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Research note

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DIET OF THE PRZEWALSKI'S HORSE *EQUUS PRZEWALSKII* IN THE CHERNOBYL EXCLUSION ZONE

ABSTRACT: In 1998, 21 Przewalski's horses *Equus przewalskii* have been introduced in the Chernobyl exclusion zone. During the years 1999–2000, studies on food preference were carried out in a special enclosure (70 ha) constructed for theses horses. A total of 52 plant species, belonging to 25 families were grazed by the horses. This comprised 43 % of all plant species recorded in this area. The most common families were Poaceae (17 species), Fabaceae (7 species) and Asteraceae (7 species). In general, *Elytrigia repens, Trifolium pratense, Vicia cracca, Poa trivialis, Dactylis glomerata* and *Bromus inermis* were the most preferred plant species. This preference has, however, varied from month to month. The most preferred plant species in May were *Elytrigia repens, Corynephorus canescens, Festuca valesiaca* and *Chenopodium albu*y; in June – Fabaceae , in July – *Dactylis glomerata* and *Trifolium* and in August – *Elytrygia repens* and *Vicia cracca.* A total of 27 anti-helminthic plant species were recorded in the study area, 18 of them were grazed by Przewalski's horse.

KEY WORDS: diet, seasonal variation in diet, anthi-helminthic plants, nuclear disaster

After the Chernobyl nuclear disaster in 1986, an exclusion zone has been established for the re-naturalization of the contaminated area around the disused nuclear plant. Since 1986, so called long-fallow lands have been developed in abandoned farmlands in this zone. Each year grasses thriving in these long-fallow land, produce enormous biomass which is only partly consumed by large herbivores. To solve this ecological problem, grazing by horses in this area has been proposed (program "Fauna", 1998). Like other large herbivore mammals, horses are the most efficient grass consumers (Janis 1976, Duncan 1990, Duncan *et al.* 1990, Janis *et al.* 1994). Therefore, 21 Przewalski's horses *Equus przewalskii* from the Askania Nova Biosphere Reserve, south Ukraine, have been introduced in the Chernobyl exclusion zone (CEZ) in 1998. The Przewalski's horse is included in the IUCN Red List of Threatened Species as critically endangered (IUCN 2011).

Research should be thereafter undertaken to show whether the introduced herd is well-adopted to this area. To date, only parasitological investigation has been undertaken (Slivinska *et al.* 2006) and the presented studies focuses on the diet composition of this herd.

Although diet composition of Przewalski's horse has been investigated in some areas of its introduction (*e.g.* Davidova and

Stepanov 1936, Pereladova *et al.* 1999), quantitative studies on food preferences were hitherto conducted only in Askania Nova Biosphere Reserve (Pozdnjakova *et al.* 1998). However, in that study food preference was measured with a subjective five-degree scale, where 1 indicates no preference, while 5 – the highest preference. In addition, the Przewalski's horses were kept there in stable and particular plant species were served for the horses by researches. Recently, diet of the Przewalski's horse and co-habiting elks *Cervus elaphus* and domestic herbivores was also quantified in the Hustai National Park in Mongolia (Sietses *et al.* 2009). This research was, however, based on pellet content analysis and was aimed to investigate food niche overlap between the herbivores, rather than their food preferences.

Our hypothesis is that the Przewalski's horses forage efficiently on a wide range of plant species in the CEZ, showing, however, preferences for some grass species, which are abundant in this area. To test this hypothesis, we have conducted studies on the diet composition and food preference.

The CEZ is located *ca* 200 km N of Kiev (51°16'41"N; 30°13'24"E), 123 m above sea level. This zone covers an area of 2 070 km^2, and falls entirely within the Polesie Lowland, Russian Plain. Climate of the CEZ is humid, with relatively mild winter and warm summers. The mean annual temperature is 5–7°C. The mean temperature in July is 18°C (max. 32°C), while in January –6.1°C (min. –25°C). The annual precipitation ranges from 550 to 750 mm. The snow cover lasts on average *ca* 50 days per year. The mean depth of the snow cover is 12–13 cm.

The CEZ is fenced with metal nets. Along with *ca* 100 peasants still living in the CEZ, only a few other persons have constant access to this area. Before the nuclear disaster, the CEZ consisted of farmlands with forest fragments. At present, *ca* 60% of the area is covered with forests (50% of which is pine forest) and the remaining consists of abandoned arable grounds, meadows, pastures and human settlements.

A total of 280 flowering plant species were recorded in this area where Przewalski's horses grazed (own data). The most common plant species were *Erytria repens, Carex spp*., Fabaceae, Asteracea and various species of weeds. The plant community shows sign of the third level of degradation of the *Elytrigia repens* long-follow land.

Studies were conducted in a special enclosure (70 ha) constructed for the Przewalski's horses. In 1999, all plant species were identified in this enclosure, as well as in the surrounding area. For studies, 36 grazing plots were designed (Galushin 1982): 19 plots in 1999 and 17 plots in 2000. Each plot was 0.5 m^2 in size. Each plot was surveyed once a month from May to August in 1999 and from June to August in 2000. Within each plot, all plants showing signs of grazing were identified to species level and it was determined whether vegetative or generative part of each plant specimen was grazed. Each grazed plant was dried and weighted.

For the food preference the Ivlev's Electivity Index – *E* – (Ivlev 1961) has been used:

$$E = (r - p)/(r + p)$$

where: *r* – the proportion (in percentage) of the number of grazed specimens of the plant species A in all plots surveyed (17 + 19 = 36 plots) to the total number of all plant species grazed in all 36 plots surveyed; *p* – proportion (in percentage) of the number of grazed specimens of the species A in a given plot out of the total number of plots surveyed to the total number of all plant species recorded (including species which were not grazed) in all plots surveyed.

The value of the E index varied from –1 to 1. The positive values indicates the preference for a given plant species, *i.e.* the higher proportion of this plant species in the diet of the horses in a given grazing plot (more palatable plant species). The negative values indicate avoidance, *i.e.* the lower proportion of this plant species in the diet of horse in a given grazing plot (less palatable plant species). The value 0 indicates no preference, *i.e.* a given plant species is equally common in the nature and in the diet of horses.

Since many plant species were not growing in the grazing plots surveyed, and the method employed is much time consuming, plants were also surveyed on specially designed transects. Transects were fixed in those areas where horses usually grazed. The

Table 1. The values of Ivlev's Electivity Index (–1.0 – +1.0) for food preference of Przewalski's Horses in the Charnobyl exclusion Zone.
Explanation: the sign '-' indicates that the given plant species was not recorded as being grazed by the horses.

Plant species	1999				2000		
	May	June	July	Aug.	June	July	Aug.
1. Plant species preferred throughout the summer							
Elytrigia repens (L.) Desv.	0.94	0.75	0.15	0.75	0.53	-	-
Trifolium pretense L.	0.68	-	0.55	-	-	0.45	0.45
Vicia cracca L.	-	0.81	-	0.38	-	-	0.65
*Poa trivialis*L.	-	0.55	0.2	-	0.75	-	-
Dactylis glomerata L.	0.55	-	0.75	-	-	0.55	-
Bromu inermis(Leyss.)	0.5	0.69	-	-	0.75	0.33	-
Corynephorus canescens (L.)	0.85	-	-	-	0.22	-	-
Trifolium arvense L.	0.65	0.5	-	-	0.75	0.55	-
T. repens L.	0.75	-	-	0.45	-	0.65	-
2. Plant species preferred in some months only							
Cirsium arvense (L.) Scop.	0.63	0.37	-	-1	0.68	-	-1
Vicia tetrasperma (L.) Schreb.	-	0.72	-	-1	-	-	-
Calamagrostis epigeios (L.) Roth.	0.7	0.55	-	-1	0.45	-	-
Oenothera biennis L.	0.63	0.55	-	-	0.55	-	-1
Festuca valesiaca Schleich.	0.75	0.5	-0.63	-0.01	-0.66	-	-1
F. pratensis Huds.	0.6	-	-0.76	-	-0.75	0.34	-1
Taraxacum officinale Web.	-0.88	-0.95	-1	-	-0.77	0.25	-
Chenopodium album L.	0.75	-1	-	-	0.25	-	-
3. Plant species avoided (negative preference)							
Rumex acetosa L.	-0.75	-0.42	-1	-	-0.24	-1	-
R. confertus Willd.	-1	-1	-	-	-0.18	-1	-
Artemisia absinthium L.	-1	-1	-1	-0.75	-1	-1	-0.78
A. vulgaris L.	-1	-	-1	-0.72	-1	-1	-0.75
A. campestris L.	-	-	-1	-	-1		-0.94
Raphanus raphanistrum L.	-0.74	-0.88	-1	-	-0.55	-0.63	-
Tanacetum vulgare L.	-	-1	-	-0.75	-	-1	-0.85
*Carex acutiformis (*Ehrh.)	-0.88	-0.42	-1	-	-0.97	-	-
C. hirta L.	-0.77	-	-1	-	-1	-	-
Urtica dioica L.	-	-0.16	-	-	-1	-	-1
Barbarea vulgaris R. Br.	-0.35	-	-1	-	-	-0.79	-
4. Plant species grazed occasionally							
Saponaria officinalis L.	-	-1	-	-	-	-	-
Euphorbia virgultosa Klokov	-1	-	-	-1	-	-	-
Viola arvensis Murr.	-1	-1	-1	-	-1	-1	-
Viola tricolor L.	-1	-1	-	-	-1	-1	-
Lamium maculatum L.	-0.75	-1	-	-	-1	-	-
Carduus acanthoides L.	-	-1	-1	-	-	-	-
Eqiusetum pretense Ehrh.	-1	-1	-	-	-1	-	-1
Myosotis micrantha Pall.	-1	-	-	-1	-1	-	-
Hieracium pretense Tsch.	-	-1	-	-	-	-1	-

grazed plants were recorded and identified on these transects in all seasons of the year.

In addition, all plant species growing in the study area were identified and their abundance was estimated using a 4-scale: 1-rare (1–19% of field records), 2-scarce (20–49% of field records), 3-common (50–79% of field records), 4-very common (80–100% of field records). Properties of each plant species were determined (A – anti-helminth, M – medical, P – poisonous) on the basis of Szafer's *et al.* (1984) key to plant species.

During the whole study period a total of 52 plant species, belonging to 25 families were grazed by the horses (recorded both by Galushin's and transect method). This comprised 43% of all plant species recorded in this area (Table 2). The most common families were Poaceae (17 species), Fabaceae (7 species) and Asteraceae (7 species).

In general, *Elytrigia repens* L.(Desv.)*, Trifolium pretense* L.*, Vicia cracca* L.*, Poa trivialis* L.*, Dactylis glomerata* L. and *Bromopsis inermis* Levss. were the most preferred plant species. All of them were also very common in the study area. Five other plant species, classified as very common in the study area, were not recorded at all in the diet (*Setaria viridis* (L.), were grazed only occasionally (*Viola arvensis* Murr. and *V. tricolor* L.) or were avoided (*Tanacetum vulgare* L. and *Taraxaxum officinale* Web.). However, three of these species (*Tanacetum vulgare, Taraxacum officinale* and *Viola tricolor*) were medical plants, therefore could have been slightly poisonous for the horses.

The order of preference varied from month to month. The most preferred plant species were *Elytrigia repens, Corynephorus canescens, Festuca valesiaca* and *Chenopodium albus* in May; Fabaceae in June, *Dactylis glomerata* and *Trifolium* in July and *Elytrigia repens* and *Vicia cracca* in August (Table 1).

On transects, the following additional plant species, grazed by the horses, were recorded: in May: *Melilotus albus* Desr. and *M.officinalis* (L.) Desr.; in June: *Iris sibirica* L., *Capsella bursa pastoris* (L.) Medic., *Viola tricolor* L. *Potentilla argentea* Tratt., *Allium angulosum* L.; in July (occasionally): *Salvia pratensis* L., *Hypericum perforatum* L., *Euphorbia virgultosa* L., *Plantago major* L., *P. lanceolata* L.

Four groups of plant species grazed by the horses were distinguished: species preferred throughout the summer (9 species); species preferred in some months only (8 species); species avoided (11 species); species grazed occasionally (9 species). The last group included poisonous and rough (with structures protected them against grazing) plant species. In the second group, those plant species are included which are preferred in certain period of the vegetation season, at early stage of plant development, in flowering stage or even in fruition stage. The same plant species may grow in different vegetation stage in different grazing plot surveyed, hence it was difficult to determine actual preference index for plants belonging to this group.

In winter, Przewalski's horses browsed *Salix* spp.*, Pyrus communis, Malus sylvatica, Pinus sylvestis, Rosa spp., Alnus spp*. They also dig for *Festuca spp., Bromopsis inermis* and *Elytrigia repens,* which were still growing under the snow cover. In general, in winter Przewalski's horses graze the same grass species as do domestic horses (Davidova and Stepanov 1936, Bikbulatov *et al.* 1997, Sietses *et al.* 2009).

It is well-known that certain ungulate species consume anti-helminthic plant species (Obolenskij 1902, Chebotaryov 1956, Krotova 1979, Danø and Bøgh 1999, Thamsborg *et al.* 1999). A total of 27 such species were recorded in the CEZ, 18 of them (67%) were grazed by Przewalski's horse (Table 1). Out of 45 medical plants present in the study area, only 36% were grazed by horses (Table 2). Most (69%) medical plants grazed were common or very common species in the field. Poisonous plants were clearly avoided. Only two such species (out of 15 present in the study area), namely *Artemisia absinthium* L. and *Thlaspi arvense* L. were recorded in the horses' diet (Table 2). It should be, however, pointed out that both those species were also anti-helminthic and medical.

In Askania Nova, Przewalski's horses preferred Fabaceae and flat-leaved species of Poaceae (Pozdnyakova *et al.* 1998), therefore, the preference was, in general, similar to that in CEZ. Under semi-desert conditions in Central Asia, grazing ungulates, including the closely-related khulan *Equus heminous*, preferred Poaceae; 24 grass species grazed were

Table 2. Plant species recorded in the field and in the diet of the Przewalski's horses.
P – plant properties: A – anti-helminthic, M – medical, P – poisonous.
F – recorded in field: 1 – rare (1–19% of field records), 2 – scarce (20–49% of field records), 3 – common (50–79% of field records), 4 – very common (80–100% of field records)
D – recorded in diet: - – not recorded, + – recorded sporadically, 1 – grazed occasionally, 2 – avoided, 3 – preferred in some months only 4 – preferred throughout the summer (see Table 1 for further details).

Plant species	P	F	D.	Plant species	P	F	D
Achillea millefolium L.	M	3	-	*Echinochloa crus-galli* (L.) P. B.		3	-
Allium angulosum L.	A	1	+	*Echium vulgare* L.		3	-
A. oleraceum L.	AM	1	+	*Elytrigia repens* (L.) Desv.	M	4	4
Alopecurus geniculatus L.		2	-	*Equisetum pretense* Ehrh.		3	1
A. pratensis L.		3	-	*Erigeron annuus* (L.) Pers.		2	-
Anchusa officinalis L.	M	2	-	*E. canadensis* L.		3	-
Anthriscus sylvestris L. (Hoffm.)		1	-	*Euphorbia virgultosa* Klok.	M	3	1
Arctium lappa L.	M	3	-	*Festuca pratensis* Huds.		3	3
Aristolochia clematitis L.	M	2	-	*F. valesiaca* Scheich.		3	3
Artemisia absinthium L.	AMP	3	2	*F. ovina* L.		3	-
A. campestris L.	A	3	2	*Filipendula ulmaria* (L.) Maxim.	AM	1	-
A. vulgaris L.	AM	3	2	*F. denudata* (J. et C. Presl) Fritsch	AM	1	-
Barbarea vulgaris R. Br.		3	2	*Galinsoga parviflora* Cav.		3	-
Berteroa incana (L.) D. C.		2	-	*Galium palustre* L.		1	-
Bromus inermis Leyss.		4	4	*Inula britannica* L.	A	1/2	+
Calamagrostis epigeios (L.)Roth		4	3	*Iris sibirica* L.		1	-
Calystegia sepium (L.) R. Br.	P	3	-	*Jasione montana* L.		1	-
Cannabis sativa L.	AM	1	-	*Helichrysum arenarium* (L.) Moensch	AM	1	-
Capsella bursa-pastoris (L.) Med.	M	3	+	*Herniaria glabra* L.	M	2	-
Carduus acanthoides L.		3	1	*Hieracium pilosella* L.	M	3	-
Carex acutiformis Ehrh.		3	2	*H. pretense* Tsch.		2	1
C.hirta L.		3	2	*Hypericum perforatum* L.	AM	3	+
C. vesicaria L.		3	-	*Kochia laniflora* Bord	M	2	-
C. riparia Curt.		3	-	*Lamium maculatum* L.		3	1
C. vulpine L.		3	-	*Leonurus quinquelobatus* Gilib.	M	3	-
Centaurea sunomensis Kalen.	M	2	-	*Lythrum salicaria* L.	M	2	-
Chamanerion angustifolium (L.) Scop.		2	-	*Lolium perenne* L.		3	-
Chelidonium maius L.	AMP	2	-	*Lupinus polyphyllus* Ldl.	P	2	-
Chenopodium album L.	AM	2/3	3	*Matricaria chamomilla* L.	M	2	-
C. urbicum L.	A	2	+	*M. inodora* L.	M	2	-
Cichorium intybus L.	AM	3	-	*Medicago falcate* L.	A	2	+
Cirsium arvensis (L.) Scop.		4	3	*M. lupulina* L.	A	2	+
Conium maculatum L.	MP	2	-	*Melilotus albus* Med.	A	2	+
Convolvulus arvensis L.	MP	3	-	*M. officinalis* (L.) Lam.	AM	2	+
Corynephorus canescens (L.) P. B.		3	4	*Mentha arvensis* L.		1	-
Cyclachaena xanthffora Tries.	M	3	-	*Myosotis micrantha* Pall.		2	1
Dactylis glomerata L.		4	4	*Oenothera biennis* L.		3	3
Daucus carota L.	MP	3	-	*Plantago indica* L.		2	-
Descurainia sophia (L.) Webb	P	2	-	*P. lanceolata* L.	M	3	+

continued

Table 2 – continued

P. maior L.	M	3	+	*Spergularia rubra* (L.) Persl.	M	2	-
Poa annua L.		3	-	*Setaria viridis (*L.) P. B.		4	-
P. bulbosa L.		3	-	*S. glauca* (L.) P. B.		3	-
P. palustris L.		2	-	*Sisymbrium altissimum* L.		3	-
P. trivialis L.		4	4	*Stachys recta* L.		2	-
Polygonum convalvulus L.		3	-	*Stellaria media* Vill.		3	-
P. persicaria L.		2	-	*Tanacetum vulgare* L.	AM	4	2
Potentilla argentea L.		1	+	*Taraxacum officinale* Web.	M	4	3
Ranunculus acer L.	P	3	-	*Thlaspi arvense* L.	AMP	3	4
Raphanus sativus L.	A	3	-	*Thymus pulegioides* L.	A	2	-
R. raphanistrum L.	A	3	2	*T. serpyllum* L.	AM	2	-
Rumex acetosella L.		3	2	*Trifolium montanum* L.	A	2	+
R. confertus Willd.		3	2	*T. pretense* L.	A	3	4
Ranunculus repens L.	MP	3	-	*T. repens* L.	A	3	4
Ranunculus sceleratus L.	MP	3	-	*Urtica dioica* L.	M	2	2
Salvia pratensis L.	A	1	+	*Verbascum lychnitis* L.	A	1	-
Saponaria officinalis L.		2	1	*V. thapsus* L.	A	1	-
Scleranthus annuus L.		2	-	*Viccia cracca* L.		3	4
Senecio jacobaea L.	MP	1	-	*V. tetrasperma* (L.) Schreb.		3	3
Senecio vulgaris L.	MP	1	-	*Viola arvensis* Murr.		4	1
Sonchus arvensis L.	P	3	-	*V. tricolor* L.	M	4	1
Spergula arvensis L.	M	2	-	*Xanthirum strumarirun* L.		3	-

common for Central Asia and CEZ (Abaturov 1984). Noskov (1969) has pointed out that aromatic plant species are indispensable as food for domestic horses. Our studies indicate that such aromatic plants species as *Artemisia absinthium, A. vulgaris, A. campestris* and *Tanacetum vulgatris* were occasionally grazed by Przewalski's horses throughout the year. They may improve digestion processes and possibly may have anti-bacterial properties.

As expected, Przewalski's horses forage on a wide range of plant species, but with special preference to grasses and clovers. Since grasses are superabundant in the CEZ, food is certainly not a limiting factor in this area. They may efficiently reduce the grass biomass, which is produced in each season in enormous amount in the CEZ. If the herd is properly managed, it may prevent the area from undesired succession stages, which may develop if grass biomass accumulate year after year, not being reduced by large herbivores or fire.

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REFERENCES

Abaturov B.D. 1984 – Mlekopitayschie kak komponent ekhosistem na primere rastitelnojadnikh mlekopitayschikh v polupustine [Mammals as a components of ecosystem, based on the example of herbivores under semi-desert conditions] – Nauka, Moskva; 286 pp. (in Russian).

Bikbulatov Z.T., Satiev B.H., Samohvalov V.G. 1997 – Kruglogodichnoe soderzhanie loshadey na zimnikh pastbischakh [Annual breeding cycle of horses in winter croplands] – Kormoproizvodstvo, 3: 24–26 (in Russian).

Chebotaryov R.S. 1956 – Ispolzovanie nekotorikh kormovikh rastenii v borbe s paraziti i parazitozami s/h zhivotnykh [Usage herbal medicine against parasites in livestock] – Problemi parazitologii. Trudi II nauch. Konf. Parazitologov Ukr. SSR. Otv. Red. Markevich

A.P. Izd. AN Ukr.SSR, Kiev; pp. 194–197 (in Russian).

Danø R., Bøgh H.B. 1999 – Usage of herbal medicine against helminths in livestock. An old tradition gets its renaissance – World Animal Review, 12: 15.

Davidova L.P., Stepanov I.N. 1936 – Zimnij pastba loshadey [Grazing by horses in winter] – Izd-vo VASHNIL, Moskva; 92 pp. (in Russian).

Duncan P. 1990 – Ecologie et comportement – Actas del seminario MAPIMI; pp. 371–387.

Duncan P., Foose T.J., Gordon I.J., Gakahu C.G., Lloyd M. 1990 – Comparative nutrient extraction from forages by grazing bovids and equids: a test of the nutritional model of equid/bovid competition and coexistence – Oecologia, 84: 411–418.

Galushin V.M. 1982 – Rol hishchnikh ptits v ekhosistemakh [The role of birds of prey in ecosystems] – Zoologia pozvonochnikh (Itogi nauki i tehniki). Cer.: Zoologia pozvonochnikh. Moskva: VINITI. Vol. 11: Rol ptits v ekhosistemakh. Ed: L.S. Lebedevoj; pp. 158–241 (in Russian).

Ivlev V.S. 1961 – Experimental ecology of the feeding of fishes – Yale University Press, New Haven; 302 pp.

IUCN 2011 – IUCN Red List of Threatened Species – IUCN, Cambridge.

Janis C.M. 1976 – The evolutionary strategy of the Equidae and the origins of rumen and cecal digestion – Evolution, 30: 757–774.

Janis C.M., Gordon I.J., Illius A.W. 1994 – Modeling equid/ruminant competition in the fossil record – Histor. Biology, 2: 111–125.

Krotova A.I. 1979 – Lekarstvennie preparati, primenajaemie pri parazitarnikh zabolelevanyakh [Medications used against helminthes] – Medicina, Moskva, 111 pp. (in Russian).

Noskov N.M. 1969 – O povedenii domashnih zivotnih [On the behaviour of domestic animals] – Povedenie zhivotnikh i problema odomashnivaniya: Sb. Statej. Otv. Red. Mashkovcev A.A. Nauka, Moskva; pp. 7–12 (in Russian).

Obolenskij V.G. 1902 – Osnovi konnozavodstva i lechebnik loshadi [Bases of horse breeding and horse veterinary] – Moskva, 460 pp. (in Russian).

Pereladova O.B., Sempere A.J., Soldatova N.V., Dutov V.U., Fisenko G., Flint V. 1999 – Przewalski's horse – adaptation to semi-wild life in desert conditions – Oryx, 33: 47–58.

Pozdnyakova M.K., Zarkih T.L., Jasineckaya N.I. 1998 – K voprosu o poedaemosti razlichnich vidov rastenii loshadiu Przewalskogo v zapovednike "Askania-Nova" [On grazing plant species by Przewalski's horses in the Askania Nova Reserve] – Rol okhoronuvanikh prirodnikh teritorij u zberezeni bioriznomanittja: Materiali konf. prisvjach. 75-richu Kanivskogo prirodnogo zapovidnika (8–10.09.1998). Kaniv, pp. 224–227.

Slivinska K., Dvojnos G., Kopij G. 2006 – Helminth fauna of sympatric Przewalski's *Equus przewalskii* Poljakov, 1881, and domestic horses *E. caballus* L. in the Charnobyl exclusion zone, Ukraine – Helminthologia, 43: 27–32.

Sietses D.J., Faupin G., de Boer W.F., de Jong C.B., Henkens R.J.H.G., Usukhjargal D., Batbaatar T. 2009 – Resource partitioning between large herbivores in Hustai National Park, Mongolia – Mammalian Biology, 74: 381–394.

Szafer W., Kulczyński S., Pawłowski B. 1984 – Rośliny Polski [Plants of Poland] – Warszawa, PWN, 1320 pp. (in Polish).

Thamsborg S.M., Roepstorff A., Larsen M. 1999 – Integrated and biological control of parasites in organic and conventional production systems – Vet. Parasitol. 84: 169–186.

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