Class Mammalia
Order Perissodactyla
Family Equidae (Horses and Relatives)

- Large mammals with large head, elongated face, long neck, large ears, eyes set to the side and high on the head, long, slender legs ending in a single hoof each, long tail, and some erect or droopy when very long.
- 200–300 cm.

- Paleartic and Afrotopical Regions.
- Most grazed to semiarid savanna, arid lowland, and mountain desert.
- 1 genus, 7 species, at least 19 extant taxa.
- 2 species critically endangered, 2 species endangered, 1 species vulnerable; 4 subspecies extinct since 1800.

Systematics
The horse family consists of only seven species, all of which belong to one genus, Equus. All species share a common body plan, outwardly manifesting a long body and a long neck that supports a large head with an elongated face and large ears; a distinctive mane tops the neck and a long tail is attached to the rear. Inwardly, each species has a fermentation chamber that enables it to subsist on low-quality forage that is clipped, masticated, and digested by broadly similar distillations and a long digestive tract. The species are easy to tell apart by their coat patterns alone; zebras have stripes, asses have two-toned coats, dark on top to paler under the belly, and wild horses have coats that are uniformly dark in color, although spins, socks, blazes, and stars accentuate their stocky homely varietal. The species displaying these distinctive color morphs tend to cluster geographically and inhabit similar habitats within each region; zebras live on the savannas and hardwoods of Africa, the Middle East to the mountains of Asia, and horses occupy the temperate grasslands of North America, Eastern Europe, and central Asia. These clusters seem to divide naturally into three taxonomic groups, or clades. Surprisingly for a group as well studied as the horse family, evidence in support of this grouping scheme is equivocal. As a result, equid systematics remain in flux. The appearance of new molecular evidence continues to challenge traditional relationships based on morphology (especially body size, facial features, dentition, and coat patterns), behaviour, karyotype genetics, and zoogeography.

The earliest horses destined to become the family Equidae appeared in the early Miocene about 55 million years ago with the description of the fruit-eating Pliohippus (formerly called Equus). The Dawson Horse by R. Owens in 1981. What was once seen as a linear sequence of gradual change leading from Pliohippis, the smallest of the Paleocene equids, to the larger ones, Parahippus and Merychippus about 15 million years ago, fit relatively modern horses, Equus, which was replaced by a tree of bushy tree-shapes of shapes and size, explorer diversification and rapid branch extinctions. Accompanying this diversification and form was extensive geographic spread from North America at the outset, the Europe, South America, Asia, and Africa. By the end of the Miocene (five million years ago) more than a dozen genera characterized the Equidae. Today, most of this diversity has been lost via extinction and what remains is limited to one genus, Equus. This genus includes the caballines or true horses, and the non-caballines. The former includes the domesticated and feral Horse (E. caballus), and the wild Przewalski’s Horse (E. przewalskii); the latter includes the hemionines or hemiones (the Assiatic Wild Ass, E. hemionus, and the Tibetan Wild Ass, E. kiang), the African Wild Ass (E. asinus), and the domestic Donkey (E. asinus), and the African zebras (the Plains Zebra, E. quagga, with its many subspecies, including the extinct “Quagga,” E. quagga, the Mountain Zebra, E. zebra, and the Grey’s Zebra, E. granti). Many other species of Equus co-existed with today’s surviving species, but they began dying out about 125,000 years ago, during the late Pleistocene and Holocene periods. Due to the Equus spread to South America and coexisted with the Hystrix horses until after 12,000 years ago, when they and their North American equid cousins, E. asinus, vanished due to a combination of human “overkill” and changing climates. Domestic Horse breeds were introduced to North America with the advent of European explorers in the 16th century. Today many roam freely as ferals.

Determining the taxonomic relationships among these species is a work in progress. Early studies using morphological characteristics showed that the horses, zebras, and asses evolved as three separate monophyletic groups, with the horse clade most closely connected to that of the zebras. The clad encompassing the asses contained both the African and Asian asses (E. kiang were omitted from the study). Within the zebra clade, Grey’s Zebra and Mountain Zebras were most closely related. Whereas cranial features generally separated the horse-zebra superclade from the other, distinct molecular features identified the hemionine-asse clade. Facial and muzzle features separated the zebras from the others.

During the last 20 years, DNA collected from living species as well as from fossils has raised questions about phylogenies constructed solely from morphological features. Early molecular phylogenies generally supported the claim that equids were divided into three monophyletic clades. But they suggested that horses, rather than hemionines or asses, separated first from ancestral species, and that the horse clade is distinct from, and distantly linked to, that of the zebras. The first molecular phylogenies also revealed that the hemiones and the asses are members of different clades. The African asses unite with the zebras, and the Asian hemiones stand together, suggesting that biogeography matters in the evolution of the equids. Although one study using mitochondrial DNA suggests that Grey’s Zebra and Mountain Zebra are more closely related, another study using a different region of mitochondrial DNA, finds Grey’s Zebra more closely to the Plains Zebra than to the Mountain Zebra. As an overview recent study, using nuclear as well as mitochondrial DNA, places the Plains, Mountain, and Grey’s Zebras in three different clades. Since molecular phylogenies are typically based on a limited number of specimens and different regions of DNA, it is difficult to assess evolutionary support for any particular molecular phylogeny. Clearly, a more complete genomic approach will be needed to unravel the major equid divisions.
Molecular data has, however, been useful in resolving some taxonomic controversies at fine scales, thus simplifying equal systems. This is especially true with respect to understanding the placement within the zebu clade of the Quagga, the first extant equid species to have its DNA analyzed. Historical records show that the Quagga shared the range of the southernmost population of the Plains Zebra, but because Quagga coats, with their uniformly collared rump and striped neck and faces, were so different from those of Plains Zebras, which were striped from head to toe, many believed that the Quagga was a separate species. A recent finetoothed analysis of the Quagga's DNA and the DNA from representatives of all extant Plains Zebra populations has revealed a very high degree of similarity among the samples, indicating that the Quagga and Plains Zebra should be considered one species, E. quagga.

Unfortunately, similar finetoothed DNA analyses have been unable to unravel the origin of the domesticated Horse unambiguously. Until the turn of the 20th century, two wild populations of horses existed: the "Tarpan" (E. ferus ferus), in the western forests of Eastern Europe and Przewalski's Horse, on the steppes of Central Asia. Unfortunately no Tarpan DNA has been preserved. Many believe that today's domestic horses are descendants of the Tarpan. Initial genetic analyses using karyotypes provided some hints, but no conclusive answers. Living equids exhibit a wide range of chromosome numbers, ranging from a low of 32 in the Mountain Zebra to a high of 66 in Przewalski's horse. The domestic horse and its feral descendants have 64, only differing from their closest relative by two. Domestic Horses and Przewalski's Horses can interbreed, suggesting that they are closely related, and fertile offspring with 60 chromosomes are produced. The combining and fusion of two pairs of homologous chromosomes, known as Robertsonian fusions, is the most likely way in which these two types of horses diverged and became species. Not knowing whether fusion happened before or during domestication makes it difficult to know whether the Tarpan and Przewalski's Horse were one or two species. Without this knowledge it is hard to discern the true ancestor of the domestic Horse. Most believe it derives from the Tarpan of Eastern Europe. C. P. Groves, however, proposed that all horses surviving into modern times belonged to one species, E. ferus, with these subspecies: E. f. ferus, E. f. manilae at the eastern edge of Eastern Europe and E. f. przewalskii of Western Asia. If correct, any of these subspecies could be the ancestor of the domestic Horse. Recent molecular analysis of DNA from two populations of Przewalski's Horse and a variety of domestic breeds, show enough similarity to indicate
of hybrids between Plains and Grey's Zebras at the northern edge of the Plains Zebra's range and Plains and Mountain Zebras at the southern edge of the Plains Zebra's range suggest that hybridization has been rare, and that such matings have been rare and only recently have been discovered. Molecular analysis has confirmed that zebras seen with moderately thin stripes not touching under the belly in Grey's and Plains Zebra's region of sympatry are indeed hybrids and that the flow of genes is from Grey's males to Plains Zebra females. Since these hybrids occur at the extreme southern edge of Grey's Zebra's range and in a population where the sex ratio is almost 90% males, it is possible that when unable to mate with females of its own species, very large Grey's Zebra males were able to copulate with more abundant Plains Zebra females, who would have been guarded by males only two-thirds the size of Grey's Zebra males. Subsequent backcrossing by hybrid females with Plains Zebra males would incorporate Grey's Zebra genes into Plains Zebras. What effect this will have on breaking up long-standing adaptations or creating new ones is uncertain, but until introgression goes the

Previously often considered a subspecies of the Asian Wild Ass, the Tibetan Wild Ass has a large head, a broader neck, shorter ears, and broader hooves than the species. The long, flowing hair of the Tibetan Wild Ass is not restricted to the tip, as they are in both Asian and Arabian Wild Asses (and the domestic Dromedary). Tibetan Wild Asses have a coat that is longer and tighter in color in winter. Some males of the subspecies hodoterren can reach 460 kg and 142 cm at the shoulder, making them the largest of all the wild asses. Male wild asses are generally larger than females, though differences between the sexes are not particularly striking.

Espen Kierp Photo: Roland Sauer

The Asian Wild Ass once ranged from Syria and the Arabian Peninsula to Western China, and from Russia to India’s Thar Desert. In different parts of the range, these ass are known by different names, which roughly correspond to the recognized subspecies: the “Kelion” (the Mongolian Kulan), Equus b. kulanis, and the “Yushe Kulan, E. b. kirguizianus,” the “Kelion” (the Persian Ounce), E. b. onager, now confined to regions in Iran and Turkey, and the “Khu” (E. b. Khu from Persia, shown here). The “Ounce” (Equus Ounce) in h. hirsutus, is extinct.

Nizam Kamal Photo: Indira Wildlife Sanctuary, Little Rann of Kutch, Gujarat, India

Generally, the further south in its range a Plains Zebra is found, the less the degree of stripe coverage on body size increases. Apart from “Basinz” (above) are “Dowzer” Zebras (below), but southern African subspecies, the Plains Zebra’s stripes cover the flanks and reach under the belly. The Wild Ass (above) is rare further south, but striping continues to its head and upper forequarters. Since in the Mountains and Grey’s Zebras the belly is always white and unstriped, it was originally thought that these were white males that had acquired black stripes. But embryological evidence suggests the background color was black, with the white stripes and belly being an evolutionary adaptation. Every child knows that the zebra got its stripes so as to hide in the vertical light and shade pattern of long grass. Sadly, it would seem that every child is wrong: there is no evidence that during a daylit hours the stripes help zebra blend into the vegetation. The stripes are thought to possibly provide better camouflage in the dark of night, especially in the moonlight. Two possible explanations have been proposed to account for why the false striping is so beneficial: one is that it facilitates social cohesion by attracting the attention of other zebras, and that striping makes the less attractive to biting flies than solid colors.

Above: Equus onager basinzz Kupers National Park, Kutch, India. Photo: INDONESIA
Below: Equus onager antilope Kudzu National Park, Nafiss. Photo: Guter Zeiter
Generally, the farther south in its range a Plains Zebra is found, the less the degree of stripe convergence, while body size increases. Apart from "Burchell's" (above) and "Transvaal" (below), both southern African subspecies, the Plains Zebra's stripes cause the flanks and neck under the belly. The extinct "Quagga," from men further south, had stripes confined to the head and upper forequarters. 

In the Mountains and Grey's Plains the belly is always white and unstriped. It was originally thought that when these white areas that had acquired black stripes. But embryological evidence suggests the background color was black, with the white stripes and bellies being sex-ratio deviations. Many zoologists believe that when the embryo develops, or as is held in the vertical light-sensitive pattern of long grass. Sadly, it seems that every child is wrong; there is no evidence that during daylight hours the stripes help identify the vegetation. The stripes are thought to possibly provide better camouflage in the shadow of vegetation, as seen in the photo below, especially in the moonlight. Two possible explanations are that when some experimental subject saw that the stripes facilitate social behaviors by attracting the animals to cover, and that striped bodies are less attractive to biting flies than solid colors.

Above: Equus quagga burchelli
Kruger National Park, South Africa. Photo: Mike Goldsmith

Below: Equus quagga zebra
Etosha National Park, Namibia. Photo: Simon Lester
other way, the gene pool of the endangered Grey's Zebra is not likely to be compromised and its endangered species designation will not be affected.

**Morphological Aspects**

All members of the horse family stand on four long legs, each ending with a single spade-shaped digit protected by a keratinized hoof. Some species are more slender and graceful than others, but in general their bodies are barrel-shaped, their necks and faces are long, and they possess long maces and tails. Their overall shape adapts them well for grazing in open country and for traveling long distances over dry, hard surfaces. Fusion of the tibia and the fibula as well as the ulna and radius produces a single cannon bone, which provides stability and increases speed, but also limits turning ability and overall agility. The exoskeleton of the horse (the gap between incisors and cheek teeth) allows equids to use their tongue and cheeks dexterously to manipulate vegetation toward two rows of high-crowned molars in the back of the mouth. This arrangement allows vegetation to be clipped and chewed at the same time. Unlike ruminants, with which equids often share habitats, equids have upper and lower incisors that facilitate clipping tough forage. As well as most herbivores, fermentation permits efficient processing and absorption of energy from fibrous leaves and stems. In equids the fermentation chamber is the caecum, which lies at the intersection of the stomach and intestines; this is where cellulose-laden microorganisms are housed. Given that fermentation takes place after the gut, food can be processed quickly, without the bacteria associated with rumen digestion. This also equips to consume all parts of lowness, but abundant vegetation; but because fermentation takes place after digestion, equids are less efficient than similarly sized ruminants at processing food on a time-specific basis. Thus a speed-efficiency tradeoff enables hindgut fermenting equids to coexist with foreign fermenting ruminants, especially in drier and more marginal habitats. Equid eyes are positioned high up on the face. Not only does this reduce pressure from the molars on the eyes while chewing, it enables equids to see above tall grass while grazing.

Members of the horse family generally stand about 100–150 cm high at the withers, weigh 200–500 kg, and are 200–500 cm long. Sexual dimorphism is reduced to all equids, with males weighing only about 10% more than females. Males, however, have a canine tooth located in the diastema, positioned about 2–3 cm behind the last incisor. This location makes the canine an effective weapon for severing the Achilles tendons of opponents during escalated male-male contests.

Although all equids share a similar and distinctive body plan, the species are easy to tell apart. Horses are easily distinguished from their congeners by long-hooved tails and long maces that fall to one side of the neck in the domestic Horses. Chevrons, also known as right eyes, are callouses found on the inner side of the leg above the knee on the佛山 and, if present, below the hock on the hindleg. Chevrons vary in size and shape and are sometimes compared to fingernails in humans. Liquid evolution involved a reduction in the number of toes to one, along with other changes to the ancestral equid foot. The chevron is thought to correspond to the wrist pad of carnivores, or to be a vestigial scent gland similar to those found in some cercids. Horses are a lone among equids in having chevrons on the hindleg, as they are absent from the hindlegs of asses and oryxes. Most breeds of domestic Horses have chevrons on all four legs, as does Przewalski’s Horse, but a few breeds of asses are reported to lack chevrons on the hindlegs.

The hooves are broad and rounded, at least in Przewalski’s Horse, stripes often cover the lower legs. Horses’ manes and tails are longer than those of other equids, as are their manes. True horses (E. caballus and E. przewalskii) have long body hair, especially in the winter, and although Przewalski’s Horse is beige in color, domestic breeds show an incredible amount of variation. African asses are covered with short body hair; mohair coats that are darker on the back and upper flanks than on the belly, and have short, tufted tails. They have chevrons only on their forefeet, and their foreheads are shorter than their hindheads. Their hooves are small and narrow. Their maces are long but smaller than forefeet, and a thin dorsal stripe runs down the back, with a short shoulder stripe created at the croup of the withers.

African asses are larger, taller, and more regal than their African cousins. A shorter hump and longer skull along with elongated metacarpals create legs that are longer and slimmer. White limbs and bellies contrast with dark flanks and backs, which can range in color from buff to brown depending on season and habitat. Erect tails on the back create a brown dorsal stripe.
The stripes of Grey's Zebra are much thinner than those of the Plains Zebra (P. m. m DC). This is the largest of the wild equid species, with the biggest males reaching up to 160 cm at the shoulder and 450 kg in weight. A big male Grey's Zebra can face a lion. Grey's Zebras also have proportionally larger heads than other zebras, with long faces and elongated nostrils. The ears are large and round, and can move independently. The mane is erect and tall, and extends into a crest along the back to younger animals. During the first few months of life, this crest is maneless and stands up when the young zebra is excited.

Gray zebra
(Plains National Park, Kenya)
Photo: L. R. Webb

The new subspecies of the Mountain Zebra have been prepared for full species status, but this is not supported by genetic analysis. "Hartmann's Mountain Zebras," shown here, is larger than the "Cape Mountain Zebra," and has slightly narrower stripes. Both subspecies can be distinguished from other zebra species by the dark tips of their ears, and from the "coffin-shaped" pattern on their rumps, marking the base of their tails. Hartmann's Mountain Zebra is sometimes found on salt flats, and sometimes in water in the Namb Desert has enabled it to survive. Hybridation between the two subspecies is thought to occur, which under some circumstances could inflate the genetic diversity of the Mountain Zebra.

Equus zebra hartmannae
Darkest race, Namibia
Photo: Simon Beilke

The Tibetan Wild Ass, often called "Kiang," is also large and has a thick head and muzzle. Its mane is long and the tail is less tufted than that of other asses, with more flowing hairs. The contrast between the red of its upper flanks and white of its lower flanks, belly, and rump is striking. The top of each hoof is tinged in black.

With their black and white stripes, the zebras are the most distinctive of the equids. They have the most upright and some of the longest manes. Like the asses, they only have chenets on their forelegs. In all zebras the metacarpi are longer than the metacarpus, so the forelimbs are longer than the hindlimbs. The three species have very different stripe patterns. Those of the Plains Zebra are broad and reach under the belly. The stripes of Grey's Zebra are thin and do not meet under the belly; the stripes of the Mountain Zebra are intermediate in width and also do not meet under the belly. Grey's Zebra's rump is white at the base of the tail, whereas the Mountain Zebra displays a "woolly-fleece" pattern on its back near the tail. Grey's Zebra is also characterized by a relatively larger head than the other zebra species have, with an elong-
gaited face, and its large rounded ears can be rotated independently in different directions.

Habitat

In general, all equids live in open habitats. Horses inhabit expansive temperate grasslands, and zebras seek tropical savannas that can stretch for hundreds of kilometers or can occur in patches that punctuate thornbush scrub. Common to all these habitats is enough rainfall to ensure that watering points are in close proximity to grassy feeding areas. The areas live in arid areas that range from hot sandy deserts to cold stony ones in high mountains. Vegetation in these habitats is sparse and much scarcer than in the habitat used by horses and zebras.

Grasses dominate the habitats used by equids. However, grasslands are not uniform; they vary depending on the relative abundance of forbs, shrubs, and trees. Species preferences for particular grassland types depend on how well each species can digest woody vegetation and cope with the heightened pre-

In many societies, the base on which it is built is one or more generations of the same family, usually the females. In equid species, the core consists and is the strong bond between mother and offspring, which is broken at the age of 2 or 3. An offspring becomes sexually active and leaves the natal group. This is not always the case, and although there is some variation in social structure among species, both males and females are found in groups, sometimes in small groups, sometimes in larger groups, and sometimes in mixed herds. In some species, the herds remain stable for long periods, while in others, they may break up and reform. The Zebra is a typical example of such a species, as it is usually found in small groups, which come together for short periods, sometimes just for a few hours. During these periods, individuals digress and reunite, and they are joined by other individuals. Larger herds may form.

Like the other four species, the Zebra forms societies consisting of unrelated individuals, and they do not have a fixed territory. The Mountain Zebra forms temporary associations with the other three species, whereas the Grevy's Zebra forms larger and more permanent associations with other species. The Mountain Zebra is the rarest species, and its numbers are declining due to habitat loss and fragmentation. The Mountain Zebra is found in hilly and mountainous areas, while the Grevy's Zebra is found in large, flat areas of grassland.

Equus quagga

Masai Mara National Park, Kenya

Photo: Marcus Schaeffer

Equus quagga

Khama Rhino Sanctuary, Botswana

Photo: Gerard & Nelma Denne

Equus quagga

Kruger National Park, South Africa

Photo: Marius Koen
Swarming eupides keep their heads (especially their vestibules) above the water and float on their own with a bobbing motion of the legs. Zebras can swim when they need to, but with reluctance to take to the water. On their migration around the Serengeti-Mara-Masai Mara ecosystem, broad-leaved kinds of Plaines Zebras are found to cross the Mara River twice a year. They are said to favor, and sometimes to stab about for, waters, and a few bold individuals take the initiative. The red cell shows the zebra has great muscles to bear the burden of the load. Every now and then, these animals, with the river in sight, are swept away by the current.

**PLAINS TROVIDAE**

**Zebras and relatives**

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**PLAINS ZEBRA**

Plains Zebras share continental groups consisting of small herds and their offspring, and usually a single male. The Mountain Zebra also forms this kind of group, whereas Grey's Zebra forms brief and temporary associations, like those of the mountain wildebeest. The Plains Zebra stallions protect their females from the attentions of leaner-ranking males. Females associating with the harem males typically gain an additional look of somnolent, following time per day; which increases their fitness to cope with the demands of gestation and lactation. Where vegetation is abundant, Plains Zebra groups can be large. But the biggest herd forms where there are too many bachelor males for individual harems holding stallions to deal with. A single stallion can drive off four or five males, but not rate or ten. By banding together, stallions can collectively dominate the bachelor groups.

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than males, dietary and habitat needs of the sexes differ. When
hounds among males and females are weak, as is the case in wild
 asses and Grey's Zebras, individuals or subgroups within pop-
ulations are free to use different habitats. In Grey's Zebras,
territorial males and non-breeding females are often found in
open areas where grass is tall and abundant, whereas lactating
females and bachelor males are found in wooded areas where
the grass is short and green. These differences in habitat are
related to differences in lifestyles. Bachelor males and lactating
females require nutritionally rich foods for growth; territorial
males and non-breeding females need large quantities of food to
build up. In addition, herding females with very young foals
need to drink more frequently than all other Grey's Zebras, so
they stay near water, especially near pools and streams where
visibility is high and safety is increased.

Migrating pride risk also shapes habitat use by Plains Zebras. During the day, when Lions (Panthera leo) typically rest
on woodland edges, the zebras graze in open areas. At night,
however, when Lions move onto the plains to hunt, many ze-
bras move into the woodlands to graze.

**General Habits**

Horses are active day and night. Long foraging periods are
prompted by short naps, especially around noon and mid-
night. A daily round is organized around drinking, which typi-
ically occurs once per day, usually in the period between late
morning and early afternoon. Foraging consumes most of the
day, but walking and socializing, which involves grooming in
adults or play among juveniles, and fighting among males, fill
in the gaps. For Equid species living in hot climates, social
activity dominates for species living in temperate zones, the
balance shifts to daytime. Equids are generally on the move
since they need to consume large quantities of vegetation.

They sleep in short bouts, often during a few hours just be-
afternoon or midnight. Although Equids are able to sleep both
standing up and lying down, sleep occurs moody while stand-
ing, except in yearlings and calves. A cocked head, a low-
crusted neck, and droopy ears characterize the sleeping posture.
Horses are able to sleep standing up because of a "stay apparatus"
in their legs allows them to relax their muscles and doze with-
out collapsing. In the front legs, their anatomy automatically
engages the stay apparatus when their muscles relax. They en-
gage the stay apparatus in the hindlegs by shifting their hip
position to lock the patellae in place. At the withers joint, a "hook"
nerve is stimulated on the inside lower end of the femur cup
the patella and the medial patellar ligament, preventing the leg
from bending. Lowering the patella rigidly the legs, allowing
many muscles to relax, thus saving energy.

Equids sleep with their eyes open and are typically light
sleepers, easily awakened by slight sounds and movements.
They are able to doze and enter light sleep while standing,
and adaptation clearly beneficial to a prey animal. Lying down
makes an animal more vulnerable to predators. Unlike hu-
man, Equids do not need a solid, unbroken period of sleep
time. They obtain adequate sleep by means of many short
periods of rest. This is to be expected of prey animals, which
need to be ready on a moment's notice to flee from predators.
Equids may spend 4-15 hours a day in standing rest, and from
a few minutes to several hours lying down. However, they may
not be actively asleep during all of this time; total sleep time
in a day may range from several minutes to a couple of hours.
They require only about 2-5 hours of sleep, on average, in a 24-
hour period. Most of this sleep occurs in many short intervals
of about 15 minutes each.

Equids spend over 60% of each hour foraging, with some
feral horses and zebras spending over 7% of their time graz-
ning. Dedicated to much time for foraging is not surprising since
Equids are herbivorous, requiring to consume almost twice as much food as similar-sized ruminants. Walking and
traveling occupy most of the remaining time, with socializing,
resting, scanning for predators, and performing health main-
tenance activities filling in the gaps. Drinking generally takes

The social behavior of the Asian
Wild Ass is highly variable. In some
subspecies, such as the Asian Wild Ass (Equus hemionus)
found in the steppes of Central Asia, the
social structure is more flexible and
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place in the late morning or at midday, in part because this is when vents are strongest and watering spots are most free of biting flies. In addition, drinking large quantities of water around midday facilitates evaporative cooling during hot afternoons. Today most equids live in areas where predators have been extirpated or their numbers have been severely reduced. For zebras, however, Lions and hyenas, primarily Spotted Hyenas (Crocuta crocuta), represent ever-present threats. When they detect predators, zebras flee. But finding predators is not easy and has led to the evolution of various strategies that help reduce overall risk. In Grevy's Zebras, reproductively active males are continually on the move searching for females to mate or for bachelor males to dominate. If a male Grevy's Zebra encounters a Lion, he will approach, stop, and stare at it with tail erect
and waving frantically. Their large size provides Grevy’s Zebras enough protection in such a stand-off.

Plains Zebras adopt a less opportunistic strategy, their daily round of movements making their whereabouts and actions less predictable. When Lions are resting during the day at wooded edges, virally all Plains Zebras forage on open plains. Generally they walk single file, taking turns lifting their heads to scan for predators. Living in groups automatically diverts each individual’s chance of being eaten, but anaphylactic acts of vigilance help amortize personal detection cost while also increasing safety for all. At night, when Lions actively hunt on plains, about half the population of zebras moves into acacia woodlands. There they maintain their normal daytime behavior of moving slowly and deliberately in as straight a line as possible as they search for abundant and digestible forage. Leaves and branches appear to reduce the visual acuity of Lions, thus increasing the odds that zebras go undetected. On the plains, zebras alter their behavior dramatically to reduce their chances of being eaten. By increasing both walking speed and turning angle, Plains Zebras adopt protean behavior that

Rolling in the dust or mud helps Grevy’s Zebras to disguise themselves, and provides a protein coating that reduces annoyance from biting insects. Before rolling, horses and other epilates will sometimes sniff or paw at the ground. The animals shake themselves after rolling. Horses and other epilates can catch their skins to disguise flies. They also rub themselves against vertical objects such as trees or walls (or each other) to release rubbing or irritation. Horses rearing from abdominal discomfort such as ulcers will also roll, and walking on the back can be a sign of indigestion, especially in foals.

Grevy’s zebra
Samburu National Park, Kenya
Photo: Dave Naylor

The “hooch” of the Plains Zebra, a repeated non-part call produced by inspiration and expiration (sometimes referred to as a hoarse hooch), is said to have given the Grevy’s name. The hooch is a contact call given by stallions. It helps feral members of the herd to recognize other members who may have become separated in the larger herd or in a group. Female zebras are much quiter, their calls are shared by most if not all epilates, such as the event accompanied by1

Grevy’s zebra chamrousse
Parc de la Chaparrouse
Photo: Rich van Aarde
When alarmed, an African Wild Dog may kick out with both hindlegs at its pursuer, and a double hindleg kick can also signal the end of a bout of play-fighting. The same signals, threats, and actions that adults use in serious encounters are used in play-fighting between pups and bachelor males. However, while adult egalists, the young animals may not be in turns to attack and defend.

From less than 13% of aggressive encounters between equals end in fights. Most are settled by visual signals such as arching the neck or shaking the head, or auditory signals such as a snarl. The sounds of dominant egalists are longer, contain more high-energy notes at the start, and end with very rapid sounds than the sounds of subdominance.

Equus hemionus hemionus (local ‘kob‘) Swayne Game Reserve, South Africa. Monograph. Photo: Gert引 & Sven-Erik Berno

makes it difficult for attacking Lions to anticipate the actions of any one zebra. If erosion fails and a zebra is attacked, male zebras generally drop back and interpose themselves between their group mates and the Lion. Powerful hindleg kicks often thwart attacks and sometimes break Lions’ jaws.

Originally zebras were thought to be white animals with black stripes, since some zebras have white underbellies. Embryological evidence, however, suggests that the animal’s background color is black and the white stripes and bellies are evolutionary adaptations. Typically, the strips are vertical on the head, neck, forequarters, and main body, with horizontal stripes at the rear and on the legs of the animal. Often it has been assumed that the function of zebra stripes is to reduce detection by predators. Unfortunately, there is no evidence that during daylight hours the stripes help zebras blend into the vegetation. In fact, at a distance zebras look gray, just like wild asses. At night, however, camouflage remains a possibility. Moonlight passing through the leaves of acacia trees produces a dappling effect that would enable curiosity and white strips to blend with the shadows.

Many other hypotheses have been suggested to explain why zebras have stripes. They enhance individual recognition: they guide partners to appropriate gazing sites on the body; they confuse predators by distracting them from focusing on any one individual; they absorb heat differently, thus creating local air currents that facilitate cooling; they facilitate bonding; and they lower biting fly attacks by disrupting the ability of flies to see edges at a distance, thus making the zebras somewhat invisible.

Only the latter two explanations have some experimental support. In one experiment, when individual zebras were placed between wooden boards painted uniformly black or painted with black and white stripes, they almost always were drawn to the board with stripes. This outcome suggests that stripes focus a zebra’s attention, attract them to come closer. Given that some visual neurons are stimulated by images of alternating black and white bars, a process as complicated as social cohesion may be controlled by a simple neural mechanism. In a second experiment, when oil drums painted solid black, solid white, and black and white were tossed through the brush deep in tsetse fly habitats, only the striped drums failed to attract flies. Shadow stripes appear on zebras within the white stripes in areas where tsetse flies are absent, which lends support to the hypothesis that the striped coat pattern may help the animals avoid the flies. But the fact that zebras often carry trypanosomes, the microbes that generate sleeping sickness and which are transmitted by tsetse flies, indicates that even if the hypothesis is true, stripes do not afford complete protection.

All equids live in groups, but sometimes these groups contain multiple species. Zebras and Griffons (Gnouf orwilla) are often seen together; because, it is thought, two modes of anti-predator detection are better than one. But some of the most intimate associations among equids and ruminants occur on the curian, or rolling hill slope, ecotones. Associations among Plains Zebras, wildebeest (Connochaetes taurinus), and Thomson’s gazelles (Eudorcas thomsonii) are common and lead to an intricate sequence of moves up and down the curia. As stated earlier, equids must process more food than ruminants to derive equivalent amounts of energy. But without any time-dependent processing constraint, zebras can forage just about anywhere. On the curia this freedom, when coupled with their ravenous needs, creates a succession of movements among the species.

The grazing successions ultimately result from seasonality in rainfall. During the rains, grass continues to grow in the valleys, on the slopes of hills, and on the edge tops. Not surprisingly, all three species (zebras, wildebeest, and Thomson’s gazelles) prefer to forage on the curia, because good visibility enhances predator detection. As long as the grass continues to grow, competition among the species is minimized. But when the rains cease, grass height decreases, eventually making it difficult for the large-bodied Plains Zebra, with their wide mounds, to consume enough vegetation to maintain good bodily condition. As a result, the zebras are forced to leave the apex and head down the slope to valleys dominated by tall fibrous stems. Fortunately, Plains Zebras can persist on such tough foliage. By consuming old growth, new growth is stimulated. Continuously grazing on the apex eventually forces wildebeest and then Thomson’s gazelles to move down the slope as well. Grazing by the zebras facilitates grazing by the wildebeest, which in turn facilitates grazing by the Thomson’s gazelles. Acting as ecosystem engineers, zebras maintain the integrity of this mixed-species community.

Communication

Equids are gregarious animals. They communicate using visual, olfactory, auditory, and tactile signals. In aggressive situations,
The most universal of equid display signals is dung marking. Females tend to defecate whenever and wherever they want, but male defections appear to be much more strategic. After females defecate and walk away, males often walk directly towards the pile and smell it. Then the male typically walks over while keeping his nose close to the ground, his body in a striking C-shaped pose. The male then defecates near, but usually not on, the female pile, after which he turns to sniff the combined piles of dung. In this way the male couples his odor with that of a female as a warning to other males, telling them that the female is with another male. Since sniffing plays an essential role in this context, males routinely learn the scent of their competitors. Sometimes males spray urine on the pile, something they routinely do so after females urinate if the male finds that a female's estrogen levels are high.

Male asses, Grevy's Zebras, and males in some populations of feral horses defecate repeatedly in particular places. Usually these are along well-traveled routes or at important locations such as at watering points, salt licks, and refuges from biting insects. In these locations, communal dung piles become visual markers that attract the attention of other males using these areas. By associating their own odor with that of others, males share information about who regularly uses an area and the identity of nearby competitors.

Studies of horses show that signals play an important role in aggression and that although they often occur in sequence, each encodes a different type of information. When equids contest resources, few interactions move directly to physical contact. In fact fewer than 15% of all encounters end with fights. Encounters usually start with an approach and a stare. Approaches are often slow and deliberate and employ postures that accommodate physical features associated with prowess and fighting ability. Necks can be arched, heads and mares can be shaken, and ears can be laid back. In approximately half of such encounters, one horse retreats and signals its submission by lowering and often bobbing its head or clacking its teeth. In encounters that continue, olfactory and auditory information dominate.

 Dominance rank in the male Przewalski's Horse, which will largely determine his later breeding success, is established during the time he spends as a young male in a bachelor herd. Dominance hierarchy remains stable until two to three years of age, with age increasing a faster drop with size and fighting ability in maintaining an animal's rank, a younger male can come on the scene. Since potential竞争对手 that house each other's status, most confrontations are settled without fighting. When encounters do lead to physical contact, they usually involve merely nipping mares or strangers. Nostrils are more likely to be the target of aggression from horse to horse within, since then fewer males are likely to be injured.
The presence of a female in an estrus is enough to provoke fighting between Grey's Zebras stallions. They will take and hold with their forelegs, and attempt to bite one another's throat, legs, and flanks. If one animal succeeds in getting a good hold, the other will maintain it until the other animal ceases to struggle. The victorious releases his grip, at which point the other male may for alternative the fight will ensue. Territorial battles have a strong advantage on their own ground, and if an estrous female enters into a territory other stallions may near their ground. Territorial males wander widely in search of estrus females and aggressively challenge them. By peremptorily using dominance behaviour in these situations, territorial males are able to devote more time to mating with estrus females than territory containing many females. Males entering a territory become, individually by knowing their limits and avoiding the dominant animal's threat and gains. The dominant stallion adopts a "found" position, with head high, neck arched, and a high earing gain. He may chase the Estrus out (though usually only if there is an estrous female from the neighborhood), release them, or just wait to see if they accept. Fights only take place when an intruder assumes equal status. Territorial males have a very strong ability to their territories, and will not leave them even in the presence of a large predator, vehicle, or hunter. When drought or food shortages force them to move, they return as soon as they can. Rights can break and fights can occur among adjacent territory holders, removing the boundary after such an absence. The fights take place in the boundary zone, which is up to 50 m wide and marked by digging holes in which both the deliberate stallions and forested males congregate. These digging pits are used as message boards, defending raising males and females alike of the identity and status of the territory holder.

Equis grevyi
Samburu National Park, Kenya.
Photo: Karl Johnson/kenyaimg.com
is used to establish dominance and subordinance. Typically horses stand on one another’s noses or genitals and this often settles the dispute. If not, then they spread, sometimes stamping a foot as well. By this point, over 85% of all confrontations are settled. Experiments have revealed that each signal conveys a different type of information about each horse’s fighting ability. When stallions were presented with the dung of other horses in their group or dung from strangers, they sniffed the dung of strangers for longer periods than they sniffed the dung of individuals. When dung of dominant or subordinates was presented to stallions, the dung was sniffed for equal amounts of time. Conversely, when recordings of squeals of dominant and subordinates were played to males, males paid attention to calls of subordinates for significantly longer than those of dominants, but the calls of strangers and geese were elicited similarly vigorous responses. Thus it appears that olfactory and acoustic signals both convey information about fighting ability, but they do so in different ways. Odor provides information about identity, whereas sound provides information about immediate fighting ability. Because the squeals of dominants are longer, contain more high-energy notes at the onset, and end with more gradual tonalities than the squeals of subordinates, instantaneous information about each contestant’s stamina is revealed. Odors, however, are related to identity. By functioning as signatures, they allow competitors to recall their opponents’ histories, so that each stallion can decide whether to stop or continue the confrontation. Thus odor, too, provides information about fighting ability, but it is likely to be less reliable since time will have passed between encounters.

Signals also play important roles in mating and socializing. When females want to attract the attention of males or incite males to compete so they can mate with the best, females “sneak” after urinating, by erection their labia, flashing a pink and white signal for all to see. Prior to ovulation, urine contains elevated estrogen levels that males use to assess how likely a female is to conceive. Makes test the urine by inhaling it into their mouth, where the Jacobson’s (converternal) organ assimilates estrogen concentration. This behavior is called flehmen: the stallion curls his upper lip to close off his nostrils, his head pointed to the sky and his teeth exposed.

Stallions also adopt a characteristic post when herding females away from other sexually interested males. The stallion lowers his head so that it is parallel to the ground, with his ears laid back. He then sniffs his head from side to side while walking briskly or running toward his females. The posture allows females to easily follow the male’s lead without incurring any physical harm and lets males herd their females without experiencing much effort.

African wild dogs use extraordinary constraint to their advantage. They are able to predict whether a kraal is present or not, and select their approach accordingly. In the latter, they will avoid the kraal and try to sneak in from behind. In the former, they will approach the kraal and start barking at the dogs inside. The barking is a way to scare the dogs away, allowing the wild dogs to enter the kraal without being noticed. This behavior is called “kraal barking” and is used to keep the dogs inside the kraal from reacting too quickly.

In the Little Rann of Kutch, India, the Indian wild ass is one of the few remaining wild ass species in the world. It is known for its unique behavior called “hobbling.” When threatened by predators, the wild ass will hobble itself by wrapping its front legs behind its back. This behavior helps to prevent the predator from biting its legs and makes it more difficult for the predator to catch it.
A female Plains Zebra that is in estrus will reject a male's attempt to mate by kicking out with both legs. Conversely, male Plains Zebras can be very aggressive towards some females. Aggression between males and female Plains Zebras is generally at a low level of intensity, such as opening the mouth as if about to bite, or making one bleat as if about to kick, but without physical contact. Dominance among female species is hard to determine, and can be influenced by factors such as reproductive status. In Plains Zebras, females, including females with non-breeding females, and calves crossing without females are more likely to initiate movement than non-breeding females, and the movement of female movement can lead to herd movements.

\[Image 0x0 to 792x1224\]

In the Little Rann of Kutch in Gujarat, India, territorial behavior of the "Khois," the Indian subspecies of the Asiatic Wild Ass, is said to develop themselves with mast on a visual display during the breeding season. During these displays, males may exhibit whirling, spinning, and rolling behaviors. Serious fights between males and other males include baring the teeth, head, neck, and legs. The winner of a fight may chase the loser for 20 minutes or more, attempting to bite its flanks, rear, and tail. Feral kite stances are said to develop during individual fighting techniques, such as systematically aiming kicks at the throat, rear, or tail of the head, or specializing in spanning with the foreheads. The defending stallion in territorial disputes has a "mother's advantage." However, in a study of the reintroduced population of Asiatic Wild Asses in Israel, defined territorial males were observed to hold territories against each other, suggesting that their loss of territory was limited. Young males are displaced by dominant males or sent to areas far from their mothers. They join bachelor groups until they are ready to disperse to challenge territorial males, although they mature much earlier. Male herds of males do not usually get the opportunity to breed until they are five or six years old.

\[Image 0x0 to 792x1224\]
Food and Feeding

Equids are predominantly grazers. Their high-crowned teeth with ridges and cementum-filled incisories enable them to eat vegetation that is tough, fibrous, and often tannin with silica crystals. With their fermentation chamber located after the antrum, equids must process almost twice a much food as similarly sized ruminants. But hindgut fermentation reduces the ability of equids to recycle nitrogenous wastes; they cannot digest them microbially as ruminants can. Instead, equids must excrete them in urine, thus exhibiting lower water efficiency than ruminants. This inefficiency has two important consequences. First, the need to drink often means that equids cannot range widely in search of food, especially during dry periods. Second, if not all individuals in a group experience the same need to drink, stems in the social fabric may appear. In the large-bodied

When predators attack, the Plains Zebra stallion makes a spirited, manoeuvred stand to give his herd time to escape. A kick from his powerful hindlegs can break a Lion’s jaws. The defense can be even more formidable when a number of zebras join together in a Jerdon’s herd, and several stallions remain behind. The herd runs at about 30 km/h, half the spot they are capable of. To give the stallions a chance to catch up, Lions are generally not able to catch a stallion if it has more than a few canned to start, and a measure of the effectiveness of the stallions’ defense is that Plains Zebras live far longer than they do in the absence of these same reasons. Plains Zebras attempt to avoid Lions by entering into woodland at night, when the zebras are most active, basing in grassland. The herd need to graze for up to 20 hours a day means that they must spend some of the hours of darkness in the open, but their movements are generally too slow to be fast and so involve more erratic turns than during the day. Lions tend to kill more males Plains Zebras than females, particularly during the rut. The rut of the major predator, the Spotted Hyena, takes more females and young animals, by silently allowing the best way to a weaker or slower animal is to separate. The Grevy’s Zebra stallion defends his territory rather than a herd, and then is a record of a Grevy’s Zebra stallion killing a Lion and a site that can be located in the open, and the zebra is also used as a zebra of the same. Despite the name, the Grevy’s Zebra was named after the famous animal of the same name.

Equus zebra

Kgalagadi Transfrontier Park, South Africa

Photos: Ann Brooker/Natural World

A study of the feeding habits of the Mountain Zebra in South Africa’s Mountain Zebra National Park found them to be selective feeders. They ate only seven of the 17 grass species available, choosing bunch grasses with a greater leaf/stem ratio and a higher protein content. They tended to reject grass growing, coarse, and crumbly grasses. When grass protein content dropped in the winter months, some zebras moved away, while others turned their attention to pasture-rich lands. Although the animal shown here is grazing on snow-dusted grass, the researchers found the majority of their in between 40 mm and 40 mm above the ground, and very close to 30 mm.

Equus zebra zebra

De Hoop Nature Reserve, South Africa

Photo: Marc Goyat/AGAMI
Gerry’s Zebras, now lactating females can go without drinking for 3–4 days, and travel far searching for areas with dense forage. Lactating females with foals less than three months old, who need to drink daily, stay near watering points. Fossils and fumins are common, and in certain seasons groups that remain intact for reasonably long periods become homogenous.

When equids graze they gather leaves and seeds with agile and sensitive lips, and push them towards their incisors, where they are clipped by a nick of the head up or down. Because they require almost twice the forage of similarly sized ruminants, equids spend upwards of 66% of every hour feeding, depending upon environmental conditions and a species’ body size. Moreover, they spend almost 20 hours per day feeding. Grazing becomes an all-consuming activity. During dry periods, leaves become scarce, and when nutritionally poor seeds also vanish, equids resort to browsing on the woody parts of shrubs, bark, and roots.

Although equids can subsist on low-quality forage, they will consume high-quality forage when it is available. Horses must feed for long periods and consume food quickly to overcome the constraints of their fermentation system. It is not uncommon for feral horses to graze up to 18 hours per day and spend 75% of every hour foraging. Yet despite requiring large amounts of food per day, horses can be selective feeders. Seasonally abundant foods of high quality are favored when available and even specialization on rare nutritious species or plant parts is common, especially for lactating females. Zebras especially enjoy feeding on crop-grown grasslands (areas where reared up keep grasses height low) that are dominated by Cynodon grasses, which are rich in calcium and phosphorus. Although forage quality matters, abundance matters more in determining diet. The relative value of these factors in shaping foraging decisions is demonstrated by the behavior of the Plains Zebras, a species in which family groups come together to form herds. Of the three possible vegetative factors that could affect herd size (abundance, quality, and species diversity) only abundance had an effect. As biomass increased, so did the size of herds ranging in a particular area.

Young equids learn from their parents what foods are good to eat. As early as a few weeks of age horses are nibbling at grass near where their mothers are grazing. At this age they also sometimes practice coprophagy, the eating of dung. But they do not eat everyone’s dung, only their mother’s. Because equids only minimally ferment their forage, their dung is coarse compared to the dung of similarly sized ruminants. Thus it is possible that via coprophagy, a young horse can taste and learn what constitutes highly nutritious food. Interestingly, mothers occasionally eat the dung of their young. Since milk contains T-cells that mothers produce to fight disease-producing agents, it is possible that by eating the dung of their infants, mothers make T-cells specifically targeted for combating the infections of their young. In this way mothers’ milk not only directly enhances infant growth, it indirectly does so by preventing microorganisms from stealing essential nutrients destined for their young.

All equid species migrate in response to seasonal changes in the environment. Most often habitat changes are related to changes in consumable resources. Plains Zebras follow the rains across the Serengeti in search of new growth. Mountain Zebras spend the rainy seasons on the plains, but move into deserts or high mountainous areas after the rains have saturated those habitats, and the Tibetan Wild Ass moves to hills in the summer for high-quality forage. This pattern mirrors the seasonal movements of feral horses in western North America. African Wild Asses also follow the rains, but they tend to move in search of water itself, they leave areas when drinking points vanish. Aerial surveys show that populations generally restrict their movements to within 30 km of water.

Breeding
Equids bear one young at a time, and although physiologically capable of conceiving every year, most equids skip one or more years between births. Thus the fractions of any population bearing young in any year is less than 50%. The actual
percentage may be much lower, depending on the overall quality of the environment. As a result, the reproductive potential of most equid populations lies well below its maximum potential.

The seasonality of births also varies among species, largely because species are distributed across many latitudes and habitats. Temperate zone species are more seasonal than their tropical cousins. Whereas horses mate and give birth between April and August, zebras give birth in all months of the year. Nevertheless, even zebras show birth peaks. These tend to be related to periods of high rainfall, which depending on location of the population in relation to the intercropping convergence zone, may occur once or twice per year. All equids are polyestrous, with estrus recurring either until conception occurs or until declining daylength shuts down the hormones that control ovulation. Thus the length of the birth season shortens with distance from the equator.

Age of first reproduction varies among equid species and differs markedly for males and females. Although males and females become physically capable of breeding at similar ages, their ranges were drastically altered by human activities and livestock, the Plains Zebra, Grevy’s Zebra, and the Arabian Wild Ass are two of the most common species to interbreed extensively with domesticated breeds of horses. The Arabian Wild Ass, a close relative of the domestic horse, is found in the hinge zone between the Saharan and the Arabian deserts. It is a fast, agile animal with a strong build and a keen sense of hearing. It is well adapted to life in both hot and cold climates.

During summer and autumn, Przewalski’s Horse builds up its body fat reserves, sometimes consuming the dry matter equivalent of up to 5-10% of its body mass in a day. In winter, even when forage is available, it grazes less and either moves to flatter areas, having up to 15% of its body mass by the end of winter. The grass available is often a fibrous type of low nutritional value, and it may be that the energetic cost of foraging and digesting can be higher than the energy it yields. Food intake often varies from one year to the next, and during times of severe drought, the horses may go for months without food. In extreme cases, they may starve to death.

Przewalski’s Horse
Kharakhorum National Park, Mongolia
Photo: Gerhard H. M. Dierer

Before their ranges were drastically altered by human activities and livestock, the Plains Zebra, Grevy’s Zebra, and the Arabian Wild Ass were considered one another among the most upland species. The Arabian Wild Ass can go without water for up to 30 days, and can travel 30 km to reach a water source daily, or find water in intermediate areas. Although grazers by preference, African Wild Asses also eat browse. They are both tolerant and known to eat small quantities of grasses.

Equus asinus
Yerba Buena Nature Reserve, Kenya
Photo: David Hosking/FLPA

When its preferred diet of grass is unavailable, the Arabian Wild Ass will eat leaves and even the woody tissue of shrubs. Overgrazing of grass by livestock and removal of shrubs for domestic fuel are two of the most serious threats to the vulnerable range. In herds (broken herds), in the Great Gobi B  Sand Dunes Protected Area, Mongolia, the population of Arabian Wild Ass has been found to graze most often on desert steppe, and are rarely seen in the area of mixed or forested areas that make up 45% of the National Park. In early spring, when their feeds are few, the horses are found around open areas where the density of grasses is highest.

Equus hemionus steppes
Kharakhorum National Park, Mongolia
Photo: Gerhard H. M. Dierer
During summer and autumn, Przewalski's Horses build up their body energy reserves, sometimes reaching the dry matter equivalent of up to 25% of its body mass in a year. In winter, even when forage is available, it grows less and, although male and female Przewalski's Horses, Przewalski's Horses, the Australian Wild Ass, and the African Wild Ass are facing the same challenge, the Utah Wild Ass is facing a more severe one because of its larger size, which was seen by the author in a video of a group of six Przewalski's Horses walking in a line, with the last one lagging behind the group. The Australian Wild Ass, on the other hand, is better adapted to the dry, arid conditions of its habitat, and the African Wild Ass is better adapted to the more moist conditions of its habitat, and is better able to withstand the heat of the summer months.

When its preferred diet of grass is unavailable, the Asian Wild Ass will eat the leaves and stems of shrubs. Overgrazing of grass by livestock and removal of shrubs for domestic use has led to the decline of this species in many areas. In the Great Gobi B Strictly Protected Area, Mongolia, the population of the Asian Wild Ass has been found to graze most often on shrubs shaped to the Social Sciences section in the Great Gobi B. In spring, when the food is scarce, the animals often turn to eating small plants and seeds, which are important sources of energy during the winter months.

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active follow their mothers. Foals tend to nurse about once per hour for about one minute per bout. They can be weaned as early as seven months, but many continue to nurse until 18 months of age. By this age juveniles are consuming large amounts of vegetation, so nursing bouts are shorter.

Males rarely participate in weaning offspring, and in fact, sometimes attempt to kill foals and mares kill foals by copulating with pregnant mares. Incidence of infanticide in horses is rare, but in one population of feral horses males force-copulated with females when taking over herds from rivals, often killing the foals. This causes the female to go into heat again more quickly, thus increasing the male's lifetime breeding success before he is ousted himself. How widespread this behavior is among the equids remains to be determined.

Horses live in temperate climates where winter conditions are harsh. At a result, reproduction is seasonal, triggered by changes in daylight length. Decreasing daylight length results in the breeding season in the spring with the growth of new vegetation. Mares usually begin breeding at three years of age, but when environmental conditions are good, they can conceive a year earlier. Although mares are also physiologically capable of breeding at three, dominant males prevent them from doing so. Instead, young males leave their natal groups and join all-age groups known as bachelor groups. Normally, males spend years rising in rank until they attain sufficient status to establish and maintain a harem with one and then other young dispersing females, or more rarely take over an existing harem. Alternatively, they establish alliances with other bachelor males, the two males leaving the group early and accepting females with whom they share matings. Gestation length is typically 11-12 months, so the birthing and breeding seasons coincide. Mares have a postpartum estrus and cycles continue until they conceive. Although females can conceive every 10 months, most females skip one or more years between pregnancies. Female fertility varies, depending on local conditions. Up until approximately two months after conception, the embryo may be resorbed, terminating the pregnancy. Females indicate their receptivity visually by exposing their vulva in a characteristic "winking" display, alternately. The male can directly detect estrogen levels in female urine by inspecting its scent into the Jacobson's organ that is located in the roof of his mouth. He does this by adopting the flehmen display, in which he curls his upper lip to close off the nares while points his nose upward. When females stray too close to other males or other males approach to close to a group, resident males herd the females out of harm's way; the male locates her and moves it from side to side. Males typically challenge other males with ritual fights that start with arched neck approaches. If this does not dispatch an opponent, then bouts of stiffness, rearing and final physical contact are employed to establish dominance and settle contests.

In the dry season, the Plains Zebra may eat roots and bulbs and other non-vegetarian foods. This is one of their most important feeding times. It is especially important at the end of the dry season when there is minimal vegetation available. They also are known to eat grasses, but these are not as important in this season as they are later in the year. In the dry season, Plains Zebras typically eat grasses in the savanna, but they also eat a variety of other plants, such as shrubs and herbs. The zebra's diet is very diverse, and it can be found eating a wide variety of plants in different seasons. This flexibility in diet allows them to survive in a variety of environments. When water is available, Plains Zebras will drink regularly to stay hydrated, and they can walk long distances to find water sources. However, when water is scarce, they will travel shorter distances to find water. They may also eat salt licks, which are mineral deposits rich in sodium chloride, to help compensate for the loss of salt through sweating and other processes.
In the dry seasons, the Plaas Zebra may eat roots and bulbs and other emergence foods. This zebra is one of the "small grazers." Other grazers, such as Puku and Common Reedbucks, are more adapted to browsing. This species is a rather odd-looking animal, with a long, slender neck and a distinctive, yellowish-brown coat. It is often seen in small groups of 2-5 individuals. In the summer months, Plaas Zebras are typically found in areas with abundant vegetation, such as riverine woodland or savannah. During the dry season, they may migrate to areas with more water resources, such as rivers or waterholes.

In contrast, the Asian Wild Ass, also known as the Indian wild ass, is a species that has adapted to desert environments. These animals are well adapted to life in the desert, where they can go for long periods without water. They are able to survive on a diet of desert grasses and other vegetation, and their long, slender legs allow them to run at speeds of up to 60 km/h.

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Movements, Home range and Social organization

When equid juveniles mature, both males and females leave home. For mambos the lack of asocial philosophy by one sex is rare. That both sexes disperse in equal is related to the fact that where limited resource competition exists, it takes the form of scramble competition. This is because each grass blade is similar to every other grass blade in a particular locale. Therefore, the best way to outcompete a neighbor is to spread out, avoid wasting time by fighting, and clip and chew as quickly as possible. This support by parents will have little influence on the foraging success of maturing juveniles. Moreover, from the perspective of stallions, juveniles that remain in the natal area are likely to become competitors after they mature. Thus both sexes disperse when they reach sexual maturity.

All equids are highly social, with groups ranging in size from tens to hundreds, if not thousands, of individuals. But what sex equid groups apart from so many others is that often they are composed of unrelated individuals. At the most basic level, kinship relationships do not help foster group living in equids.

Like many other mammals, male eqids use a genre known as “harem” to reproduce, the communal gland is in their testes, which can detect aromas in a female’s urine. Female eqids indicate their receptivity is lower sexually, by meeting their males in a characteristic “wink” and vibrating. An estrous female

Grevy’s Zebra outside a territory may be competed for by as many as nine males. But a male stallion has exclusive access to an estrous female in his territory, so will follow her closely, running and nipping until she submits. The estrous female may wander through the territories of many stallions and mate with several of them. The male stallion repeatedly flushes out his rivals as it pursues his predecessors.

Species profile

Grevy’s Zebra

Photo: Thomas Driessen

Indian Wild Ass Stature

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When not in estrus, a domesticated Wild Ass mare will not tolerate a stallion's advances. With her ears laid back, she crouches, struggles, and keeps her head down. If she continues to do so, the stallion may probe her with his prepuce. A mare showing these signs of estrus may also behave like the mare in the following photograph.

The mare is in estrus and her neck is extended, allowing the stallion to mate with her. The mare appears to be resisting the stallion's advances.

**Figure 1.**

*Indian Wild Ass Sanctuary, Little Rann of Kutch, Gujarat, India.*

Photograph: Gurjeet & Meliune Devjani

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Like Gore's Zebras (above), the male Indian Wild Ass vigorously defends his territory by associating with other males. After a period of estrus, young males compete for mates, usually by engaging in a series of interactions involving the use of the male's neck and body to establish dominance. The dominant male will assert his dominance by exerting pressure on the neck and body of other males, thereby preventing them from mating with estrus females.

**Figure 2.**

*Indian Wild Ass Sanctuary, Little Rann of Kutch, Gujarat, India.*

Photograph: Gurjeet & Meliune Devjani
Equid sociality comes in two types. In one, typified by horses as well as Plains and Mountain Zebras, females and their young offspring live in closed membership family groups with one male. These groups range widely, with home ranges that overlap with those of many other similar groups, making it difficult to isolate females. In the other type—male and female groups (harem)—the number of individuals in bachelor groups varies among the species. In the other social variant, exhibited by Grey's Zebra and African, Assinim, and Tibetan Wild Ass, associations among adult males and females are temporary, lasting only a few hours. In these groups, the only strong bond that develops is that between a mother and her offspring. Instead of associating with a few adult females for long periods, males establish resource-based territories that allow them to associate with many females for as long as they remain in their exclusive areas. As in the harem system, matings are polygynous from the males'.

**Equus zebra zebra**
Mountain Zebra National Park, near Cradock, South Africa.
Photo: Wieland Winkelski

**Equus hemionus kirkii**
Kaziranga National Park, Assam, India.
Photo: Gunjan & Rakesh Garg

**Equus hemionus asinus**
Indian Wild Ass Sanctuary, Little Rann of Kutch, Gujarat, India.
Photo: Gerard & Helmut Dornow
Generation in captivity is 11–12 months, and in species that have distinct breeding seasons (generally those farther from the equator) breeding and birthing occur in winter. The African Wild Ass breeds seasonally, and adult bulls are born in January. Most groups of Mountain Zebras consist of a single stallion and 1–3 mares with their young. These groups can remain stable for up to 15 years, but the stallions are normally driven out by younger males. Furthermore, when a new male takes over, the whole female dominance hierarchy may change at this time.

**Future zebra status**
Mountain Zebra National Park, near Cradock, South Africa.

Photo: Wirhord Wallis, www.wirhordwallis.com

**Equus tippelskirchi**
Indira Wild Ace Sanctuary, Little Kurayri, Karan Valley, India.

Photo: Gertrud & Holmich Deenva perspective, but from the females’ perspective matings are polyandrous, since sexually receptive females cross from one male territory to another. Because many females associate with one male, many males are not able to associate with females. As in the other social systems, these males live in bachelor groups. For species built on such similar body plans, why shouldn’t different systems of social organization evolve? And why do these social variants cut across taxonomic lines?

Individuals form groups whenever benefits exceed costs associated with increased disease transmission, detection by predators, and competition for food or mates. Ultimately, the abundance and distribution of key resources (food, water, and safe sites) determine whether groups will form and what form they will take. Since natural selection favors females that outreproduce other females, a female’s success is directly tied to solving resource problems posed by particular environments. Because sexual selection favors males that outreproduce other males, their success depends on how well they dominate other males and how well they attract the attention of females. How males succeed at doing this depends on the abundance and distribution of females; and how females distribute themselves on the landscape depends on how they solve their resource-acquisition problems. Thus male and female relationships are connected and together their solutions produce a social system.

In many species the connections between males and females depend mostly on the nature of same-sex relationships; but in equids this is not the case. Intersexual relationships are of paramount importance because female competition is of the scramble type. For a female to consume more than others, she needs more grazing time, but cannot gain this time by reducing time spent on vigilance. Alternatively, groups would enable females to share the cost of vigilance, but the most effective way of reducing this cost and maximizing time devoted to grazing is to pass the cost of vigilance on to males. Since males are typically already highly vigilant because they are on the lookout for mating, cuckoldry bachelor males, both females and males benefit if males take on this cost. Females increase foraging success and a male increases the likelihood of exclusively mating with the females that choose to join him. Since postmating sperm competition is low in such circumstances, repeated mating rarely occurs in horses or Plains and Mountain Zebras. What enables this type of society to hold together is that food and water are locally abundant much of the time.

This enables females in different reproductive states to meet their needs by remaining together and deriving the material benefits of extra foraging time provided by males.

The landscapes of the Zebra and the species of wild asses inhabit are more arid than those of the barren-living specks. Water and food are often far apart and females with young need to separate to meet their respective needs. Since both classes of females can come into estrus, the most able males maintain access to mating opportunities with both by defending large territories adjacent to water. In this way, females with young foals form temporary harems by remaining with dominant males. Yet these males are still able to intercept females when they come to water. Since such females are likely to mate with other males, repeated copulations and ejaculations that help flush out sperm of other males are common and likely shorten the receptive period of starving females as well. Testes in these species are much larger than those adopting the other harem type of social system since sperm must be produced at high rates.

Although different in many ways, the two social systems are variants of a few common themes. The first is that the needs of females shape the structure of all equid societies. Two social forms emerge because rainfall levels lead to different distributions of food and water. The second is that males respond to the distribution and associations of females. Although the outcomes appear radically different, they are tested by one common feature: even where only some females can take advantage of the time benefits that males offer, females that can (lactating females), will. That nonlactating females cannot bear the female social fabric profoundly, and causes males to change how they use space and how they cope with polycyclic rather than monogamous females. At the level of core social groups, habitat features drive the evolution of equid social organization. But they also do so where higher levels of sociality appear. Although horses and Plains Zebra live in harems groups, only Plains Zebra harems coalesce to form herds. Studies showed that level of cuckoldry pressure was the major factor determining herd size. Vegetation abundance had a small effect, and predation pressure had no direct impact. Perhaps once a harem contains ten individuals, the extra protection gained by adding more individuals to the group is of little significance. It appears that barren males form coalitions as insurance against being approached when
alone on a landscape by a large number of bachelors. In areas where the ratio of bachelor males to stalleis is high, herds are larger than in areas where the ratio is small. That single stallions can drive off 3-4 bachelors, but not 9-10 each male suggests that predation risk may play an important indirect role in determining equal herd size. It is intriguing to note that where bachelor groups are small and loosely connected, predators are absent (those populations), but where they are large and more tightly bonded, predators are abundant (several). This correlation supports the notion that the intensity of predation may determine the size of bachelor groups, and therefore alters the intensity of culling of pressure that led to the evolution of stalleis herds.

Because preferred resources often change seasonally in abundance and location, some stalleis populations migrate. Those living in montaneous areas move up and down in pastures in the summer and back down to drier, but summer vallies in winter. For many others, daily changes in local weather conditions alter the attractiveness of habitats and prompt small-scale local movements. As large-bodied herbivores, horses roam widely in search of food, water, and minerals. Yet each individual restricts its movements to a core area that it knows best. The size of these home ranges can vary, depending on local, but they are typically less than 100 km². Home ranges generally overlap because competition is the scramble-variety, which fosters sharing resources when they become limiting. On a number of islands, however, where geography makes the defense of exclusive areas energetically economical, group territories can be established.

Relationship with Humans

Equids and humans have a long and close history. Neolithic drawings of horses, some dating back 10,000 years, cover the walls of caves in Italy, France, and northern Spain. The horses are shown with long erect manes and coats in many colors, They are seen alone and in groups and often in herds with other species. Clearly, horses were viewed as an important part of the landscape. And although they were hunted for food, people and horses lived together. However, when humans migrated to the New World, their skills as social hunters gave them an extreme advantage over the native horses they found there, leading to large-scale killings as whole populations of horses were speared over stalleis to their death. The effectiveness of humans on horses was so great that during the 400 years it took humans to travel from Alaska to Florida and Central America, horses and most of North America's giant megafauna were driven to extinction. Only the arrival of Europeans from Europe brought the horse back to North America, the place where the genus Equus originated.

Throughout human pre- and modern history, the close relationship between horses and people has been transformational. Human civilization was changed forever after nomads of the Asian steppes domesticated horses about 6000 years ago.
Young zebras are "foals" rather than "foals." They play and keep up with the herd from a few days old. Some foals have been seen to race around their mothers' legs in a very lively way before they have reached the first month. In the Great Gobi "B" South Protected Area, Mongolia, the Dastarli Wolf, an unknown, the "Hodgson's Foal," forms groups consisting of a stallion with several females and their foals. The stallions widely defend their territories against wolves, and when several females join up to form a herd the stallions defend them cooperatively, rather like Plains Zebras. Nevertheless, less than half the young Kalahari in the Gobi in previous years could in the South Gobi, where wolves are more, all females groups of Kalahari are seen commonly.

From the first hominids until well into the prehistoric period, humans eked out an existence as hunter-gatherers. Varieties of rams were both gathering nutritious plants and killing large game difficult, and this helped keep birth rates low and population sizes small. Domestication of animals as well as plants dramatically altered this balance by increasing energy and nutrient availability. Consequently, family sizes increased, groups grew larger, and social relationships became more complex. Although living with animals had its problems since their diseases jumped to humans, the benefits that domesticated animals provided far outweighed these disadvantages. One of the first animals domesticated was the Horse, and it provided numerous advantages by changing the way humans lived. It transformed the transport of people and goods; it enabled people to convert forests into farms and it allowed the tilling of more difficult soils. The domestication of the wild ass and subsequent cross-breeding of Donkeys with Horses produced hybrids such as mules that were even stronger and more resilient than either parental species. At first the changes wrought by the domestica- tion of horses were: for the good. Productivity skyrocketed, surplus wealth was created and specialized social and economic classes emerged. Bureaucrats, scholars, religious leaders, and
warriors were just some of the specialists that societies could support and the inventions they created enabled civilization to flourish. But domestic Horses also served as agents of war. For better or for worse, domestication of the horse changed the balance of power of the haves over the have-nots and increased inequality among peoples and nations.

It is perplexing that although horses and asses were domesticated, zebras were not. Some were tamed and drove chariots and carried goods for trade, but a large-scale transformation of zebras into useful beasts never occurred. Given that all equids have a common body plan and that wild equid species exhibiting both social organizations were domesticated, it remains a puzzle as to why the Plains Zebras were never domesticated. It is not as if they were rare; they surely came in contact with the indigenous African peoples. Diamond lists many attributes necessary for domestication of wild species that wild horses and asses possess: extensive sociality, the ability to recognize individuals, and a tendency to form dominance hierarchies that humans can co-opt by becoming bosses. But the added requirement that a species must not be overly aggressive may only apply to horses and asses, not zebras. Only zebras live in large herds composed of many core social units. Males in these

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GROUPS

The largest remaining population of the African Wild Ass is in Mongolia, though illegal hunting for meat may reduce numbers by 5–10% per year. The wild ass is usually easier to locate near watercourses, and in some areas it is abundant enough to be economically important. In other areas, such as the Serengeti, the wild ass is more elusive and its population is threatened by habitat degradation and fragmentation.

STATUS AND CONSERVATION

In recent years, efforts have been made to protect and conserve the African Wild Ass. In Ethiopia, for example, the Ass保卫者Asservation Project has been established to protect the remaining population. In addition, international organizations such as the IUCN and the African Wildlife Foundation are working to protect the wild ass in its natural habitats.

The future of the African Wild Ass remains uncertain. While efforts are being made to protect the species, habitat loss and fragmentation continue to pose a threat. Continued monitoring and conservation efforts are necessary to ensure the survival of this magnificent animal.
the steppes of China and Central Asia. Written accounts exist from Tibet around 900 AD, and the 16th century Russian explorer N. Przewalski described the horse in Central Asia. Przewalski was given a green and white skin, which were examined at the Saint Petersburg Academy of Sciences and became the type specimen for the species. Many horses were captured and were sent to zoos where they were crossed with domestic herds. Small groups were reported in Mongolia in the 1940s and 1950s, but numbers apparently fell dramatically after World War II. Since the late 1970s, captured wild animals have been used and their descendants successfully reintroducted, with the result that numbers are increasing at a number of locations in Mongolia and China.

Most equid species are endangered. Grevy’s Zebra is classified as Endangered on The IUCN Red List. Its total population has declined from around 15,000 in the late 1970s to about 2500 today. Although hunting for their skins ceased in the early 1990s and despite being listed as a CITES Appendix 1 species, which bans the sale of any animal parts, numbers have not increased. Limited access to water and sufficient forage remain major problems, that put lactating females with young foals at risk. Increasing numbers of pastoralists and their herds have

Until 2008, Przewalski's Horse was classified as Extinct in the Wild on The IUCN Red List. The last confirmed sighting was in 1969. But successful reintroductions since the 1990s have seen its status changed to Critically Endangered. Mongolian is the only country where truly wild reintroduced populations exist outside of its native range. In China no known group has survived since the Qingtang River in 2005, and another six horses were free during surveys; but even then their reintroduction has been in vain. All Przewalski's Horses alive today are descended from only 17 or 18 individuals, and captive breeding animals worldwide are managed with the goal of maintaining over 99% of genetic diversity for the next 200 years.

Eupan trojanus
Chacma Baboon National Park, South Africa. Photo: Ernie Druinse

Many populations of feral horses exist around the world, like the "mustangs" of North America and the "brumbies" of Australia. But of truly wild horses, the only survivors is Przewalski's Horse (above), which exists in the wild only because of reintroductions. The "Fairies" survived in the forests of Eastern Europe and the steppe of Ukraine into the 19th century. The last Tatars of solid stock, the offspring of captive animals, died in 1911. The "Korolk horse," shown here, is believed to be the descendent of these horses in the Tarpan. The only living Korolk horses in Poland's Bialowieza Forest, and they have been introduced into a number of large national reserves around Europe in perform, ecological engineering functions of nature: large herbivores.

Eupan rhabdurus
Common Waterbuck, Netherland. Photo: Mark Harrower. Wild Wonders of Europe
led to the monopolization of watering points during the day, making it hard for the arabs to drink where Lions are resting and when they need water for evaporative cooling. Support by non-governmental organisations (NGOs), especially American and European zoos, has helped engage, empower, and reward communities that share these critical resources with Gerry’s Zebras. Since 2009 numbers have stabilized in north-ermost Kenya, where over 3500 reside.

Mountain Zebras are classified as Vulnerable. The remaining Mountain Zebras are divided into many small populations. The “Hartmann’s Mountain Zebra” subspecies (Equus zebra hartmannae) is more populous than the “Cape Mountain Zebra” subspecies (E. z. zebra), but census estimates are highly variable and both suffer from the possibility that entire populations could be lost. When coupled with the possibility of interbreeding among the subpopulations and interbreeding with sympatric populations of the more abundant Plains Zebra, the genetic integrity of both subspecies is threatened. Increased protection, monitoring, and research are necessary to assess the current state of the populations and the problems each faces.

Wild asses, once widely distributed across large tracts of northern Africa and even extending into the Middle East, now only occupy a small part of this historic range. One subspecies, the “A Chinwid Ass” (Equus africanus aegyptiaca), which was found in the Atlas region of north-eastern Algeria and parts of Morocco and Tunisia until about 900 BC, is extinct. There have been more recent reports of wild asses in northern Chad and the Hoggar Massif of the central Sahara, but these may be not true wild asses. The IUCN Red List classifies the African Wild Ass as Critically Endangered. Populations are small and poaching still occurs. Moreover, as with Gerry’s Zebras, competition with livestock over water and pasture is severe. Given that both resources are scarce in deserts, solutions involving support of local communities will be more challenging than was the case with respect to Gerry’s Zebras. Therefore increased protection against hunting and better monitoring will be needed where resources between livestock and wild asses is great.

The Asiatic Wild Ass was once distributed through much of Mongolia, north to Transbaikal Russia, east to north-eastern New Mongol and possibly western Manchuria China, as well as west to Eungariin Gansu. It also occurred in Kaza-khstan, north to the upper Irysh and Iral rivers in Ruskea, and westward, north of the Caucausus is not at the least to the Donois river (Ukraine), Anatolia (Turkey), Syria, and south-east of the Caspian Sea in Iran, northern Iraq, Afghanistan and Pakistan, and east to the Thar Desert of north-western India. It survived in Armenia and Azerbaijan until the 17th–18th centuries. The Asiatic Wild Ass is now classified as Endangered on the IUCN Red List, although some subspecies are severely threatened. Once, the “Syrian Onager” (Equus hemionus hemionus) was extinct in 1957, but the “Persian Onager” (E. h. onager) is now restricted to two protected areas. Numbers are starting to increase, but overgrazing, shrub removal, and illegal hunting for meat of those dispersing from the two parks will slow their recovery. The “Kulan” (E. h. kulan) of India is threatened largely because pressure by herders continues to increase. “Ku- lan” (E. h. ammonius) numbers in the Gobi desert are currently at reasonable levels, but hunting for meat and medicines have recently led to large declines. The need to leave the reserve for summer pastures puts the Kulan at risk of increased hunting and excursions from important seasonal habitats, as herdswmen more range further for their increasing herds. For both onagers and Kulan, better enforcement of anti-poaching laws is necessary to foster population growth in some reserves and to limit declines in others.

The Tahitan Wild Ass is fortunately not so threatened and populations seem to be stable, and the IUCN Red List classifies it in the Least Concern category. Many of the populations are small and isolated, and little is known about their status and basic biology. Effort spent filling in knowledge gaps will prove valuable; as the only exotic that typically lives for some of the year above 5000 meters, basic knowledge about its ecology and resource use will help develop conservation plans as climates change.
Genus EQUUS

1. Przewalski’s Horse

Plate 5

Habitat: The habitat range of Przewalski’s Horse is limited and fragmented due to its original distribution in the steppes of Central Asia and Mongolia. It was once found in the steppe and desert regions of Mongolia, but now it is primarily found in protected reserves in China and Mongolia. Przewalski’s Horse is adapted to a semiarid environment and is capable of surviving in areas with scarce vegetation.

Food and Feeding: Przewalski’s Horse is a herbivore and primarily feeds on grasses, herbs, and leaves. It has been observed to eat a variety of plants, including grasses, herbs, and leaves. It is known to graze and browse in the early morning and late afternoon.

Breeding: Przewalski’s Horse is a monogamous species, and breeding occurs in the spring. The gestation period is around 11 months, and the young are born in the spring. They are weaned at around 6 months of age. Przewalski’s Horse is known for its high-quality meat and has been hunted by humans for centuries. It is currently protected in its natural habitat and is a species of concern due to its limited distribution.
PLATE 5

Genus EQUUS

1. Przewalski's Horse

Equis przewalskii

Fossils of the Equus genus have been found in Europe and Asia, dating back to the Pleistocene epoch. The genus Equus is known for its diverse species that have inhabited various regions and climates. This species, Equus przewalskii, is notable for its distinct appearance and behavior, making it a fascinating subject for study.

The Przewalski's Horse, Equus przewalskii, is a wild horse native to central Asia. It is one of the most endangered species, with only a few hundred individuals left in the wild. Its primary diet consists of grasses, while its habitat includes open steppes and deserts. The Przewalski's Horse is known for its unique behavior, such as its ability to run at speeds of up to 65 km/h, which is comparable to that of the domestic horse.

Movements, Home range, and Social Organization. Przewalski’s Horses exhibit many of the behaviors of other wild horses. Female groups are often formed, and dominance hierarchies arise among them. Males are solitary or live in small groups. Przewalski’s Horses are known for their stamina and endurance, capable of running at high speeds for long distances.

Social behavior seems to be influenced by the presence of a dominant stallion. The stallion is generally the first to arrive at a new feeding site, and other males follow a few minutes later. The females, on the other hand, tend to arrive last and may be subjected to harassment by the dominant male. Overall, the social structure is highly flexible, and interactions between individuals are often complex and dynamic.

Habitat. Przewalski’s Horses are found in the steppes and deserts of central Asia, particularly in Mongolia and Kazakhstan. Their habitat consists of open grasslands, savannas, and semi-deserts. The climate in this region is typically dry and hot during the summer months, with cold winter temperatures.

The Przewalski’s Horses are known for their adaptation to extreme conditions. They can survive in environments where the temperature drops to below freezing, and they are able to thrive in areas with scarce water resources. This adaptation is crucial for their survival in their natural habitat.

Food and Feeding. The Przewalski’s Horse primarily feeds on grasses and other vegetation. Their diet consists of a variety of plant material, including leaves, herbs, and fruits. They are known for their ability to feed on a wide range of plant species, which allows them to adapt to changing environmental conditions.

In conclusion, the Przewalski’s Horse is a fascinating species with unique adaptations and behaviors. Its survival is threatened by habitat loss, hunting, and competition with domestic livestock. Conservation efforts are ongoing to ensure the survival of this magnificent creature.
Breeding. Gestation in Asiatic Wild Ass is eleven months and breeding is highly seasonal. Both peaks during April and September, depending on rainfall and food. Within one population, birth occurs within a 2-3 month period. Females reach puberty at three years of age and give birth to only one foal at a time. Foals generally weigh 30-40 kg and are seen within 30 km of their mothers. Caucasians frequently in need of fire
- Activity patterns. Asiatic Wild Ass are most active at dawn and dusk, when temperatures are cooler. Although they are usually nocturnal, they are also active at dawn and dusk. They are not usually alone, but travel in groups of 2-5.

Monte Carlo, Family and Social organization. The running and social behavior of Asiatic Wild Asses is highly variable. Many populations show seasonal movements, with the males moving out of the herd in the winter months and returning to the herd in the spring. The behavior of the herd itself is also highly variable, with some herds being highly social and others being more isolated. The social structure of the herd is based on the dominance hierarchy, with the dominant male being the leader of the herd.

Statio and Conservation. The IUCN Red List of Threatened Species currently lists the Asiatic Wild Ass as a species of Least Concern. The population is stable, but there are some threats to the species, including habitat loss, poaching, and competition with domestic livestock.

3. Tibetan Wild Ass Equus kiang

Tibetan Wild Ass Equus kiang, 1848, Large, hairy, well-adapted to the harsh environment of the Himalayas. It is found in the Tibetan plateau and the Himalayan region. Three subspecies are recognized. Subspecies and Distribution. E. k. kiang (the Tibetan Wild Ass) found in the Tibetan plateau and the Himalayan region. E. k. hians (the Ladakh Wild Ass) found in the Ladakh region. E. k. chagpas (the Kham Wild Ass) found in the Kham region.

4. African Wild Ass Equus aethiopicus

African Wild Ass Equus aethiopicus, 1825, Characterized by its large size, dark coat, and distinctive face pattern. It is found in eastern Africa, from Ethiopia to South Africa.

5. Plains Zebra Equus quagga

Plains Zebra Equus quagga, 1791, Characterized by its distinctive black and white stripes. It is found in eastern and southern Africa. The color of the stripes is determined by the genotype, with the dominant allele producing black stripes.
Flying leeches are a natural enemy of the Pink Palace.  

The Pink Palace is very fond of its leeches, and is always eager to attract more. However, the leeches are becoming a bit of a nuisance, as they are infesting the palace's gardens and lawns. The palace has tried various methods to control the leech population, but nothing seems to work. The leeches are also a danger to the palace's guests, who are constantly being attacked by the leeches while walking through the gardens.

The palace is planning to hire a professional exterminator to get rid of the leeches. In the meantime, the palace staff is trying to keep the leeches at bay by using various repellents and barriers. However, the leeches are proving to be quite resilient, and it seems that a more drastic solution will be needed to get rid of them once and for all.
quantity. At any one locale, migratory or resident populations also exhibit local movements involving landscape areas. During the rains, Plains Zebras graze on hilly slopes where vegetation productivity is high and good visibility increases safety from predators. When the rains cease and grasses grow slow, the zebras seek habitats where food is more abundant, because of density-associated characteristics with their relatively high body mass. They move to valley bottoms and grasses where grass is abundant, even though it is fibrous and of low quality. Their grazing transforms these habitats. Residual moisture and increased light penetration induces vegetation growth, which benefits the zebras as well as wildlife (Cassatteur et al.) and Thomson's gazelles (havreux et al.). As a result, these populations require higher-quality vegetation than zebras. It is their good fortune that by the time they are forced to leave the hilly slopes, high-quality grasses in the valleys are abundant enough to sustain them. Thus Plains Zebras play an important role as engineers rehabilitating bottomland communities.

Status and Conservation. Classified as Least Concern on the IUCN Red List. In 2002, total numbers were estimated at 688,000. More than 75% of the world's Plains Zebras are "Grévy's Zebra" (O. G. 1993), some 500,000 in the Serengeti-Mara (of which a third live in Kenya). The two countries they inhabit, Kenya and Tanzania, have extensive national park systems covering savannas from southern coasts, cooperated with sophisticated governance-protected monitoring systems. Wildlife-friendly ranching practices tend to protect even zebras living on private land in Kenya. Plains Zebras will probably not become threatened in their localities, but aerial surveys data from Tanzania suggest a population decline of approximately 10% from the late 1990s to the mid-1990s. Equus zebra, the other subspecies of the species, is not listed with the at-risk species. The current subspecies status of E. z. grevyi is not clear-cut. The subspecies has been proposed to be destroyed and the subspecies E. z. equus has been listed as endangered. The subspecies E. z. grevyi is listed as threatened.

Activity patterns. Grévy's Zebras are opportunists and more or move great distances in search of fresh food and water. During the rainy season, they move about 100 km per day and use water sources to gather and disperse. During the dry season, they move about a kilometer per day within limited ranges. They are sensitive to human disturbance and can be threatened by habitat degradation.

Food and Feeding. Zebras are grazers that prefer fresh grasses, but they also consume herbs and roots. They are capable of eating a variety of plants, including grasses, sedges, and herbs. They are known to feed on a wide range of plants, including grasses, herbs, and even roots. They are also known to feed on fresh grasses, but they also consume herbs and roots. They are sensitive to human disturbance and can be threatened by habitat degradation.

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Move, Range and Social Organization. Grévy's Zebras differ significantly from the other two species of zebras; they do not live in closed membership family groups or harems. As the Norse, Grévy's Zebras live in open membership groups in which the dominant males are the only long-hauling members in between mothers and their young. Adult females together at water sources and good grazing sites and continue to travel together; their small need for protection and social behavior is likely to be served. More information on the social behavior of other subspecies is needed to better understand the differences in social behavior. The IUCN Red List of Threatened Species does not list the species for either subspecies.

1. Habitat. Grévy's Zebras inhabit semi-arid to arid grasslands and shrublands. They are found in areas with sparse vegetation, such as savannas and semi-arid grasslands. They prefer areas with low vegetation density and limited water availability. They are known to feed on a wide range of plants, including grasses, herbs, and even roots. They are capable of eating a variety of plants, including grasses, sedges, and herbs. They are known to feed on fresh grasses, but they also consume herbs and roots. They are sensitive to human disturbance and can be threatened by habitat degradation.

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7. Mountain Zebra. Equus zebra

The Mountain Zebra is a subspecies of Equus zebra from southern Africa. It is found in mountainous areas of South Africa and is known for its distinctive black fur.

Taxonomy. Equus zebra domesticus, 1778, South Africa, southern-western Cape Province. Two subspecies recognized.

Subspecies and Distribution. E. z. domesticus, 1778 – South Africa (S & W of the central plateau & the Eastern and Western Cape Provinces).

Mor 注意事项： 将内容翻译成英文。
zebra species by the desalp under its neck. This pattern of striping is also inter-
protect between the other two species. The stripes are half as wide as and more 
numerous than those of Plains Zebra (E. quagga) and the belly is white as in Grevy's Zebra (E. grevy) Mounain Zebras have a "cauliflower" pattern on the 
mane near the root of the neck. On the rump, the 
narrow stripes change to broad and bold 
stripes, while those of "Grazing Zebra" (E. borni). The "Cape Mountain Zebra" is smaller than "Hartmann's Mountain Ze-
bra" and has slightly wider stripes.

Habitat. As its name implies, the Mountain Zebras inhabit slopes and plateaus in montane areas. Cape Mountain Zebras are found up to 3000 m in the summer. Hartmann's Mountain Zebras sometimes are found up to 500 m. In the winter they are commonly found in the hilly karoo upland shrub where summer droughts were concentrated for the maintenance of a diet.

Food and Feeding. Mountain Zebras are mostly grazers, although browse in the form of leaves and bark is occasionally consumed. Mountain Zebras generally drink twice per day.

Breeding. Births occur throughout the year, with peaks in December-January for Cape Mountain Zebras and in November-February for Hartmann's Mountain Zebras. Females give birth to a single young every 1-3 years, after a gestation period of approximately 11 months. The young are weaned at around 10 months and leave the natal group at 1-3 years of age. Males are capable of mating while they are 1-3 years of age.

Activity patterns. Mountain Zebras are most active in the morning and in the late afternoon and at sunset. They remain inactive during the middle of the day and seek shelter from the heat when possible. Individuals feed for more than half the daylight hours. Hartmann's Mountain Zebras have a grazing area of 6-20 km² during winter and considerably smaller areas in the summer. Their home ranges are thought to be around 5-10 km².

Movements, Home Range and Social Organization. Mountain Zebras generally live in small permanent membership groups with overlapping home ranges. Most groups contain a single male and 1-5 mares and their young. Sometimes groups join to
form temporary herds of 30 or more individuals. Stallions can maintain herds for more than 15 years, but they are usually driven out by younger males before then. bachelor groups are composed of both young males and old stallions that have lost their groups. There is a strict hierarchy among males in bachelor groups, and
mature females in breeding groups.

Status and Conservation.ITES Appended 1 (captive) and Appendix II (untapped).Classified as Vulnerable on The IUCN Red List. Historically, Mountain Zebras ranged from southern Africa through Namibia to extreme southwestern Angola. Habitat conversion to agriculture, competition with domestic livestock, hunting, and poaching are the main threats facing Mountain Zebras. Crossbreeding between the two subspecies is considered a potential threat in South Africa, where both subspecies occur; this would mix and disrupt the genetic diversity of the species. Crossbreed-
ing with Plains Zebras is also a potential threat just as it is for Grevy's Zebra. Cape Mountain Zebras suffered devastating declines because of trophy hunting and herd conversion to agriculture in South Africa during the 19th and early 20th centuries. By the 1950s they were on the brink of extinction. In 1973, a census counted just 45 individuals. Since the establishment of national parks in the locations where the few surviving individuals remained, the population has increased to around 100. Cape Mountain Zebras now live in 17 provincial nature reserves and national parks, the largest being the Addo Elephant and the Cape Peninsula National Parks. Hartmann's Mountain Zebras also suffered massive population declines during the 1950s and 1960s, primarily due to persecution from an expanding livestock industry. Hartmann's Mountain Zebras continue to occur in conflict with livestock farmers, particularly during droughts when resources are in short supply. Hartmann's Mountain Zebras is a protected species in Namibia and any use requires permits. The Namibian Ministry of Environment and Tourism has encouraged the commercial use of Mountain Zebras to provide an incentive for conserving the species. Numbers are increasing on farms and overall numbers are in the range of 50,000. Today, populations are isolated, inhabiting the MKN and GCPC1 Nature Reserves, Ampe, Central, and Richtersveld National Park. The animals also occupy numerous private estates in the Northern and Eastern Cape Province of South Africa, as well as in protected areas and national parks in Namibia.