

The saiga

Saiga tatarica:

a review as a model for the management of endangered species

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Ungulates have a long history of captive propagation dating back to 9000–7000 BC, when the process of domestication began. None the less, two genera stand out in their persistent failure to adapt to captivity outside their natural areas of distribution: the pronghorn *Antilocapra* and the saiga *Saiga*.

The saiga is often referred to as an antelope, which it is not. Rather, with its cousin the chiru or orongo *Pantholops hodgsoni* of the Tibetan Plateau, it is classed in a special tribe, the Saigini, of the subfamily Caprinae or goat-like animals. Morphologically, the saiga and chiru represent a more genuine bridge between the antelopes and the goats than do the Rupicaprini, or goat-antelopes. Little is known concerning their origin, but because of their morphological, ecological and geographic specialisations – which make them peculiar even within their own subfamily – it would appear that both genera have followed an independent course of evolution since the late Miocene or early Pliocene.

An adult ♂ Russian saiga *Saiga tatarica tatarica* stands approximately 76 cm at the withers, ♀♀ being slightly smaller. In summer the colour is dull yellowish with a whitish throat and indistinct facial markings. In winter this changes to a near-uniform whitish all over the body, without markings. The ears are short and thickly haired, and the short tail is the same colour as the body. Only the ♂♂ carry horns, 33–36 cm long, which are ringed and of a peculiar waxy amber shade.

The Mongolian subspecies *S. t. mongolica* is an isolated and more recent population, smaller in size and of a sandy grey colour, with a clearly defined brown spot on the rump. The most characteristic feature of the saiga is the large, elongated nose, which is bent downwards and inflated, with the nostrils opening downwards. During the rut, the nose of the ♂ increases in size to produce a distinct ridge on the dorsal surface. In the Mongolian form the bulbous nose is less highly developed. The function of this enlarged proboscis is not yet understood.

STATUS AND NATURAL HISTORY

The saiga has been known in European literature since the 1st century AD. Strabo, reporting on the land of the Scythians and Sarmatians in his *De Rerum Geographicum*, relates the following: 'Among the four-footed animals there occurs the so-called "Kolos", which is between a deer and a sheep in size, of a white pelage and faster than either a deer or sheep; when drinking, water is drawn into the head through the nose where it is stored, so that it can live in waterless regions . . .'

During the Pleistocene, fossil evidence indicates that the same species as lives today occupied a vast range extending from England across central and western Europe and east in Siberia as far as the mouth of the Jana River and the Novosibirskie Islands. Recent fossil finds have shown it to have been a contemporary of the Woolly mammoth *Mammathus primigenius* in

Alaska. In Recent times the Russian form has been confined to an area lying between the foothills of the Carpathians and the foothills of the Altai, while the Mongolian subspecies inhabits the Dzungarian Gobi and the western portion of the Mongolian People's Republic; the two subspecies are separated by the Mongolian Altai.

In the last 30 years, the saiga has recovered from the brink of extinction to become one of the most common wild ungulates in the Soviet Union. Information concerning its previous abundance in the early 19th century and its decline during the 1930's is sparse, but the publications of the 18th and 19th centuries indicate that it was then a very common animal on the Russian steppes. Pallas in 1770 wrote that it was very numerous along the Ural River and that all areas not settled by the Kirghiz were full of saiga. In 1773 he wrote that it was so abundant that his cossacks were able to shoot all they wanted. In the first half of the 19th century there was no appreciable reduction in population or habitat, but during the next 80 years the tide turned and there was an enormous decline, not only in range, but in numbers as well. At the beginning of the 1930's only a few hundred saigas were left in Kazakhstan, and in the Dzungarian Gobi only a few dozen. Only on the western bank of the Volga did they remain in any numbers. Over the entire range there were probably no more than 1000 animals. It was at this point that the species was given protected status in the Soviet Union and hunting was forbidden.

Throughout its range, the species is confined to pure, dry steppes and semi-deserts, where the complex plant associations appear to provide optimum conditions. Thus, over a rather limited area, the saiga can find sufficient food throughout the year. In winter it moves to the hilly steppes as a protection against snow storms.

Saiga usually wander, so it is only during the rutting period that a ♂ with his harem will remain within a limited territory, about 3-10 km². In May, before the newborn lambs are able to follow their dams, the ♀♀ stay within 2-3 km of where the young lie. Generally, the animals will move a few dozen kilometres a day, the distance being governed by the size of the herd and the pasturing conditions. During the migratory period a herd may cover 80-120 km or more a day.

Migrations are not characteristic of the entire population, nor do they occur every year. In the Mongolian population they are unknown, and on the right bank of the Volga, in years with average rainfall, some saiga do not migrate. However, the greater part of the population does assemble in particular areas, according to season. Winter concentrations are formed in regions with the least amount of snow, while summer massing depends on the amount and distribution of summer rain and coincides with the loss of pasture and the drying of sources of water. The timing of these concentrations varies from year to year. Should there be widespread drought, relatively large groups will be found near rivers and lakes. In spring, the animals usually congregate during the lambing season, returning to the same areas more consistently than in the summer and winter.

Saiga are highly gregarious and during the summer can be observed in herds of 30-40. At times there are gatherings of as many as 1000 animals, but within these large groups smaller herds of from 5-50 can be distinguished. There are no dominant or lead animals except during the rut. In December, mature ♂♂ begin to collect harems of 5-15 ♀♀, while the non-breeding ♂♂ form separate herds numbering from a few dozen to hundreds of animals. Savage fighting occurs between the ♂♂ during the rutting period, which may result in the death of one of the combatants. At this time the ♂♂ rarely graze, but often eat snow. They become less observant and extremely dangerous, even attacking human beings. Mating takes place at night, the ♂♂ resting for long periods during the day. At the conclusion of the rut, the exhausted adult ♂♂ die in large numbers and by the onset of spring the survivors may constitute only 10-15%, and occasionally as few as 3-5%, of the entire population. Nevertheless, their polygynous organisation seems to ensure that these losses do not adversely affect saiga populations.

The lambing season occurs in April and May, at which time the pregnant ♀♀ gather in specific areas to bear their young, usually on the open steppe where grazing is poor. Older ♀♀ normally produce twins, young ♀♀ a single lamb. After 48 hours, the lambs are able to run so rapidly that a man on foot cannot overtake them. They follow their mothers when grazing and can move

from one area to another with the adult animals. However, they are still comparatively weak and spend a great deal of the time curled up in the sun, rising mainly to feed in the early morning and in the evening. By the time they are four to five days old, they accompany their mothers the entire day, walking near them and playing. Females reach maturity at 7-8 months and ♂♂ at two years of age. Gestation lasts five months.

Other than man, the chief enemy of the saiga is the wolf *Canis lupus*, whose distribution is closely correlated with that of the saiga. Wolves are always more common on the summer and wintering grounds of the saiga. A single wolf cannot successfully hunt a strong adult animal, but ♂♂ that have been weakened by the rut, pregnant ♀♀, and newborn lambs fall easy prey. In heavy snow a lone wolf can also succeed in bringing down a healthy adult, as the weight of the saiga, which is over four times that of an adult wolf, acts to its disadvantage. Normally the wolves hunt in packs, part of the group following the saiga and another section cutting off the way of escape. It has been calculated that in Kazakhstan wolves took between 20-25% of the population, primarily lambs and weakened ♂♂ (Bannikov, 1963). With the reduction of wolf populations over the saiga's range, there has been a corresponding increase in saiga numbers.

Adult saiga have no other natural enemies. However, ravens *Corvus corax*, Golden eagles *Aquila chrysaetos*, Tawny eagles *Aquila rapax*, foxes *Vulpes vulpes* and stray dogs will attack newborn lambs. The ♀♀ attempt to protect their young from birds of prey by leaping into the air and trying to strike the birds with their heads and forelegs, a defensive reflex which has also been provoked by low-flying aircraft. Further hazards are the occasional stomatitis epidemics, and the approximately 35 varieties of internal parasites which are known to infest wild saiga.

HISTORY IN CAPTIVITY

Before the Second World War, the saiga was relatively rare in captivity, which is probably attributable to its rapid decline in the wild between 1850 and 1930. The first animal exhibited outside Russia was a ♂ presented to the Zoological Society of London in 1864. In the same year the saiga was first exhibited in the Moscow Zoo. It was seen in Berlin in 1872, Cologne in

1874, Hamburg in 1877, Antwerp in 1878 and Bremen in 1889. Longevities are not recorded for the majority of 19th century captives, with the exception of a pair received in Berlin in 1872, where the ♀ survived until 15 October 1873 and the ♂ until 12 October 1875.

In 1902 the 11th Duke of Bedford purchased a group of saiga from Hagenbeck for his collection at Woburn, but the animals only survived a short time. A second importation from Hagenbeck in 1906 of 19 animals was also unsuccessful, although 12 lambs were born in that year. Hastings, 12th Duke of Bedford (1949) writes: 'We had two importations of the extraordinary saiga antelope and both had the same curious and ultimately disappointing history. They recovered quickly from the effects of their journey, bred and threw amazingly for nearly two years, and then all died off with the exception of a solitary individual, from what cause I do not know. . . . It is possible that the tantalising third-year epidemic might be avoided if saigas were moved annually on to fresh pasture, the old pasture being heavily salted and limed.' It is a matter of history that many of the ungulate species imported to Woburn were unsuccessful due to heavy parasitic infestation.

According to Mohr (1943), between 1900 and 1938 only about eight saiga were exhibited at Berlin, Stellingen (Hamburg) and Hanover, where they did not live long. There are no records of the causes of their deaths, nor of their ultimate disposal. Nevertheless, additional animals were imported into Germany by the firm Ruhe and exported abroad. It was from this source that the National Zoological Park, Washington, obtained a pair on 5 December 1934, followed by a ♀ on 14 May 1935. Similarly, the New York Zoological Society imported a ♂ in 1936 and another in 1937, while the St Louis Zoo obtained a pair in May 1937 and an additional ♀ the following July.

Saiga do not again appear in collections until 1950, when two pairs arrived at Prague Zoo. Between November 1950 and October 1972, 52.84 and 12 unsexed animals passed through the collection at Prague; the majority were destined for other European zoos. Of these, 29.43 and four of unknown sex died before they could be shipped.

As a transit point in the East-West animal trade, Tierpark Berlin (East Berlin Zoo) received 22

shipments of saiga, consisting of 143 animals, between 1958 and 1972 (Pohle, 1974). Of these, 87 were transferred to other collections abroad and one animal, a ♂, was later returned to Berlin. Of the 57 imported animals which were retained in Berlin, none was alive in 1974.

It was from the Prague and Berlin transports that saiga again found their way into western European and North American collections. The first post-war imports arrived in the United States in 1955, when a trio reached the St Louis Zoo, and another (2.1) the National Zoological Park. Further imports were received at New York in 1956; Lincoln Park, Chicago in 1958; Dallas in 1959 and 1962; Philadelphia in 1960, 1961 and 1962; San Diego, San Francisco and Toledo in 1962; Albuquerque, Oklahoma City and Omaha in 1969. As far as I have been able to ascertain, 17.30 and one of unknown sex (National Zoo) were transported into the United States between 1955 and 1969.

The first saiga born and raised in the USA was a ♀ in the St Louis Zoo born on 15 May 1939, which died on 19 June 1945. Among the post-war imports, the first birth occurred in St Louis in 1956, followed by Dallas and San Francisco in 1963, Oklahoma in 1970 and Albuquerque in 1971. Additional herds were established in Winnipeg, Canada, from animals bred in Dallas (2.2) and San Francisco (0.1); at the Alberta Game Farm, Edmonton, from the herds in Oklahoma (1.1) and Albuquerque (1.0); and at the San Diego Wild Animal Park from the Oklahoma (1.0) and Albuquerque (0.1) herds. At least 40 captive births were recorded in North America between 1955 and 1975, but today there remain only three animals, at the San Diego Wild Animal Park. These are a ♀ received from Albuquerque on 25 November 1970, a ♂ received from Oklahoma on 16 August 1973, and a ♀ born on 13 May 1975.

Captive longevities have been remarkably short, with an average between 2-3 years, similar to that reported by Pohle (1974) for saiga in Tierpark Berlin. However, four animals in North American collections have exceeded five years: a captive-born ♀ at Winnipeg (6 years); a captive-born ♀ at St Louis (7 years 6 months); an imported ♀ at San Francisco (7 years 10 months in the collection); and a captive-born ♀ at San Diego Wild Animal Park (6 years).

In Antwerp Zoo there are two ♂♂ born on 11 April 1971 which were still living as on 23 January 1976. On average, however, captive longevity for ♂♂ has been less than four years, which may be in part correlated with their extreme aggressiveness and resulting traumatic injuries. The known longevity for wild saiga living under optimum conditions is relatively short, c. 12 years, although few animals in the USSR are known to reach this age (Bannikov, 1963). Nevertheless, captive longevities fall far short of those recorded for the wild. The maximum, as we have seen, was under eight years, although this animal, which was already adult on arrival, was probably more than nine years old at time of death.

PAST FAILURE, FUTURE POLICY

In reviewing the pathology of saiga under captive conditions one sees a recurrence of similar problems. In the USA, the major causes of death can be attributed to trauma and associated stress, parasitism and bacterial infection, in that order. The same is true of Prague, where 30 animals died from traumatic causes. In East Berlin the picture has been somewhat different. Pohle (1974) reports that of the 53 post-mortems performed on imported saiga, 15 animals died of bacterial infection and 15 of infections of the stomach and intestinal tract, but he gives no further details. In only ten cases were parasites found, principally *Cysticercus tenuicollis* and *Taenia hydatigena*. According to Bannikov (1963), parasitic infestation among wild saiga is extremely high, and in some parts of the range it accounts for nearly all deaths.

The captive history of the saiga has proved it to be one of the most difficult ungulates to maintain in zoos. What is most disconcerting about the negative picture here described is the repetition, from one institution to another, of demonstrably unsuccessful management practices - a repetition that spans many decades. Whether this pattern of failure could have been avoided is open to debate, but the lesson that it holds for the future is clear.

The major difficulty may well centre upon the poverty of communication between zoos, and the lack of application of what is known of the biology of the animal in the natural state. The saiga is no longer endangered in the wild, but its

precarious situation in captivity marks it in the same category as those more threatened species for which zoos also possess only a small nucleus wherefrom to seed an active breeding programme. It is imperative that individuals responsible for the care and propagation of such species should be familiar with the literature and sufficiently motivated to enquire into the management practices and results achieved in other collections. Experiences require to be shared, irrespective of whether they have been completely successful or not. In the latter instance, a review of past failures can sometimes establish a trend that will clarify and lead to the solution of a hitherto intractable problem. The present system of studbooks for rare animals, in as much as it is confined to a simple listing of births, deaths and transfers, is in this respect quite inadequate and much valuable material remains unrecorded. The recent decisions made at Munich in April, and at Scottsdale (Arizona) in May 1976 to expand the Przewalski horse and Arabian oryx studbooks are to be commended. The inclusion of the pathology of all dead animals will provide a rapid check of recurrent problems, and one would hope that in time all studbooks will likewise be expanded to include not only pathology reports, but also, as Benirschke (see pp. 50-60) suggests in another paper at this Conference, chromosome assessments and other genetic markers.

In attempting to assemble the captive history of a given species, enquiry is, of course, only as good as the response it receives, and in my own review of saiga data, one-third of the institutions surveyed regrettably failed to reply. Such apathy is something we cannot afford. Nevertheless, it is possible to make certain recommendations, based on a study of the available material from captivity and on the biology of the saiga in the wild.

Whether or not ova are present in faecal samples, it would seem advisable to put newly acquired saiga on one of the broad-spectrum anthelmintics, which can be placed either in feed or water. This should be done as soon as possible, in order to reduce the parasitic load which tends to multiply rapidly in times of stress. Toxicity is low enough to give a margin of safety.

As gregarious mammals, saiga should always be maintained in groups larger than a single pair. In pair situations, particularly during the rut

when the ♂ is extremely aggressive, fatal injuries are often inflicted on the ewe. The group situation allows for a greater degree of aggressive dissipation. During the breeding season, ♂♂ should have their horns capped, and it is also at this time - when the ♀♀ are constantly subjected to stress - that special care should be taken to reduce or eliminate parasitic load. Under no circumstances should more than one ♂ be housed in a group; juvenile ♂♂ must be removed at time of weaning. At the conclusion of the rut, when the ♂♂ are usually in poor condition, it is advisable to remove them from the breeding group and provide supplementary feeding.

Large enclosures must be available to these wandering animals. Because of their flight distance requirements, the exhibits should be designed to have a greater depth than is generally provided for other ungulates. Moated enclosures are best, but if fences are used, sight barriers should be erected to prevent the animals from crashing into the fences when they become frightened. Like wild sheep and goats, saiga should not be kept on grass but should be given a dry, sandy substrate which will mitigate the risk of parasites.

Unfortunately, there is no effective treatment for the bacterium *Sphaerophorus necrophorus* (necrobacillosis), which is a major killer in saiga. It may be, however, that this organism is a secondary invader to a primary infection or inflammation. If that is the case, it should be possible to reduce the number of deaths attributed to *Sphaerophorus* by creating a better captive environment.

SOCIAL BEHAVIOUR AND CAPTIVE MANAGEMENT

The unhappy record of the saiga is a conspicuous instance where - either through ignorance or omission - the biology and behaviour of the species in the wild has failed to influence management practices in captivity. In gregarious ungulates, an understanding of the natural structure and organisation of the herd, of the interaction of the sexes, and of the socially cohesive function of aggression is crucial to the determination of breeding performance and the prevention of sometimes fatal injuries. In the following pages I shall discuss some of the implications of these factors, particularly as they relate to zebra and

the Przewalski horse and the relevant measures adopted at the San Diego Wild Animal Park.

Zebra: Even where there has been some study of social behaviour, we must be careful of making broad assumptions based simply on taxonomic affinities. Like all equids, zebra are gregarious animals, and only rarely do stallions take up a semi-solitary existence. In relation to herd formation the three species behave quite differently. Burchell's zebra *Equus burchelli* tend to stand and graze close together in comparatively large herds, while Grevy's zebra *E. grevyi* groups, although behaving much the same, tend to be smaller, and the ♂♂ appear to be territorial. Mountain zebra *E. zebra*, on the other hand, are never found in large herds, but rather in small troops in which the individual members are widely scattered. They are by comparison solitary animals, with each member of the troop requiring a fairly extended 'individual distance'. When Mountain zebra are in close association, e.g. at watering places, they display their evident displeasure at the situation in aggressive signals such as laying back the ears, and kicking.

The relationship between the sexes during the breeding season also varies from species to species. Grevy's stallions will drive their mares for upwards of half an hour before mating takes place. They call a great deal, and the mares will kick fiercely during the entire pre-mating period. This pattern is similar to that displayed by wild and domestic asses, but unlike the more vicious asses, the zebra stallions seldom damage the mares. In the Mountain zebra, however, there is no driving by the stallions, and it seems almost as if the oestrous mares play the dominant role in mating. Outside the breeding season the stallions revert to their individual distances and express their dislike of close approaches by attacking the mares with teeth and hoofs. The Burchell's zebra, which are otherwise spirited animals, exhibit a rather quiet pre-mating behaviour. Within a large herd, the number of sexually mature ♂♂ and ♀♀ is about equal. Unlike the asses, there is never a fight to the death among the stallions, most fighting being of a ceremonial nature. In the wild, there appears to be no antagonism between mature ♂♂ and the herd stallion; maturing ♂♂ are not driven out of the herd, but appear to leave of their own volition. Quite often a mated

pair will stand to the side of a herd where it will not be disturbed by other mares in oestrus, as often happens among domestic horses.

In the past, the Mountain zebra, because of its apparently aggressive nature, had developed a reputation for being incompatible in captivity. In fact the problem was one of improper husbandry, based on false assumptions drawn from the behaviour of the other zebra species. In one of the first large importations of Hartmann's mountain zebra *E. z. hartmannae* received in the USA after the war, the majority of the adult mares were pregnant at time of arrival. The entire group of some 15 animals was housed in an enclosure of about 0.4 ha and levels of aggression - kicking and biting - were so high that almost all the mares aborted.

At the San Diego Wild Animal Park, the Hartmann's troop at present consists of ten mares and one stallion, which are housed with other species of southern African ungulates in an enclosure of nearly 36 ha. Aggression seems to be absent, and reproduction is excellent. We have not as yet been able to determine the maximum carrying capacity of the enclosure, but with a growing birth rate, the numerical limitations should eventually define themselves in an increased level of aggressive encounters. This species is not suited to a long-term breeding project under traditional zoo conditions unless institutions are willing to commit the space necessary for successful husbandry. It is particularly important that this be borne in mind when considering the future establishment in captivity of the more severely endangered Cape mountain zebra *E. z. zebra*.

Przewalski horse: The Przewalski horse *Equus przewalskii* is another gregarious species that should be kept in groups, and it is interesting to note from the studbook that in collections which house these animals in single pairs there is little or no reproduction. Quite possibly the larger numbers act as reproductive stimulus; this is certainly the case with the White rhinoceros *Ceratotherium simum*, and other species. Furthermore, pair husbandry often leads to fatalities, particularly during the breeding season.

Great care must be exercised with species exhibiting stormy pre-mating behaviour or aggressive social structures. It has been demonstrated

at the San Diego Wild Animal Park that the structure and organisation of the Przewalski horse herd is dependent upon aggressive behaviour, with the stallion exercising complete control over the herd through ritualised displays of aggression (Mackler & Dolan, in press). The ♀ hierarchy is also determined by fighting, the dominant animals asserting themselves in attacks on lower-ranking individuals. The high degree of co-operation exhibited in the herd has evolved in response to the aggressive nature of its social structure. Mares co-operate in defence of the young, and in the defence of individual mares during chase. The leading animal will intervene between individuals to reduce aggression and to protect herd stability. Non-aggressive interaction also strengthens the stability of the group. Mutual grooming appears to have a calming effect and may be a means of reducing the stress inherent in such a social structure. Following a bout of fighting, mares will approach the stallion, and *vice versa*, and the animals touch muzzles in what seems to be a gesture of conciliation or comfort. In relation to the care of the young, ♀ control over aggression is quite remarkable; a foal is rarely, if ever, subjected to attack, no matter how much irritation its play inspires.

The study of the social structure of this herd has brought to light several factors critical to the proper captive management of the species. High levels of aggression are intrinsic to the social structure of the Przewalski horse. The herd as a unit, as well as its individual members, is functional in dissipating aggression, particularly that directed against a specific individual. Since these aggression-reducing mechanisms are a function of the group, it is inadvisable to maintain the animals in single pairs. Without the social mechanism to reduce aggressive behaviour, the animals are a potential danger to one another and there is grave risk of losing one of a pair. Better understanding of complex herd behaviour and the effects of social organisation on breeding potential is needed if the species is to survive in captivity.

In the Asiatic wild ass *Equus hemionus*, herd structure is also based on an aggressive social organisation, levels of aggression here being greater than those of the wild horse, although similar in pattern. Because of this, it is even less advisable for wild asses to be maintained in pairs.

Disruption of, or tampering with, existing social structures can have a decisive effect on reproduction. At the end of 1973, a 12-year-old Przewalski mare that had never bred was received from the Los Angeles Zoo and introduced to the breeding group, which at that time consisted of a stallion and five mares. 'Henrietta' was an extremely aggressive animal exhibiting certain stallion-like behavioural traits. Shortly after the introduction there was a marked change in rank order: the mare which had previously occupied the highest ranking position was forced to the periphery of the herd, and although there was little overt aggression, an obvious tension existed between the two ♀♀. During the 1974 season, two foals were born - one to the deposed alpha ♀ and one to the mare next in the hierarchy. The following year, however, owing to Henrietta's intervention the former dominant ♀ failed to produce, because Henrietta had always interposed herself between this animal and the stallion. This illustrates how necessary it is to ensure that when new members are introduced into an established group, the revised dominance roles do not interfere in ♂-♀ interaction. Early in 1976, Henrietta was removed from the herd and placed with a second stallion and, with her removal, the former herd structure was reinstated.

Maternal behaviour: A knowledge of the maternal behaviour of a species, and its application at the appropriate time, is as vital as the study of its social organisation. In certain gregarious ungulates, such as European bison *Bison bonasus*, ♀♀ approaching parturition isolate themselves from the main body of the herd and remain segregated until the calf is strong enough to follow its mother; it is at this time that the young animal is introduced into the herd structure. If a zoo is to keep such species, it must make sure that it has sufficient space to provide the necessary isolation facilities during and after birth.

In other species, where parturition normally takes place within the family unit, it is often undesirable to remove term ♀♀. This is particularly true of the Arabian oryx *Oryx leucoryx*, which has a highly developed hierarchical system based, as in the wild horses, on aggression. Furthermore, we have observed at the San Diego Wild Animal Park that oryx ♀♀ are covered within a week of giving birth. Their removal at

time of parturition, especially if they are then withheld from the herd for several weeks or months, can result in serious problems when they are subsequently reintroduced. Disturbances within the herd as rank order is re-established can lead to injury and even death.

At the present time we know very little of the social behaviour of species whose observation is difficult in the wild, e.g. desert forms such as addax *Addax nasomaculatus*, Scimitar-horned oryx *Oryx dammah*, and various gazelles. Fortunately, both addax and Scimitar-horned oryx are now well represented in collections, especially in North America, and are available for study. One such investigation is currently in progress at San Diego to define the social and behavioural patterns of a captive herd of 38 addax. If the

history of the saiga is not to be repeated, then these, and many other similar studies, must be undertaken and the material disseminated for the benefit of all concerned with the captive propagation of endangered species.

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