for this cycle and for the whole time of investigation (37 years) and actual number of roe deer in 2014 as many as 5,367 individuals is the highest for the whole time of the 35-year observations of the dynamics of number of this species.
The average duration of the small cycle fluctuations in number of roe deer in Crimea is 4.6 years with range from 3 to 9 years. Time periods of growth and decline of roe deer numbers have duration from 1 to 6 and from 1 to 5 years respectively. The minimum values of decline and rise are observed on the background of general decline or rise occurring during this time within the large cycle. These small in relative magnitude rises and declines were not reliable according to the series criterion, which make doubt concerning existence of small cycles. Thus, their existence is, apparently, should be recognized as a hypothesis.
The validity of this hypothesis, to some extent, correlate with the data on population dynamics of the roe deer at certain lands of Crimea. Some of them are marked trends in higher or, on the contrary, in a minimum degree, although most of these relatively local groups of the roe deer showed similar trends in long-term dynamics in their number. Figure 2 presents the most peculiar of the identified dynamics. At the lands of Simferopol forestry and hunting farm three waves of increase and decline with a period of 12 years are recorded. At the lands of the All-Army Military Hunting Association the first cycle of rise and decline (which lasted 13 years) ended with the deepest recession of number, and the rest of the time there was a slow growth with no significant differences in number. Two well-defined long cycles are clearly evident at the lands of the Crimean Nature Reserve with the longest duration of one of them as long as 18 years. Here also the biggest difference during the transition from period of high to period of low number – as much as 88.5%. It should be noted that these highest figures were recorded for the protected area. A characteristic feature of this group of roe deer is also a series of distinct short cycles.

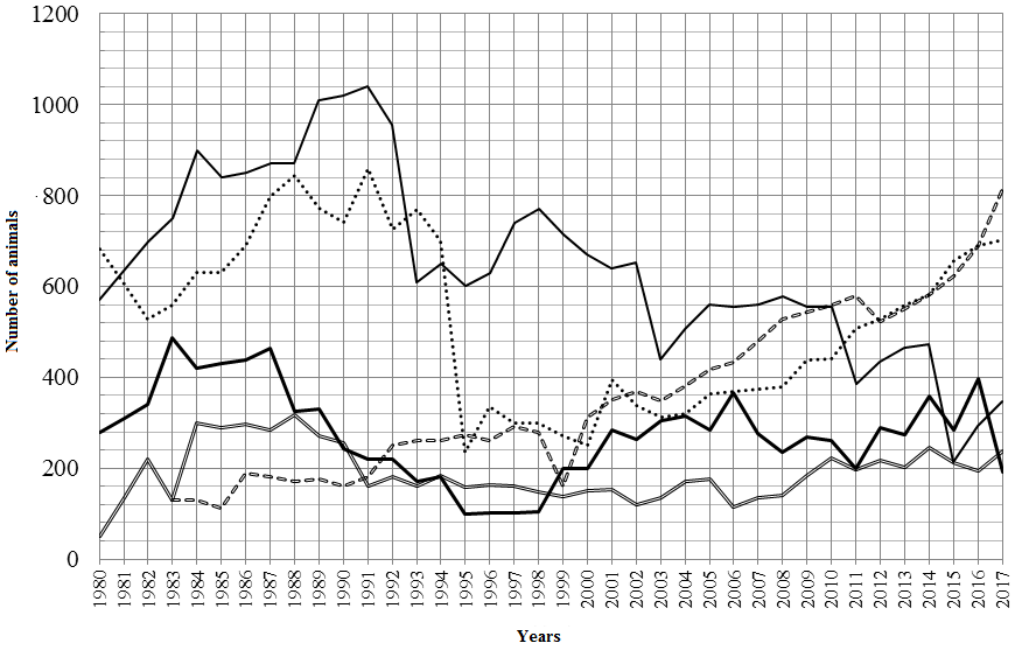

Fig. 2. Population dynamics of European roe deer at certain lands of Crimea.
——– Simferopol forestry and hunting farm; ═══ – Stary Krym forestry and hunting farm; ▪▪▪▪▪▪ – All-Army Military Hunting Association; ▬▬▬ – Crimean Nature Reserve; ═ ═ ═ – Sudak forestry and hunting farm.

At the lands of the Stary Krym forestry and hunting farm the first good recognized 12-year long cycle had been replaced by a series of short cycles without visible general rise in number. The continuous rise of population during the entire observation period is found at the Sudak forestry and hunting farm with a very weak expression of short cycles.

At the Karadag Nature Reserve the growth in number of the roe deer began since the creation of the reserve and take place up to the present time (Fig. 3). After the establishment of strict protection regime at the nature reserve in early 90th the number of the roe deer began to grow rapidly up to 2007 with the ratio 1.2. After 2007 there was a decline (by 25 %), but since 2009 a new upturn in the numbers with the same ratio began. By 2016 the number of roe deer reached maximum during the time of observation namely 750 individuals at the density of 437 individuals per one thousand ha. Each of the marked rises and declines in number is reliable except the last one-year decline.

Impact of atmospheric precipitations. Annual amount of precipitation during 1980-2013 changed in a wide range from 550 to 1600 mm (Fig. 4). During this, there was 5 time periods with gradual reduction in amount of precipitation, each period was lasting from 3 to 6 years, and 4 time periods of increase in precipitation varying from 3 to 5 years. The thin line in the chart represents the considered time periods of the fall and rise of annual precipitation.

Analysis of the impact of reducing or increasing of the annual precipitation during several seasons showed that for 3 cases of 4 of increase in precipitation the parallel growth in number of the roe deer took place. And in one case, the increase of the annual precipitation occurred in the period of the fluctuations in the number of the roe deer without its significant shift in both smaller and bigger side. For 5 marked periods of decrease in precipitation only in two cases there were parallel decreases in the number of the roe deer, in two another cases some increase in their number took place, and in one case a period of declining precipitation coincided with the period of fluctuation in number of individuals at the same level.

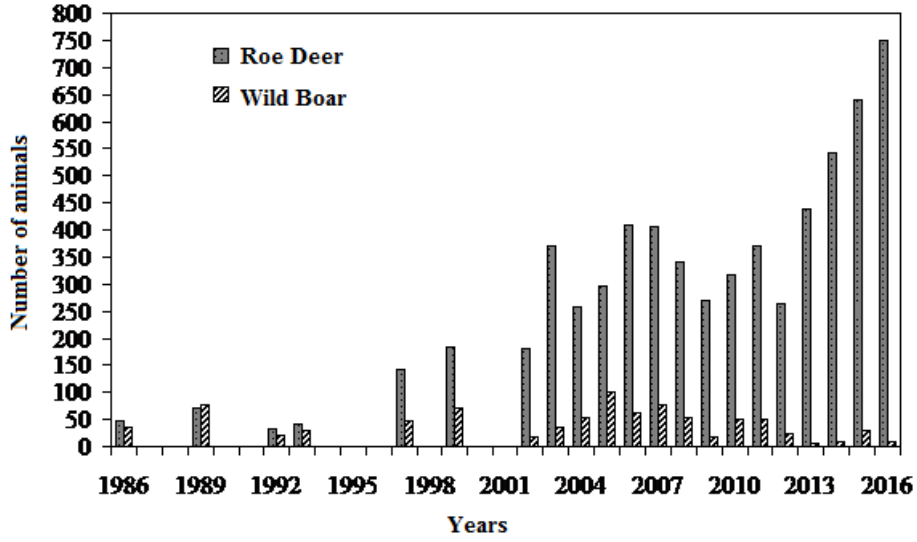

Fig. 3. Population dynamics of the roe deer and wild boar in the Karadag nature reserve during 1986–2016

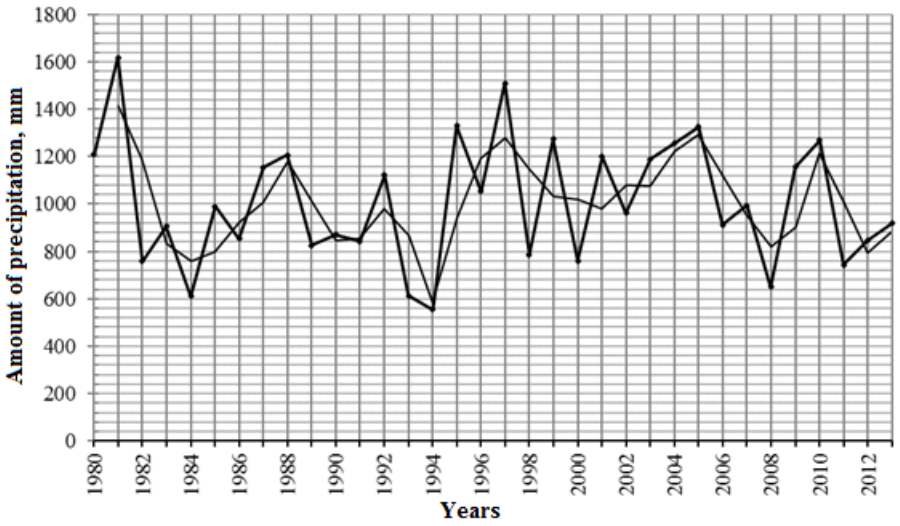

Fig. 4. Dynamics of annual precipitation at the Mountainous Crimea according to the Ai-Petri Weather Station

A comparison of precipitation per year with the number of the roe deer showed that the increase in precipitation during current year as well as their reduction had no significant influence on the number of the roe deer next year.

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; Wynne-Edwards, 1964; Shilov, 1998), which is characterized by small amplitude and a long period (10–20 years) of the numbers fluctuations.

Direct evidences and calculations according to some publications allows to conclude that the period of oscillation of the elk (*Alces alces*) populations in the Middle Urals is 28-30 years, and roe deer – 12-15 years (Korytin et al., 2002), and elk in Finland – about 29 years (Nygrén et al, 2007). According to I.K. Lomanov (1999) the duration of the periods of fluctuations in number of ungulates in the European part of Russia is somewhat smaller (13-16 years). Number of the roe deer at the hunting lands in Ukraine according to the population counts during the last 40 years has fluctuated with a periodicity of 17-18 years (Khoyetsky, 2013). While the years of maximum and minimum numbers of the roe deer at certain oblasts of Ukraine coincided not in all cases. Shift in phase between certain oblasts reached 5-6 years (Khoyetsky, 2013, p. 153). Data that we obtained in Crimea confirm this feature of the roe deer population dynamics, which, probably, is linked with relatively settled life style common for this species.

Periods of population fluctuations of mountain Crimean red deer and roe deer that we have identified are generally consistent with the known information about population dynamics of these species, though the cycles of population fluctuations of the roe deer (8 - 15 years) is somewhat less than that determined for Ukraine (Volokh, 2004; Khoyetsky, 2013).

Complete similarity of the Crimean population of the roe deer with the Ukrainian one consists the amplitude of fluctuations in population size: 22-35 % for the Crimean and 16-35 % for the Ukrainian population. At the same time, full asynchrony of population fluctuations of the deer in the Mountainous Crimea and Ukraine are projected on an absolute time scale. So, period of maximum abundance of the roe deer during 1995-2003 in Crimea (Fig. 1) corresponds to the period of minimum number of this species in Ukraine (Khoyetsky, 2013, p. 150).

Peculiarity of the Crimean populations of red deer and roe deer is possible existence of additional short cycles of fluctuations in numbers which impart the dynamics of these species the originality, which could be interpreted as a shift toward r-strategy, which is typical for smaller animals. Let us mark that the labile type mentioned above is characterized by significant amplitude, when the number is changed by dozens of times. But in our case the maximum range of changes in number of the red deer reaches 50.0 %, and in number of the roe deer — 33.9 %.

The uniqueness of the obtained curves of population dynamics of the roe deer at certain lands suggests that the territorial groups of the roe deer in Crimea form relatively isolated subpopulations. In most cases we can discuss the reasons of originality of the number dynamics of the roe deer at certain lands of Crimea only presumably. With high probability, we can only assume that long-term population growth related to absence or weakening of limiting factors.

The familiarity with the organization of activity at the Sudak forestry and hunting farm allows to conclude that the constant increase in the number of the roe deer here were provided by good protection of land and moderate hunting. Reliable protection of lands and total stop of shooting cause an almost exponential rise in number of the roe deer at the Karadag Nature Reserve. Absence of such growth at the Crimean Natural Reserve, perhaps, is due to the strong competition from the red deer – a big number of this species is maintained artificially. Crimean Nature Reserve is the only territory in Crimea, where the population number of the red deer is twice bigger the number of the roe deer.

A natural factor regulating population numbers of ungulates in natural conditions is the activity of predators. For the Roe deer and Red deer, the most important is wolf (*Canis lupus* L.), long absence of which in Crimea (until mid 2000s) eliminates this factor of influence on ungulate population at the peninsula (Yarysh, 2007). The lack of climatic and epidemiological disasters at the peninsula in recent decades has also nullified their influence on the dynamics of the roe and red deer.

Population of the red deer and roe deer in Crimea for a long time were under the influence of intensive hunting both licensed and illegal (Volokh, 2004), and only recent years situation became better because of improvement of protected measures at protected areas. As a result, at some lands the classic type of population dynamics of ungulates as "waves of life" changed to the continuous growth of the population. However, at farms with an initially good organization of activity, as noted above, this continuous growth is observed throughout the analyzed period since 1980 (see Fig. 2, the trend line of the Sudak forestry and hunting farm).

In any case, the peculiarity of the curve of changes in number of both local and quite integrated populations of large herbivores is determined by the combined impact of many spatial and temporal factors that may directly or indirectly affect the demography and population dynamics (Mysterud et al., 2002). At the time, I.A. Shilov (1998) insists that known options of estimation of survival strategy are not discrete and between them there are some transitions.

Animals, whose evolution for a long time happened near human including rather all hunting species which have developed many protective mechanisms that allow them to resist the influence of anthropogenic pressure. It is about the so-called ecological reserve, namely population homeostasis (Folitarek, 1980) – it means compensation of mortality (natural or caused by human activities) by intensifying the reproduction.

With the appearance of wolfs in Crimea the relationship of the Crimean populations of the red deer and roe deer with the environment becomes more complicated because mechanism of the number regulation by the "predator–victim" type is switched as extra component of such a regulation. The complexity of modeling of such systems even in their pure form is not a simple task (Fedorov et al., 2004). That is why it is particularly important to continue efforts concerning monitoring the status of the red deer and European roe deer populations at the mountain-forest zone of Crimea.

Conclusions

The fluctuations in the number of the red deer in the Mountainous Crimea during the last 37 years (1980-2017), accompanied by two periods of growth and one period of decline that can be interpreted as a phenomenon of cyclical fluctuations in the number of Crimean population of the red deer with a period of 25 years. During fluctuations, the increase and decrease in the number of the roe deer in the range of 26-50 % are determined. During the extended periods of a general rise and decline in the number of the red deer in Crimea there were small in amplitude coherent fluctuations of numbers with a period of 6-9 years. The cyclical change in population size at this rhythm is characterized by a different duration of the periods of growth and decline of livestock. Duration of periods of increase is 2-7 years, and the decline – 1-6 years, at amplitude of 8.4–39.6 % and 4.5–25.4 % respectively. Statistical reliability of the presence of short cycles is shown only for certain phases of some of them. Thus, their existence yet should be considered as conjectural.

The average duration of the oscillation period of the Crimean population of the roe deer population for the whole Crimea is 12.3 years. The growth and fall of population number is in the range of 22-34 %. The Crimean population of the roe deer is characterized by the presence of additional smaller sequential population fluctuations with a period of 2-9 years, as for the red deer. The cyclical change in the population number is characterized by different duration of the periods of growth and decline of livestock (2-7 and 1-6 years respectively) and different amplitudes of growth and decline in population number (8.2–29.4 and 5.4–33.9 % respectively). Statistical reliability of the presence of short cycles is shown only for certain phases of some of them. Thus, their existence yet should be considered as conjectural as well as for the red deer.

For long-term population dynamics of the roe deer at the certain non-protected areas in Crimea in most cases in general it is typical show how common mechanisms functioning. But for some of these groups significant differences in individual parameters of long-term dynamics, in particular for the duration of the cycles and the mismatch in phase are revealed. The originality of the number dynamics of the roe deer at certain lands proves the existence of several relatively independent groups of the roe deer at the mountain-forest part of Crimea.

At two Crimean protected areas located in the Mountainous Crimea, significant differences in long-term population dynamics of the roe deer both among themselves and from the general trend in Crimea are noted. At the Crimean Nature Reserve the cycle time of fluctuations of numbers of the roe deer was highest and amounted to 18 years. At the Karadag Nature Reserve since 1976the exponential growth of the number of the roe deer is continued up to the present time. By 2017 number of the roe deer reached 469 individuals with a density of 273 individuals per 1 thousand ha. Duration of the cycle of fluctuation appeared last 16 years is 9 years.

From totality of weather conditions for the Crimean population of the roe deer may be important the periodical rises and declines of the annual precipitation amount. There was a trend of increase in number of the roe deer population during periods of growth in the amount of precipitation.

"Island" location of the Crimean populations of the red deer and European roe deer, their relatively small number and susceptibility to the permanent impact of extreme factors of both natural and anthropogenic origin, have contributed to a special mechanism of survival of these populations. The elements of such a mechanism include some features of multiyear population dynamics – a reduction of duration of the period of cyclic population fluctuations, while maintaining their amplitude and sometimes the appearance of additional short cycles, providing more flexible response of the population to the impact of both negative and positive environmental factors.

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