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RE-ACCLIMATIZATION OF EUROPEAN BISON (*BISON BONASUS* L.) IN THE SKOLE BESKIDS (THE EASTERN CARPATHIANS)

The outcomes of bison re-acclimatization in the Skole Beskids (the Eastern Carpathians) undertaken in the period 1965-2013 have been examined. 10 bisons were first brought to the Skole Beskids in May 1965. They became founders of the Maydan sub-population. The bison numbers reached their peak in the 1980s. In 1990s, adecline in this population was recorded. The last bison of the Maydan sub-population died during the 2008-2009 period. The causes of their death were food shortage in winter, poaching, diseases and others. In 2005, the Large Herbivore Foundation (Holland), in collaboration with the European Bison Friends Society (Poland), [Stowarzysyenie Miłośników Zubrów, Polska] developed the program «Restoration of the European Bison population in the Eastern Ukrainian Carpathians». Under this project, 6 bison were brought from the Thüringen Waldzoo Gera (Germany) to be placed in an enclosure in the Skole Beskids in June 2009. In Nowember 2010, five individuals were brought from the Bavaria Forest National Park (Germany) and the breeding centre «Marschfeld Castles» (Austria). The two groups of animals created a herd. During winter time, the animals are provided with supplementary food. The bison numbers in the herd have increased during the 2009-2013 period amounting to 15 individuals at present time.

Keywords: re-acclimatization, sub-population, population numbers.

Introduction. The re-acclimatization of bison (*Bison bonasus* L.) in the Skole Beskids began in the latter part of the 20th century. In 1965, a group of bison was brought to the mountainous part of Lviv region (the Skole Beskids), these became founders of the Maydan sub-population [4, 7, 9, 11]. There were no systematic observations made about the process of re-acclimatization of the Maydan sub-population bison. On establishing the Skole Beskids National Nature Park and thus including the bison biotopes into the protected zone, the study on the species vital activities in mountain conditions began: feeding behavior, spatial distribution, migration patterns etc. In the course of the study, migration routes, summer and winter biotopes frequented by the bison, peculiarities of their nutrition were identified, as well as forage supplies available in winter time were estimated [3]. The 1990s saw a decline in bison numbers in the Skole Beskids. The causes of the population decline were analyzed in the literature [3, 5, 8, 9, 10]. Early in the 21st century the Maydan sub-population did not exceed 10 individuals and continued to decrease.

In view of the fact that the bison numbers of the Maydan sub-population declined precipitously in 2005, the Large Herbivore Foundation (Holland), in collaboration with the European Bison Friends Society (Poland), developed the program «Restoration of the European Bison population in the Eastern Ukrainian Carpathians» [11]. Under this program, the first animals were brought to the Skole Beskids in 2009, the next group of animals was brought in 2010. Therefore, there is a need for considering and analyzing the outcomes of bison re-acclimatization in the Skole Beskids.

Material and methods. The studies of bison vital activities in the Skole Beskids have been conducted during the 1999-2013 period . In estimating the bison numbers, statistical data on bison inventory from the Ministry for Environmental protection as well as the author's own investigations were used [8].

For the purpose of establishing the causes and determining the time of bison death, forest wardens, hunters, forest employees were interviewed and surveyed by

questionnaires [2]. In analyzing the causes of animals death, the reports on post-mortem examination of dead animals carried out by vet laboratories specialists were used.

Results and discussion. In May 1965, ten bison were brought to the Maydan game enterprise (the Skole Beskids) from the Belovezhskaya Forest (Belarus). The ancestors of the Skole bison were 3 males and 9 females of the Lowland-Caucasian Line [12].

Table 1. Register of *Bison bonasus* brought to the Skole Beskids (May 1965)

Parents		Name of the animal	Date of birth	Gender
male	female			
Pustosz	Pliszka	Byegonia	August 22, 1952	female
Pustosz	Byeta	Byezdna	May 3, 1955	female
	Purpura	Byesiedka	May 3, 1955	female
Puchatek	Byeza	Byerendej	November 7, 1960	male
Pul	Byegonia	Byezsmertnyi	June 21, 1960	male
Pul	Byeljanka	Byelena	May 11, 1962	female
-	Byeloczka	Byeloglazka	June 1963	female
Puchatek	Byezumnaja	Byezumiec	May 17, 1963	male
Puchatek	Byerdanka	Byerdiansk	May 11, 1963	male
-	Byerdanka	Beha	1965	female

The analysis of age-sex structure of the bison population points to a satisfactory selection of the animals brought to the Skole Beskids. The researchers who studied the bison biology noted that bison females become sexually mature at the age of 3 to 5 years, while males are already sexually mature when they are 3 years old; however, in the wild, young males are not allowed by older bulls to participate in breeding until the young bulls are physically strong, which occurs at the age of 5 or 6 years [6]. Taking into account the fact that of all bison animals, only 2 males and 4 females attained sexual maturity and that cows under natural conditions produce calves once in every 2 or 3 years, the population growth rate during the first years may be considered as being satisfactory. The period from 1965 to 1971 saw the birth of 14 calves. Under natural conditions, bison females commonly give birth to one calf and rarely to twins. In the Skole Beskids 2 calves were born each year, only 1 calf was born in 1967, and 3 calves in 1971. During a 7-year period (1965-1971), 11 bison died. As of January 1, 1972 there were 13 individuals (4 males and 7 females) in the Skole Beskids [7]. In the late 1970s, all the bison became sexually mature; yet the bison numbers growth was slow: two individuals per year, which is accounted for by bison's essentially high death rate.

The bison that had been brought to the Skole Beskids were kept for about 2 years in an enclosure of area about 4 ha. Since feeding them with beetroot and potato caused health problems, the animals were released into the wild in 1967. The increase in the Maydan sub-population was recorded until the late 1980s (Fig. 1).

The average annual increase in the bison numbers amounted to 12.4±1.8%. In 1980, thirty-one individuals were recorded (14 males and 17 females). In the period from 1980 to 1984, eight calves were born, and seven adult animals died, mostly in winter. In the 1990s, birth and death rates in various years varied greatly: 1 to 7 calves were born while 2 to 4 individuals died each year. There were years when no calves were born at all. In 1995, over 35 bison were recorded in the Skole Beskids, the main herd amounting to 17 or 18 individuals. The sexual structure of the Skole population varied from year to year. The share of males made up 38-48%, accordingly the share of fe-

males was – 52-62%. The bison population was getting old. In 1993, adult animals made up 48% of the total number, in 1998 – 64%. In the late 1990s, the main herd numbered 14 individuals, while the early 21st century counted 10 individuals. In was in this period that the sub-population declined dramatically. The last bison of the Maydan sub-population died, presumably, within the 2008-2009 period.

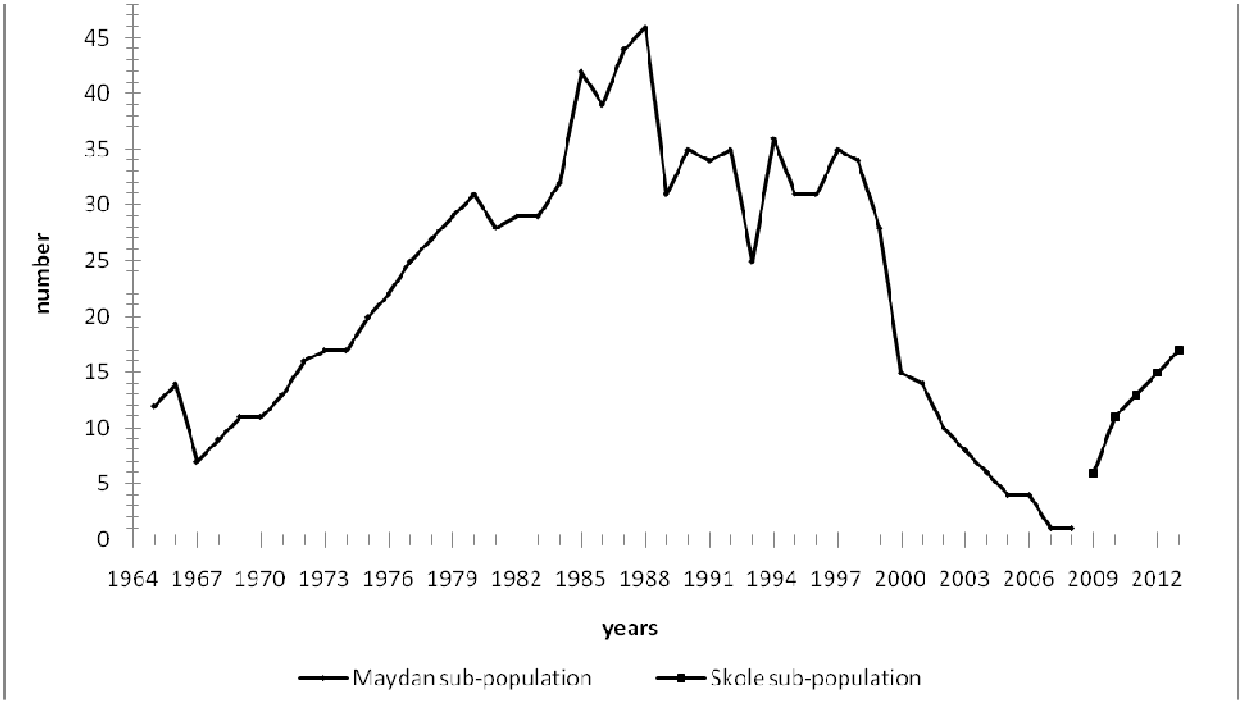

Fig. 1. Dynamics of Bison bonasus numbers in the Skole Beskids

We have identified 7 causes of the bison death. The population numbers were affected by snowy winters: a thick blanket of snow made in difficult for the animals to access forage, which led to their exhaustion and, consequently, to death. 34.5% of bison death cases was due to forage shortage in winter period. It is usually difficult to discover a dead animal under natural conditions. Very often, on discovering a dead animal, the state of this dead animal body made it impossible to identify the cause of death. That is why in 17.2% of cases, the cause of death could not be identified. A considerable number of animals (20.7%) died due to accidents. Illegal hunting was responsible for 13.8% of bison death cases. The other causes (13.8%) that led to the bison numbers decline were transport, old age, diseases.

In keeping with the project of bison re-acclimatization, there was established a 3 ha-sized enclosure in the Skole Beskids in 2007 for temporary keeping bison in the lands of the Maydan forest unit of the Skole Beskids National Park. Forest lands occupied about 60% of the enclosure area, small clearings – 40%. The predominant vegetation within the enclosure area was beech-spruce-fir associations which grew on the slopes of western exposure, the undergrowth was sparse formed with *Corylus avellana* (L.), *Populus tremula* (L.), *Salix triandra* (L.), *Sorbus aucuparia* (L.), *Betula pendula* (R.). The herbaceous cover was well-developed represented by *Potentilla erecta* (L.), *Pteridium aquilinum* (K.), *Polygonatum officinale* (L.), *Carex acuta* (L.) and others. Two streamlines ran across the area of the enclosure.

In June 2009, six bison belonging to the Lowland-Caucasian line were brought to the enclosure from the Thüringen Waldzoo Gera (Germany). All the females from the

introduced bison group were of reproductive age, while the oldest of the males was only 3 years old, the other two males – 1 and 2 years old, respectively (Table 2).

Table 2. Register of *Bison bonasus* brought to the Skole Beskids (June 2009)

Parents		Name of animal	No.	Date of birth	Gender
male	female				
Orion	Zwetschke	Theo	10711	October 9, 2006	male
Orion	Lina	Thunderbird	10983	April 30, 2007	male
Orion	Thyra	Thasidos	11182	May 31, 2008	male
Orion	Lina	Thyra	9773	June 21, 2002	female
Orion	Thyra	Thalia	10710	October 5, 2006	female
Orion	Zwetschke	Thoska	9774	July 11, 2002	female

Naturally, the rut with bison occurs late in August – early in September. Pregnancy duration averages 9 months, therefore bison calves in natural conditions are born in spring or early in summer. In the Gera Waldzoo where the bison were supple mentally fed up and their living conditions did not vary much over the year compared to those in the wild, the rut period was much longer and calves were born at different times in the year. 3 bison which were brought to the Skole Beskids were born in May-June, which is the most favorable period for calf birth. In July, the birth of Thoska was recorded, in October – Theo and Thalia were born. As bison become wild – in their passing to living in the wild without feeding up – the rut period will become shorter and, in the course of time, the rut will occur in August-September with further birth of calves in May-June. Thus, in 2013, the huntsman guard registered bison rut in September. As is seen from Table 2, the introduced individuals descend from 1 male and 3 females. 1 male and 1 female are direct descendants of 1 female from the herd. Already at the initial stage of its formation, the herd was featured by a considerably high level of inbreeding. The genetic variability was essentially low. Close-related crossbreeding in highly-inbreeding herds is inadmissible because this results in essentially high incidence of various congenital anomalies the bearers of which were relatives who themselves did not have such abnormalities. In particular, among major problems are the following: fetal death of calves due to abnormal development of embryo (which is incompatible with further development of embryo) [7]; early post-natal death of calves become of frequent occurrence, their birth weight decreases. They are slow to gain in weight and are susceptible to various diseases during their lifetime, they often suffer from sexual disorders and are characterized by a shorter lifespan; that is, close inbreeding results in decline of general viability of progeny. Thus, on September 26, 2009 the female Thyra gave birth to a calf, however the calf died in October owing to poorly healed navel string. The calve Tymko, that was born by the female Thoska, has survived.

The breeders' practical experience shows that prolonged inbreeding which takes place from generation to generation commonly results in reduced reproductive ability (fecundity) and productive performance, and other negative effects.

Close-related breeding causes substantial reduction in the variability of inbreeding lines, animals may lose their ability to be adapted to changing environmental conditions. The improperly formed herd, in which close relatives were found (brother-sister), was a cause of bison death of the Nadvirna sub-population (the Eastern Carpathians). The mean inbreeding coefficient of the sub-population was 40%, which resulted in decreased genetic variability, particularly for genes responsible for resistance to diseases.

Hereditary diseases emerged and became widespread among the animals of the herd caused by lethal and semi-lethal genes, in particular, stillbirth, cryptorchism (undeveloped testicles). Also common in the animals are infectious genitor-urinary diseases caused by staphylococci and purulent actinomycetes. Some males suffered from acute form of purulent balanoposthitis [3].

In October 2009, the male Thasidos died of exhaustion, although the animal had enough forage: they were regularly provided with supplementary feeding by game wardens of the Skole Beskids National Nature Park. The first several months (between 4 to 5 months) of the animals dwelling in the enclosure was the period of the herd's formation. The period of lactation in bison females lasts for about 1.5 to 1.8 years up to the next rut and calving. The animal's rank is known to depend on its age and weight, so calves benefit from their mother's hierarchical status for a prolonged time. The calf Thasidos was weaned from its mother (Thyra) at the point when breaking blood and social ties led to the calf's stress state the cause of which was the female's next calving (in September 2009). Repeated manifestation of aggression against Thasidos from the side of other animals in the herd made the calf keep away from the herd. Gradually, Thasidos integrated into the herd; however its lowest rank was responsible for food shortage. Under conditions of nutrition competition with larger and older individuals the calf had to content itself with food of the lowest energy value. Therefore, the cause of Thasido's death was the excessively high density of animals within the small area and the lack of full value nutrition during the stage of herd's formation.

In November 2010, five individuals of the Lowland-Caucasus line were brought from the Bavaria Forest National Park (Germany) and the breeding centre «Marschfeld Castles« (Austria) (Table 3). The animals behaved rather quietly during the transportation except for the male Aboko which showed aggressiveness during the transportation and also at the time of releasing into the enclosure.

Table 3. Register of *Bison bonasus* brought to the Skole Beskids (November 2010)

Parents		Name of animal	No.	Date of birth	Gender
male	female				
Scharan	Pomroka	Schah	11426	August 1, 2009	male
Abkes	Aboka	Aboko	11334	June 27, 2008	male
Abkes	Abtei	Abtebo	11518	September 28, 2009	male
Abkes	Abalu	Aballa	11519	November 6, 2009	female
Abkes	Aboka	Aboker	11520	November 27, 2009	male

The other group of animals was kept in the enclosure from November 12, 2010 till February 2011 when they were released into the wild after one of the males (Schah) managed to break out of the fenced area to join a free-ranging herd. This free-ranging herd often had come near up to the enclosure. After the animals were released from the enclosure the two groups came together to form a single herd. In March 2011, Thyra gave birth to twins (a male and a female). In May 2012, Thalia gave birth to a male calf, and in July a female from the second group gave birth to a female calf. In spring 2013, only male bison were born: the female Thoska gave birth to one calf while the female Thalia gave birth to one calf in May. In winter, the herd usually ranges within a limited area not far from the enclosure; this has resulted in depletion of natural forage supplies. The bison intensively fed on twigs and bark of *Corylus avellana*, *Populus tremula*, *Salix triandra, Salix daphnoides.*

From time to time, some males which were introduced in Nowember 2010 (Schah, Abtebo and Tymko) move off the herd to a distance of 3 to 5 km (Fig. 2), while the male Aboko would move to a greater distance and for a longer period of time. Thus, Aboko left the herd in autumn 2011 to rejoin the herd only late in February 2012. The male was exhausted but, in general, its state of health was satisfactory. The 2009-2013 period in the Skole Beskids saw the most severe and long winter of 2012-2013, a deep and dense blanket of snow formed in December 2012 and did not melt until mid-April. In winter the bison are additionally fed up with hay, beetroot, cabbage, and mixed fodder. The feeding ground is situated not far from the enclosure (Fig. 2). During the feeding up process it was possible for the visitors come nearer to the feeding ground within a distance of 3 to 5 m.

Fig. 2. The main herd of Bison bonasus in the Skole Beskids

Conclusions:

1. The process of bison re-acclimatization in the Skole Beskids is proceeding successfully. The animals were introduced at different times from various bison breeding centers. They have integrated into a single herd and reproduction of bison has been recorded. During a 4-year period, 6 calves were born, 1 calf and 1 young male have died. The current bison numbers amount to 15 individuals.

2. It is registered that male individuals prevail in the herd, the sexual ratio is 1.8 : 1.0.

3. In winter the game wardens of the Skole Beskids National Nature Park provide the animals with supplementary feeding; proper guarding and protection of the bison herd are organized.

4. The Maydan bison sub-population, which was established in 1965, ceased to exist, presumably in 2008-2009. Therefore, the present herd is appropriate to call the Skole sub-population.

References

1. **Balyuk, S., Bunevich, A., Kochkov, F.** (1986) *Puti sokhraneniya genofonda Belovezhskogo zubra* [Ways to preserve the gene pool of the Bialowieza bison]. Proceedings of Soviet Symposium *Problems of Protection genetic resources and ecosystem management in protected areas of the forest zone.* Moskov, 17-19 (in Russian).

2. **Bondarenko, V., Delehan, I., Soloviy, I., Rudyshyn, M.** (1989) *Oblik dykykh tvaryn. Praktychni rekomendatsiyi.* [Accounting for wildlife. Practical advice]. Lviv (in Ukrainian).

3. **Bondarenko, V., Kotsaba, R., Khoyetskyy, P.** (1999) *Zubry znovu nad prirvoyu* [Bison again over the precipice]. *Scientific Bulletin of the UNFU, 9.9*, 274-279 (in Ukrainian).

4. **Halaka, B.** (1973) *Pro suchasne poshyrennya zubra (Bison bonasus L.) na Ukrayini* [About the modern spread bison (Bison bonasus L.) in Ukraine]. *Bulletin of the Zoological Museum, 35*, 85-87 (in Ukrainian).

5. **Herus, K., Kryzhanivskyy, V.** (2005) *Suchasnyy stan populyatsiy zubra v Ukrayini* [The current state of bison populations in Ukraine]. *Bulletin of Lviv National University: Series biological, 39*, 109-113 (in Ukrainian).

6. **Korochkina, L.** (1973) *Pokazateli razmnozheniya zubrov v Belovezhskoy pushche* [Indicators of bison breeding in Belovezhskaya Pushcha]. *Belovezhskaya Pushcha. Research collection, 7*, 148-165 (in Russian).

7. **Tatarynov, K.** (1973) *Fauna khrebetnykh zakhodu Ukrayiny: ekolohiya, znachennya, okhorona* [Fauna of vertebrate at the West of Ukraine: ecology, values, health]. Lviv University Publ (in Ukrainian).

8. **Khoyetskyy, P.** (2002) *Pro mihratsiyi zubra na Rosokhatskykh Polonynakh* [About the migration of bisons at Rosohatskyh mountain valley]. *Scientific Bulletin of the UNFU, 12.3*, 83-86 (in Ukrainian).

9. **Khoyetskyy, P.** (2010) Reasons for extinction of the European bison (*Bison bonasus* L.) in the Western region of Ukraine. *Bulletin - Bison and its protection, 3*, 25-31.

10. **Khoyetskyy, P.** (2011) The history and current state of the *Bison bonasus* L. population in Western Ukraine. *Bulletin - Bison and its protection, 4*, 21-30.

11. **Khoyetskyy, P.** (2009) *Stan populyatsiyi zubra* (*Bison bonasus* L.) *v zakhidnomu rehioni Ukrayiny* [State of bison population in the western region of Ukraine]. *Bulletin - Bison and its protection, 2*, 30-33 (in Polish).

12. **Zabinskyy, J.** (1965). *Zubr Rodoslovnaya kniga* [Bison pedigree book]. Warsaw (in Polish).

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Реакліматизація зубра у Сколівських Бескидах (Східні Карпати)

Реакліматизацію зубра у Східних Карпатах проводять з 1965 р. На початку 90-х років XX ст. чисельність поголів'я досягло максимальної чисельності – близько 270 особин. Тут існувало три субпопуляції зубра (Майданська, Надвірнянська, Буковинська). З 90-х років минулого століття зареєстроване зменшення чисельності. Останніх зубрів Надвірнянської субпопуляції реєстрували в кінці 90-х років минулого століття, останні звірі Майданської субпопуляції ймовірно загинули зимою 2008-2009 рр., зменшується чисельність Буковинської субпопуляції. Сучасна чисельність поголів'я Буковинської і Майданської субпопуляцій є незначною і становить понад 40 голів, що зумовлює необхідність здійснення заходів з охорони і відтворення поголів'я зубрів. Перспективи реакліматизації зубра у Східних Карпатах полягають: у створенні розплідників на території НПП «Сколівські Бескиди», Вижницького НПП; у завезенні особин із Уладівської субпопуляції (Україна), Білорусії, Польщі, Росії та інших європейських країн для формування у новостворених розплідниках стад зубра; створенні двох нових місць оселення звірів у Східних Карпатах на території Івано-Франківської областей; завезення зубрів у біотопи поширення Буковинської субпопуляції.

Ключові слова: реакліматизація, субпопуляція, чисельність, розплідник.

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TRANSFORMATION OF ENERGY BASE IN POLAND. ENERGY CONSERVATION AND USE OF RENEWABLE ENERGY

The article is about the energy transformation of the Polish economy over the last 25 years. The basic steps of transformation, mechanisms of white certificates, energy audits, energy conservation processes in the industry. Also, the article focuses on the use of renewable energy sources in Poland, such as biomass, hydropower engineering, wind power engineering, etc., as well as mechanisms for financing projects in the field.

Keywords: energy efficiency, renewable energy sources, biomass, energy audit.