REWILDING HORSES IN EUROPE

Background and guidelines

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SECOND EDITION

STAFFAN WIDSTRAND / REWILDING EUROPE

Foreword

The wild horse in Europe: majestic and essential

Wild horses speak to our imagination. Songs are written about these symbols of freedom and enduring legends exist in many parts of Europe. If the cultural importance of these majestic animals is beyond doubt, then their impact on the European natural landscape is also invaluable.

In a sense we know the horse very well. But when we talk about horses as kept animals, we forget that domestication covers only a small part of European horse history. Long before humans and horses became better acquainted, wild horses were roaming the European plains in large numbers, shaping conditions for thousands of plants and animal species. In a domestic context this co-evolution of horses and other species continued, albeit in a slightly different way.

Over the last few decades, however, Europe's herbivore-related biodiversity has been increasingly put at risk. As marginal areas have been abandoned by farmers, so their livestock has also disappeared. After millions of years of natural grazing and some 10,000 years of domestic grazing, we now see large parts of Europe lacking this essential natural process. This is why returning large herbivores to European landscapes is one of Rewilding Europe's key activities, with the wild horse one of our focus species.

The European wild horse may be officially extinct, but is still present in many types of domesticated horse. From Exmoors in the west to Hucul in the east, several primitive horse types still possess many characteristics of the original wild horse - this renders them suitable for rewilding and well-placed to reprise their vital role in European ecosystems. The Przewalski's horse, originally native to the steppes of Central Asia, is the last extant wild horse in the world, and can also be a great asset in restoring the functional role of extinct wild horses in Europe.

This document, which follows an earlier version published in 2014, has been updated and revised based on the latest information, publications and insights. It guides the reader through the rich world of European horse types, makes a first selection of horses suitable for rewilding, and gives guidance on how the rewilding of horses should be carried out, in line with the latest scientific and practical information.

While this updated document informs readers of the latest information and best practice regarding horse rewilding in Europe, it should be viewed as a live document, which is how Rewilding Europe will use it. Knowledge on this topic continues to develop rapidly.

By sharing our practical experience of horse rewilding across Europe, together with the latest scientific information, our aim is to help reach the ultimate goal: well-functioning European ecosystems, with the wild horse present as a defining species. Attaining this goal would add a new chapter in our special relationship with this noble animal.

I would like to thank Rhys Lemoine, post-doctoral researcher at Aarhus University in Denmark, Leo Linnartz from ARK Rewilding Netherlands, and Renée Meissner from Herds & Homelands, for their invaluable help updating this important publication, which will act as a critical guide to the rewilding of horses in European landscapes for years to come.

Frans Schepers

Executive Director
Rewilding Europe

Wild Bosnian mountain horse in Malo Libinje, Velebit Mountains, Croatia.

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LEO LINNARTZ / ARK NATURE

Executive summary

Wild horses evolved in North America and once ranged all over Eurasia where, in combination with other large wild herbivores, they had a substantial influence on the nature of the landscape. However, the improved hunting skills of an increasing human population precipitated their decline. Many large herbivores, like rhinos and elephants, began to disappear towards the end of the Pleistocene epoch, but horses survived in relict populations and did not completely disappear.

Once domesticated on the west-Eurasian steppes, domestic horses spread quickly across Europe. Genetic evidence suggests that while domesticated herds spread, wild mares were added, allowing these locally adapted horses to integrate with the domesticated ones. This interbreeding resulted in the conservation of genes belonging to local variations of the European wild horse and was the origin of many locally adapted, domestic horse breeds.

The tradition of keeping these locally specialised horse types in a semi-feral state made sure that wild gene variants survived. Predator avoidance, free partner selection, competition between stallions, winter hardiness, and rain/ice resistant coats were all preserved. These native breeds may even be direct descendants of local wild horses carrying a few domesticated horse genes. Regardless of what the exact proportion of domestic versus wild horse genes may be, the absence of strong human selection and the influence of natural selection have kept these animals fit and suitable for rewilding, so these ancient breeds, especially those that have been living feral or semi-feral lives, represent an important gene pool.

Unfortunately, the recent trend of land abandonment in rural areas has caused a sharp decrease in the numbers of semi-feral herds, increasing the need to conserve surviving descendants of the original European wild horse as soon as possible. These 'new' wild horses may then reclaim their lost role in landscape management in Europe's extensive areas of abandoned agricultural lands and could facilitate many other species' survival.

Although scientific knowledge on the subject has been improving, there is still a lack of clarity on the genome of the European wild horse. The genetic background of modern 'rewildable' horse breeds and their relation to the extinct European wild horse is heavily disputed. The sequencing of several ancient horse genomes means that knowledge on this subject has increased enormously. However, there is still much to be studied and clarified, including the original DNA variation in wild horses, the variation in the stallion's Y-chromosome, the original variation in coat colour, etc.

Further DNA studies will be needed to unravel the mysteries surrounding the original European wild horse. It should be noted, however, that the goal of rewilding modern horses should not be to "breed-back" the wild horse as it was, but rather to ensure that future wild horses have the adaptations and genetic diversity needed to adapt and thrive as wild populations.

Fit for rewilding

Rewilding horses means using current and future scientific knowledge to conserve, and where necessary select, the descendants of the original European wild horse and adapt them to modern natural environments. However, to make the rewilding process successful, scientific knowledge should follow practical experience and consider ethical concerns. These new wild horses will not be identical to the original European wild horse, but will be capable of surviving without interference, thereby regaining their lost role in Europe's wild ecosystems.

Rewilding horses also means moving from domestication towards wildness and from human care to self-sufficiency. When choosing horses for rewilding, it is best to use regional and well-adapted animals that are still used to living in the wild. Often, several local breeds are quite alike and share an ancient common background. Crossing these breeds together is sensible, as it will help to broaden genetic diversity and fitness.

Many rewilding projects that utilize horses can end up using a single, uncrossed breed exclusively, even unintentionally. However, breed standards are not relevant in a rewilding context and the new wild horses should not be treated as belonging to one of their founding breeds. Inbreeding can be a concern as well. Unwanted colour morphs or white markings might be selected out at first, but for the most part, nature should do the selection process. Wolves, bears, harsh winters, and dry summers may all serve to exert a selective pressure on the herd and the animal's traits will slowly adapt to their new environment and living conditions. This will result in new wild horses, based on hardy old breeds, but adapted to living in the wild in their own local environment.

As primitive landraces are often rare breeds, this approach can lead to conflicts with breed associations or enthusiasts, especially if a rewilding project wants to cross their horses with other appropriate types or if the animals begin to deviate from breed standards. However, although our interpretation may turn out to be subjective, we firmly believe that it is in line with rewilding purposes, for which proof is always in the practice.

The Process of Rewilding

Rewilding horses takes time! It is a process, combining both (epi)genetic and cultural changes. It is a radical transition from a focus on individual care to a concern for the ecological whole. How best to deal with this transition is the responsibility of the wildlife manager and depends on local circumstances. Respect for the wild nature of animals and thus respect for the potential wildness of post-domestic animals is an important aspect of rewilding.

Management of a rewilded herd means consideration at a population level, thinking at the herd level, acting at the social group level, and keeping a watchful eye on individuals. One must bear in mind that reduced welfare for some individuals will, over time and generations, bring better survival for the species.

In order to create a population that will be large enough to be viable in the long-term, it is best to start rewilding with a herd of at least 3 socially integrated harems and one stallion group, containing 6 genetically distinct adult stallions and 12 genetically distinct adult mares and their offspring. These founder animals should already

Przewalski horses in Causse Méjean, France.

live in socially balanced groups before the introduction into the rewilding area (see ch. 4.1). Ultimately, a herd of at least 150 genetically diverse animals is considered the minimum for a self-sustaining population.

There should also be enough food and water in both summer and winter, with places to shelter from adverse weather conditions. As a result, the final herd's minimum area requirement ranges from at least 450 hectares in a nutrient rich delta to at least 4,500 hectares or more on poorer soils. Such a large area may not be required initially, but should be available as the herd grows.

While selecting individuals, care must be taken to select animals that

- Live as near as possible to the area
- Are well adapted to the terrain type, local climate, and other circumstances
- Are used to living in the wild
- Form an existing balanced social group, with all ages represented
- Are ideally of a homogenous appearance
- Are readily available

Rewilding often means translocation of horses to a new rewilding area. This means that horses have to get to know their new territory. Translocation is best done with existing social groups. Later, younger animals can be added with two or more individuals that already know each other, in line with natural dispersal patterns, and these can join existing groups of wild horses. Mimicking natural dispersal behaviour will improve integration into an existing herd and give newcomers more opportunities to learn how to cope with local predators, especially if they have no previous experience.

When starting with any rewilding activity, make sure to have a communication plan and local action plan [IUCN/SSC 2013]. Wildlife managers of rewilding areas should inform themselves about all laws and rules relevant for their work. Rules and regulations regarding horses can be complicated, especially in border situations. More information about releasing and managing newly wild horses can be found in Vermeulen [2012]. Releasing newly wild horses in rewilding areas requires recognition of the "wild" status for the newly rewilded horses. Appropriate legislation should be considered, allowing rewilded horses to have no responsible owner and to become truly wild.

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1. Rewilding Horses

Land use is rapidly changing across Europe. Where possible, the use of good quality agricultural land is being intensified, which increases food production but decreases biodiversity in the immediate surroundings. Simultaneously, poor quality or less accessible land is being abandoned at a very high rate of many thousands of hectares per year. This land is no longer suitable for agriculture. Villages are left to decay or are only inhabited by a few elderly people, who are unable or unwilling to relocate. However, this rapid change of land use also presents an opportunity – a chance to bring back wild fauna and develop an economy based on wild nature and wildlife, in which wild horses can be a flagship species. Rewilding Europe wants to grasp these opportunities and improve the future for a new European wild horse.

By restoring natural processes, such as wild herbivory, migration, floods, and wildfires, something resembling the original European biodiversity can reappear. Wild horses used to play an important role in grassland and semi-open forest ecosystems. Together with other mega-herbivores they can revitalise the natural processes of grazing, browsing, and debarking. At the same time natural processes such as wallowing, treading, seed dispersal, and nutrient redistribution are promoted by large grazers such as horses. The need for suitable organisms, like wild horses, to restore natural processes as part of ecosystem restoration was highlighted in IUCN guidelines: "Where species are extinct, consequent changes in the ecosystem can indicate a need to restore the ecological function provided by the lost species; this would constitute justification for exploring an ecological replacement" [IUCN 2013].

Rewilding horses means moving from domestication towards wildness and from human care to self-sustainability, which should not be confused with recreating extinct wild horses. Rewilding also suggests placing less emphasis on the concept of breed, as horse type differences are a human-made artefact resulting from breeding and artificial selection. Prior to artificial selection, these differences were only driven by natural selection and adaptation to local circumstances. Therefore, the emphasis of this document is currently on rewilding and the re-enaction of these natural processes, not on back-breeding. "Those that are rewilded have had their history ruptured, but their wildness has been restored" [Norton 1995].

Growing knowledge about the extinct wild horse can nonetheless be used to help identify the best breeds and characteristics among existing horses for rewilding purposes. Our understanding of the ancient European wild horse is still very incomplete and future scientific knowledge can and should be used to inform the rewilding process, for example by adding or excluding certain gene variants from rewilded herds. Rewilding also enables ground-breaking scientific research on the ecological role of the newly wild horses in natural areas. As such, rewilding can immediately contribute to the conservation of the most appropriate descendants of the original European wild horses while re-adapting them to modern natural environments.

Exmoor ponies, one of the oldest and most primitive horse breeds in Europe, Keent Nature Reserve, The Netherlands.

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2. The role of wild horses in European ecosystems

Dehesa landscape in the Monfrague National Park, Spain.

2.1 Prehistoric Landscapes

Some 40 million years ago, horse-like animals started to appear and slowly evolved into the horses we know today. 5 million years ago Equus species roamed the plains of North America and Eurasia. During the last Ice Age, wild horses were present in Europe and co-existed with a wide range of megafauna we now only know from Africa and Asia: elephants (mammoth and straight-tusked), (woolly and other) rhinos, spotted hyena and (cave) lions. Pictures of these horses and other animals are still visible in ancient cave paintings [Chauvet 1995].

At the end of the Ice Age much of the megafauna disappeared from Europe and North America. There are strong indications that modern man and their ever-improving hunting techniques – including the use of dogs [Shipman 2015], fire, spear-throwers and other long-distance weapons – were the main causes. At the end of the Ice Age, temperatures increased and megafaunal species of the cold steppes moved to the north and east. Temperate flora and fauna that had survived in warm refugia in the south and southeast returned to Central Europe. Among them were fallow deer, aurochs, wild ass, and wild boar.

Other species, such as saiga, wild horse, red deer, roe deer, and giant deer remained widespread, but while they roamed the new grassy plains and open savannah woodlands in early-Holocene Northwest Europe, other species were not able to recolonize these new habitats. A growing human population and mounting hunting pressure likely kept them from recolonizing the new grasslands and open woodlands and the continuously growing human population depleted the herds of megaherbivores. The larger the animal, the more vulnerable it appeared to be [Crees 2013]. One by one, species started to disappear from large areas or retreated to less hospitable areas in order to escape hunting pressure. Without the constant high grazing pressure, forests started to dominate over grasslands [Sandom et al. 2014].

2.2 Ecological Impact

Together with natural disturbances like storms and forest fires, and natural processes including insect and disease outbreaks, the combined influence of grazing, browsing, trampling etc. by large herbivore species works to maintain open or half-open landscapes in many of Europe's climate zones, but only if herbivore numbers are sufficiently high and the species composition sufficiently diverse. Different species occupy different niches and not only compete, but also facilitate each other. Their combined impact on the landscape is thus much more than the impact of one single species.

As part of this combined grazing guild, horses play an important role that can be observed in modern-day nature reserves where wild-living horses coexist with other large grazers. In the Mongolian Hustai National Park, argali (sheep), Mongolian gazelle and red deer all returned after the Przewalski's horse was reintroduced, as the horses turned the homogenous tall grasslands into typically grazed mosaic grasslands, which were attractive to the other herbivores.

Horses can survive on nutrient poor grasses and eat dead grasses as a major part of their diet. By removing dead grassy material, they stimulate regrowth, enabling species like aurochs and deer to live in greater numbers in nutrient-poor landscapes. In nutrient-rich landscapes, grazing deer, bison, and species like aurochs reduce the height of tall grasses and herbs to that preferred by horses [Nieuwdorp 1998a]. Horses in turn, maintain grasslands in a short-grazed state, preferred by grazers like rabbits and geese.

Often, nutrient-rich environments are only seasonally available and horses, together with other grazing animals, migrate from rich environments in summer to nutrient-poor ones in winter, thus using both habitat types. Furthermore, while horses can shape the landscape, the reverse is also true. The availability of nutrients determines the horse's body size and intestine surface, and a flat, open landscape favours horses with long legs, whereas horses with relatively short legs are better suited to mountains.

Horses also debark poplars, willows, spruce, and beech, thus opening up patches of closed forests. However, as a non-ruminating species, they cannot digest the bark of poisonous species, like elderberry or black cherry, which are eaten by ruminants. Therefore, where they occur together, ruminant and non-ruminant herbivores can act

Stone-age artwork in the Chauvet Cave, France, is more than 30,000 years old.

HERITAGE IMAGE PARTNERSHIP LTD / ALAMY

A pair of stallions fight on the Lika Plains in the Velebit Mountains rewilding landscape.

Debarked tree in Keent, The Netherlands.

to open gaps in forests, offering space for open habitat species like bushes, herbs, grasses and accompanying insects and birds.

On top of these effects, horses create wallows, facilitating insects that need these de-vegetated patches for thermoregulation or breeding. While grazing and walking they mix soil, dung and dead plant material, stimulating nutrient cycling, and in their coats, seeds are transported. Their preference for roots and the bulbs of reeds, grasses and sedges opens up monotone stands of these species, enabling herbs to become established.

In many of these aspects, horses are unique and complement other large herbivores. Together these species have a major positive impact on the environment and its biodiversity. Removing or drastically reducing the numbers of key players in an ecosystem, as humans have done since the late Pleistocene, results, via trophic cascades, in decreased biodiversity [Eisenberg 2009, Sandom et al. 2014]. Wild horses, elephants and aurochs were key players, as were wolves and lions. Without them, Europe's early Holocene grasslands and savannah woodlands transformed into a tree-dominated landscape. The remaining open land species – horse, bison and aurochs – were forced to retreat to inhospitable places, like wetlands or mountains, where grasses were still available [van Vuure 2014], or started living in forests in much lower densities.

3. Extinct, But Not Lost

From around 6000 to 5000 BC onwards, domesticated animals such as cattle, sheep, goats and pigs, started to appear in Central and Northern Europe. Current knowledge suggests that horses joined these domestic herds after 3000 BC. Domestic animals thus eventually replaced dwindling populations of their wild counterparts, while competition from domestic herbivores and constant hunting pressure forced wild herbivores to retreat even further. Wild animals were excluded from agricultural fields and predators were hunted down in order to protect livestock. Fertile lowland grasslands were abandoned by wild herbivores, which retreated into mountains, forests and marshes [Mémeth et al. 2016]. The isotope contents of the bones of ancient aurochs bear witness to this change in habitat [Noe-Nygaard et al. 2005, Drucker & Bocherens 2009, Cromsigt et al. 2012].

By around 2000 BC, the breeding of domestic livestock was widespread, and the clearing of forests began. For the second time, humankind changed the landscape on a large scale. The post-Ice Age open forest landscapes returned, but were now occupied by domestic cattle, horses, pigs, sheep and goats. Their wild counterparts still survived, but in restricted numbers and hidden in uninhabited and often inhospitable places.

Over time, humans were able to colonise more and more of these last refugia, causing wild herbivores and their predators to further decline. One by one, species became extinct: the aurochs in 1627, the 'tarpan' in 1909 and the last wild bison in 1927. However, it is now thought that the last horses living in the wild, such as the "tarpan" seen in the forests of Europe during the 18th and 19th centuries, were not genuine wild horses but instead were of mixed wild/feral origin, with the original European wild horses having disappeared roughly 4000 years ago [Librado et al. 2021].

Extinct, but not lost, the genetic heritage of both the European wild horse and aurochs survived in their domesticated forms. Mitochondrial DNA investigation has shown that domesticated horses derived from at least 77 different mare bloodlines. However, current knowledge shows low variation of mtDNA in wild horse populations, indicating this broad variation was not obtained from initial domestication. Instead, it probably meant that while domesticated horses spread through Eurasia, local gene variants of wild mares were added to the domestic herds [Jansen et.al. 2002, Cieslak et al. 2010, Foidl 2014]. At the same time, wild stallions would have included domesticated mares in their harem or covered them on occasion. As there are several reports (e.g. van Vuure 2014) mentioning that the offspring from wild stallions and domesticated mares delivered unmanageably wild horses, it is likely that these animals were not incorporated into the wider breeding pool.

Consequently, while domesticated horses gradually replaced wild herds, Europe-wide interbreeding with wild mares helped to preserve many of the local adaptations and genetic variation found in wild horses. Variation among present-day domestic breeds has been built partially on pre-domestic variation adapted to the different climates, landscapes and food supplies in the different corners of Europe. However, many breeds have been influenced by human breeding, for traits associated with racing horses, show jumping horses and draft horses. Genetic evidence has demonstrated that there were two clades of horse in Europe, one in Iberia and one for the rest of the continent [Librado et. al., 2021]. Only the latter clade is ancestral to the domestic horse, and this form was found in Europe during both glacial and interglacial periods, rather than the Przewalski's horse as previously thought.

Horses exhibit adaptations to their environment in their physical appearance. For example, short-muzzled horses are adapted to cold weather where their short, broad nose cavity is used to warm up the cold air. Compact builds are adapted to more closed landscapes and heavy terrain such as snow and mud. More lightly built, slender, and long-legged horses are adapted to running and walking long distances in open, dry landscapes [pers. comm. V. Eisenmann].

Throughout history, war and trade brought domestic and sometimes even wild horses from one place to another. Alexander the Great, the Huns, the Arabs, the Vikings, Genghis Khan, and

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Exmoor ponies in the Keent Nature Reserve, The Netherlands.

many other conquerors travelled thousands of kilometres with their armies, even by boat, and fought in many locations, dispersing horse gene variants across large distances.

Where domestic and wild animals could meet, crossbreeding often occurred. Wild stallions or bulls covered domestic mares and cows in heat. Domestic animals escaped and joined wild herds or formed feral herds of their own. During war or plagues, animals were left behind and became feral, as mustangs did in America. This has continued into modern times, as when during the war in Croatia, sturdy regional horses were left behind in the mountain pastures of Velebit, while in the Letea forest (Danube Delta) a large group of horses has been rewilded in recent decades.

In many places in Southern and Eastern Europe, local breeds traditionally roam free in mountainous areas in a semi-feral state. Such free-ranging horses can also be encountered in Great Britain (e.g. Exmoor) and in Iceland. Thanks to this tradition, natural selection has continued to exert pressure on local variants and wild genes were kept intact.

This is in contrast to highly specialised modern horse breeds. The absence of natural selection in favour of artificial selection for conformity, gracefulness, colour, and tameness has encouraged inbreeding and produced animals unfit for rewilding. Luckily, breed registries are a relatively recent invention and most have only existed since the end of the 19th century. What's more, while some individuals were 'improved' according to breed registry standards, others were still kept traditionally and maintained their natural characteristics.

4. Fit for Rewilding

4.1 Natural social system/ Horses' specific social system

In the past, the existence of large tracts of wild land allowed large grazers to live in natural herds. The carrying capacity of the environment, the seasons and interactions between animals determined which species roamed the country. Every species had its own social system, ensuring its strength and fitness, with species-specific behaviours increasing safety from predation, especially for young animals. These social systems also prevent inbreeding and direct habitat use.

For horses, a natural herd composition has three distinguishable groups, i.e. harems, bachelor groups and (temporary) adolescent groups. Most important are the harem groups with a lead stallion, his mares, and their foals. Sometimes several stallions are present, working together to defend the harem against competitors and predators. Older foals of both sexes are expelled from the group as they mature and then look for another group to join.

Young mares join other harems or a temporary adolescent group. Young stallions form bachelor groups in which they can mature and learn to fight or they may join temporary adolescent groups. Strong adult stallions leave the bachelor group to secure their own harem, while others find safety in the bachelor group and can stay there for the

Konik horse release in the Danube Delta, Ukraine.

ANDREY NEKRASOV/ REWILDING UKRAINE

rest of their lives. Harems are very stable: usually both lead stallions and adult mares stay in the same group throughout their life. All offspring leave the harem when reaching maturity, thus avoiding inbreeding. Consequently, female harem members are not composed of mothers and daughters.

Harems and bachelor groups are quite small, averaging 6-16 individuals, but these groups may coalesce into very large herds of horses containing many harems and several stallion groups, each keeping its distance from each other. The large herd of over 1000 semi-feral Konik horses in the Dutch Oostvaardersplassen contains over 60 harems, with the largest consisting of 25 horses with one stallion and the smallest one young mare with two stallions, the lead stallion and a subordinate. All over the world, free roaming herds of wild equids and feral horses live according to this social pattern, with some small variation.

The social structure of horses and other equids is very different from the maternal social structure of bovines, water buffalo and wisent. Bovines typically have female groups with an old female in the lead, containing cows and their offspring. Young females stay, but young bulls leave the group once they reach maturity, often migrating to areas where other female groups reside. Adult bulls are solitary or live in smaller groups. When female groups become too large, they split and an older cow will take all her daughters and their offspring with her.

This difference in social structure has implications for establishing rewilded herds. Successfully rewilding horses requires a strong social structure within the group that has been stable for several years. Putting together a few suitable individuals does not make a natural herd; it takes time for social bonds to develop, and a group of individuals that have to put energy into finding the right hierarchy have less energy for other purposes, which may be particularly costly where predators are around. Successfully rewilding horses may thus require a long preparation process, optimally spanning one naturally born generation.

4.2 From domestic breeds to wild herds

The original variations of the ancient wild horse were naturally well-adapted for local survival in the wild. Their DNA, with specific gene variants and gene expressions, has partly been lost but their phenotype could be recovered. However, there is still a lack of clarity on the genome of the European wild horse and the genetic background of modern rewildable horse breeds remains heavily disputed.

Several breeds are often touted as the last descendants of true wild horse populations and so better suited for rewilding than others. There is little evidence for these claims, however. Examples include Exmoor ponies, Sorraias, and Koniks. All three are very hardy breeds well suited to living in wild conditions, but all have very recent, well-understood breeding histories as well [Green, 2013; Foidl, 2017, Lovasz et al, 2021].

It is known that the first modern horses were domesticated on the West-Eurasian steppes and that the practice of keeping horses spread quickly across Eurasia. During this expansion, local wild horses were integrated into the new domesticated herds [Jansen 2002], resulting in a broad variety of locally adapted horse types across Europe. Alternatively, horses could have been domesticated in several locations, spread over Eurasia, or a combination of both [Cieslak 2010]. Archaeological and genetic evidence, however, points to the first alternative [Jansen 2002; Librado et al, 2021], as does the small diversity of the male Y-chromosomes compared to the very broad diversity of mare mDNA [Lindgren 2004].

As a result, the original wild horses of Europe still survive in all of their domesticated, feral and semi-feral offspring. That is why the amount of adaptation of a horse to local circumstances and living in the wild is a good standard for selecting suitable founders. 'Fit for purpose' is ultimately what makes a founder suitable for rewilding.

Garrano horses in the Faia Brava reserve, Portugal.

STAFFAN WIDSTRAND / REWILDING EUROPE

5. Selecting Horse Breeds

5.1 General

When choosing horse breeds for rewilding, it seems wise to use local, well-adapted breeds, especially if they have an ancient phenotype (adaptation) which can be developed further by natural selection after rewilding. One consequence of rewilding is the abandonment of breed standards. This includes the possibility to rewild a population of mixed breeds or to join and mix several populations of different breeds, so long as all breeds included meet appropriate criteria.

Suitable local breeds are often very similar in appearance and may even have been a single type before the breed standards that drove them apart were established. Re-joining these breeds with others of similar heritage broadens the genetic diversity of these horses and so increases their fitness for survival. When selecting individuals from several breeds, care must be taken that all individuals do appear like the original type, thus avoiding an artificially mixed appearance. For example in Iberia, many breeds are developed in isolated mountainous areas, but they are still quite similar.

Mixing breeds for rewilding has an advantage for genetic diversity and is a basic form of back breeding that gives room for natural selection. New research can help clarify the roots of certain breeds, but should never overrule the 'fit for purpose' standard. Rewilding means working towards a future wild horse, using domesticated offspring of extinct wild horses from the past. But only after a successful step-by-step feralization (i.e. the process of becoming feral), can horses be truly rewilded.

5.2 Selection criteria

Domestication is an ongoing process. Rewilding necessitates that we switch from this domestication process towards one that promotes adaptation to a future life in the wild. To understand this switch, we need to understand what happened during domestication. In general:

- Selection for rare breeds resulted in low genetic diversity
- Animals became tame
- Adults retained imitation behaviour typical for young animals (neoteny), rendering them obedient and eager to learn
- Adaptation to the local natural environment decreased, but fortunately, not as acutely as in sheep and cattle
- Body sizes became differentiated, with very large and very small breeds appearing
- Physical appearance changed
- Social behaviour changed
- Reproduction increased
- Genetics changed

Domestic characteristics can arise quickly, with the risk of losing wild characteristics through genetic drift. From fossil DNA, old rock carvings, written sources etc., we can partly reconstruct the original European wild horse types as effectively as possible and compare how ancient wild and modern domestic horses differ from each other. However, resemblance to the ancient wild horse does not necessarily equate to 'fitness for purpose'.

New research can bring new insights and can change the relative ranking of breeds on fitness for rewilding. In order to reverse domestication, the changes that domestication has precipitated and the implications for rewilding are discussed in detail below.

Low genetic diversity

Many of the potentially 'fit-for-rewilding' horse types are rare breeds with low genetic variation. It is therefore desirable to increase genetic diversity by combining horses from several related breeds when building herds for rewilding [Vermeulen 2012]. Where local breeds look quite similar, this approach increases genetic variation without losing local climate and terrain adaptations. During subsequent rewilding, natural selection may decrease this variation again by removing gene variants that derive from domestication and offer no advantages in a wild population. Nevertheless, this 'mixed' wild population is likely to end up with more genetic variation than is found in 'purebred' domesticated breeds.

Exmoor pony in De Maashorst, The Netherlands.

Tameness

We cannot measure the impact of domestication on tameness/wildness. We can only compare it with the last extant wild horse, i.e. Przewalski's Horse. This subspecies cannot be tamed. In contrast, North American mustangs are still easily tamed, even after being feral for five centuries. We can also see that there is a difference in tameness between different breeds, which is important not to confuse with learned behaviour. Evasive behaviour can be learned and even imitated between individuals. Following rewilding, the durability of tameness as a characteristic is difficult to predict. It is not known if gene variants for wild behaviour have been lost forever as this was the characteristic that was de-selected most heavily during domestication. During the rewilding process, we will learn quickly how this tameness disappears, if it disappears at all.

Natural behaviour

The domestication of horses did not change their genetic make-up as severely as in many other domestic mammals. The absence of strong human selection and the continued influence of natural selection have rendered some of the wilder and more ancient breeds perfectly fit for a natural life in the wild. All across Europe, local horse breeds have traditionally roamed natural areas in a semi-wild state. These horses were expected to find their own food and shelter, which guaranteed the preservation of important wild traits and appearances, enabling horses to stay fit and alive under semi-wild conditions.

Knowledge of how to avoid/defend themselves against predators, competition between stallions, how to survive cold, snow and drought, and the development of coats resistant to rain, snow, and ice, were all preserved and local adaptations were developed. Populations of rewilded and semi-wild horses therefore represent important gene pools, where adapted individuals can survive most successfully.

Rewilding horses takes generations in order for them to fully adapt and learn to live in the wild again. It follows that these old, well-hardened breeds will be the most eligible for rewilding. Often these are the ancient terrestrial types [pers. comm. Hall], which share many similarities with their wild ancestors. Individual horses' past and current lifestyles – whether they were feral, semi-feral or kept in a stable – should also be considered an


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important factor in determining whether they are suitable for rewilding. The amount of time and effort required to effectively rewild a particular horse depends greatly on its history. Though many of them eventually succeed, some won't.

Body size and conformation

Rock paintings and ancient carvings generally depict sturdily built, medium-sized horses, and fossil records show that body size and morphology of ancient horses varied with the environment. Horses from Northern latitudes tended to be small and robust, temperate horses were more slender, while larger body sizes and more robust limb bones were associated with mosaic steppe environments [van Asperen 2010]. In general, they all had strong legs, strong joints, strong jaws and teeth.

As a result of mixing local wild mares with domesticated horses imported from elsewhere, several modern day domesticated horse breeds still exhibit many of the phenotypic adaptations of their local wild ancestors, including differences in body type, shape of head, and length of legs, as well as composition of muscles, bones, and joints. Such skeletal changes likely represent adaptation across several generations, reinforcing the need to consider the local landscape when choosing which breeds to introduce for rewilding.

We know from data gathered from ancient bones that wild horses' height at the shoulder varied between 1.20 m and 1.40 m, but height is also one of the characteristics that can change very quickly. For instance, in the Oostvaardersplassen and other large-scale nature areas in the Netherlands, Koniks developed a smaller and broader body size in 10 generations as an apparent result of natural selection [pers. obs. R. Meissner, J. Griekspoor]. Extremely oversized or undersized horses are not usually considered for rewilding, although it may happen exceptionally. For example, the popular Shetland pony is a dwarf version of the original Shetland pony. This breed was originally much taller and fell within the lower end of the natural height range. When using such breeds for rewilding, care must be taken to use only appropriately sized individuals for the local environmental context. As a guide, typical body mass for an adult Przewalski's horse is estimated at roughly 250-350 kilograms and this was likely typical for most European wild horses, although some variation would be expected.

Two skeletal traits have been identified that differ between some domestic horses but occur consistently in wild equids. One of these traits is that in wild equids the nuchal ligament lamellae (tendon-like structures that support the head) attach to the 2nd-7th cervical vertebrae, whereas in most domestic horses there are no attachments on C6 or C7 [May-Davis et al, 2018]. Wild equids also possess an extra interosseous ligament attached to their metacarpals (foot bones) giving extra stability [May-Davis et al, 2019]. These traits are more common in some domestic breeds, including Koniks and Bosnian mountain horses, although they can also be found in more derived breeds occasionally. It is possible that these traits are related to load-bearing or gaits, or simply lack of selection, and it should be further investigated whether they have any influence on fitness. As a first indication, among Koniks lead stallions have been observed to possess a thicker, more developed interosseous ligament, whereas subordinate stallions do not [pers. comm. Tanja de Bode].

Coat colours

The genetic determination of equids' coat colour is still not entirely understood. European wild horses were unusual in being one of the few large mammals to be naturally multi-coloured. The various coat colours of these animals are best explained in stages, with more complicated colours being built on top of more basic ones. At its most basic, horse colour genetics starts with a single gene which determines how dark the horse's coat is. Animals with the wildtype version of the gene will be darker, while those with the domestic variant of the gene will be lighter, resulting in a coat with Chestnut/Sorrel colour. The phenotype (appearance) can then be altered by another gene, which determines whether the animal will be bay or black, both considered wildtypes. A third gene then determines whether the horse will be dun (lighter coloured with primitive striping) or not, with the non-dun state having both a wild (non-dun with markings) and domestic (non-dun without markings) type.

These three genes thus interact to create the four coat colours that are associated with the European wild horse: Bay, Bay Dun, Black, and Black-Dun. They would also have possessed various other genes that altered these coats further, such as leopard-spotting, mealy, and sooty, though it is unclear how widespread these were. Dun and wildtype non-dun can result in striping on the back, neck, and legs. These are often interpreted as a sign of wild origin but really, they only signify the presence of these gene variants, which are widespread.

Manes

Manes in wild equids are stiff, as can also be seen in European wild horses depicted in ancient rock paintings. Longer and possibly hanging manes can potentially also be seen in some cave paintings and in the Yukon fossil horse, but this has been

Wild Bosnian mountain horses in the Paklenica National Park, Velebit Mountains, Croatia.

debated. Hanging manes could already have been present in the Holocene among the wild horses of Eurasia [Hovens 2013], possibly as a way of deterring heavy rainfall, but this feature could also be a result of domestication [pers. comm. C. Van Vuure]. There is still little evidence either way, so this should not be used as a trait for selection.

Forelock

The forelock between the ears is absent in Przewalski's horses. This could be related to dry climates, similar to the stiff manes. A short forelock is seen occasionally on an individual level in many modern breeds, while some breeds generally have shorter forelocks than others. A long forelock protects the eyes against rain and insects. The extreme long forelock of the Yakut horse is useful as protection against very cold weather and a long forelock was probably favoured during domestication. As its exact utility and origin is unknown, forelock size is not a selection criterion, unless it hampers fitness for rewilding.

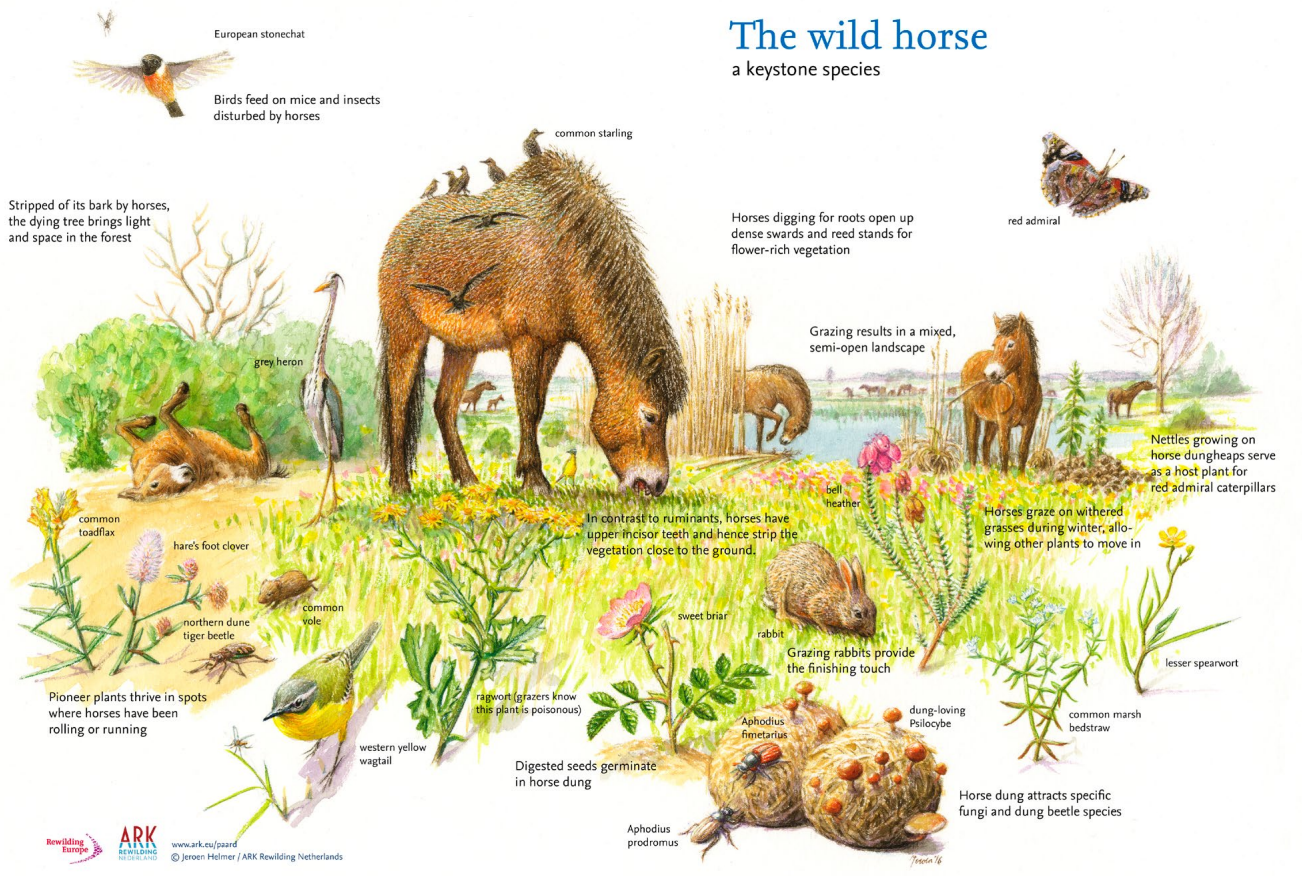
Hooves

The growth potential and shape of hooves is strongly related to the environment. Soft marshy wetlands promote wide, slow-growing hooves. Rocky surfaces demand strong, fast-growing, small and narrow hooves. Domestication has influenced the growth of hooves by shoeing and trimming horses hooves' used for cart-pulling or riding. Therefore, there must be no history of trimming or shoeing during the previous generation among horses selected for rewilding, and they should be adapted to the same type of soil as the rewilding site.

However, experience with Dutch Koniks suggests that horses can adapt hoof constitution quite quickly and pass this epigenetically on to their offspring so that within a few generations, a good adaptation to local conditions is visible [pers. exp. R. Meissner]. Adaptation in the first generation of rewilding brings less discomfort if horses with fast-growing hooves are introduced to soft soils rather than vice versa. Hooves that are too long will break off, while hooves that are too short are very painful and make natural movement impossible. Hoof condition is highly important for survival and the level of adaptation to local circumstances should be used to select breeds and individuals before introduction.

Suitable coat

Domestication has removed, in some cases, the need to safeguard against cold and wet conditions. The impact has been different for each breed. Founders for rewilding herds must have coats with the ability to protect them against the environment, against extremes of temperature, wetness, insect bites, seasonal changes, etc. For the most part, this requires having a double coat in winter as a strict selection criterion. Horses in cold climates should also grow a "beard" in the winter.



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Wild horses in the Danube Delta, Romania.

Social behaviour

Once again, there is no reference point available to draw comparisons with other than the Przewalski's horses and feral breeds, worldwide. Although nobody knows the exact natural social behaviour of wild European horses, there seems to be a lot of similarity in social behaviour across modern domesticated horse variants, which suggests that the genetic drivers expressing it are still close to the original wild ones. Studies on the Asiatic wild ass suggest that natural, social behaviour in equids can depend on local circumstances, such as the degree of predation pressure [Feh et al. 1994].

Research also shows that original, or at least useful, social behaviour can arise when the right conditions are established in a rewilded herd, including a natural sex distribution, age structure, and existing bonding and relationships, which results in bachelor stallion groups and multiple harems [Nieuwdorp 1998b, Feh 2001]. Depending on local circumstances, the social structure can vary in terms of harem size and the number of lead stallions [Feh 1999, Linnartz & Linnartz-Nieuwdorp 2016]. All horse breeds show this social behaviour when given the opportunity and this strong social structure is important if a herd might have to fight off predators, such as wolves.

Stallions that did not grow up in a competitive environment often perform poorly or unnaturally when having to compete with other stallions as an adult. Similarly, mares that did not grow up in a social environment often have problems with integration and bonding. Unnatural behaviour brings unbalance in the herd, which makes it vulnerable to predators. Therefore, individuals that have grown up within a natural social structure are preferred over individuals that grew up without it. In addition, integrated groups are preferred over individuals. This is not a breed selection criterion, but an argument in favour of experienced herds. In general, groups of horses habituated to living in natural herds with multiple stallions are strongly preferred for rewilding purposes.

Reproduction

The selection process that accompanied domestication in horses never focused on characteristics related to reproduction or lactation. Birth synchronisation at the most suitable time of the year is therefore likely to be restored in

Exmoor ponies in Keent, The Netherlands.

one or a few generations, while udder sizes and milk-giving characteristic seem to be unchanged from wildtypes. Early fertility in domestic breeds may occur but is less visible in feral horses. Birth problems are rare, even in underdeveloped mares. Sometimes young mares lose their young foals, which can be a natural occurrence, but may also be a signal of early fertility. We do not know what wild horse reproduction rates were like during the lifespan of a mare, and so this is not a criterion for selection. Altogether, it seems that domestication has not had much influence on reproductive traits.

The ability of horses to easily abort foetuses, observed even in domestic horses, suggests that birth rates respond to natural circumstances. Future long-term studies of rewilded populations will probably teach us more on this issue. Results from mustangs and Przewalski's horses indicate that reproduction rates are lower for these relatively wilder types compared to domestic mares or semi-feral mares. External conditions, like wolf predation, can further reduce effective reproduction. For new introductions to rewilding areas, the best advice is to start with animals that are already in a natural cycle, established in a similar climatic zone.

Gaits

Mobility is very important for survival, as horses have evolved to take flight in order to escape from predators. They can, or should be able to, walk long distances for daily food and drinking needs, an adaptation to dry steppe areas. Legs and joints should be both strong and mobile and provide the ability to sprint, reach high speeds and run long distances in any type of landscape. In this regard, it is interesting to note that a gene mutation has recently been found for alternative gaits. This provides the additional possibility that the legs are used laterally instead of purely diagonally [Andersson et al.]. This can also be seen in other species; for instance, elephants use it while moving quickly. It is possible that this mutation arose in wild horses and gave them an additional opportunity to increase their speed in mountainous landscapes.

Meissner [pers. com.] suggested that early humans selected these horses for breeding, perhaps because they offered a smoother ride. Lateral gaiting was highly selected for horse riding until carts and roads came in fashion. From then onwards, this property only survived in remote, domestic breeds or was exaggerated for showing purposes. Some of the rewildable breeds still have these lateral gaits.

It is not a selection criterion, but it may turn out to be one in the future if research demonstrates this mutation in pre-domestic wild horse DNA or, more importantly, if it turns out to improve fitness.

5.3 Przewalski's horse (Takh)

The Przewalski's horse is a genuine wild horse native to the steppes of Central Asia, and a protected species. This makes Przewalski's horses physically suitable for rewilding but complicated to reintroduce for management reasons. However, Przewalski's horses have been successfully introduced in several fenced, natural, areas in Europe where they have adapted to living in new environments. Rewilding Przewalski's horses not only has potential to help the conservation of the species, but they can also be used instead of domestic breeds to restore the functional role of extinct wild horses in Europe.

Whether Przewalski's horse is a subspecies or a different species is still scientifically debated. A 2011 mitochondrial DNA study concluded that Przewalski's horses and modern domestic horses diverged some 160,000 years ago [Goto 2011]. However, an analysis based on whole genome sequencing and calibration with DNA from old horse bones gave a divergence date just 38–72 thousand years ago [Orlando 2013].

The status of the Przewalski's horse as a wild animal has also been challenged in recent years. This has largely been based on the results of an analysis that nested the living animals within the genetic variation of the Botai horses, generally considered the first known domestic horses, although not the ancestors of domestic horses alive today [Gaunitz et al. 2018]. The archaeological evidence associated with the Botai horses suggests that they were wild Przewalski's horses that had been corralled for slaughter, rather than domestic animals used for riding or milking [Taylor & Barrón-Ortiz 2021]. As such, the continued treatment of Przewalski's horses as the last truly wild horses is here considered appropriate.

Przewalski's horses have very low genetic variation and an extra pair of chromosomes, but can still produce fertile offspring when interbred with modern horses. Interbreeding between Przewalski's horses and both wild European horses and later domestic horses has been a common occurrence since the two lineages split [Wutke et al. 2018]. There are crossbreeds present in Europe and

Przewalski's horses on the grassland of the Hortobagy National Park, Hungary.

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even in European rewilding areas. The Lippeaue in Germany, for example, features a herd of Koniks, a single Przewalski mare, and several individuals of mixed ancestry. There may even be a legal justification for this, as crossbreeds are treated as wild animals under German law. Heck horses are the descendants of Gotlandic and Icelandic ponies crossed to a Przewalski stallion, though this ancestry has been substantially reduced through subsequent crossings with Koniks. It is not the intention of this document to encourage or discourage this practice, but it is of interest with regards to the possible reintroduction of wildtype alleles lost in the domestic population.

5.4 Recommended breeds

Horses that are used to living in the wild and in natural social groups are more suitable for rewilding than other breeds or individuals. It follows that horses used to living in fully domesticated circumstances should not be used for rewilding. Such horses should first be given an opportunity to adapt to a semi-feral lifestyle, before continuing for further rewilding.

Adaptation to local circumstances – soft or rocky soils, mountainous or wet terrain, birth synchronisation with the regional start of spring, etc. – is also highly desirable. In the worst cases, maladaptation could lead to mortality and failure of the project. Although horses can learn quickly, acquiring wild behaviour and wild-type physical characteristics takes time, even generations, during which rewilding is not effectively taking place. Horses living on hay and fenced off from predation cannot qualify as feral/wild horses, regardless of their physical appearance.

Given the selection criteria above, the following set of horse breeds are recommended for rewilding:

- Atlantic Western Europe: In these regions, the most appropriate landraces can be found in Britain and in northern Iberia, where the descendants of Celtic-type horses adapted to heavy rainfall are found. Examples include Exmoor, Dartmoor, Garrano, Pottoka, and related breeds. Some of these breeds may also be appropriate for Northern/Central Europe, and vice versa.
- While Yakut ponies might be ideal for the semi-arctic areas of northern Scandinavia, their availability is limited. Native breeds from Scandinavia or the Baltics may be serviceable.
- Primitive landraces from Central/Northern Europe are few, with the best example being the Konik. Koniks are widely available and generally fit for rewilding purposes. There are also several related breeds that can be used more or less interchangeably, such as the Heck horse, Liebenthaler, and Dülmener. In the more mountainous areas of Central Europe, Hucul may be more appropriate.
- In the Mediterranean areas of Iberia and Italy, long-legged breeds like Retuerta and related breeds will be more appropriate than mountain breeds like Pottoka, Pentro, and Esperia. Camargue horse might be better suited to wetland areas.
- In the Balkans, a number of horse types are suitable, such as Karakachan, Bosnian/Serbian mountain ponies, Myzegea and Thessalier.
- Other local breeds will be ideal in eastern Europe, Turkey, and the Caucasus.
- Rewilding organisations in any area may decide to use the genuinely wild Przewalski's horse instead of a domestic breed.

None of these recommendations are binding, and availability, cultural acceptance, and other factors will always need to be considered. Ultimately, it is the choice of those responsible for obtaining and managing the animals. Rewilding Europe has itself deviated from its original breed selection plan due to necessary compromises and practicalities. As indicated before, breed standards are of little relevance for rewilding and the new wild horses should no longer be considered as belonging to a certain breed. Unwanted colour morphs or white markings might be selected out at first, but for the most part, nature will carry out the selection process.

It is possible that several local horse types may be mixed at the start of a rewilding project, recognising the fact that breed names and standards are artificial and mixing between various local horses has been common for thousands of years. Combining breeds restores genetic diversity and gives natural selection the opportunity to pick the most suitable animals in a much more effective way than humans can.

After rewilding, predators, harsh winters and dry summers will all act to harden the new wild horses, and physical characteristics like height and other traits will slowly adapt to the horses' new environment and way of living. What will appear is a range of new wild horses, based on hardened, ancient types, but evolved into a new set of wild horse types, all adapted to living in the wild in their own contemporary regional environments. It is important that rewilding initiatives do not associate themselves too strongly with breed conservancies, as the need for studbooks and breed standards enforced by these organisations is counterintuitive to the formation of wild herds.

Konik horse and foal in the Millingerwaard, The Netherlands.

Table of rewildable horses

very suitable and readily available types suitable and readily available types not as suitable as the previous types or not readily available

Horse type name	European zone, country Local region of origin	Climate	Landscape, vegetation, soil of origin	Status of wildness in place of origin	Predation experience	History of the type	Colour Average height in metres	Locations of (semi-) feral populations	Overall fitness for purpose	Availability	Attention Remarks for rewilding
Exmoor pony	NW-Europe SW-England	Temperate Maritime Rainfall	Hills Moors Peats	Semi feral	No	Isolated unmixed population with breeding programm since 1921.	Uniform colour. Bay, mealy. Originally also grey and black. 1.30	Exmoor in England, Netherlands, Brittany in France.	Very good	Good	Attention for genetic diversity and for purity
Dartmoor pony	NW-Europe SW-England	Temperate Maritime Rainfall	Hills Moors Peats	Semi feral	No	Often mixed with other breeds	Dark bay, grey, brown, black. 1.30	Dartmoor	Good	Rare	Use only pure hill ponies
New Forest	NW-Europe S-England	Temperate Maritime Rainfall	Flatland Open forest, sandy, loamy soil	Semi feral	No	Often mixed with other breeds	Original type: all colours. 1.35	New Forest Netherlands	Reasonable	Rare	Use only original type and semi-feral horses
Welsh pony	NW-Europe SW-England, Wales	Temperate Maritime Rainfall	Hills Moors Peats	Feral herd Carneddau, Brecon Beacons Natural herds	No	Rather unchanged phenotype since at least Roman times	Dark bay, grey, brown, black. 1.28	Not known	Good	Rare	Use only original type and (semi)-feral horses
Highland/ Fellpony	NW-Europe Scotland, Borderlands England	Cold Maritime Rainfall	Mountains Peats, gleys.	Kept	No	Often mixed with other breeds	All colours, dun shades, wild striping. 1.40.	Not known	Reasonable	Rare	Use only semi-feral horses
Shetland pony	NW-Europe Scotland, Shetland Islands	Cold Maritime Rainfall Stormy	Hills, rocks Peat, Sandy soil	Semi feral	No	Isolated island pony since 4000 year, some influx from related breeds.	All colours. Original island type 1.15.	Marginal lands across Europe, Netherlands	Good/ reasonable	Good	Use only original type and semi-feral horses. For islands and very marginal dunes.
Eriskay pony	NW-Europe Scotland, Hebrides islands	Temperate Maritime Rainfall Stormy	Hills, rocks Peat, Moors Sandy soil.	Semi feral	No	Norwegian origin, rather unchanged phenotype since Viking times: 800 AD	Bay, black, grey. 1.30	Not known	Good	Rare	Attention for genetic diversity
Faeroe pony	NW-Europe Faeroe island	Maritime Rainfall, Stormy	Hills, volcanic fertile soil	Semi feral	No	Norwegian origin, rather unchanged phenotype since Viking times: 800 AD	Bay, black, dun shades. 1.20.	No, not allowed outside Faeroe	Good	Rare	Attention for genetic diversity
Kerry Bog	NW-Europe Ireland, Kerry	Temperate Maritime Rainfall	Hills Peats, grassy valleys Mineral rich soil	Kept, extensively	No	Some mixed from Asturia and Scandinavia by Vikings rather unchanged phenotype since 1700	All colours. 1.20	Not known	Reasonable	Rare	Attention for genetic diversity
Icelandic horse	Northern Europe Iceland	Cold Maritime Rainfall	Hills, rocks, volcanic fertile soil	Extensively kept	No	Rather unchanged phenotype since Viking times, 1200. Import ban.	All colours. 1.38	Netherlands, Germany, Norway	Good/ reasonable	Many	Use only semi-feral horses

Horse type name	European zone, country Local region of origin	Climate	Landscape, vegetation, soil of origin	Status of wildness in place of origin	Predation experience	History of the type	Colour Average height in metres	Locations of (semi-) feral populations	Overall fitness for purpose	Availability	Attention Remarks for rewilding
Fjord horse	Northern Europe Norway	Temperate Maritime Rainfall Snow	Mountains, fertile flatlands	Kept, semi-feral in Netherlands.		Rather unchanged phenotype for 4,000 years.	Bay dun, some red or grey-dun. 1.40	Netherlands	Reasonable	Good	Use only semi-feral horses
Nordlands-hest/ Lyngshest	Northern Europe Norway Lofoten	Temperate Maritime Rainfall	Mountains, fertile valleys, steep slopes	Extensively kept	No	Type known since Viking times or older.	All colours. 1.30	Norway, Lofoten	Good	Rare	Use only original type
Gotland Pony	Northern Europe Swedish Islands	Temperate Maritime Sub-Mediterranean	Hills, flatland, moor, chalky fertile soil	Wild on Lojstra wooded moor. Rest of island: semi feral until 1858, now kept.	No	Since prehistoric times wild in Loistra. Some mixing in 20th century.	Bay, black, duns. 1.30	Unknown	Good	Rare	Attention for genetic diversity. Use only (semi)-feral horses
Yakut pony	NE-Europe Siberia	Continental, extreme cold Snow	Tundra	Feral in Pleistocene Park in Tsjerski. Semi-wild kept by Yakoet people.	Yes	Probably old mixed descendant Yukon horse, Przewalski	All colours, many grey. 1.30	Not known outside Siberia	Very good	There are many, but not easy to obtain	Suitable for Rewilding in the far north of Europe. Used to survive deep snow.
Estonian horse/ Estonian bush pony	Northern Europe Estonia	Temperate maritime to dry continental	Open forest, flatland	Most extensive/ semi-feral kept.	Probably	Rather unchanged phenotype for 2,800 years.	Bay, duns, grey. Became taller by human selection. 1.45	Estonia Sweden, Öland Finland	Reasonable	Good	Use only semi-feral horses
Žemaitukas	Northern Europe Lithuania	Temperate maritime to dry continental	Open forest, flatland	Most extensively kept	Unknown	Rather unchanged phenotype the 6–7th century.	Bay, black, duns, grey. Became taller by mixing 1.35	Historically Poland/ Russia now unknown	Reasonable	Good	Use only original type and semi-feral horses
Konik Polski	Northern Europe Poland	Temperate continental	Flatland, wetlands	Feral, semi-feral, kept. Several big natural social herds.	Several popula-tions: wolf	Selectively breed since 20th century from semi wild robust local breed.	Black-dun, bay-dun, black, brown. Colour originally more diverse. 1.35	Netherlands, Belgium, Latvia, France, Bulgaria, England Germany	Very good	Many	Use only (semi)-feral horses
Danube Horse	Central Europe Romania Danube Delta	Continental	Flatland, wetlands, dunes, open forest, sub-steppe	Feral in Letea forest, Danube delta	Probably jackal	Descriptions of wild horses since centuries.	Black, bay, grey, duns. Became taller by (cross) breeding. 1.40	No	Reasonable due to recent feralisation	Good	Due to veterinarian regulation, replacement ban
Hucul	Central/ Eastern Europe Carpathian mountains	Continental	MountainsFertile valleys, steep slopes	Feral, semi feral and kept.	Yes, wolf	Rather unchanged phenotype since 1600. Migrated with nomads, probably older.	Bay, black, grey, dun, wild striping. 1.35	Ukraine, Romania, Hungary, Germany, Poland, Czech rep, Slovakia	Very good	Good	Use only semi-feral or extensive kept horses with only solid colours
Bosnian mountain pony	SE-Europe Bosnia and Herzegovina	Continental	Mountains, fertile valleys, steep slopes	Feral in Livno and Kupres	Yes, wolf	Rather unchanged phenotype since Middle Ages. Related to tarpan/ European wild horse, mixed with Mongolian horses	Bay, black, grey, dun, wild striping. 1.38	Bosnia, Herzegovina, Croatia, Slovenia	Good	Good	Use only feral and semi-feral horses

Horse type name	European zone, country Local region of origin	Climate	Landscape, vegetation, soil of origin	Status of wildness in place of origin	Predation experience	History of the type	Colour Average height in metres	Locations of (semi-) feral populations	Overall fitness for purpose	Availability	Attention Remarks for rewilding
Serbian mountain pony	SE-Europe Serbia	Continental	Mountains Fertile valleys, steep slopes	Feral in Stara Planina	Yes, wolf	Rather unchanged phenotype since middle ages.	Bay, black, piebald, grey. 1.35	Serbia, Bulgaria, Croatia	Good	Good	Similar to Karakachan horse. Use only original type for rewilding
Karakachan horse	SE-Europe Bulgaria	Continental	Mountains Fertile valleys, steep slopes	Feral in Pirin, Rila and Rhodopi mountains	Yes, wolf	Rather unchanged phenotype since middle ages.	Black, bay. 1.30	Bulgaria, Serbia	Good	Rare	Similar to Serbian pony. Use only original type for rewilding
Posavina/ Turopolje	SE-Europe Croatia	Continental	Riverbanks, wetlands	Feral in nature reserves along the river Sava, Ljonko Polje.	No	Rather unchanged phenotype since middle ages. Became bigger by mixing with big horses.	Bay, brown. 1.45	Croatia	Reasonable	Rare	Use only semi-feral horses. Use only original type.
Myzegea horse	Southern Europe Albania	Mediterranean	Mountains and (marshy-) highland plains	Semi-wild, abandoned herds.	Probably	Introduced by Illyrian people 5th BC, mixed with other hardened breeds.	Black, bay, grey, brown. 1,32	Albania	Good	Many	Use only semi-feral horses Related to Hucul.
Pindos pony/ Thessalier	Southern Europe Greece	Mediterranean, alpine	Mountains Fertile valleys, steep slopes	Semi-feral in Thessaly and Epirus	Yes, wolves, bears.	Rather unchanged phenotype since 15th century, introduced by Turkish rulers.	Bay, brown, grey 1.40	Greece, Descendants on Ionian islands	Good	Rare	Mountain specialists
Skyros horse	Southern Europe Greece	Mediterranean, arid	Arid, rocky mountains	Feral on the island Skyros	No	Rather unchanged phenotype since 5-8th century BC. Small island type, remnant of very old land type.	All colours, many bay. 1.00	Greece, Skyros, some private Corfu, Attica Zoo Athens.	Reasonable	Rare	Ban on export from island.
Authentic Greek breeds	Southern Europe Peloponnesus, Greek islands	Mediterranean	Most arid mountains/ plains, valleys	Semi feral	No	Types known since ancient history, many local breeds.	All colours, 125-140	Greece Peloponnesus Rhodes, Crete, Kefallinia	Good	Good/rare	Use only semi-feral horses
Dülmener wildpferd	Northern Europe, Germany	Temperate	Moors, open forest	Semi-feral, Merfelder Bruch	No	First described 1300, probably older. Feral until 1950, semi feral now. Mixed with Welsh, Exmoor, Hucul, Konik.	Black-dun, bay -dun, wild striping. 1.32	Unknown	Reasonable	Many	Until now no experience with feral living nature reserves
Esperia pony	Southern Europe Italy	Mediterranean	Forested rocky mountains	Semi-feral	No	Related to Anadolu pony by inbreeding.	Black 1.35	Only local Lepini Mountains	Good	Rare	Use only semi-feral horses
Pentro horse	Southern Europe Italy	Mediterranean, alpine	High plains, seasonable wetlands	Feral in high plains Pantano della Zittola/ Abruzzo mountains	Yes, wolf, bear	Type known for 2,000 years. Origin wild mixed with Berber horse. Mixed with Italian breeds since 1913, strong natural selection.	All colours, many chestnut, white markings. 1.38	Only local	Good	Rare	Use only original type
Monterufoli pony	Southern Europe Italy	Mediterranean	Forested, scrubbed hilly mountains	Feral in Montefuroli-Caselli nature reserve	No	Ancestor was Selvina horse, rescued since 1913 in nature reserve.	Black, some bay. 1.35	Only local	Reasonable	Rare	Use only original type
Sanfratellano	Southern Europe Sicily	Mediterranean, alpine	Forested mountains	Feral in Nebrodi nature Park	No	Type known since 11th century, mixed with other breeds	Black, bay. 1.50	Only local	Reasonable	Rare	Use only original type
Giara/Achetta	Southern Europe Sardinia	Mediterranean, alpine	Marshy highlands	Feral near Bardigiano, Foresta Burgos	No	Introduced by Gallicians, 4th century BC, related to Asturcon horse.	Black, bay, some grey, white markings. 1.30	Only local	Good	Good	Use only original type

Horse type name	European zone, country Local region of origin	Climate	Landscape, vegetation, soil of origin	Status of wildness in place of origin	Predation experience	History of the type	Colour Average height in metres	Locations of (semi-) feral populations	Overall fitness for purpose	Availability	Attention Remarks for rewilding
Camargue horse	SW-Europe France	Mediterranean	Fertile saline marshes	Semi-feral in Rhone Delta	No	Rather unchanged phenotype since time immemorial, supposed ancient horse. Similar to cave painting Niaux	Uniform colour grey. 1.42	Some nature reserves in France	Good	Many	Accustomed to mosquitoes. Use only semi-feral horses.
Merens	SW-Europe Pyrenees, Andorra	Temperate/ Mediterranean	Mountains Fertile valleys, slopes	Semi-feral	Until now not, but in future, wolves	Probably mixed with Iberian and Berber horses	Uniform black 1.40. Historically smaller.	Unknown	Reasonable	Good	Use only (semi-) feral horses. Attention for genetic diversity.
Landais/ Barthai	SW-Europe Les Landes, France	Maritime, warm	Lowland, forest, dunes, marshes river banks	Feral until 1950, recent semi feral in local nature reserves	No	Rather unchanged phenotype since before 700 AD. Some mixing with Iberian and Berber horses	Bay, black, chestnut. 1.28	Only local	Good	Rare	Good for marshy coastlands. Attention for genetic diversity.
Pottoka **Part of the Northern-Iberia group of horses**	SW-Europe France, Spain Pyreneans	Temperate maritime rainfall, snow	Mountains Fertile valleys, steep slopes	Feral and semi feral	Yes	Probably almost unchanged phenotype since Paleolithicum, little mixed with Exmoor in 20th century.	Black, piebald, chestnut. 1.30	In Basque mountains, Extremadura:Piornal / Pena Negra,	Very good	Good	Use only (semi-) feral horses
Asturcon **Part of the Northern-Iberia horses**	SW-Europe Spain, Cantabria	Temperate, cool, rainfall	Mountain slopes and highland plains	Feral in nature reserves in Eastern Asturia/ Sueve	Yes, wolves, bears	Related to the Celtic ponies and the pre-historic horse. Mentioned by Pliny (23-79 AD)	Black and some bay. White markings on head. 1.20	Spain Eastern Asturia	Good	Good	Use only (semi-) feral horses
Losiño **part of the Northern-Iberia horses**	SW-Europe Spain, Castilla Leon, Losa valley	Temperate, cool, rainfall	Mountain slopes, valleys	Semi feral in Pancorbo (Breed rescue program)	Yes	Rather unchanged phenotype since middle ages, probably older.	Uniform black. White head marks allowed, no fetlocks. 1.38	Spain Pancorbo, Quincoces	Good	Rare	Use only (semi-) feral horses. Small population, but 200 horses seem to be available in W-Iberia
Monichino	SW-Europe Spain, Cantabria	Temperate, cool, rainfall	Mountain slopes, valleys	Semi-feral	Yes	Rather unchanged phenotype since Middle Ages, probably older. Recent decades mixed with slaughter horses.	Black, bay. 1.35	Spain Cantabria Small herd in Germany	Good	Rare	Use only original type. Small population
Retuerta	SW-Europe Spain, Doñana	Sub-steppe	Fertile floodplains	Feral	No	Rest population in remote area. Probably genetically close to original wild horse.	Uniform bay. 1.40	Spain Doñana, Campanarios de Azaba Reserve	Good	Rare	Use only (semi-) feral horses.
Cabalo Galego / Faco **Part of the Northern-Iberia horses**	SW-Europe Spain Galicia	Temperate, cool, rainfall	Coastal hills, shrubs, dunes, forest	Feral	Yes	Rock carvings 2500BC. Known by Pliny, Strabo, Martial. Since 1600 export all over Europe, e.g. Iceland, Great Britain. Prob. related to Exmoor. In 20th century mixed with slaughter horses, back to origin since 1994.	Original type black, bay 1.28	Spain Around Pontevedra, Lugo	Good	Good	Use only original type. Near identical to Garrano
Garrano/ Minho/ Géres **part of the Northern-Iberia horses**	SW-Europe Portugal Minho, Geres, Tras-o-Montes, Alto douro	Temperate, cool, rainfall	Mountain Fertile slopes,	Nature reserves	Yes	Rather unchanged phenotype since 200 AD, probably older. Ancestor of Andalousian and Galego ? Recent decades mixed with slaughter horses	Original type black, bay 1.25	Portugal Minho, Tras-o-montes, Alto Douro	Good	Good	Use only (semi-) feral horses and original mountain type. Near identical to Galego

Horse type name	European zone, country Local region of origin	Climate	Landscape, vegetation, soil of origin	Status of wildness in place of origin	Predation experience	History of the type	Colour Average height in metres	Locations of (semi-) feral populations	Overall fitness for purpose	Availability	Attention Remarks for rewilding
Sorraia	Europe Portugal, Santarem province	Maritime temperate climate	Fertile riverbanks, lowland	Kept in private herds, semi-feral in Valle de Zebro	No	Presumed ancient, rediscovered in feral state in 1920. Revived last decades. mDNA shows mixed origin and unrelated to ancient Iberian horses.	Only black-dun and bay-dun with wild striping. 1.40	Portugal Extensively kept: Canada, US Germany,	Reasonable	Rare	Use only (semi-) feral horses.
Anadolu pony	Southern Europe Anatolia, Turkey	Mediterrenean, sub-steppe	High plains, scrubbed mountain, valleys	Feral, semi-feral and kept	Depending status, some by wolf	Native breed since at least 1000 years, originally mixed with hardened Asian breeds	All colours, many bay, dun 1.25–1.37	All over Turkey	Good	Good	Only extensively or semi-wild kept animals
Kabarda	Caucasus Georgia, European Russia	Continental	Mountains, high plains	Originally kept in semi wild harem groups	Yes, wolf, bear	Breed described since 400 years, dating back to Hittite times	Black, bay	Caucasian countries, Germany and some in European countries	Very good	Rare	Use semi wild or extensively kept animals
Megrel, Megrelakaya, Mingrellan	Caucasus Western Georgia	Continental	Lowland, mountains	Almost forgotten, hardened breed	Yes, wolf	Known since BC	Bay, chestnut, black,dun, grey 1.25–1.30	Western Georgia	Very good	Unclear	Use only primitive type
Ayvacik, and other Turkish landraces, "Yilki"	Turkey	Mediterranean, warm steppe, warm continental	Open forests, steppes	Often semi-feral, increasingly feral, old types common	Probably wolves, bears, leopards	Likely descended from Central Asian breeds	Brown, black, grey <1.5	Cappadocia, Antalya province in the south	Good	Mixed, depends on variety/ locale	Avoid recent crosses with Arabians
Bashkir	Bashkortostan, Russia	Continental	Mountains and steppes	Often semi-feral, kept in fenced reserve "Wild Field"	Probably wolves, bears	Central Asian origin, similar to Kazakh horse	Bay, chestnut, roan, and grey 1.40–1.45	"Wild Field" – sister project to Pleistocene Park	Good	Good	Avoid crosses, but original type common
Vyatka	Kirov Oblast, Russia	Continental/ Boreal	Open forests, mountains?	Probably semi-feral in the past	Probably wolves, bears	Similar to other NE European breeds like Estonian, almost extinct in 1917	Originally dun, other colours now common ~1.40	None currently	Good	Low, but possibly common locally	Genetic diversity possibly a concern? Avoid crosses with draught horses
Przewalski's horse	Central Eurasia Mongolia	Continental steppe climate: cold in winter, hot in summer	Steppe	Wild in several Mongolian National Parks, semi-wild in European nature reserves	Yes, wolves in Mongolia	Genuine wild subspecies1 of the Eurasian wild horse.	Dun with pangaré 1.34-1.46	Mongolia, Germany, France, Hungary, etc.	Very good	Rare	Suitable for large eastern continental steppe areas. Has the status of a threatened wild species, which has management consequences.

Status of management: Domesticated, semi feral, feral, rewilded. Semi feral must be interpreted in many ways. Often the term is used for grazing on common grounds. Sometimes managed with additional feeding or movement to winter grazing areas. In all cases it means that the animals have owners, they are just scarcely looked after and surviving is by natural selection. Partner choice is not always natural, neither is the social organisation.

1 *Whether the Przewalski's horse should be seen as a subspecies or as a relatively recently split separate horse species, is still a scientific debate. This report considers the Przewalski's horse as a genuine wild and rare horse type, not to be mixed with horses of another (sub)species.*

6. Guidelines for rewilding horses

6.1 Rewilding Takes Time

All living creatures adapt to their environments. Natural selection causes maladaptive mutations to disappear and beneficial mutations to proliferate. Far more quickly than this, however, there are indications that even during their lifetimes, living creatures can change their gene expression without changing underlying DNA sequences, as a result of epigenetic changes.

Epigenetic changes have been shown to be heritable and might provide a faster route towards adaptation to living in the wild compared to random DNA mutations. Nevertheless, epigenetic changes also take time, as every generation will adapt increasingly to a new environment. For instance, Koniks imported into the Netherlands experienced problems in their first few years. They were raised in Polish stables, where they had had their hooves manicured and shoed, and consequently they had problems with long hooves in their first few years in Dutch nature reserves. Hoofs with problems were handled conforming to individual welfare, except for the most hopeless individuals, which were selected out. Now, after 30 years of human and natural selection, these Koniks are very well adapted to wild living in Dutch nature reserves [ARK pers. exp., FREE Nature pers. exp., Linnartz & Linnartz-Nieuwdorp 2016].

However, when brought to Latvian nature reserves, the Dutch Konik had to adapt and learn again. Dutch winters are much less severe than Latvian ones and do not include wolf predation. Thicker coats had to be grown and an effective predator defence had to be developed. After a few years, their winter coats had grown thicker and their social structure had changed to cope with wolf predation [pers. com. Jan van der Veen], with the former change being an example of an epigenetic change, whereas the latter change was the result of a learning process and a cultural change. Specifically, stallions learned how to defend their harems and to accept assisting stallions into the harem for additional protection. Rewilding can thus be seen to be a process, combining both (epi)genetic and cultural changes. Year after year, adaptation and natural selection will improve the hardiness of the horses involved.

Human interference can only disturb or undo these vital changes. Rewilding eventually means a "hands off" approach, abandoning concepts such as breeds, races and studbooks. After years of rewilding, new wild horses will emerge, which are locally adapted and without a studbook. This should, however, not be mistaken as meaning the exclusion of research and monitoring.

6.2 Rewilding defined

When being rewilded, all horses, whether their origin is feral, semi-feral or domestic, have to become truly wild as they deal with what can be called the rewilding process. It is necessary to realise that relocation for rewilding is not simply crossing a line between cultures, or between captive and wild animals. The animals concerned do not simply walk from domestication into the wild. Equally, for the humans managing this rewilding process, a radical transition is required from an ethical approach focused on care for individual animals to a concern for the ecological whole.

Dealing with this transition is the responsibility of a rewilding project's wildlife manager and depends on the circumstances. For example, in a context where there is a herd of horses of a local breed already living in semi-wild conditions, the transition may be easy and seamless. On the other hand, in situations where animals are not of a local breed and do not know each other, more consideration and lots of time will be needed to ensure a successful transition. The difficulty of reversing domestication, a process that took thousands of years, should not be underestimated [P. Koene 2002].

This may lead to a temporary duality of focus, with attention being paid to individual animals at the same time as attempts are made to maintain an overall eco-ethic approach, meaning no interference is made with the lives and deaths of wild-living animals. This duty of care can be considered inversely proportionate to the size of any rewilding area, practically, ethically and with

Konik horses in Krammerse Slikken, The Netherlands.

regard to laws and regulations. In smaller areas, animals may still be considered at the level of the individual, but in larger rewilding areas consideration should be given to the wider interests of the species, whilst in the largest wilderness areas, the needs of the ecosystem must be given priority.

In practice, many rewilding areas will increase in size over time, from hundreds to thousands of hectares. There is inevitably a time component - not only because rewilding areas tend to expand over time, but also because newly introduced animals should get the opportunity to adapt to local conditions. The management of any rewilding area will therefore be unique to its specific context and should be accompanied by a local action plan following IUCN guidelines, taking into account this temporal component.

Rewilding pays particular attention to restoring wildness and the wild character of animals. Where the wild character of a species has been lost through domestication and artificial selection, rewilding aims to regain these characteristics to allow animals to survive and thrive in the wild. Practical management must aim for high levels of self-sustainability in rewilded animals – with the more similarities to the original wild horse, the better.

6.3 Horse habitats

Horses are non-ruminants and therefore not equipped to cope with the chemicals produced by some herbs, bushes and trees to deter herbivores. Consequently, as bulk feeders, horses eat large quantities of grass supplemented with non-toxic bark, leaves and herbs, but while horses need a massive amount of food, they are relatively tolerant of low-quality nutrition.

Horses can live in a diversity of habitats. They were once found all over Europe and beyond, in many different types of landscapes [Sommer et al. 2011]. However, they tend to prefer grasslands and open landscapes, where predators can more easily be detected and outran, and this is also apparent in their physical attributes: eyes at the side of the head, a muscular physique, strong and agile legs and strong hooves.

It would be a mistake to consider those areas which support the last surviving wild horses as exemplars of the most suitable habitat for the species. Instead, these habitats correspond to where horses survived under pressure from humans and changes in land use, and should be seen as refugee habitats rather than preferred

habitats [Kerley et al. 2011]. Although they have the same strong, basic physical traits, horses can also adapt to their local environment, and some breeds show significant morphological differences after living for generations in habitats like mountainous areas or marshlands.

6.4 Choosing a founder herd

When deciding on the founder herd to rewild in a specific rewilding area, the following steps should be undertaken:

1. The area should be suitable for a population of horses and large enough to support a larger group of horses to avoid inbreeding in the first few decades. Preferably, the starting group should include at least three socially integrated harems and one stallion group, containing unrelated adults and subadult stallions. The mares should also have different bloodlines, ideally distinct from those of the stallions. There should be enough food, water and minerals in both summer and winter, and enough places to shelter from adverse weather conditions for the size of the starting group, and for the growing herd. As an open grassland animal, horses do not need much shelter but they will benefit from the presence of shady forest, bushes, big trees, cliffs or even caves and ravines. Under optimal conditions, the herd may increase yearly by up to 30%; however, harsh winters, predators, diseases and maladaptation can reduce this number to zero or even negative growth. In winter, large areas can be covered with deep snow, rendering food unavailable, and droughts can have a similar effect on food availability. In very nutrient-rich areas, horses can live in densities of up to 1 horse per hectare, but in poor or dry areas, 30 hectares per animal or more is needed (see also chapter 6.5). A herd of 150 genetically diverse animals is enough to form a self-sustaining population. Thus, the above densities result in a minimum area requirement ranging from at least 150 hectares in a nutrient-rich delta, up to at least 4,500 hectares on poorer soil. Naturally, such a large area does not need to be immediately available for a small founder herd, but there should be space to support a larger herd in the longer term if the aim is to support a self-sustaining population.

Hucul or the Carpathian pony in the Bieszczady Mountains, Poland.

GRZEGORZ LESNIEWSKI / WILD WONDERS OF EUROPE

2. Refer to chapter 5.4 for the best (combination of) breeds to start with. If one of these breeds is already present and semi-feral and kept in the area, it is preferable to select the most suitable horses from this herd and combine them with suitable horses for rewilding from elsewhere, as per chapter 5.4. In case there are suitable breeds without any experience of semi-wild living under natural circumstances, a de-domestication phase or "tools-learning process" is needed. Creating the right social structure for living in the wild takes time and probably at least one generation.

3. When selecting a founder herd, it is important to try to select animals that:
   a. Live nearest to the area
   b. Are well-adapted to the terrain type, local climate and other circumstances
   c. Are used to living in the wild
   d. Already live within a social herd with all age-groups represented [Meissner 1997, Nieuwdorp 1998, Vermeulen 2012]
   e. Have no white markings, white legs or unnatural colours
   f. Are within the natural height range of local wild-type horses
   g. Are readily available
   h. Do not upset local opinion. You may have to select a second-best option.

4. Make sure all animals are healthy before translocation. Wildlife populations, including semi-feral horses, are usually very healthy and demonstrate a high degree of resistance to pathogens. They may nevertheless carry communicable diseases or have parasites that can in turn carry communicable diseases which, if introduced into a new environment, can have consequences for all species present in the area. Rewilding with unhealthy or diseased animals therefore risks spreading their diseases and parasites. On the other hand, newly introduced horses should also be prepared for the diseases and parasites for which they lack resistance and are about to encounter in their new area. Vaccination might be advisable in some cases. Consultation with veterinary experts will inform decisions on whether such interventions are necessary or desirable. Health monitoring as part of a management plan can provide good insights into the prevalence of diseases and this may include a health check of deceased horses. Knowledge on this subject is still underdeveloped and the exchange of experiences between rewilding managers, veterinarians and ecologists may be advisable.

6.5 Ensuring adaptation

Management of a rewilded herd means always considering the overall population, thinking at the herd level, acting at the social sub-group level, and keeping a watchful eye on individual horses, bearing in mind that welfare compromises at an individual level will, over time and through natural selection over generations, lead to increased adaptation and fitness for the species. In general, it appears that domestic horses can quickly rewild and adapt to a natural way of life. Conversely, they are easily tamed, as observed for example in mustangs and brumbies [Kerson 2011].

Rewilded horses should preferably live like their wild ancestors. Wild populations of any species will express their natural social behaviour, with a mixed age structure and an optimal sex-ratio, which supports free partner choice, inbreeding avoidance [Duncan et al. 1984], and natural selection. Semi-feral or extensively kept horse herds have often lacked this freedom. Research on feral horse populations and reintroduced Przewalski's horses shows that it takes several generations to build and restore a solid natural population structure, highlighting the need to start with as many bloodlines as possible, with socially integrated harems and bachelor groups (see also chapter 4.1). This will help to minimise losses to predators and in-fighting, and will enable the herd to progress swiftly along the rewilding scale.

Adding or removing animals should preferably be done in a manner that mimics natural group formation and dispersal behaviour. Pre-existing harems or bachelor groups should be translocated as a group. Removing individuals should also be carried out in a similar way to that of natural social behaviour where young mares and stallions leave their birth harem at the age of 1-3 years and can therefore be removed at this age with less stress for the remaining harem.

When horses are translocated to supplement another rewilded herd, at least two sub-adult animals should be moved together. Single, translocated horses are likely to demonstrate insecure and uncertain behaviour and the introduction of individuals into an existing social group can cause stress, which has a detrimental effect on adaptive capacity. Both factors make the newly arrived horse's integration difficult and sometimes impossible. Consequently, it is always best to mimic natural social behaviour and translocate two or more animals together. This will enable the translocated horses to express their natural herd behaviour in their new environment.

BOGDAN BOEV / REWILDING EUROPE

Konik horse in the Rhodope Mountains, Bulgaria.

If it is necessary to add new bloodlines, and the introduction of a complete integrated harem is not possible, new stallions can be added to the herd. This is best done by adding two young stallions at the same time, enabling integration to be as natural as possible, before they reach maturity and become aggressively competitive. Adding adult stallions will often bring unrest and unnatural energy loss for the whole group, while there is a real risk that the new stallion will never engage in reproduction. In the case of adding mares, again it is important to avoid individual introductions. Introductions are more successful when the animals already know each other. Fighting for the hierarchy will be more fluent and natural, with less risk of disorder and more chances for success.

Rewilding often means translocation of horses into an unfamiliar habitat. This means that horses must learn where food and water is available, where shelter can be found, which plants are palatable or poisonous, and where to avoid predators or harmful insects. Their digestive systems – e.g. intestinal bacteria – will have to adapt to new food and their immune system will have to adapt to local parasites and illnesses [Vermeulen 2012]. The horse's hoof size and growth will need to adjust to new terrain, and their fur to the local seasons. Muscles and tendons will need to be developed, especially when moving from flat land to a mountainous area. In some cases, the birth cycle will have to adapt to the new climate. Horses can acclimatise relatively well, but this process takes time. Knowledge of local terrain and conditions can be imparted onto new herds by adding a few local horses that have been living locally in the wild. If these local horses are not intended to be part of the rewilded herd long-term, then these individuals and their offspring should be removed after one or two years.

A few years after translocation, a herd should be able to survive under local, natural conditions. In areas with predators, horses should not be the only wild prey species available. Sometimes it is necessary to introduce more wildlife in order to successfully rewild large, slow reproducing species like horses. In areas with predators, it is preferable to rewild a large group of horses with a strong social structure and, if possible, some predator experience. Losses from predation will be lessened, as will the impact on the total genetic variation within the herd. A strategy for coping

with predation in the first years of rewilding should form part of the translocation plan, where introducing an existing set of social groups is a basic anti-predator measure.

An additional good option is to keep the new horses in a predator-free area to let them get accustomed to the local food, terrain, and weather under semi-wild conditions. After one or two years of habituation they can roam free in a larger area. When there is a need to increase the population, a social group of new horses can be added to an already experienced group. However, care must be taken that the new group does not outnumber or dominate the old group, which risks jeopardizing recently acquired learned behaviour. After a number of years, when numbers have increased and horses have developed efficient, anti-predator behaviour, human interference can be scaled down. From that point onwards, nature will select and determine the path and future of this new population of wild horses.

6.6 Number regulation

The existence of wild horses in fenced areas inevitably leads to the question of number regulation. Natural number regulation can be by old age, predation, illness, parasitism or by starvation. The last three may be an indication of overcrowding. Especially if it is not limited to a single individual animal.

The top-down regulatory influence of predators, such as wolves, on the behaviour and population size of herbivores is still being determined and appears to be very species-specific. The idea that predation can effectively limit overall herbivore numbers is contested. Rather than limiting total herbivore population, it seems that predation keeps medium-sized herbivores from dominating the herbivore spectrum and shifts the species composition of herbivore numbers in favour of larger species.

For example, in the northern hemisphere, deer numbers are controlled by predators, but only when both wolf and bear are present [Ripple & Beschta 2012]. In North America, as deer numbers decreased after the return of wolves to Yellowstone, numbers of bison – a larger animal - increased, with their numbers seemingly unaffected by predation. It is unclear how equids, as medium-sized herbivores, fit into this. In Africa, zebras can be controlled by predation in some systems, as food and disease are less likely to be a limiting factor for them when compared to ruminants. The predator guild in Africa also includes lions and spotted hyenas, both larger than wolves, although only the former is known to exert population-level effects on equids. Lions occupied part of the European wild horse's historical range, and virtually all of its Pleistocene range was as well, but this predator is now locally extinct, and its return would obviously be problematic in the current European landscape. On the other hand, recent experience in Bulgaria and Croatia shows that wolves can also be effective predators of horses.

How predation affects herd size, via direct mortality or behavioural changes (landscape of fear), requires observation and monitoring by the manager. However, as predation is potentially of limited effectiveness in controlling horse numbers, and many rewilding areas will not have predators present, the question remains whether

Group of Karakachan horses reintroduced in the Rhodope Mountains, Bulgaria. This local breed is maintaing the mosaic landscape that is typical for the region.

numbers should be constantly regulated or only occasionally, i.e. as necessary. What should a manager pay attention to? How can human management intervene in a way that corresponds as closely as possible to natural mortality or dispersal patterns?

If we interpret rewilding as being in favour of natural processes over human intervention wherever possible, then the answer is to let the animals self-regulate. The inevitable result, especially in the absence of predators, will be the depletion of food resources once the population reaches carrying capacity, followed by a percentage of the population dying of starvation. Starvation events are not an unnatural or uncommon phenomenon, and many large herbivores, even smaller ones like wild boar, are primarily food-limited rather than predator-limited, but the consequences of food limitation within fenced areas are both more stark and more abrupt than in unfenced landscapes, where animals can naturally disperse or migrate in search of food. In arid areas, water may instead be limiting while disease can be a factor once populations become too crowded. The exact dynamic will thus vary greatly depending on the size of the rewilding area and both ethics and legal regulations must be considered when dealing with this situation.

In case numbers must be regulated by humans, the question becomes one of how to choose which animals should be removed or killed, and what should be done with the carcasses. Translocation of animals to other rewilding areas can postpone the problem, but only until no more viable locations remain. Sustainable offtake of animals for meat or other purposes may be an option, but this would require significant intervention and would remove nutrients from the ecosystem. Horsemeat and horse hunting are also both poorly developed markets.

Number regulation should always be done in line with the natural social system of horses (chapter 4.1). Offspring can be removed after they are expelled or dispersed from the harem of birth at the age where this would happen naturally. Alternatively, a complete social group can be removed. Horse carcasses are very important for nutrient cycling as well as supporting a host of scavenging animals and fungi, many of them endangered due to the general lack of carcasses in the modern human landscape. Depending on the country's laws and regulations, culled animals can be left in the area for scavengers and remain part of nature. The way this issue is handled will depend on the local legal situation, local public opinion and the scale of the area in question.

6.7 Human assistance during rewilding

Wild populations are constrained by the amount of food available to them, but in nearly all semi-feral populations, humans intervene before populations reach the ceiling of food availability. That is why knowledge about population dynamics and food availability is limited [Duncan, 1992], and therefore this knowledge needs to be built up during rewilding. Supplementary feeding goes against the general principles of rewilding and should be avoided for large herds. Normally, the area where the horses live should be large enough to supply ample food in both summer and winter. Supplementary feeding ultimately causes more problems such as overcrowding, increased disease

IVO DANCHEV

LEO LINNARTZ / ARK NATURE

Konik horses in Beuningen, The Netherlands.

and parasite transmission, and removal of winter grazing effects which are important for biodiversity.

However, there may be situations when supplementary feeding is wise or even legally required. Examples include: when exceptionally heavy snowfall is preventing the animals from obtaining natural food, when a project is in its first year and the animals are not yet familiar with their new environment, when numbers are low and no individual can be lost for genetic or other reasons, or when the horses are in a very small area. However, supplementary feeding should never be a permanent management measure.

In cold climates, when all open water freezes and no snow is present, newly rewilded horses may need to be given supplementary water, which can be done by making holes in the ice but more experienced horses living in the wild will make these holes themselves. Attention should be paid to dried-up water sources in the dry season, as newcomers will not yet be familiar with the area and may not have found alternative sources. When natural water sources are far apart, it may be necessary to introduce groups of horses near several of these water sources, as it can take a long time before introduced horses will find these new sources by themselves.

Supplying additional salt or minerals should not be necessary, as rewilding areas should preferably have sufficient minerals or natural mineral sites. Only in very rare cases, and if the animals suffer from a lack of minerals, should supplementation be considered. Preferably, the horses will be taught where to find the natural mineral sites in the area.

When dealing with health, well-being and diseases, a distinction should be made between individual illnesses and communicable, infectious diseases. Both affect the well-being of individual animals. In the case of illness or injury to an individual animal, it is best not to rush intervention. However, in the case of fatal injuries or illness, the horse in question should be euthanized to end suffering. Vaccinations should only be used for temporary protection when introducing new animals. Deworming is also undesirable, but might be necessary after horses have been translocated to a new area with different parasites. Always use a drug that is effective for only a short period. Depending on the drug used, removing contaminated dung from the nature reserve could

be advisable, so as to avoid contamination of the soil and soil fauna.

In the case of infectious diseases within the rewilded population, consultation with experts will help decide if intervention is necessary, desirable, or even mandatory, especially if there is a risk of disease exchange with other populations or species. Some infectious diseases are notifiable by law, because they can affect the animal health status of a country, which may have consequences for national trade interests. For all of these reasons, it is important to maintain regular contact with a local veterinarian and with the national veterinary service. Health monitoring by a veterinarian in a rewilding herd is not necessary but can be very useful in extending the expertise of rewilding in general, and to help prevent unwanted surprises. Depending on the country, a degree of monitoring might also be obligatory. A veterinary plan for inspection and monitoring can be part of the management plan and can clarify answers to difficult questions by critics.

Once rewilded it will be difficult and indeed undesirable to catch wild horses, although it might be necessary to tranquilise an animal for treatment or translocation, which clearly demands specific expertise.

6.8 Rewilding horses and communication

Today, people are no longer familiar with truly wild horses in Europe. Horses or ponies used for riding and kept in small enclosures or stabled in a riding school are the new norms. These horses are fed, groomed, protected from harsh weather, and often vaccinated and de-wormed.

Before introducing wild horses to a new location, the local population should be extensively informed about the process and directed to further education material. Clear signage and brochures that clearly set out behaviour required of the visitors can avoid problems. The wildlife manager should already be up to speed on a wide range of information regarding rewilding management, but is likely to be confronted with specific horse-related questions. Frequently asked questions and possible answers are presented below:

Why horses?

Wild horses used to be present throughout Europe, where they filled important ecological roles as herbivores and ecosystem engineers.

Konik horses in the Rhodope Mountains, Bulgaria.

IVO VIKTOROV DANCHEV

The European wild horse is now extinct, but its genes survived in domestic horses. Meanwhile, the Przewalski's horse is the only remaining wild lineage of horse present in Eurasia. Both feral domestic horses and Przewalski's horses are good candidates to restore the ecological role of European wild horses. Reintroducing them in European landscapes will support wilder nature and enhance the cycle of life.

Don't we have to feed the horses when there is snow and ice?

Explain to the public what you are doing and demonstrate that the horses really don't need additional food. Giving the horses additional food will provide them with a disincentive to find it themselves and thus encourage dependency. The area is suitable, meaning there should be enough food, even in winter. Wild horses will shift snow aside to reach for the grasses below, and those horses which are experienced at living in the wild make these holes themselves. They will also debark edible trees, thereby increasing their effect on the (open) landscape.

Don't they need a stable for shelter?

No, they don't. A stable will keep their coat from reaching its normal winter thickness. The landscape with its trees, cliffs, mountain tops, and valleys can provide shelter, shade, a breeze against stinging insects, etc. The horses will learn quickly how to use them.

Do they need a veterinarian?

The horses are strong enough to live without the help of a veterinarian. When they are very badly wounded or too ill to recover, the wildlife manager or a predator will kill them to end their suffering.

May we feed them or hug them?

No, wild horses are supposed to live life in the wild and to keep some distance from visitors. By feeding them or hugging them they will continuously search for the company of humans, and that will undo an important part of their natural effect on the landscape. Besides, horses might start to demand food from people, resulting in conflict and in people fearing them. Always keep your distance from the animals, maintaining at least 25 metres between yourself and the wild horses (this important piece of information should be clearly displayed on information panels.)

May we ride them?

Riding wild horses can be very dangerous, especially when a horse has never been ridden before. The horse will panic and think that it has a predator on its back, and it will very much disturb the whole herd and increase the potential risks for the person involved.

Herd of semi-feral horses grazing on snowy mountain slope in the Central Apennines, Italy.

Do we need to groom them?
No, they will not tolerate people doing this, and anyway it could render the coat more permeable to rain by rubbing off natural oils. The seeds in the coat may make the horses look unkempt but this is a natural process of dispersing plants.

Do we need to take care of the hooves?
No, their hooves will grow and wear down according to the surface. Cutting the hooves will make them grow too quickly and brings discomfort to the horses.

Do they need to be de-wormed?
No, they learn which plants have a de-worming effect and they will eat them when necessary.

Do we need to keep an eye on the young age of reproduction of mares?
No. Wild horses will only become fertile when their body is ready for reproduction.

Apart from these general questions, it is always best to keep the public informed and to establish and maintain good working relations with communities living in proximity to the rewilding area.

6.9 Rewilding horses: pitfalls and challenges

When starting with rewilding horses, it is important to be aware of the following potential pitfalls and challenges:

- The most recent locations where semi-feral horses were widely kept or roamed are not necessarily suitable for living in the wild all year round. Often these sites are only suitable for summer grazing, and suitable winter grazing grounds must be included.
- Rewilding areas need not be limited to poor grazing grounds, and land abandonment offers plenty of opportunities for securing access to good grazing grounds.
- At the beginning of the rewilding process, the number of horses should be significantly fewer than the local carrying capacity of the rewilding area. This gives the horses the opportunity to adapt to their new environment while there is plenty of food and offers space for the herd to increase in size.
- It is important to bear in mind that the carrying capacity in most rewilding areas is much less than in agricultural areas and rewilded agricultural areas will gradually lose their increased productivity. Densities can range from 1 animal per hectare on fertile soil to 1 animal per 15 or even 30 hectares on poor sandy soil or in dry areas. It is also important to bear in mind that horses mainly feed on grasses. Lakes and ponds, rocky areas and dark, closed forests may offer vital access to water and useful shelter but they do not offer much grazing capacity and should be excluded when calculating carrying capacity and grazing densities.
- Carrying capacity is always calculated in the worst season when food is in shortest supply (whether that is in winter or dry summer).
- Many breeds on the rewilding list have gone through a genetic bottleneck. The number of founders is relatively low and current numbers may still be low. When starting with rewilding it is important to have as broad a genetic pool as possible. Because the introduction of existing social groups is of great importance for the success of the project, it is a challenge to simultaneously guarantee genetic diversity and social cohesion.
- When the rewilding area is small, the herd of wild horses must remain small, meaning that inbreeding and genetic erosion can appear and counter measures should be planned, ideally by exchanging social groups of horses between two compatible rewilding areas.
- For herds of 150+ genetically diverse horses, the risk of inbreeding and genetic erosion is minimal for a long period of time [Kurstjens 2004, Smulders et al. 2006], but even with high numbers, some exchange of groups of horses is desirable. This can also be achieved by connecting two rewilding areas and allowing the horses to mix naturally.

A number of challenges can occur when horses are translocated to an environment to which they are not adapted:

- When moved from flat terrain into a mountainous area, horses' tendons can become very sore and painful. This hampers movement and decreases their ability to escape from predation.
- When moved from soft to hard terrain, horses' hooves wear down excessively and become painful. This also hampers movement.
- When moved from a nutrient-rich environment to a nutrient-poor one, food intake and digestive ability through the intestines may not be sufficient. Animals will have to spend much more time feeding or may not succeed in digesting an adequate amount of food. Their offspring will perform better, as their intestinal surface area will become adapted to nutrient availability in the first years after birth.

- If the area was previously treated with fertilizer or is otherwise oversaturated with nutrients, Equine Metabolic Syndrome, similar to diabetes, may cause Laminitis. A period of time where new vegetation and ruminant herbivores absorb some of the excess may be necessary, followed by a period of adaptation where the animals are closely watched. In terms of excessive food intake, this poses much less of a problem so long as there is a natural social structure protecting them from this behaviour. Multiple stallions are kept busy fighting each other, young animals will just grow faster, and mares will be pregnant or have foals. The risk for Laminitis is higher when horses are moved from a nutrient poor environment to a nutrient rich area.
- When moved from a dry to a wet climate or vice versa, the coat has to adapt. Overheating can be a serious problem at the start of this process.
- When moved from warm to cold or vice versa, coat and fat deposition must change. Freezing to death or overheating can be a problem in the first few years and risks must be minimised.
- When moved from an area without predation to one with predation, prey animals like horses have a disadvantage and extra care (see earlier discussion of the use of enclosures during a period of adaptation) should be taken to prevent predation until the animals have adapted to their new surroundings.

One or two years of adaptation are quite normal after translocation. Authentic rewilding starts with the first wild-born generation of horses and continues with each following generation. The amount of time and the measures taken all form part of the local rewilding action plan. More information about releasing and managing the newly wild horses can be found in Vermeulen [2012].

6.10 Towards truly wild horses

The current body of European Union legislation divides animals into categories defined as either wild or domestic. Wild animals are regulated under the Habitats Directive, whereas domestic animals and wild animals kept in captivity are regulated by both veterinary and food safety regulations. In Europe, horses are considered domestic animals by law, although each member state makes its own list of endemic species for the Habitat Directive. The wild Przewalski's horse is currently not on any of these lists.

Within the framework of the European Union there is room for exceptions within the rules at national, regional or even community level, as long as they do not contradict EU legislation. Currently there is no separate status for rewilded horses. Consequently, rules for kept animals apply to rewilded horses. This means that rewilded horses have an owner who is responsible by law. According to current laws, owners of rewilded horses:

- Are responsible for damages
- Have an identification duty for individual animals
- Have veterinary obligations, depending on local legislation or situation
- Can use horse meat for consumption
- Cannot leave carcasses in the field, unless exceptions to this are arranged
- Have ethical obligations around the animal's health and condition
- Must follow transport regulations which are identical for both rewilded and tame horses

Wildlife managers of horse rewilding areas should inform themselves about all laws and regulations applicable to their work. Rules and regulations can be complicated, especially in cross-border situations both inside and outside the EU. When necessary, wildlife managers should be aware of, and implement any new provisions, measures or permits necessary [IUCN/SSC 2013].

Rewilding horses in rewilding areas brings the need for recognition of wild status for the newly rewilded horses. This should include appropriate legislation and perhaps a separate official subspecies name. Obtaining wild status for rewilded horses would be an important step in the overall recognition of the new wild horse and its role in Europe's ecosystems, helping to restore the wild horse's role and place in these ecosystems.

If this succeeds, rewilded horses would no longer have a responsible owner. Translocating or harvesting could thereafter regulate populations of the newly wild horses, their meat would be considered as game or venison and carcasses could be left in the field for vultures, bears, insects, etc. Translocations, on the other hand, would then only be possible after official authorisation. While neither Rewilding Europe nor any other organisation to our knowledge is working on this currently, it is something that we recommend be pursued. For the sake of completeness, it should be clear that introduction of the (already) wild Przewalski's horse is possible if a country includes the species on its endemic wildlife list where the EU Habitat Directive applies.

7. Additional Notes

Notes on Taxonomy/Common Names

With the recent determination that the type population for the "Tarpan" (*Equus ferus*) was of mixed wild-domestic ancestry [Librado et al, 2021], by the rules of taxonomic nomenclature, that name might not be applicable to the original European wild horse. As such, the existing name of Equus caballus might be more appropriate. This name is older than the *ferus* designation but the latter was given preference based on a guideline that states that no wild taxon should be named after its domestic equivalent. Potential synonyms include *Equus equiferus, germanicus, gmelini, gracilis, mosbachensis, silvaticus/sylvestris, sequinanus, sussenbornensis*, and *tarpan*, but these are all invalid for similar reasons to ferus. As such, the older name Equus caballus is likely the most suitable choice.

This leads to a further question of whether rewilded European horses should be given their own designation. For legal purposes, it might be useful if rewilded horses were given their own status as a subspecies, allowing them to be treated like wild animals instead of livestock. To propose said name is not the purpose of this document, but it should be addressed in the future. A convenient shorthand for both the original European Wild horse and rewilded horses would also be useful. Tarpan is not appropriate for either, as it referred to a specific population of mixed horses. The simple moniker "wild horse" is likely sufficient as a common name in the interim.

Przewalski horses in Causse Méjean, France.

FRANS SCHEPERS / REWILDING EUROPE

Wild living, reintroduced Konik horses in the Eastern Rhodopes, Bulgaria.

STAFFAN WIDSTRAND / REWILDING EUROPE

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Glossary

Fit for rewilding
Fit for rewilding are horses that are potentially suitable for de-domestication and rewilding, but have not yet undergone action towards that goal.

De-domesticated
De-domesticated horses live wild in natural areas, but still have an owner who will take care of them when necessary and who is responsible by law. They are sometimes fed in wintertime, but only when really necessary because of extreme weather conditions. Often they have free partner choice and live in natural social groups.

Feral
Feral horses are escaped horses roaming free in natural areas. They have free partner choice and live in natural social groups. They live like rewilded or de-domesticated animals, except that their release was unintentional and could be reversed.

Semi feral
Horses living wild in natural areas, but they still have an owner who will take care of them when necessary and who is responsible by law. They may have free partner choice, but not always. Semi feral horses can sometimes be kept in stables in wintertime, taken to winter areas, artificially fed or treated by a vet.

Rewilded
Truly wild horses that live wild in large natural areas, have completely free partner choice, live in natural social groups, have no owner and their wild status is not supposed to be changed ever.

Aerials over the Letea forest in the Danube delta rewilding area, Romania.

About Rewilding Europe

Founded in 2011, Rewilding Europe wants to make Europe a wilder place. It is our vision that wild nature is valued and treated as an essential element of a prosperous and healthy society with far more space provided for wildlife and natural processes. We want to see rewilding being practised at a large scale across Europe. We aim to demonstrate the benefits of wilder nature by creating at least 15 rewilding landscapes by 2030 and to inspire and enable others to engage in rewilding by providing tools and practical expertise.
www.rewildingeurope.com

About ARK Rewilding Netherlands

ARK Rewilding Netherlands has pioneered rewilding in the Netherlands since its founding in 1989. It demonstrates in practice how restoring natural processes provides new opportunities for both nature and people in the Netherlands. ARK is convinced that more space for nature will improve the quality of life. Robust, spontaneous nature is essential for plants and animals, but also for economy and all people's well-being.
www.ark.eu

About Herds & Homelands

Herds & Homelands is an independent Dutch consultancy. It is specialized in natural grazing with domesticated species to equal the ecological role of the extinct Aurochs and Wild Horse. Herds & Homelands has more than 30 years of international experience in rewilding cattle and horses in European nature areas, as well as a long time involvement in bringing back Eurasia's last surviving wild horse, the Przewalski, into the steppes of Mongolia and the reintroduction of European Bison in the Netherlands. The transformation of domesticated herbivores into the rewilded ecological key species that were once their wild ancestors, asks for a comprehensive approach. Expertise concerns natural grazing, species-specific behavior, social relationships, population dynamics, law and regulations, transports and veterinary aspects. By exploiting best practices, Herds & Homelands is often bridging the gap between field and theory or theory and prejudices. Always with an open eye for research and new insights in this pioneering field. Renée Meissner is founder and owner at Herds and Homelands.

STAFFAN WIDSTRAND / REWILDING EUROPE

Rewilding Europe®

Making Europe a Wilder Place

Rewilding Europe wants to make Europe a wilder place, with more space for wild nature, wildlife and natural processes. In bringing back the variety of life, we will explore new ways for people to enjoy and earn a fair living from the wild.

Let's make Europe a wilder place together!

www.rewildingeurope.com

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