

# Ecological substitutes for Wild horse (*Equus ferus* Boddaert, 1785 = *E. przewalskii* Poljakov, 1881) and Aurochs (*Bos primigenius* Bojanus, 1827)

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## 1 . Abstract

Since 1998, the WWF Large Herbivore Initiative has been occupied with the protection of endangered ungulate species in Europe, Siberia and Central Asia. The second objective is to allow grazers and browsers to play their natural role in ecosystems. Large herbivores, especially the extinct megaherbivores like elephants or rhinos and grazers like wild horse and aurochs, are thought to have had a considerable impact on vegetation and landscape of the primeval ecosystem. Under interglacial conditions, they thus create richly structured landscapes comprising a mosaic of open habitats and forests and therefore can be seen as umbrella species that provide habitats for others.

Like the megaherbivores, all specialised grazers are extinct in the wild in northern Eurasia. If we want to restore typical landscapes formed by the appropriate natural processes, grazers are on the list of things we need. Some species do not exist anymore, but horse and cattle can be replaced in the ecosystem because wild subspecies or domesticated forms survived.

In the case of the horse, there still exist a subspecies that lived in the wild in Central Asia until a short time ago – Przewalski's horse - and several original domestic breeds that can be seen as descendants of the European tarpan, e.g. Konik or Exmoor pony. They represent the few known features of the tarpan quite well. However, it is controversial whether the tarpan was a wild animal or an ancient feral horse or a combination of both possibilities. Open points concerning the domestication history of the horse complicate the assessment of old breeds. Which horse should be used in projects of ecosystem restoration? For projects in Central Asia, Przewalski's horse is the natural choice, but for projects in Europe and Siberia there is no unequivocal answer. For European projects, the Large Herbivore Initiative prefers the use of a breed that can be conceived by the public as a wild-living animal. The Konik horse serves this purpose.

The aurochs did not survive as a wild animal, and no old domestic cattle breed combines the known features of the wild from. An attempt by the HECK brothers to "breed back" the aurochs resulted in the so called Heck cattle, a mixture of about 15 different cattle breeds. This mixed breed shows some similarities with the aurochs, but some differences as well. Nevertheless, for the time being this breed seems to be the best substitute for the aurochs in nature development projects. There is the possibility to approximate Heck cattle phenotypically towards the aurochs by crossbreeding them with other breeds, e.g. Italian Chianina or Spanish Sayaguesa. Such a project has been started in Northrhine-Wesphalia.

## 2. Introduction

In 1998, the WWF Large Herbivore Initiative (LHI) was formed (BAERSELMAN in this volume). Its geographical working area covers Europe, Siberia, Central Asia and Mongolia. The initiative has two main objectives: to prevent the disappearance and decline of large herbivore species and to allow grazers and browsers to play their

natural role in ecosystems. Herbivory is a natural process essential for shaping habitats. The different herbivore species occupy different ecological niches (fig. 1) and differ in the influence they exert. Some formerly wide-spread species like the aurochs are extinct, but some of these free ecological niches could be filled by substitutes.

The reason for the protection of endangered ungulates is obvious - but why should someone want to introduce horses or cattle into the Eurasian ecosystem in areas where these species have not occurred in the wild for a long time? To answer this question, an excursion into the past is necessary, because species and ecosystems that we try to conserve today evolved long ago.

Large herbivores, especially the extinct megaherbivores like the straight-tusked elephant (*Elephas (Palaeoloxodon) antiquus*) or rhino species (*Stephanorhinus (Dicerorhinus)*

	Concentrate selectors (browsers) & omnivores	Intermediate types (mixed grazers/ browsers)	Grass/ roughage eaters (grazers)
Ruminants			
Nonruminants			

Fig. 1: Classification of Central European large herbivore species of interglacial conditions according to feeding types (see HOFMANN 1989, HOFMANN & SCHEIBE 1997)

Abb. 1: Einteilung von mitteleuropäischen Großherbivorenarten interglazialer Bedingungen in Ernährungstypen (vgl. HOFMANN 1989, HOFMANN & SCHEIBE 1997)

*kirschbergensis*, *S. hemitoechus*) and grazers like wild horse (*Equus ferus*) and aurochs (*Bos primigenius*), are thought to have had a considerable impact on the ecosystem. Under interglacial conditions, they thus created richly structured landscapes comprising a mosaic of open habitats and forests and were therefore umbrella species that provided habitats for others (e.g. BUNZEL-DRÜKE 1997, VERA 1997, 1999, BUNZEL-DRÜKE et al. 1999). Like elephants and rhinos, all specialised grazers are extinct in the wild in large areas of the northern half of Eurasia (Fig. 1). In Europe, steppe rhino (*Stephanorhinus hemitoechus*), wild ass (*Equus hydruntinus*), horse and aurochs are missing. If we want to restore typical landscapes formed by the appropriate natural processes, grazers are on the list of things we need. Some species do not exist anymore, but horses and cattle can be replaced in the ecosystem because wild subspecies or domesticated forms survived in human care. Which horse or cattle forms - subspecies or breeds - should be chosen for the restoration of ecosystems or nature development projects?

### 3. The horse

#### 3.1 The history of horses in Eurasia: attempt at a short review

The equid family evolved in North America. The first species of the genus *Equus* to reach Eurasia more than two million years ago was the zebra-like or stonine *Equus stenonis*. Caballine horses appeared later. The fossil record of caballine horses in Eurasia during the Pleistocene is quite good, but horse taxonomy is complicated and still controversial (e.g. KURTÉN 1968, KAHLKE 1994, GUÉRIN 1996). In Central Europe, wild horses lived during glacial and interglacial periods on steppes as well as in partly wooded habitats (von KOENIGSWALD et al. 1995). In late Pleistocene and early Holocene times there was obviously only one species of caballine horse (*Equus ferus*) in Eurasia, forming several more or less definable subspecies. In large parts of Europe, this horse lived side by side with the stonine European Wild Ass (*Equus hydruntinus*), and in Central Asia it was sympatric with stonine Asiatic Wild Asses (*Equus hemionus* and *Equus kiang*). About 15 000 years ago *Equus*

*ferus* had a continuous range from Iberia in the west to Beringia and Alaska in the east. For thousands of years the wild horse was an important game species for man, but it became progressively rarer during the Holocene (UERPMANN 1990). The last indisputably undomesticated horses, belonging to the subspecies Przewalski's horse or takhi (*Equus ferus przewalskii*) (fig. 2), were seen in Mongolia in 1968 (VOLF 1996). Although it went extinct in the wild shortly after that, the subspecies survived in zoos. The breeding program of Przewalski's horse succeeded in spite of some problems (KNOWLES & WAKEFIELD 1992, VOLF 1996):

- all the about 2500 animals existing today descended from only 12 individuals captured in Mongolia between 1899 and 1947 and one domestic horse,
- the population has a significant but incompletely documented contribution of genes from Mongolian domestic horses,
- some of the genetic diversity represented by the original 13 animals was lost, among other things by variable and artificial selection,
- already after five generations in human care certain signs of domestication became evident, e.g. very early sexual maturation.

Meanwhile breeding and reintroduction programs have started at at least four sites of the subspecies' historic range, e.g. 1989 Bukhara Breeding Centre, Kyzylkum Desert, Uzbekistan (PERELADOVA et al. 1999) and 1993 Hustain Nuruu Mountain Forest Steppe Reserve, Mongolia (BOUMAN 1998).

As one subspecies or population of the wild horse still exists there does not seem to be any need for a replacement of the wild horse with another breed. Nevertheless, the Asiatic subspecies may not be the best horse for European nature reserves as it is adapted to dry steppes and semi-deserts at the species' extreme range limits.

In historical times, other forms of free-living horses were found in Central Europe and in the steppes of southern Russia, both called „tarpan“ today, though this name was sometimes used in the past for other horses as well, including Przewalski's horse. To make things yet



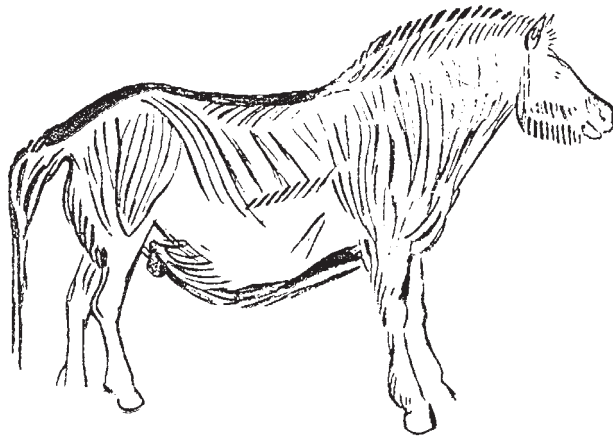
Fig. 2: Przewalski's horse (*Equus ferus przewalskii*) in winter coat

Abb. 2: Przewalski-Pferd (*Equus ferus przewalskii*) im Winterfell

more complicated, the two tarpan varieties are thought to have represented two different subspecies: the smaller forest horse of Central and Northwest Europe (*E. f. silvestris* = *E. f. silvaticus*) and the slightly larger steppe tarpan of the Russian plains (*E. f. ferus* = *E. f. gmelini*) (HEPTNER et al. 1966).

Typical tarpans were lighter built than Przewalski's horses, had smaller heads, a grey coat with a black eelstripe along the back and black legs. Their black manes were mostly not erect, which is explained by the influence of domestic horses (HEPTNER et al. 1966). The tarpan features are contrary to most European cave paintings which depict horses of Przewalski type (fig. 3).

Tarpans went extinct in the wild at the end of the 19th century. The last zoo animal died in 1919 (SLOB 1966).



**Fig. 3:** Wild horse; drawing from the cave of Niaux (Ariège), France (after BELTRAN et al. 1973)

**Abb. 3:** Wildpferd; Zeichnung in der Höhle von Niaux (Ariège), Frankreich (nach BELTRAN et al. 1959)

The original status of these horses is still not very clear. They could have been the last remnants of European wild horse populations or ancient feral horses (CLUTTON-BROCK 1999) or a combination of both possibilities.

The genetic material of the tarpan - whatever its origin - was not lost completely, but survived in several primitive horse breeds, for which just two examples are given:

- Konik (fig. 4): The last tarpans in Poland were caught near Bialowieza around 1780 and, after some years in a reserve in Zwierzyniec near Bilgoraj, they were given in about 1806 to local farmers and mixed with domestic horses. Starting in 1936, VETULANI gathered Polish horses of tarpan type to create a breed resembling the vanished tarpan. This breed is called „Konik“ today which translates as „little horse“ (PRUSKI 1963, JEZIEFSKI & JAWORSKI 1995, JAWORSKI 1997). Since World War II, the Konik has been „improved“ for agricultural work by selection (JEZIEFSKI & JAWORSKI 1995). Crossbreeding with Hucul and Przewalski's horse occurred and offspring of at least the latter hybridization was included into the Konik breeding program (JAWORSKI 1997).
- Exmoor pony (fig. 5): The small dark brown horse with a light muzzle is the most primitive English breed. Some believe it to be the last really wild horse of Europe (SPEED & ETHERINGTON 1952, SPEED 1956) - a claim that has

been made for other breeds as well. Probably the wild horse was extinct in Great Britain before domesticated horses arrived (e.g. YALDEN 1999). SPEED & ETHERINGTON (1952) complain about tendencies to „mongrelise“ the Exmoor pony.

An attempt to „breed back“ the tarpan in competition with VETULANI's project was started in Germany between the wars by the HECK brothers. They crossbred Gotland horses, Koniks, Iceland ponies and Przewalski's horses (HECK & HECK 1934, H. HECK s.a., SLOB 1966). The resulting „Heck horse“ is unfortunately called „Tarpan“ in Germany. It is not impossible that today's Polish Koniks were influenced by Heck horses, because during World War II Koniks from Poland were taken to Germany and later 21 brood animals were returned (JEZIEFSKI & JAWORSKI



**Fig. 4:** Konik horses in winter coat

**Abb. 4:** Konik-Pferde im Winterfell



**Fig. 5:** Exmoor pony

**Abb. 5:** Exmoor-Pony

1995, JAWORSKI 1997). After the war, Koniks were integrated repeatedly in German Heck horse breeding, and sometimes other breeds were used as well. Today, Koniks and Heck horses are phenotypically indistinguishable.

Another mixed breed that might be incorporated in the Heck horse is the „Dülmener Wildpferd“ of Northrhine-Westphalia (H. HECK 1936). A local domestic horse living in a small semi-reserve was crossbred over the years with Przewalski's horse, Konik, Exmoor pony and maybe others resulting in a mixture of breeds looking not too different from the Heck horse.



Further breeding attempts aiming at a breed with a greater similarity to the vanished tarpan or other extinct horse subspecies do not seem advisable at least for the time being because the characteristics of the different horse subspecies are not (yet?) known. For example the Polish Konik and the Heck horse represent the few known features of the tarpan quite well. One exception may be the structure of the mane that is not erect. Though it is not proven that holocene European wild horses had upstanding manes like Pleistocene horses and recent Przewalski's horses, following UERPMANN (personal communication) this seems highly probable because all living wild equids possess such manes.

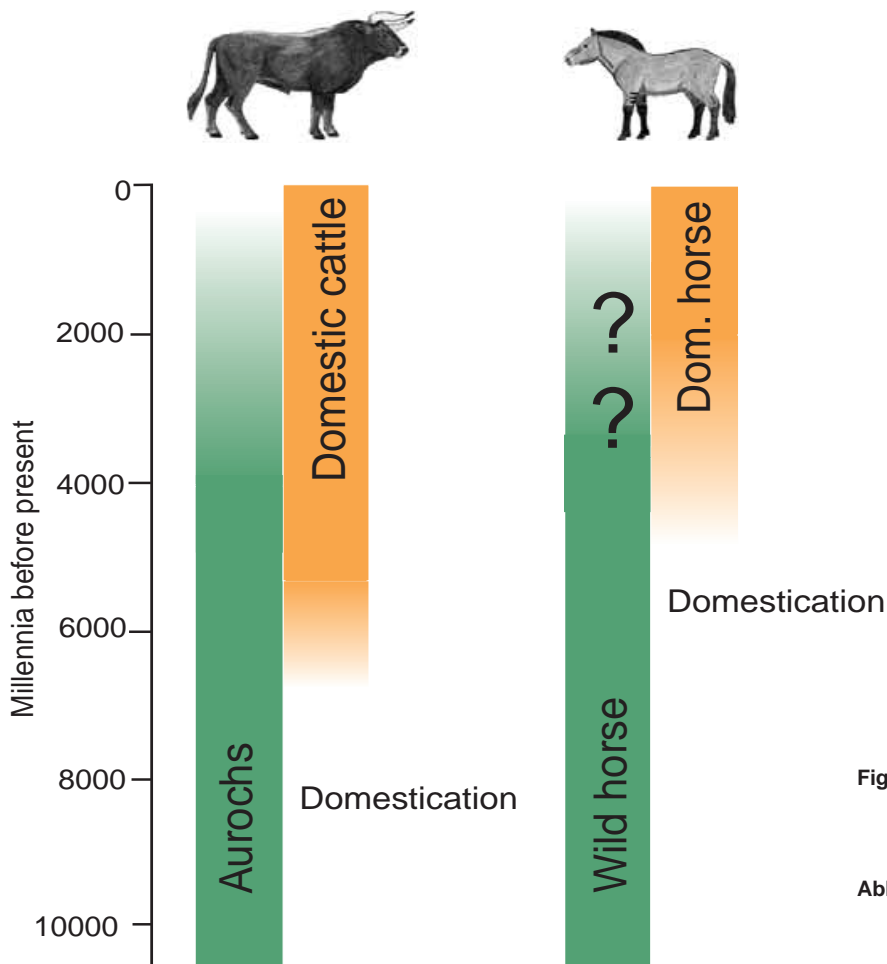
There is a controversy about horse domestication that affects the assessment of primitive horse breeds. Horses were domesticated rather late (fig. 6), at the earliest about 3500 B.C. (e.g. BÖKÖNYI 1984). It is nearly impossible to distinguish between the bones of wild and domesticated horses. If it is true that domestication happened only once in human history in the area north of the Black Sea (e.g. BIBIKOVA 1967, 1986, CLUTTON-BROCK 1999) and that domestic horses reached most areas only after the local wild horses were already extinct, then the recent domestic horse breeds (*Equus ferus f. caballus*) would derive from the same subspecies and most differences between breeds would be anthropogenic. On the other hand, if horses were domesticated at different places, as UERPMANN (1990) thinks possible, some primitive native horse breeds could be seen as descendants of local wild horse populations and therefore be eligible for nature development projects.

### 3.2 Horse: Conclusions

Coming back to the initial question of which horse should be used in projects of ecosystem restoration, there is no unequivocal answer. For projects in Central Asia and Mongolia Przewalski's horse is the natural choice, but for projects in Europe and Siberia there is no definite solution as to which horse form(s) should be regarded as native, characteristic or best adapted. Most „primitive“ horse breeds can probably survive in wild or semi-wild conditions and can act successfully as ecological substitutes for the extinct European or Siberian wild horse subspecies. In dry grassland Przewalski's horse could be used as well.

As some decision is needed for possible projects, some personal views are given below.

It seems highly unlikely that wild horses disappeared everywhere in Europe before the arrival of domestic horses from the Black Sea region. So original local breeds can be assumed to include at least some genetic material of indigenous horse populations, either by local domestication attempts or by inadvertent mating of domestic and wild horses. Although most or all original breeds changed to some extent over the years by anthropogenic selection or cross-breeding, it is worth studying the history of old horse breeds that are still homogeneous in size, morphology and coloring. Among the candidates for a closer inspection in the western part of Eurasia are e.g. the Norwegian Fjord horse and some breeds from Turkey. In Siberia the yakutian domestic horse



**Fig. 6:** Occurrence of wild and domesticated cattle and horses in Central Europe during the Holocene

**Abb. 6:** Vorkommen von wilden und domestizierten Rindern und Pferden in Mitteleuropa während des Holozäns

should be studied as it shows phenotypical similarities to the extinct *Equus ferus lenensis* (KAHLKE 1994), of which a frozen specimen was found in a gold mine near Selerikan (LAZAREV 1977, GUTHRIE 1990).

It should be noted that in most breeds some features of domestication or other deficiencies are likely to occur that could be eliminated by selection. Examples are white markings (in most breeds, even in Przewalski's horse), atypical coloration (e.g. sorrel coat in the Konik) or summer eczema, a genetically fixated allergic reaction (e.g. in the Iceland pony (UNKEL et al. 1987) and the Exmoor pony (WILLMANN 1990)). Apart from the elimination of such negative features and maybe a positive selection for upstanding manes, no further breeding attempts are advisable as there are no models of any of the extinct horse subspecies.

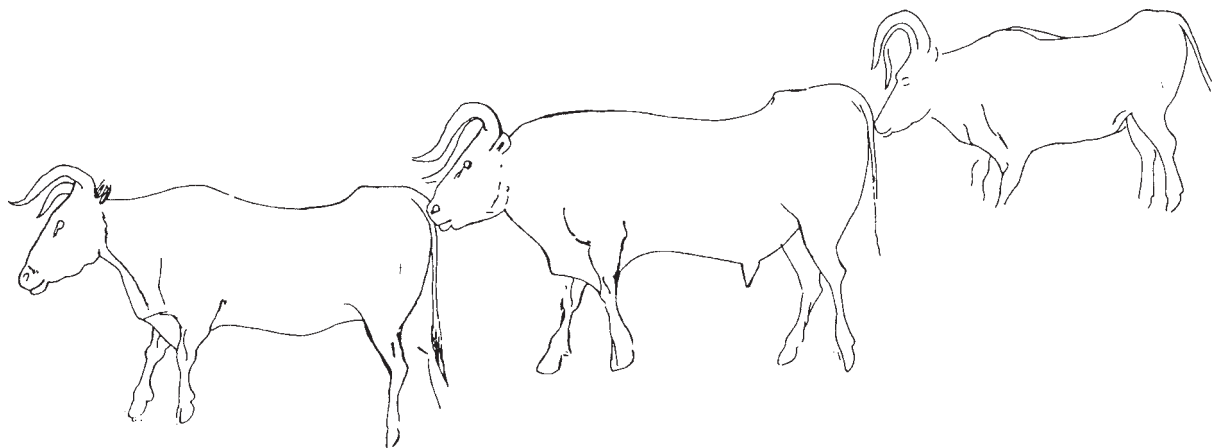
Of the breeds mentioned above, Exmoor ponies have been living for a long time under semi-wild conditions in England (e.g. SPEED 1956), Koniks since 1952 in a reserve in Poland (JEZIEWSKI & JAWORSKI 1995), and Koniks and Fjord horses have been used successfully in semi-reserves in the Netherlands since 1983/84 (e.g. CORNELISSEN & VULINK 1995, 1996). Yakutian horses have been grazing since 1998 in the "Pleistocene Park" project in northeast Siberia, where the hypothesis that herds of ungulates can change the tundra biome back into the original Pleistocene mammoth steppe is being studied (STONE 1998, CHAPIN 1999).

## 4. The aurochs

### 4.1 The history of the aurochs in Europe: rise and fall of a bovid

Since the middle Pleistocene, aurochs were found in glacial and interglacial periods in Europe (KURTÉN 1968). They were widespread over most of the northern hemisphere with the exception of North America. Many authors recognize three subspecies: the European aurochs (*Bos p. primigenius*), the progenitor of domestic humpless cattle (*Bos primigenius f. taurus*), the Asiatic or Indian aurochs (*Bos p. namadicus*) that presumably gave rise to domestic humped cattle or zebu (*Bos primigenius f. taurus = Bos p. f. indicus*) and the North African Aurochs (*Bos p. africanus = Bos p. opisthonomus*), whose genes could be included in African domestic cattle (e.g. CLUTTON-BROCK 1999). In the European and in the North African aurochs, there may have been some geographical variation in features like coat colour, possibly denoting further subspecies, but a conclusive study is missing.

The aurochs reached its highest population densities in Europe in the early Holocene, at a time when other large herbivore species were already extinct, and became rarer after that. Reasons for the decline were hunting, habitat loss and competition with domesticated cattle. Contrary to the horse, no wild population of the aurochs has survived up to now. The last known animal died in 1627 in a hunting reserve in Poland (MERTENS 1906). From skeletons, cave



**Fig. 7:** Engraving of three aurochs from the cave of La Mairie, Teyjat (Aquitaine), France (after WÜST 1999)

**Abb. 7:** Gravierung von drei Auerochsen in der Höhle von La Mairie, Teyjat (Aquitaine), Frankreich (nach WÜST 1999)

A discussion in the WWF Large Herbivore Initiative coordination group in Guzeribl (Russia) in september 1999 led to the emergence of two options for the selection of a horse breed for European nature restoration projects. The first option is to use an original local domestic breed which people in the project area are familiar with. The second option is to choose a breed from farther away that can be conceived by the public as a foreign, wild-living animal. Most participants of the WWF Large Herbivore Initiative coordination group inclined to the second option because it would probably cause fewer problems with breeders' associations and animal welfare groups. A breed that could serve the purpose is the Konik horse.

art (fig. 7) and few later representations, the general appearance of the European aurochs can be reconstructed, but not much is known about the species' biology. When it went extinct, the genetic material was not lost completely because in the biological sense domestic cattle are aurochs too.

The typical European aurochs was a rather long-legged animal with big head, sturdy neck and long, thick horns (e.g. REQUATE 1957). Holocene bulls stood 1,65 - 1,85 meters at the withers (BOESSNECK 1957), while cows were about 1/4 smaller. Aurochs horns curved forward and in the longitudinal axis were only slightly raised above the horizontal plane (HILZHEIMER 1926); at least in the northern part of Central Europe the horn tips always pointed inward and slightly upward (VON LEITHNER 1927). Adult bulls had a black coat with a pale eelstripe along the backbone and a whitish ring around the muzzle. Most cows were brown, only few had dark coats like bulls; calves were born uniformly brown (MERTENS 1906, BUNZEL-DRÜKE 1996).

The domestication history of cattle differs in many respects from that of the horse (fig. 6). The earliest aurochs domestication seems to have occurred in southwest Asia or southeast Europe and is dated at about 6000 B.C. at the latest (e.g. EPSTEIN & MASON 1984) - that is about 2500 years earlier than horse domestication. The first domesticated aurochs were longhorned types (sometimes called *primigenius* cattle), looking very much like the wild ancestor but showing a marked reduction in size. These longhorns spread to the west and north during the Neolithic revolution when Linearbandkeramik farmers colonized large parts of Europe and brought along their domestic livestock. They reached Central Europe about 4500 B.C. and southern Scandinavia about 3000 B.C. (PRICE et al. 1995).

It is thought that in Western Asia a small, shorthorned cattle breed (*brachyceros* = *longifrons*) was developed from the Neolithic Longhorn. Starting about 3000 B.C., shorthorns presumably spread from Asia Minor to Africa and Europe, sometimes replacing the earlier longhorned types, sometimes existing alongside and sometimes mixing with them (EPSTEIN & MASON 1984). However, new research seems to contradict the hypothesis of a genetic difference between the *primigenius* and *brachyceros* groups (MEDJUGORAC 1996).

The long time in human care and the different forms of utilization (e.g. meat, milk, draught) produced a lot of cattle breeds that differ more strongly from the aurochs than most horse breeds differ from the wild horse.

The wild aurochs went extinct in western Europe and large parts of Central Europe between 1000 and 1400 A.D. (BUNZEL-DRÜKE 1996). The date of extinction is not controversial as it is in the case of the wild horse. Early domestication of the aurochs and late extinction of the wild form resulted in the contemporary occurrence of domesticated and wild cattle over a period of several

thousand years. During this time, wild aurochs were apparently incorporated in various regions and at various times into the domesticated herds (e.g. EPSTEIN & MASON 1984, MEDJUGORAC et al. 1994, FELIUS 1995, MEDJUGORAC 1996) and even local new domestications are possible (e.g. EPSTEIN & MASON 1984, ESTÉVEZ & SANA 1999). It can therefore be assumed that some cattle breeds incorporate genes from local aurochs populations. This probability should be highest in old longhorned breeds.

#### 4.2 Options for an aurochs substitute

Which cattle breed is the best substitute for the aurochs? Several old breeds show certain features typical for aurochs but they differ in other features. Some examples are given below:

- Lidia or Spanish fighting cattle have a good general resemblance to the aurochs and the typical sexual dimorphism in size, but they are too small and may have a defective intimidation behavior, being bred to attack without a prior threat display.
- Corsican and Turkish cattle often show aurochs-like coat coloration with the sexual dimorphism of black bulls and brown cows, but they are far too small and have rather small horns.
- Hungarian Steppe cattle possess a good general build and are about the right size, but they show wrong coat colour, wrong horn form and pronounced dewlaps.

Heck cattle (fig. 8) - another attempt by the HECK brothers to "breed back" an extinct animal - was created by crossbreeding about 15 different cattle breeds, both longhorned and shorthorned (table 1). The resulting breed shows a definite resemblance to the aurochs but still has some deficiencies like rather short legs and skull, lack of height and often atypical horns (e.g. BUNZEL-DRÜKE 1996, UERPMANN 1999, van VUURE this volume).



Fig. 8: Heck cattle in Oostvaardersplassen reserve (Flevoland), The Netherlands

Abb. 8: Heckrinder im Schutzgebiet "Oostvaardersplassen" (Flevoland), Niederlande



**Tab. 1:** Cattle breeds used for the creation of Heck cattle (for breeds used by the HECK brothers see BUNZEL-DRÜKE 1996; for crossbreeding after World War II see HAENSEL 1985; German names as used by the HECK brothers, English names following FELIUS 1995)

**Tab. 1:** Rinderrassen, die für die Züchtung der Heckrinder verwendet wurden (zu Rassen, die die Gebrüder HECK verwendeten s. BUNZEL-DRÜKE 1996, zu Einkreuzungen nach dem 2. Weltkrieg s. HAENSEL 1985; Deutsche Namen wie von den Gebrüdern HECK verwendet, Englische Namen nach FELIUS 1995)

<p><b>Breeds used by the Heck brothers and which have a high probability of still being incorporated in today's Heck cattle</b></p>	<ul style="list-style-type: none"> <li>• Ungarisches Steppenrind (Hungarian Grey Steppe)</li> <li>• Podolisches Steppenrind (Podolian: original strain of Ukrainian Grey)</li> <li>• Schottisches Hochlandrind (Highland)</li> <li>• Allgäuer (Allgäu: original strain of today's German Brown)</li> <li>• Werdenfelser (Murnau-Werdenfels)</li> <li>• Angler (Angeln = German Red)</li> <li>• geschecktes Niederungsrind (probably German Original Black Pied Lowland or German Red Pied)</li> <li>• geschecktes Gebirgsrind (probably German Fleckvieh)</li> <li>• Korsisches Gebirgsrind (Corsican)</li> </ul>
<p><b>Breeds used only (?) by Lutz Heck in Berlin and which have a lower probability of still being incorporated in today's Heck cattle</b> (because the Berlin strain of Heck cattle was possibly wiped out during the war)</p>	<ul style="list-style-type: none"> <li>• Spanisches Kampfrind (Fighting cattle = Lidia)</li> <li>• Französisches Kampfrind (Camargue)</li> <li>• Montafoner (Montafon: original strain of today's Austrian Brown)</li> <li>• Graubraunes Höhenvieh (collective term for several breeds or strains, among others Tirol Grey Brown Mountain, Allgäu and Murnau-Werdenfels)</li> <li>• Englisches Parkrind (White Park)</li> </ul>
<p><b>Breeds possibly used by Lutz Heck</b></p>	<ul style="list-style-type: none"> <li>• Schwedisches Fjällrind (Swedish Mountain)</li> </ul>
<p><b>Breeds mixed in after World War II and still incorporated in today's Heck cattle</b></p>	<ul style="list-style-type: none"> <li>• Ungarisches Steppenrind (Hungarian Grey Steppe)</li> <li>• Watussi (Watusi)</li> </ul>
<p><b>Breeds mixed in after World War II with a low probability of still being incorporated in today's Heck cattle</b></p>	<ul style="list-style-type: none"> <li>• Jerseyrind (Jersey)</li> <li>• Ungarisches rot-weiß geschecktes Rind (Hungarian Pied)</li> </ul>

Which cattle breed should be chosen to replace the aurochs? Is it sufficient to use any breed that can survive without human care or is it sensible to combine the known features of the aurochs in one breed? The main problem in finding an ecological substitute for the aurochs is that we do not know very much about the species' biology. It is mostly just the appearance of the animal that can be reconstructed. And the ecological significance of the known features is understood vaguely at best. Nevertheless, animals closely resembling the aurochs might perform better in wild or semi-wild conditions than other breeds: after all the aurochs' features developed as an adaptation to its habitat even though we do not know which features offer which advantages for survival.

For a decision about an aurochs substitute other factors also have to be considered:

- In nature reserves where ecotourism is meant to play a role, a cattle breed closely resembling the extinct aurochs would be far more attractive than domestic breeds.
- Concentrating typical aurochs features in one breed might be a form of preservation of the species' genes, the only way to preserve the remains of the aurochs, especially in view of the present-day endangerment of many „primitive“ cattle breeds.
- The so-called „breeding-back“ of the real aurochs is not

possible. The idea has been disputed vehemently since the time of the HECK brothers. Even trying to create a cattle breed that looks like the aurochs and can possibly perform the species' ecological functions is still a very emotional issue.

Four different options for cattle breeds that could replace the aurochs in nature reserves could be discussed:

- existing primitive cattle breeds,
- Heck cattle,
- Heck cattle improved by crossbreeding with other breeds,
- newly created cattle breed approximating the aurochs (without using Heck cattle).

The pros and cons of each option are given in table 2.

#### 4.3 Aurochs: Conclusions

A cattle breed closely resembling the extinct wild form would be the most appropriate aurochs substitute for nature development projects. Heck cattle seem to serve their purpose under semi-wild conditions in Oostvaardersplassen reserve in the Netherlands (e.g. CORNELISSEN & VULINK 1995, 1996) (fig. 8). Nevertheless, more aurochs-like cattle might perform even better. Although Heck cattle can be expected to evolve during the so-called “de-

domestication" (e.g. KAMPF in this volume) and will perhaps even develop a greater resemblance to the aurochs, this process would last a very long time. Crossbreeding Heck cattle with other breeds will show faster results - at least phenotypically – perhaps even giving a better start for a new evolution.

Instead of trying to create a completely new breed resembling the aurochs, using Heck cattle as a basis for an aurochs-like breed seems to be a fast and relatively easy option. The "Arbeitsgemeinschaft Biologischer Umweltschutz", a local nature conservation society in Northrhine-Westphalia, has started a small-scale approach of crossbreeding Heck cattle with two further breeds:

- Italian Chianina (BORGIOLO 1981) (fig. 9): a giant breed reaching the size of the aurochs, but possessing very small horns; the coat colour is recessively white, but heterozygous cross-breeds (with e.g. Swiss Brown) seem to show the typical aurochs coloration;



**Fig. 9:** Chianina bull (Perugia, Italy)

**Abb. 9:** Chianina-Stier (Perugia, Italien)



**Fig. 10:** Sayaguesa bull (Zamora, Spain)

**Abb. 10:** Sayaguesa-Stier (Zamora, Spanien)



**Fig. 11:** Two cross-breed bulls nearly two years old fighting, on the left "Lucio" (father Heck cattle, mother Sayaguesa), on the right "Leonardo" (father Heck cattle, mother Chianina)

**Abb. 11:** Zwei kämpfende, fast zweijährige Mischlingsbullen: links „Lucio“ (Vater Heckrind, Mutter Sayaguesa), rechts „Leonardo“ (Vater Heckrind, Mutter Chianina)

- Spanish Sayaguesa (BELDA 1986) (fig. 10): a large, long-legged draught animal of longhorn type with medium-sized, sometimes aurochs-like horns, black coat with yellow eelstripe and white muzzle ring.

The first calves look promising (fig. 11). Meanwhile cattle breeders in Thuringia and Bavaria have joined the project, and Italian Maremma cattle and Lidia (Fighting cattle) from Spain (BELDA 1986) will be incorporated into the genetic basis. Albanian "Divjake" which have been claimed to be the last aurochs (RADKE 1996) will probably not be used because recent studies revealed the animals to belong to a *brachyceros* type domestic breed of rather small proportions (MIX, personal communication). For the future, it is planned to evaluate other breeds as well, e.g. Anatolian cattle. The WWF Large Herbivore Initiative supports the crossbreeding attempts.

Nevertheless, until „improved Heck cattle“ are available, Heck cattle seem to be the best aurochs substitute for nature reserves.

## 5. Acknowledgements

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## 6. Zusammenfassung: Ökologischer Ersatz für Wildpferd (*Equus ferus* Boddaert, 1785 = *E. przewalskii* Poljakov, 1881) und Auerochse (*Bos primigenius* Bojanus, 1827)

Die „Large Herbivore Initiative“ des WWF befasst sich seit 1998 mit dem Schutz bedrohter Huftierarten in Europa, Sibirien und Zentralasien und hat außerdem zum Ziel, den Herbivoren ihre Rolle im Ökosystem zurückzugeben. Großen Pflanzenfressern, insbesondere den ausgestorbenen Megaherbivoren wie Elefanten oder Nashörner und den Gras- und Rauhfutterfressern ("grazer") wie Wildpferd und Auerochse wird in der Naturlandschaft ein erheblicher Einfluss auf Vegetation und Landschaft zugemessen. Unter interglazialen Bedingungen schaffen sie danach reich strukturierte Lebensräume, die ein Mosaik aus Offenland und Wäldern darstellen. Die Herbivoren sind somit als Schlüsselarten anzusehen, die Habitate für andere gestalten.

Wie die Megaherbivoren sind alle typischen Grasfresser im nördlichen Eurasien in Freiheit verschwunden. Wenn versucht werden soll, typische Landschaften wiederherzustellen, die von den ursprünglich dazugehörigen natürlichen Prozessen gestaltet werden, sind u.a. auch Grasfresser erforderlich. Während einige Arten weltweit ausgestorben sind, können Pferd und Rind wieder in das Ökosystem integriert werden, weil wilde Unterarten bzw. domestizierte Formen überlebt haben.

Beim Pferd existieren noch eine bis vor kurzem wildlebende Unterart aus Zentralasien – das Przewalski-Pferd - und mehrere ursprüngliche domestizierte Rassen, die als Nachfahren des europäischen Tarpans gelten können, z.B. Konik oder Exmoor-Pony. Diese repräsentieren die wenigen bekannten Merkmale des Tarpans recht gut. Es ist allerdings umstritten, ob der Tarpan ein Wildtier oder eine sehr alte verwilderte Hauspferdrasse oder eine Mischung aus beidem war. Unklarheiten in der Domestikationsgeschichte des Pferdes erschweren die Bewertung alter Rassen. Welches Pferd sollte in Projekten zur Renatu-



rierung von Ökosystemen benutzt werden? In Zentralasien ist das Przewalski-Pferd die beste Wahl, aber für Projekte in Europa und Sibirien gibt es keine eindeutige Antwort. Die „Large Herbivore Initiative“ bevorzugt für Projekte in Europa die Verwendung einer Rasse, die von der Öffentlichkeit als Wildtier angesehen werden kann. Das Konik-Pferd erfüllt diesen Zweck.

Der Auerochse überlebte nicht als Wildtier, und keine alte Hausrindrasse vereinigt die bekannten Eigenschaften der Wildform. Ein Versuch der Gebrüder HECK zur „Rückzüchtung“ des Auerochsen resultierte im sogenannten „Heckrind“, einer Mischung aus etwa 15 verschiedenen Rinderrassen, die einige Ähnlichkeit, aber auch einige Unterschiede zum Ur aufweist. Dennoch scheint diese Form derzeit der beste Ersatz für den Auerochsen in Naturentwicklungsprojekten zu sein. Es besteht aber die Möglichkeit, das Heckrind durch Einkreuzung weitere Rinderrassen wie italienischen Chianinas oder spanischen Sayaguesas dem Auerochsen phänotypisch stärker anzunähern. Ein solches Projekt wurde in Nordrhein-Westfalen begonnen.

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