

Saiga Husbandry and Management at the Oklahoma City Zoo

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With 2 Figures

The saiga, *Saiga tatarica*, has been one of the zoo profession's most challenging mammalian species to maintain (DOLAN 1977). Many attempts to keep this high-strung and fractious species in captivity have failed, and sustained, captive reproduction has only rarely been accomplished (FONTAINE 1965, VOSS 1969, POHLE 1974, CURTIS 1977, ZIMMERMAN 1980).

The Oklahoma City Zoo (OKC) has made 2 efforts to keep saiga. The first attempt was unsuccessful, however, the second colony has been maintained since 1977, with annual reproduction and successful rearing of young beginning in 1978. The colony has survived despite a severe herd disease problem and the major changes in husbandry and enclosures required to solve that problem.

This report reviews the history and husbandry of saiga at OKC and outlines the specific management techniques undertaken to cope with an outbreak of Johne's disease in the saiga colony.

History of Saiga in the Collection

Three importations of saiga were made to the OKC. The first saiga (2.4) were acquired as adults in 1969 from Europe. This group experienced considerable mortality early; with 1.1 animals dying in the first year. Reproduction occurred from 1970 through 1973, with 14 (10.4) calves born. Two adult animals (1.1) were recruited into this colony in 1974, however by 1975 all original or purchased saiga had died, and all offspring of the colony had either died or been sold.

In 1977, 2 groups of saiga were imported from Russia (2.8 and 0.2), and, in 1978, an additional Russian male was added. The 1977 imported animals were divided into 2 herds; herd 1 (1.6) and Herd 2 (1.4). All zoo-born female calves were retained in the herds and these individuals began contributing to reproduction in 1980. Eighty-two (38.44) live-births and 3 (1.2) still-births occurred in these herds, by the end of 1983.

In 1981, the zoo began hand-rearing all calves born in Herd 1 because of the herd's infection with Johne's disease. In 1982, the zoo began hand-rearing all saiga born in both herds, due to Johne's infection. Hand-reared saiga were maintained separately from their herds of origin and began producing young in 1984. By the end

of the 1987 calving season, the hand-reared saiga had produced 20 (10.10) live-born calves and 6 (6.0) still-births.

The OKC saiga have experienced extremely high mortality, compared with other ruminant species in the collection. Despite sustained calf production and retention of all female calves, the number of active breeding females in the zoo's import herds remained roughly constant. Of the 1977/78 imported animals, the males survived an average of 1.3 years (range: 1–2 years), and the females survived an average of 3.1 years (range: <1–9.5 years). The longevity record for this species at the OKC was established by a female imported in 1977, presumably as a yearling. She survived, until euthanized for disease control reasons in January 1986, to an estimated age of 10.5 years. Of saiga born at the zoo, the longest lived was a female who survived, until euthanized for disease control reasons, 7.5 years.

Husbandry

Enclosures

Imported saiga were maintained in 3 enclosures at the OKC and the hand-reared animals exhibited in 4 different enclosures. The 1969 importation herd was exhibited in a grassy 3375 m² rectangular pen, with viewing by the public on 2 sides. The back of the exhibit was a 2.1 m chain-link fence and the viewing sides were 1.2 m concrete walls, topped by 1.2 m of chain-link fencing. The animals' inability to avoid proximity and visual contact with the public is felt to have contributed to the high incidence of traumatic injuries within this group, one of the principal reasons for failure of this herd.

The herds developed from the 1977/78 importations were maintained in 2 pens; herd 1 on exhibit and herd 2 off public view. Herd 1 was kept in a 4197 m² (averaged dimensions- 109 m × 39 m) rectangular grassy yard with public viewing at one of the small ends. The side fences were 2.1 m chain-link with the lower 1.2 m covered with wooden planks. The back fence was 2.1 m chain-link covered with wooden planks and the viewing end fencing was similar to that described for the viewing fencing in the exhibit above. A slight central rise visually separated the back half from the front half of this exhibit. Herd 2 was kept in a 8998 m² (average dimensions- 170 m × 58 m) rectangular grassy yard, which had a gentle east-west slope of approximately 5 m. The yard was surrounded on 3 sides by 1.8 m chain-link or "non-climbable" fence and the back fence was 2.1 m high wooden planking.

The above enclosures were covered with bermuda grass, which the animals grazed readily. Water was available ad lib from shallow pools and unheated barns were continuously available. The barns were rarely utilized, even in the coldest weather. One herd of hand-reared saiga (maximum size 1.6 adults) has been kept in a 1880 m² flat, rectangular, grassy yard, with public viewing along one long side. The fencing for this exhibit is similar to that described above for the herd 1 exhibit. This exhibit has a pole barn, enclosed on 3 sides, which is occasionally utilized by the group. The other breeding herd of hand-reared saiga has been kept in a 297 m², oval-shaped, dirt surfaced yard, with public viewing along one half the perimeter (Fig. 1). The back fence is 1.65 m stockade and public viewing is through a 2.0 m chain-link fence. Water for this exhibit is available in a small trough and a small barn, 18 m², is available.

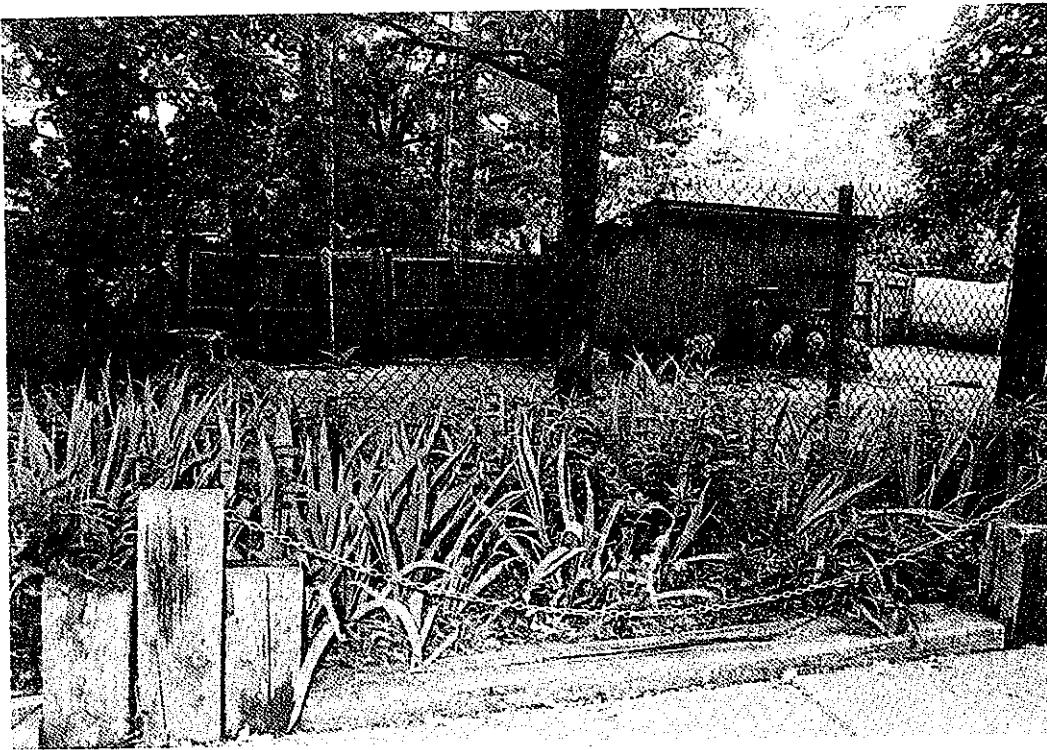


Fig. 1. The smaller, hand-reared saiga exhibit at the Oklahoma City Zoo

Two bachelor herds have been maintained in dirt-surfaced enclosures, similar to the oval enclosure described above but slightly larger. The herds have been composed of mother and hand-reared males. A herd composed of yearlings worked well once a social hierarchy has been established. A herd composed of males of different ages experienced problems. At the conclusion of each breeding season when breeding males are returned to the bachelor herd, a social hierarchy must be reestablished. The males are often in a weakened condition after being in with the females and enter the bachelor herd at the lower end of the dominance order. Visual barriers of 1.2×2.4 m plywood, wedged between bales of hay, have been used to provide temporary hiding places for these males. These barriers are removed once a hierarchy is firmly established. At 5 to 6 months of age, all males' horns are trimmed and capped with aluminium "knobs", to prevent them from injuring other animals or keepers (Fig. 2).

No attempt has been made to clean the entire area of the large grassy enclosures, however areas surrounding the feed stations are cleaned daily. Dirt surfaced exhibits are cleaned entirely on a daily basis.

Diet

The saiga are fed a sweet feed ration (Table 1) and alfalfa hay daily, in mangers or shallow rubber tubs. The amounts fed are adjusted according to season, sex and reproductive condition. General feeding regimes are presented in Table 2. Mineral salt^a) and iodized salt^b) blocks are available ad lib.

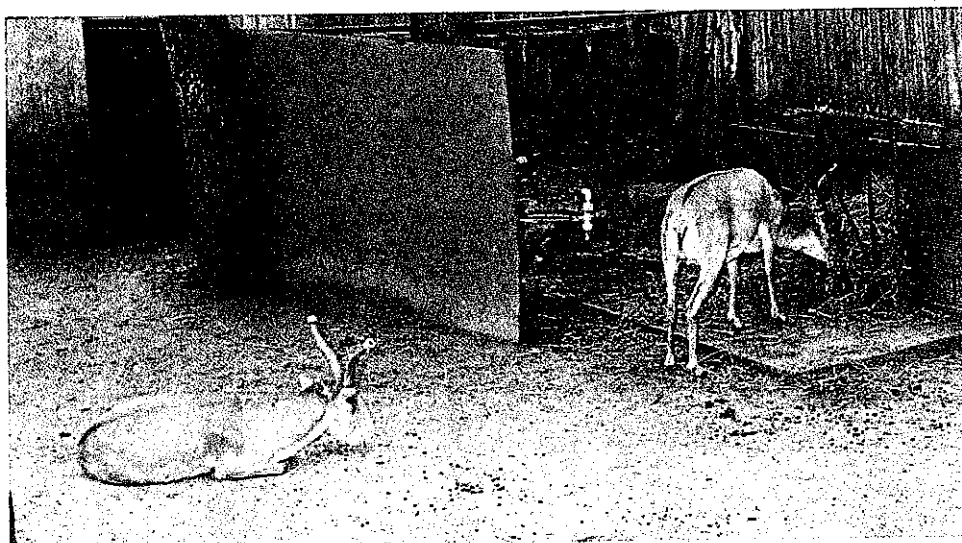


Fig. 2. Male saiga with the tips of their horns protected by aluminum "knobs"

Table 1. Nutritional analysis of the Oklahoma City Zoo sweet (6% molasses) feed ration

Protein	12.9%	Phosphorus	0.6%
Fat	1.9%	Salt	1.0%
Fiber	9.7%	Vitamin A	0.025%
Calcium	0.9%	Vitamin D	0.015%

Table 2. Adult saiga diet and feeding regimes at the Oklahoma City Zoo

	Alfalfa hay (kg)	Sweet feed (kg)	Diet supplied by grazing (%) — presumed —
Winter			
Males	0.6	0.4	0
Females	0.45	0.3	0
Summer			
Males	0.23	0.3	75
Females	0.12	0.22	50
Females in during the 3rd trimester and lactation			
	0.45	0.45	50

Reproduction and herd management

Breeding herds have been maintained as single adult male/multiple female groups. Female calves are usually transferred from their herd of origin to the other herd in late summer. Females will breed in the fall following their birth. Male offspring are routinely removed by the fall of the year of birth, to prevent their injury by the herd male.

In herds 1 and 2, the herd males were left with the females year-round unless removed for health reason. The larger enclosures in which these herds were kept allowed the males to "run" the females during breeding season with minimal injury to the females. In the smaller exhibits, persistent "running", presumably due to the constant proximity of the females to the herd male, occurs and occasionally results in injury to the female. In the herds of hand-reared animals, the breeding male is placed in the herd prior to breeding season and removed prior to calving. During the breeding season it has been common to observe an increased number of lamenesses and other injuries in the females.

Certain males have been very aggressive toward the keepers, to the point of being dangerous. In large enclosures, keepers use hand-held shields to protect themselves. In smaller exhibits, it is easier to hand-catch aggressive males by the horns and restrain them while the exhibit is cleaned and feed distributed. Only the 1969 herd's exhibit had an adjacent catch pen for the male.

Breeding is seldom observed in the OKC herds and is presumed to occur at night. The reported breeding season in the wild and other zoos is late December (BANNIKOV 1967, POHLE 1974, FONTAINE 1965) and gestation is reported to be 139 to 152 days (BANNIKOV 1967). It would appear that the OKC saiga breeding season is more variable than those reported, as births have occurred from 16 April to 21 July (10 births occurred in April, 111 in May, 6 in June and 3 in July). There have been 30 incidences of twins but no triplets recorded. The incidence of twins in primiparous animals appears to be very low.

Currently, all calves are ear-tagged and have their navels dipped in a providone iodine or tincture of iodine solution the day of birth. No antibiotics or vitamin injections have been routinely given to newborns. Animals removed for hand-rearing are weighed and the mean day-of-birth weight is 3.08 kg (range 2.2 to 3.8 kg, $n = 30$).

Saiga dams in one of the hand-reared herds permit nursing by any calf in the herd, such that after 3 days post-partum mother/calf relationships are difficult to determine, unless calves are identified. Occasionally, a dam becomes debilitated due to nursing multiple calves, especially if experiencing other medical problems, requiring her separation from the herd and calves for treatment.

Hand-rearing

Prior to 1981, calves were reared by dams unless maternal neglect required hand-rearing. Of 41 live-births prior to 1981, only 3 calves needed to be hand-reared. Beginning in 1981, calves from herds infected with Johne's disease were hand-reared, to prevent infection of the calf. By 1987, a total of 45 saiga had been hand-reared.

The hand-reared saiga calves were allowed to remain with their dams 12 to 24 hours after birth, to suckle colostrum. Beginning in 1982, if a calf had not nursed colostrum when removed from the exhibit, it was fed bovine colostrum (10% of its body weight), during its first 24 hours in the nursery.

Hand-reared saiga have been fed a formula of 4 parts evaporated milk plus 1 part water (ROHRER 1979). A vitamin A and D supplement^c (1/4 t sp/animal/day, after 6 weeks of age) and microbiotic inoculum^d (1 t sp/7.3 kg body weight/day) is added to the formula. The formula has 5.6% protein and 6.3% fat, which has proved

to be a sufficient approximation of saiga milk's 5.37% protein and 6.7% fat (BANNIKOV 1967). Formula is fed in a 240 ml bottle with a standard black lamb's nipple, at 10% of the calves' body weight per day, divided into 4 equal daytime feedings. Small amounts of bovine calf starter^c) and alfalfa hay are offered after the first week. Reduction of bottle feedings begins at 3 months, although most calves will have begun to wean themselves by this time.

Restraint

Hand-reared saiga and dam-reared males can be captured and restrained by hand in very small pens or exhibits. Hoop nets can be used to catch saiga in small paddocks, however, in large exhibits "drive" nets or chemical restraint are required for capture.

Exhibit size and pre-darting excitement are major factors affecting the success of chemical immobilization. Blow darts or a cap-chur gun and darts^d) are used to deliver immobilizing drugs. For relatively calm adult saiga, in small enclosures, a combination of etorphine HCl^e) (1.5–3.0 mg IM, total dose), xylazine^h) 5–10 mg IM, total dose) and acepromazine maleateⁱ) (0–2.5 mg IM, total dose) or carfentanyl citrate^j) (0.6–0.75 mg IM, total dose) alone or combined with xylazine (1.0–3.0 mg IM, total dose) have been used to immobilize animals. A combination of etorphine HCl and xylazine which produces satisfactory immobilization in excited animals in large enclosures has not been determined, despite considerable experimentation with drug dosages. Hand-catching of darted animals was usually required and hyperthermia (39.4–42.2 C) has been a frequent complication of these immobilizations. Carfentanyl citrate immobilizations of excited animals have shorter induction times and saiga are less responsive to stimuli once caught, than etorphine and xylazine combinations.

In juvenile and neonates, a combination of xylazine (0.1–0.5 mg/kg IM) and followed by ketamine HCl^k) (5 mg/kg IV or 10 mg/kg IM) is useful for simple procedures, such as radiology. Inhalation anesthesia, halothane^l) vapor in oxygen delivered by mask or endotracheal tube, provides better restraint and analgesia in adults and neonates for longer diagnostic procedures and surgery.

Health

Morbidity

Trauma, hoof problems and intestinal parasitism have been the most common saiga health problems necessitating veterinary intervention at the OKC. Fractured limb bones and non-fracture lamenesses have occurred more frequently in saiga than any other of the 26 species of ruminants kept in the collection. Excessive hoof growth has been sporadically encountered in saiga from all herds, necessitating frequent restraint and hoof trimming. Intestinal parasitism has been a chronic problem in all saiga groups, despite frequent (from 3 to 12 times a year) anthelmintic therapy. Recently, dystocias and parturition related problems have become more common.

Mortality

Trauma, neonatal enteritis and Johne's disease have been the 3 major causes of saiga mortality at the OKC. Trauma cases have been principally limb fractures not amenable to repair, broken necks and abdominal hernias. Enteritis, particularly a single outbreak of salmonellosis which claimed 8 calves, was the major cause of hand-reared neonatal saiga deaths. Improved nursery hygiene, separation of neonates during the first 3 weeks in the nursery and careful monitoring of colostrum intake has dramatically reduced the incidence of neonatal enteritis in hand-reared calves.

Management of Johne's Disease in the Colony

Johne's disease is a bacterial disease of ruminants caused by *Mycobacterium paratuberculosis*. In 1981, a 1977 import female died of Johne's disease and, subsequently, 10 zoo-born saiga died or were euthanized due to Johne's infection. The principal, in most cases only, clinical sign was general body wasting. Diarrhea, when it occurred, was present only the day prior to death. Zoo-born saiga which became infected lived an average of 38 months (range: 24 to 65 months). Diagnosis was based on characteristic histopathology for Johne's disease and presence of acid-fast organisms in the ileum and mesenteric lymph nodes. Diagnosis was confirmed by post-mortem culture of the etiologic agent from 2 individuals.

Control of Johne's disease was accomplished by quarantining all saiga exposed to clinically ill individuals in the off-exhibit (herd 2's) paddock. All structures, feeders and fences in the contaminated exhibit were disinfected with a mycobacteriocidal disinfectant and the exhibit was cultivated twice during the 2 years it was left vacant of ruminants.

The exposed saiga were allowed to breed for 3 seasons, with all calves removed within 24 hours of birth, for hand-rearing. In 1986, the animals remaining in the exposed herd were euthanized to eliminate the risk of spread of the infection.

Hand-reared animals were vaccinated with one half dose of an experimental Johne's bacterin, developed for use in cattle. The bacterin was administered intramuscularly, in the brisket, at age 5 days. Two vaccinates died within 24 hours of vaccination. The only lesions present in these individuals were hemorrhagic areas at the sites of vaccination and we believe their deaths were vaccination related.

Hand-reared saiga were raised in an area of the zoo separate from the exotic ruminant collection. Fecal cultures for *M. paratuberculosis*, (four at 4 month intervals) were performed on each hand-reared saiga which was born in the exposed herd, beginning at one year of age. All fecal cultures were negative. Additionally, all saiga which have died or were euthanized were necropsied and ileum, mesenteric lymph nodes and large intestine examined for microscopic lesions of Johne's infection and presence of acid-fast organisms and cultured for mycobacteria. No lesions or organisms of Johne's disease have been found.

Discussion

Our experience confirms prior observations (POHLE 1974) that mother-reared saiga require large (by traditional zoo standards), relatively private exhibits to do well

in captivity. In their adaptation to life on the open steppe, saiga have evolved a flight response of straight-away running. They turn in wide circles and can not stop quickly. As a result, in small enclosures mother-reared individuals frequently run into walls or each other when frightened. The large enclosures, occupied by the import herds, allowed the saiga to physically and visually isolate themselves from people and also permitted sufficient space for females to avoid the male during the "running" of breeding season. These large enclosures also permitted females in labor to distance themselves well away from the herd for parturition. We believe the large size of these enclosures to be the principal factor in the successful keeping of the 1977/78 import herds.

Hand-rearing saiga has proven to be relatively easy and produces animals which possess several behavioral advantages. They are far more tractable and adaptable to smaller exhibits than mother-reared animals. The tame nature of most hand-reared saiga permits individuals to be more easily hand-caught or netted and physically restrained, leading to fewer chemical immobilizations. Administration of immobilizing drugs to calmer, hand-reared animals also produces more satisfactory immobilizations. Although our experience in transporting saiga is minimal, we have had several deaths occur during transport. Based upon our experience in moving individuals within the collection, we feel the hand-reared calves tolerate the stress of transport better than mother-reared animals and are more likely to survive long distance transportation.

Hand-reared animals will reproduce and raise young in small exhibits, however since saiga have been kept in smaller enclosures at OKC, there has been a steady decline in the Zoo's saiga population. There has been a reduced frequency of twinning and an increased frequency of dystocias. Breeding female mortality has also continued to be a problem. There are several possible explanations for this. No new animals have been introduced into the collection, so the inbreeding coefficients for individuals have risen. To limit contamination of exhibits, the zoo has left the hand-reared saiga and their offspring (mother-reared animals) in small exhibits, pending determination of the success of the Johne's disease management program. For the mother-reared animals especially, this may be creating problems. Additionally, the larger herd of hand-reared females was intentionally not bred its first reproductive season, to limit surplus animals. In subsequent years, this herd has had a high frequencies of barren females and other reproductive problems. Leaving the females unbred for their first year may have been contributing factor to their reproductive problems. At present, it appears that the management program has solved the problem of Johne's disease in the OKC's saiga, however it may have caused another series of reproductive problems for this colony.

Johne's disease has occurred in two other captive saiga herds (RAPHAEL personal communication, SCHRÖDER 1985) and is a disease which should be a concern to institutions importing saiga. The lack of good ante-mortem diagnostic tests and the draconian measures required to control it, make this disease particularly difficult problem. A good health history of the herd of origin, a strong quarantine program for all incoming animals, including fecal cultures for Johne's organisms and possibly mesenteric lymph node biopsies, and careful necropsy of all quarantine deaths can help prevent entry of this disease into a collection.

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Products mentioned in text:

- a) Trace mineral block, Cargill Inc., Minneapolis, MN
- b) Brine Block, Cargill Inc., Minneapolis, MN
- c) Vitamin A & D mixture, Omaha Vaccine Co., Omaha, NB
- d) Feed Mate, Anchor Laboratories Inc.
- e) Startena, Purina Co., St. Louis, MO
- f) Palmer Co., Douglasville, GA
- g) M99, Lemon Co., Sellersville, PA
- h) Rompun, Haver-Lockhardt, Bayvet Div. Shawnee, KS
- i) Tech America, Elwood, KS
- j) (experimental drug) Janssen Pharmaceutical, B-2340 Belgium
- k) Vetalar, Park-Davis Co., Morris Plains, NJ
- l) Halocarbon Laboratories, Hackensack, NJ

Addendum

The saiga population at the Oklahoma City Zoo continued to decline from 1987 to 1989. In January, 1987 there were 31 (13.18) animals in the collection, but by July, 1989 this number was down to 5 (3.2). These 5 surviving animals were subsequently sold. As stated previously, stress due to space limitations and inbreeding are possible explanations for this decline. The fertility of the saiga hand-reared in 1981, 1982, and 1983, did not decline as previously speculated but was approximately the same as the fertility of mother-reared animals.

A major cause of saiga mortality from 1987 to 1989 was amyloidosis. The cause for this disease is unknown but may be associated with the Johne's disease vaccination program. Of the 19 animals which were vaccinated and survived two years or more, 11 developed amyloidosis. Of the other 8 saiga, 4 showed no signs of amyloidosis and 4 were not evaluated histologically. Only the hand-reared animals received the experimental Johne's vaccine and it would appear, in hindsight, that it may have done more harm than good. The amyloidosis problem in these animals is being described elsewhere (BARRIE, M., in prep.).

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