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Ten years of development of the Przewalski horse population in the Chernobyl Exclusive Zone

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INTRODUCTION

In 1998, the Biosphere Reserve 'Askania Nova' launched a Programme on the Establishment of the free-roaming population of the Przewalski horse (*Equus ferus przewalskii* Poljakov, 1881) in the Chernobyl Exclusion Zone (CEZ). The aim of the Programme was to enrich the biodiversity of the biocenoses damaged after human activities and to maintain the ecological balance in such biocenoses. In 1998 and in 1999, the Reserve Askania Nova transferred several groups of Przewalski horses (PH) to CEZ, with financial backing of the State Forest Enterprise 'Chernobylles' (Zharkikh et al., 2002). Over the next ten years authors have observed the development of the PH free-roaming population in CEZ. The dynamics of the populations and reasons for their changes are analysed in the present paper.

METHODS

The Ukrainian part of the Chernobyl Exclusive Zone (2600 km^2) is situated in the northern part of the Kiev Region. The climate is temperate continental, with a mean annual temperature of +7.20 °C; in July +18.0 °C (max. +32.0 °C) and in January −6.10 °C (min. −25.0 °C). The annual precipitation is about 604 mm. Eighteen expeditions to CEZ were made between 1998 and 2008; out of them, 12 were carried out between October and March. Each expedition lasted 7–8 days but there were three one-day expeditions. Before 2001, we used cars and horse carts for the search of Przewalski horses; only cars have been used since then. The day route varied between 20 and 150 km. Some censuses from helicopters were made in different years during flying around for fire-prevention.

Fig. 1
Photo by N. Yasynetska

We came to horses on foot at a distance of even up to 50 metres; sometimes horses came closer on their own initiative. All Przewalski horses were identified by their individual characteristics: body size, coat colour, shoulder spots etc; 18 characteristics with 2 to 4 variations in each were used. A 10 × 45 monocular or a 75-magnificant-factor telescope was used. New-born foals were registered in the General Studbook for the Przewalski horse.

When remains of dead Przewalski horses were found, the cause of death was ascertained where possible. The date of death was ascertained by degree of putrefaction. Criteria for estimating the ages of horses up to 5 years was based on tooth eruption and replacement; after 5 years, age was estimated based on subjective evaluation of tooth wear (Krasnikov, 1957). The sex in adults was determined by canine teeth. Information about dead Przewalski horses found by other people was also collected. Some horses with injures or sickness were observed a few days before they died; thus, the causes of their death were known despite the fact that their bodies had not been found. If a horse was not found anywhere during population censuses for 2–3 successive years, it was registered as a casualty since the date of the last registration. Youngsters under the age of 18 months were registered as casualty too if they were not found in their natal herds.

Reliable information about Przewalski horses from people who worked or lived in the CEZ was also used for this investigation.

Fig. 2 Bachelor
Photo by T. Zharkikh

Fig. 3 A herd of Przewalski horse from the helicopter
Photo by I. Lagodych

RESULTS

Founders of the population

In 1998 and 1999, thirty-one Przewalski horses were transported to CEZ; out of them 28 came from Askania Nova and 3 came from the local zoo of the Lozovski stud-farm (Table 1). Most of them were 6 or 7 years old; there were two yearling males and one 16-year-old female.

Eight Przewalski horses died during transportation or soon after due to injury or stress (Table 1). Others formed two harem groups and one bachelor group. On arrival, the Przewalski horses were placed in large pasture enclosures for acclimatization, where they were kept a few weeks to eight months before releasing into the wild. The only stallion from the Lozovski stud-farm who survived after transportation, did not want to leave acclimatization enclosures; he broke through ice at the pond and died 18 months later (Zharkikh et al., 2002).

Przewalski horses from other zoos

Three horses from Kiev Zoo and 10 horses from Odessa Zoo were transported to CEZ in 2004, unknown to the Reserve 'Askania Nova' (Table 1). Upon arrival, the Przewalski horses were released into the forest without any acclimatization.

Przewalski horses from Kiev Zoo were released in the outskirts of the town of Chernobyl in January. Two of the stallions were soon caught and castrated because of an untypical sign (white star on the forehead) in one stallion; the other one was castrated because of his attempts to seize domestic mares from a municipal service. Then, both of the stallions were released again. The stallion with a white star (studbook # 2710) died soon after castration due to an unknown reason. Two others had been living for about a year. They did not move far away from the town of Chernobyl, sometimes they went to the town to seek food from garbage containers or to cadge bread from people. In January 2005, stallion # 3151 was killed by a car on a road. The last Kiev Przewalski horse, stallion # 2929, died because of progressive weight loss due to some leg disorder (possibly, he had laminitis) in March 2005.

In September, Przewalski horses from Odessa Zoo were released at a place 30 km from Chernobyl, outside home ranges of harem groups and bachelors of the current population. The horses had poor body development as a result of being raised in a small zoo enclosure; they were completely unadapted to the wild environment. They all died very soon after arrival. The last three individuals (2 males and one female born in 2000) were observed in December 2004. They joined a harem group consisting of Przewalski horses which had been born in CEZ. The horses from Odessa were emaciated with a dishevelled coat. Members of the harem group threatened and attacked the newcomers at every turn. Soon the Odessa horses vanished.

The data about these Przewalski horses were not used for demographic analysis hereinafter.

Fig. 4 Forest guard pulling remains of a Przewaksi horse killed by a poacher out of the cellar
Photo by T. Zharkikh

Fig. 5 Cellar with reamins of a Przewalski horse killed by poachers
Photo by T. Zharkikh

Fig. 6 Observing of the Przewalski horses in the Chernobyl area during solar eclipse, 11th August 1999
Photo by N. Yasynetska

Fig. 7 Free forever, August 2001
Photo by N. Yasynetska

Table 1: Age and sex composition of groups of Przewalski horses transported to CEZ in 1998, 1999 and 2004, their mortality after transportation

Age, years	Place of births					
	Lozovski stud-farm	Askania Nova Zoo		Kiev Zoo	Odessa Zoo	
	males	males	females	males	males	females
1	2 (2)					1
2					1	2
3		4 (2)			1	
4			1			2
5			1		1	
6		2	8 (1)	1		
7	1	2	4 (2)			
8			1	1		2
9		1 (1)				
10		1		1		
13			1			
14			1			
16			1			
Total	3	10	18	3	3	7

Note: the number of Przewalski horses who died during transportation or soon after is given in brackets.

Breeding

Przewalski horses started breeding soon after their arrival at CEZ in 1998. Two stallions and 15 mares (61 % of all horses brought from Askania Nova) became founders of the current population. The foaling rate for mares aged 3 years or older varied with years (Fig. 1).

The number of harem groups varied with years: in 1999–2003, there were two harems headed by stallions from Askania Nova; in 2004, there were four harems (two stallions were from Askania Nova, two others were born in CEZ); in 2005, there were six harems (one stallion was from Askania Nova, the rest were born in CEZ); in 2006, there were 3 harems headed by stallions born in CEZ; in 2007, there were 4 harems; in 2008, there were 5 harems.

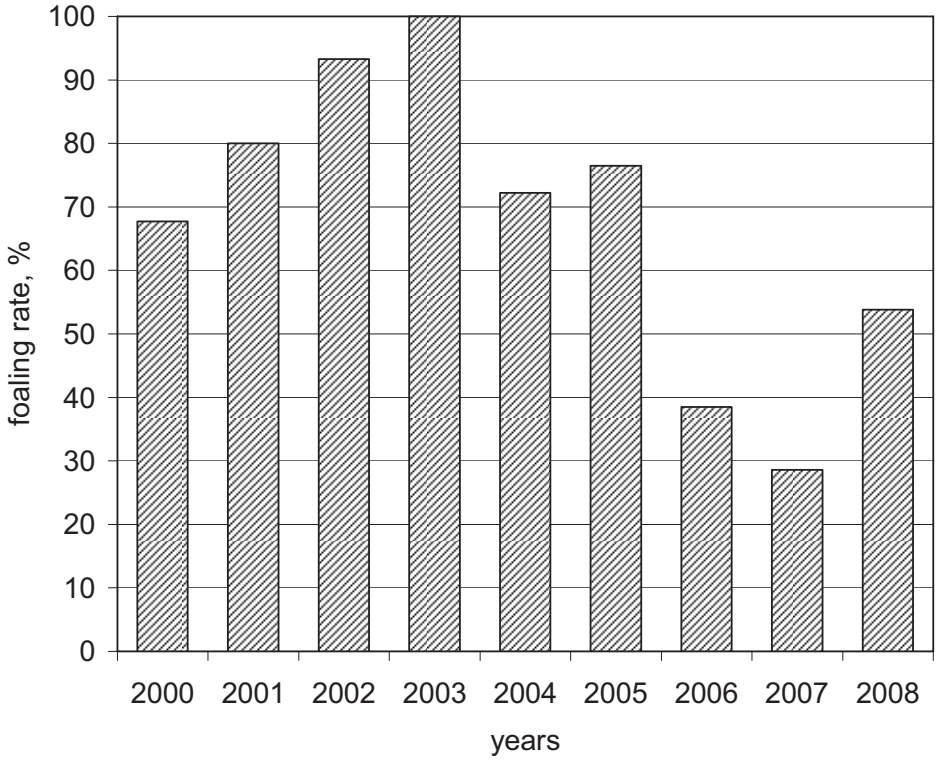

Fig. 1: Foaling rate for Przewalski mares aged 3 years and older in the Chernobyl Exclusive Zone

In total, 101 live foals were born over a 10-year period, between 1998 and 2008; the sex ratio was 1:1. At least 20 live foals of the 2nd generation were born between 2004 and 2008. The highest number of foals were born in 2002 – 14 individuals. Survival rate of youngsters under the age of 2 years was 91.3 %. Mortality rate of foals under the age of 12 months was 3.3 %.

The population dynamics

Between 1999 and 2003, the population increased with peaks of 65 specimens in 2003 and 2004. Then, the population gradually decreased to about 50 Przewalski horses in 2007. Sixty four Przewalski horses were counted in CEZ at the end of 2008 (Fig. 2).

Fifty-five individuals were lost in the free-ranging population between 1999 and 2006; causes of death were determined in 18 cases (Table 2). Over the first 5 years, 10 Przewalski horses died; the mortality rate was 13.7 %. Between 2004 and 2006, 45 Przewalski horses died, the mortality increased to 47.4 %.

Table 2: Causes of death of free-ranging Przewalski horses in the Chernobyl Exclusive Zone between 1999 and 2006

Causes of death	Number of horses	
	absolute data	%
Disease	2	3.6
Parturient complication	1	1.8
Injury	2	3.6
Poaching*	13	23.7
Unknown cause	37	67.3
Total	55	100

Note: * 17 Przewalski horses were illegally shot dead in 2007, according to unofficial information.

Home ranges and dispersal across the territory.

Przewalski horses prefer open spaces; they may seek shelter from bad weather in forests and abandoned villages. Harem groups have more or less stable home ranges, bachelors roam mainly between the home ranges of current harems. The total area occupied by Przewalski horses increased by 4.5 times over a 10-year period; from 125 km^2 in 1999 to 565 km^2 in 2008 (Table 3).

Table 3: Total area (m^2) occupied by Przewalski horses in the Chernobyl Exclusive Zone between 1999 and 2008

Years	Size, km^2	Years	Size, km^2
1999	125	2004–2007	420
2000	230	2003	370
2001–2002	325	2008	565

Przewalski horses inhabited the central area of CEZ. Yet, some individuals and groups migrated outside the borders (Fig. 3). The farthest location where a PH was noticed in 2007 was near the town of Narovlya (Gomel Region, Byelorussia), at 30 km from the border of CEZ. They are noticed more often in the neighbourhood of CEZ. In summer 2007, eight Przewalski horses were observed near the village of Prybirsk, about 10 km from the border of CEZ. One or two individuals were occasionally noticed near the villages of Olyzarivaka, Varivsk, Termakhivka and others. In 2007 and 2008, small groups of Przewalski horses

Fig. 8
Photo by N. Yasynetska

Fig. 9
Photo by N. Yasynetska

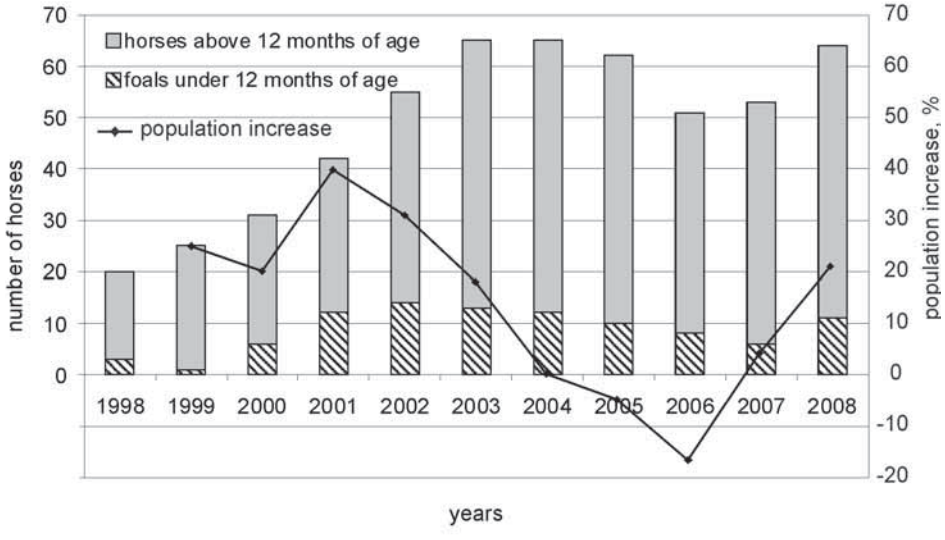

Fig. 2: The population dynamics of Przewalski horses in the Chernobyl Exclusive Zone

(up to 8 individuals) with youngsters were sometimes sighted in the territory of the Polesskij Radioecological Reserve (Byelorussia) adjoined to CEZ (Fig. 3). Out of them, three individuals were shot dead when they left the protected area of the Reserve and crossed its northern border in 2008.

Wolves and Przewalski horses

There is a stable population of 60–80 wolves in CEZ. It is obvious that Przewalski horses successfully defend themselves from wolves. The density of even-toed ungulates (red deer, roe deer, wild boars, elks) is high in CEZ (Gaschak et al., 2006); that is why wolves prefer hunting them as Przewalski horses are too big and dangerous prey. Wolves did not even kill sick and weak horses. Thus, three Przewalski horses – mare studbook # 1203 (died in 2003), stallion studbook # 2929 (died in 2005) and an unidentified individual (died in 2006) – were very emaciated as a result of a lingering illness. They could not follow their herds and spent several autumn and winter months alone. Wolves and their footprints were often noticed in the areas where the sick horses lived; yet, predators did not kill the horses and they died a natural death.

There were some eyewitness accounts about defensive behaviour of Przewalski horses in CEZ. In winter 1999, a bachelor band of 6 males brought from Askania Nova (two of them were 3.5-year-old; others were 6.5- or 7.5-year-old) chased and circled two wolves. One of the wolves escaped and ran away, the other one was killed. Younger stallions kept aside and did not touch the wolf. Elder stallions snapped at the wolf, threw it up and then struck with forehooves over and over again until only some scattered wolf's remains were left. In December 2002, we watched a pack of 12 wolves hunting a young solitary Przewalski stallion. The

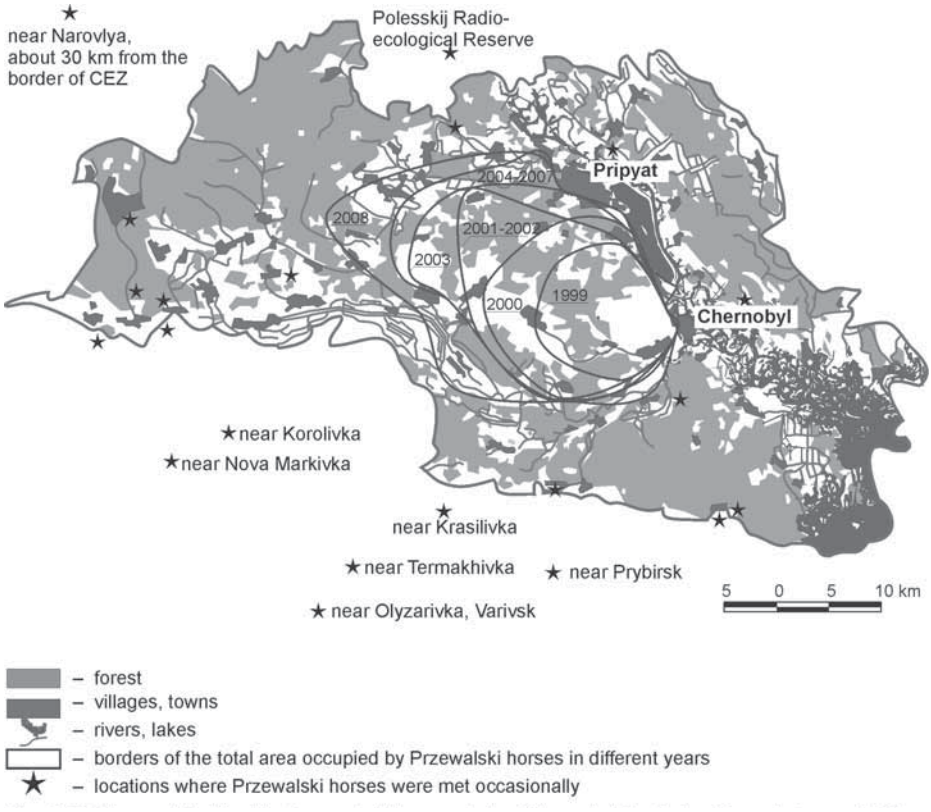

Fig. 3: Total area inhabited by Przewalski horses in the Chernobyl Exclusive Zone between 1999 and 2008. Names of villages near which Przewalski horses were ever met are indicated.

stallion noticed the wolves first and started running towards them at a high long trot with his head elevated and ears pricked up. Three wolves made a quick run from behind the horse while others lay in hiding on a knoll. When the stallion came abreast with the knoll all the wolves rushed at him. However, the stallion galloped away, and the wolves did not chase him for long. (M. Shkvyrya, the Institute of Zoology NAS Ukraine, speculated that it had been a training chase). In summer 2003, a duty observer on a fire watchtower observed a herd of Przewalski horses aggressively chasing a wolf with an apparent intention to kill it.

Parasitoses

Could influence the survival rate of Przewalski horses in the wild (Bouman, 1995; van Dierendonck et al., 1996). A monitoring of the parasitological situation in the Chernobyl population has been conducted since 1998 (Zvegintsova et al., 2008). The intensity of infection with intestinal helminths in Przewalski horses has become stable on a low level over the past few years. As there are no clinical symptoms of helminthiases in the PH population in CEZ, the present level of infection is considered to be harmless to the horses.

Fig. 10
Photo by N. Yasynetska

Fig. 11 Harem group 1
Photo by A. Borovskij

Fig. 12 Harem group 2
Photo by T. Zharkikh

Fig. 13 Harem group 3
Photo by T. Zharkikh

DISCUSSION

Przewalski horses from the Biosphere Reserve 'Askania Nova' successfully adapted to the environment of Northern Ukraine and established a breeding population in the Chernobyl Exclusive Zone. Unlike them, all Przewalski horses from city zoos died without posterities soon after transportation.

Neither diseases nor predators influence the population dynamics of the Przewalski horses. Mortality rate of foals, the most vulnerable members of Przewalski horses' herds, is very low; there was no proof that any of the foals were killed by wolves. However, anthropogenic factors affected the high mortality of Przewalski horses, as more than 70 % of deaths with a determined death cause were the result of illegal hunting (poaching). Kaseda et al. (1995) reported about a significant positive correlation of lifetime stability with lifetime reproductive success for feral mares. We suggest that changes in the composition of Przewalski horses' herds caused by shooting of their members, might affect the reproduction parameters of 2006 and 2007 (the foaling rate was <40 %). Some Przewalski horses migrate out of the territory of CEZ; yet, their life span is not long as they are shot by local people.

In 2005 and 2006, we informed Ukrainian authorities, scientific societies and mass media about poaching of Przewalski horses in CEZ. The information drew a wide public response; we guessed that it helped to stop or, at least, to decrease illegal hunting in CEZ. The increase of foaling rate and the total number of Przewalski horses were registered during annual census in 2008.

As the population descended from few founders, killing of some of their offspring of the 1st and 2nd generations can lead to the loss of the genetic diversity followed by extinction of the population. In future, the Przewalski horses population may be threatened by diminution of its habitats as a result of artificial forestation of the territory and by possible hybridisation with domestic horses if extensive horse-breeding is to be started within CEZ.

Acknowledgements

We express our sincere gratitude to Alexander N. Borovskij for his help and support during this study.

Fig. 14 Harem group 6
Photo by N. Yasynetska

Fig. 15 Chernobyl landscape zone
Photo by I. Lagodych

Fig. 16 Harem group 4
Photo by T. Zharkikh

Fig. 17 Harem group 5
Photo by A. Borovskij

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