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Reproduction and Conservation of Wild Yaks (27-Nov-2000)

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Summary

Wild yaks, the closest ancestor to domestic yak, are perhaps the most threatened animals in the Qinghai-Tibet plateau. By the 1970's, wild yaks were on the verge of extinction, but due to protective measures by the Chinese government some wild herds are now reported at elevations between 4000 and 4500 m. Wild yaks and other wild ungulates of the Tibetan Plateau are gaining increasing attention from international conservation organizations; they are listed on Appendix 1 of CITES and are the first class of "key" species of wildlife protected by Chinese legislation. Conserving wild yaks and their habitat requires more knowledge of their reproduction, habitat and grazing. Information on reproduction in the wild yak is scanty and most is focused on the male. This review summarizes the available literature to provide basic knowledge to promote conservation of these animals.

Introduction

Wild yaks (*Bos mutus*, Prez, 1876), the closest ancestor of the domestic yak, are found in the central and eastern cold pastures of Qinghai-Tibet Plateau. Herds existed on the cold pastures of western Sichuan, Qinghai and Gansu provinces. Male wild yaks could be seen mingling and mating with the domestic female yaks. A few individuals with hair color characteristics of wild yaks are present in domestic herds. However, excessive hunting of wild yaks drove them from the plateau to high altitudes (above 4500 m) and right to the tops of the mountains (6000 m). By the 1970's, wild yaks were on the verge of extinction. Some were present in China's Kunlun Mountains, but due to protective measures by the Chinese government, some wild herds are now reported at elevations between 4000 and 4500 m [1,2].

Other than a paper by Schafer [3], the literature on the wild yak consists of explorer's records [4-6] and brief comments when discussing other species [7,8]. A report on the Arjin Mountain Reserve in Xinjiang [9] provided some important information on the ecology of wild yaks and, more recently, Miller et al. [10] and Lu and Li [11] reported more important data from field investigations.

The number of wild yaks has declined considerably in recent decades due to widespread hunting. Explorer's accounts from a century ago describe seeing enormous herds of wild yak in the eastern Kunlun Mountains, on the upper reaches of the Yangtze River and near the headwaters of the Yellow River in Qinghai Province. The construction of roads and government policies favoring shooting of wildlife for food from 1950 to the 1960's substantially reduced the numbers of wild yak. Wild yaks and other wild ungulates of the Tibetan Plateau are gaining increasing attention from international conservation organizations; they are listed on Appendix 1 of CITES and are the first class of "key" species of wildlife protected by Chinese legislation (PRC) [12]. Conserving wild yaks and their habitat requires more knowledge of their reproduction, habitat and grazing.

Evolution and Historical Range of Wild Yaks

Yaks combine the features of the genus *Bos* and genus *Bison* and occupy a somewhat intermediate position between them. Wild yaks are descendent of the Pleistocene Trans-Baikal *Poephaqus baicalensis* that disappeared in Mongolia and the Trans-Baikal area under the influence of man. The historic range of wild yak extended throughout the Tibetan Plateau, northwestern Mongolia and into the Lake Baikal region of Russia.

The taxonomic classification of wild yak is still disputed. At one time, wild yaks were considered a separate species (*Bos mutus*) from domestic yaks (*Bos grunniens*). Olsen [13] argues that yaks should be classified as *Peophaqus grunniens*. However, based on genetic and ecological studies, we believe that the wild yak (which has been naturally selected over many generations) is a dominant wild species, while domestic yak (which survived with a low nutritional level) is a deterioration species. Therefore, we maintain that wild yak should be classified as a separate species *Bos mutus* [14,15].

Distribution Status

Wild yaks are presently found in the area surrounded by the Kunlun and Aejin Mountains with a total surface area of 1.400 000 Km² and the lowest altitude of 4.000 m (above sea level). The average annual temperature is about -8°C and the growing season for grass lasts about 100 days. Wild yaks have to travel about 200 - 300 km for grazing every day.

In recent years, the wild yak population has been increasing as wildlife conservation laws were implemented. A herd of wild yak (n= 230) was found in Wutumeiren in the Geermu region. According to a survey from Qinghai, Tibet and Gansu [15], there are about 20.000 - 40.000 wild yaks in China. An accurate estimate of the wild yak population on the Tibetan Plateau is unavailable, but based on the report by the investigations of Miller et al. [10], there are about 15.000 wild yaks in the Plateau. Therefore, the status of wild yak on the Tibetan plateau is regarded as threatened. Despite being classified as a Class I protected species in China, wild yaks continue to be hunted and are probably the most threatened wild animal in Tibet.

Types of Wild Yak

Yaks were domesticated at least 4.000 years ago. Wild yaks are classified as Qilian mountain type or Kunlun mountain type, according to their body conformation, horn shapes and the natural characteristics of the regions in which they live.

Qilian Mountain Type - The Qilian mountain type wild yak (called "Gaxi" by the nomads of Tibet) is found mainly on the alpine meadow in the west Qilian Mountain and the east part of the Aejin Mountains. These yaks are not fierce and tough and generally do not attack people or other animals [2]. Bulls are 160 - 170 cm at the withers, chest girth 210 cm, live weight 500 - 600 Kg with a prominent hump, long legs, long face, small muzzle, short ears, and no dewlap. Females are smaller than males; both have horns, but the male's are bigger. The distance at the base of the horns is more than 70 cm with a ellipsoid and round scur. The horn grows outward and curves backward. The brisket, belly, rib, sides, legs, and hump are all covered by long hair. The hair is brown-black, and the nose ring, eye ring and back line are gray-white. The tail is long, fluffy and broom-like.

Kunlun Mountain Type - The Kunlun mountain type wild yak, called "Hengde" (snow hill wild cattle) by Tibetan nomads, is found mainly on the alpine meadows of upper reaches of the Yaluzangbu river, the Kunlun Mountain and the northern part of Tibet. These yaks are very aggressive and may attack people or other animals. They are bigger than the Qilian type. Adult males are 205 cm at the withers with a 270 cm chest girth, trunk length of 240 cm and live weight of about 1200 Kg. The shoulder has a prominent, tuberos projection and the legs are stocky. The face is short but the forehead is wide and prominent. On adult males, the scur is thick with a circumference > 50 cm (the nomads use these horns for storing milk). The distance at the horn base is up to 100 cm and the horn grows openly. Hair color is black or black brown and the back line is rather clear. The nose and eye rings are gray-white. Although the face does not have hair, the hair on the top of the head is long. Furthermore, there is long hair on the shoulder, rib, and legs (in bulls the hair may touch the ground).

Reproductive Characteristics

Information on the reproduction of wild yaks is scanty. Most of the available data are studies on crossbreeding between domestic and wild yaks and focused on male reproduction, especially semen characteristics and the productivity of hybrids.

Sperm Concentration

Fresh semen of the wild yak bull contains 2.13×10^{10} spermatozoa per ml, much higher than those of the domestic yak (1.10×10^{10}) and yellow cattle (6×10^9). Wild yak semen was diluted (ratio 1:3 to 1:6) and $1.5 - 1.7 \times 10^6$ spermatozoa per pellet were frozen. From 1984 to 1989, frozen-thawed semen was used to inseminate domestic yaks with a conception rate of 88.9 %. In addition, 771 local yellow cattle were inseminated with the frozen wild yak semen and the calving rate was 71.85 % [15].

Sperm Motility

The motility of wild yak semen averages 63 and 39 % for fresh and frozen-thawed semen, respectively. Fresh semen (diluted with 7% glucose) survives for 57 hours at 0 - 4°C. Frozen semen thawed at 37°C subsequently survives 12 hours. The resistance coefficient of the sperm of wild yak, domestic yak and domestic cattle is 144.000, 12.750 and 6.000, respectively, indicating that wild yak sperm have exuberant motility [15].

Morphology of Spermatozoa

For wild yaks, the percentage of defective sperm for fresh and frozen-thawed semen is 6.3 and 9.2 %, respectively. Post-thaw, 87.5 % of wild yak spermatozoa have intact acrosomes (approximately twice as high as domestic cattle). Careful freezing technique (and extender composition) are important to maintain acrosome integrity, otherwise conception rate will decrease. Semen characteristics include: milky-white and slightly yellow; specific gravity, 1.055; osmotic pressure, 0.65; and pH 6.60 (none of these are significantly different from the domestic yak). The moving viscosity of wild yak semen is 1.169 centipoise (compared to 1.94 - 4.1 centipoise for domestic cattle). The low moving viscosity of wild yak semen enable the spermatozoa to move easier, faster and with less energy, thereby prolonging their survival time and increasing the chance of

fertilization. The total nitrogen of wild yak bull semen (1437.7mg/100ml, approximately twice as high as in ordinary cattle) supports sperm metabolism [15].

Ultrastructure of the Sperm

Yak spermatozoa are a typical flagellar type. The length and width of the head and middle piece of wild yak sperm are not significantly different from those of domestic yak, but the principal piece is significantly longer (Table 1) [15].

Type	Number of Cows		Principal Piece (mm)	Middle Piece (mm)
	Length (mm)	Width (mm)		
Wild yak	8	4.29	54	13.7
Domestic yak	8.1	4.1	49.67	14.47
Yellow cattle	9.8	-	49.67	-
Buffalo	7.1	-	48.77	12.47

Characteristics of Hyaluronidase (HAase) and LDH

Semen HAase activity is important in fertilization. The mean activity of sperm HAase of wild and domestic yaks is 9.75 ± 3.77 and 8.71 ± 3.25 U/ml (significantly different). The activities of LDH, succinic dehydrogenase and cytochrome oxidase are also related closely to the fertility. The metabolic intensity of sperm cells directly influences their biological activity and also has an adverse effect on fertility. Oxidase in semen could be considered as an indicator of male reproduction. The LDH activity of semen from wild and domestic yaks is 2.17 ± 0.46 and 1.47 ± 0.81 U/ml [15].

According to the electrophoresis and scanning diagram of LDH isoenzyme, the activity of each isoenzyme is significantly different; LDHx is the most active and is considered an important index of fertility of males [15].

Utilization of Wild Yak for Improvement

Data from 4700 F1 calves that were produced by crossbreeding wild (male) and domestic yaks (female) showed that the birth weight, live weight at 6 months and 1 year were increased by 30.8 %, 55.4 % and 47.7 %, respectively (compared to domestic yaks), and that yields of hair, beef and milk of the F1 cows were increased by 28.4 %, 24.1 % and 11.7 % respectively. The milk yield, milk fat percentage of hybrid containing 1/4 wild yak blood were 9.5 and 17.2 % higher than that of the domestic yaks [15]. These data indicated that crossbreeding is a new way to improve the economic traits of domestic yaks and provided the basis for creating a new yak breed.

It is said that the heterosis is expressed in crosses between wild and domestic yaks. However, the relative importance of additive genetic effects and of heterosis is not known. Although contemporaneous comparisons of wild and domestic yaks (and their crosses) have never been done, there is circumstantial evidence that heterosis exists and hence the presumption of differences in gene frequencies among different yak populations [16,17].

Conservation

Although the wild yak is covered under Chinese legislation to protect wildlife, wild yaks are probably the most threatened animals on the Qinghai-Tibetan Plateau. Conservation of wild yak requires more knowledge of their ecology, enforcement of regulations against hunting, establishment of reserves to protect wild yaks and other wildlife, and management of the rangeland resources which wild yaks and other ungulates depend upon for survival. These actions are crucial for ensuring the survival of wild yaks in the face of growing threats from modernization.

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