Husbandry Guidelines
For the

Common Eland

Taurotragus oryx

Mammalia: Bovidae

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DISCLAIMER

OCCUPATIONAL HEALTH AND SAFETY RISKS

WARNINGS

- ***These animals are classified as Hazardous. This is upgraded to Dangerous if an animal escapes.***
- ***A viable escape route must be maintained at all times when working around these animals.***
- ***These animals are flighty around humans and will run easily if threatened.***
- ***They may run into their night yards when given access in the afternoon. Stand clear of gateway and take care opening access gates.***
- ***Do not lock in.***
- ***Do not chase.***
- ***Do not force into a corner.***
- ***Do not split the group.***

(TWPZ Animal Husbandry Notes)

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1 Introduction

Spiral-horned antelope are linked with wild cattle and the four-horned antelopes in the subfamily Bovinae. They evolved from animals resembling the present-day four-horned antelope and the nilgai. The spiral horn is a layer of keratin over a bony core. It is swept back with a dramatic corkscrew effect following the plane of the face. The size and length is partly a function of body size but the twisting is a throwback to its four-horned ancestors. The fusing of the two sets of horns may have been caused by the keratin on the frontal ridge of the skull growing at a different rate to the main horn, producing a corkscrew effect. *(Macdonald 2006)*

It is believed that the eland has evolved from a giant form of kudu that was abundant about 1.3 million years ago. They are green foliage gleaners from a wide variety of mostly unstable habitats. They do not tolerate true desert. Social structures are rudimentary. Herding is not induced by habitat but is thought to be a defensive strategy of females and young. This could also be the reason for the development of horns in females. *(Kingdon 2007)* When they are attacked, elands use their horns to defend all parts of the body. When fighting other males, the horns accentuate body size and are important in establishing dominance. Females tend to be more generic. *(Macdonald, 2006)*

The Common Eland, also known as the "Southern Eland" is a savannah and plains antelope found in East and Southern Africa. It is considered the largest of the antelope species, though in many respects they are quite bovine. The Giant Eland is similar in size to the Common Eland but is found in more northerly regions of Africa.

Population densities and mortality rates are often affected by food supply, predation, disease and presence of humans. By putting up fences for cattle, ranchers disturb natural migration routes of eland. This affects access to an adequate food supply. Drought related mortality is common after several seasons of below average rainfall. Eland, particularly calves, are an important source of food for many large predators such as lions, hyenas, wild dogs and cheetah.

Thus eland have disappeared from large sections of their former range due mainly to excessive hunting and habitat loss. However, they are still widely distributed and well represented in national parks. They are locally vulnerable or endangered (in Uganda and Rwanda) but overall not endangered. (*Kingdon 2007)*

Eland are considered docile and easily tamed. However, they require a large area in which to graze. In Natal South Africa they are domesticated for meat and dairy production. Eland milk has almost three times the fat and double the protein of milk from a dairy cow. (*Pappas 2002; Benoit 2008; Kingdon 2007)*

In several other countries, eland are semi-domesticated. In captivity their diet can be supplemented with grains and hay or chaff. Salt licks are necessary. *(Ebedes & Van Rooyen 2002)*

There are disadvantages to domestication. *(Pappas 2002)* The cost of supplemental food can be considerable, and large quantities are necessary to maintain health. Also, eland sometimes graze at night to avoid heat stress. This can create risks with predation and losses caused by wandering. Herders tend to corral them to prevent this.

Keeping eland inside enclosures is difficult because they are good jumpers. Because of their sheer mass they can break through fences or dividers. Wild eland, particularly males, have been known to break into paddocks where domesticated eland were held. *(Pappas 2002)*

Advantages of domesticating eland include their low demand for water, hence their ability to cope with drier climates, and their abundant milk production. Eland can produce several litres of rich creamy milk per day. The milk is easily preserved and can last much longer than that of domestic cattle. Eland milk exposed to air for two hours then stored at 37^{o}C will last up to eight months, whereas milk of domestic cattle under similar conditions will decompose in days. *(Pappas 2002)*

Captive eland reproduce successfully, although calf survival is low and some females tend to lack sufficient mothering skills. Calves are sometimes removed from the group to ensure they remain healthy and well fed. *(Pappas 2002)*

Taronga Western Plains Zoo has held eland since 1976 and has bred over 130 calves. Of these, 14 were hand-reared to fulfil the requirements of other institutions.

Transporting adult eland has proven to be difficult due to the exaggerated flight response during veterinary and loading procedures. Capture myopathy is a considerable problem. *(Benoit 2008)*

1.1 ASMP Category

No Regional Program. Management Level 3.
Planned Category: Population Management Program. Management Level 2
Taronga Western Plains Zoo TAG Recommendations – Follow Regional Recommendations.

1.2 IUCN Category

Lower Risk – Conservation Dependent.

1.3 EA Category

VPC Status: Serious. Category 2 – Limited to statutory zoos or endorsed special collections.
Source: Overseas captive populations.
Availability: Australia requires Bovid IRA to import.
ARAZPA population size has decreased in recent years. Rescue Plan developed by ARAZPA office. Transport issues to be resolved. *(ASMP 2007)*

1.4 ASMP Species Coordinator

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1.5 ASMP Studbook Holder

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(Benoit)

2 Taxonomy

Common Eland are sometimes considered part of the genus *Tragelaphus*, but are usually categorized as *Taurotragus* along with the giant Eland.

The name "Eland" is derived from the Dutch word for "moose". When Dutch settlers came to the Cape Province they named the largest wild ruminant herbivore they met with the name of the huge northern herbivore. In Dutch, the animal is called "Eland antilope" to distinguish it from the moose, which is found in northern boreal forests. *(Wikipedia 2008)*

2.1 Nomenclature

Class	**Mammalia**
Order	**Artiodactyla**
Family	**Bovidae**
Subfamily	**Bovinae**
Genus	**Taurotragus**
Species	**Taurotragus oryx**

2.2 Subspecies

- *Taurotragus oryx livingstonei.* (Livingstone's Eland). Found in Central woodlands. Brown with up to 12 stripes.
- *Taurotragus oryx oryx.* (Cape Eland). Found in South and South West Africa. Tawny colour. Adults lose their stripes.
- *Taurotragus oryx pattersonianus* (East African Eland). Found in East Africa. Has a rufous tinge with up to 12 stripes.

(Kingdon 1997)

2.3 Recent Synonyms

- Common Eland
- Eland

2.4 Other Common Names

- Livingstone's Eland
- Cape Eland
- East African Eland
- Elan du Cap (French)
- Elanantilope (German)
- Pofu (Swahili)

(Fahey 1999)

3 Natural History

3.1 Morphometrics

The eland is considered to be the largest and most oxlike of all the African antelopes. They are spiral-horned antelopes whose massive size and horns are used to protect them from predators. They are too slow to outrun any predators such as lions, hyenas, leopards, cheetahs and wild dogs but are quite agile and can jump over regular fences. *(Krugerpark)*

The head is short and small with comparatively small, narrow ears. Beneath the neck is a prominent dewlap. The tail is hock-length and cow-like with a black terminal tuft.

Colouration varies individually and geographically. Generally, the eland is a tawny colour, darkening with age. Young eland are reddish brown with 10-16 white stripes and a dark dorsal

3.1.1 Mass and Basic Body Measurements

Females weigh 300-600 kg, measure 200-280 cm from the snout to the base of the tail and stand 125-153 cm at the shoulder. Bulls weigh 400-1000 kg, measure 240-345 cm from the snout to the base of the tail and stand 150-183 cm at the shoulder. The tail adds a further 50-90 cm.

3.1.2 Sexual Dimorphism

Eland are sexually dimorphic, with females being smaller than the males. As males age, they tend to turn a greyer colour. Both sexes have a dewlap, but as males mature the dewlap can become very pronounced, hanging down nearly to their wrists. Adult male eland also have a large tuft of darker hair on the forehead which covers glandular skin. *(Davidson, 2005).*

3.1.3 Distinguishing Features

.All elands have a tawny coat with distinctive vertical white stripes, although individual and geographical variations are present. The colour tends to darken with age. Young elands are usually reddish-brown.

Markings are more pronounced in the northern *Taurotragus oryx pattersonianus,* fading in the more southerly subspecies, and faint or absent in the South African *Taurotragus oryx oryx.* Most have a dark dorsal crest with white markings on the legs and black garters on the upper forelegs and around the hooves.

All have very large necks and shoulders. Both males and females have horns measuring 65 cms long and with a steady spiral ridge resembling that of the bushbuck. The female's horns are wider set and thinner than the male's. Both male and female horns slant backwards.

The difference between the Giant Eland and the Common Eland is not size. Rather, the Giant Eland has much larger, diverging horns which make it a giant over the Common Eland. *(Zoossa)*

3.2 Distribution and Habitat

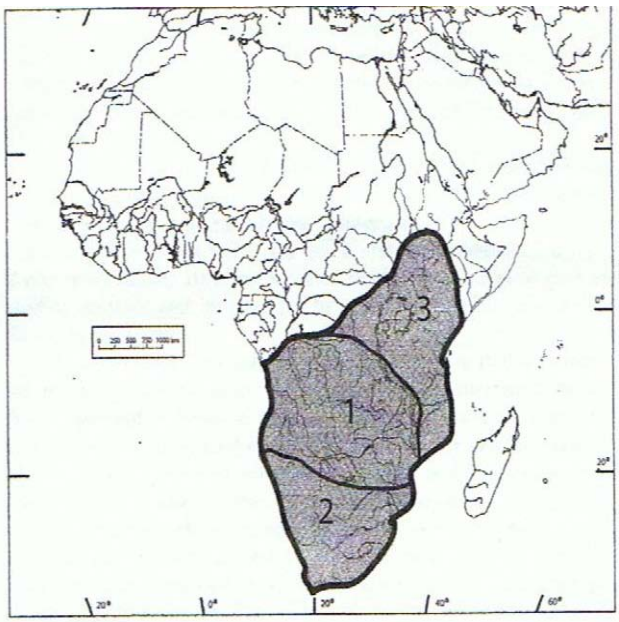

Figure 1. Geographic distribution of *Taurotragus oryx.* Subspecies are (1) *T. o. livingstonii, (2) T. o. oryx,* and *(3) T. o. pattersonianus.* Map modified from Ansell (1972) and Estes (1993).
(- Pappas 2002)

Once widespread throughout suitable habitat in southern, central and east Africa, the Common Eland has become extinct in many areas, and populations have declined in others.

The eland now has a range that extends north into Ethiopia, to the east into western Angola and Namibia, and into South Africa. Most of the populations in the southern part of Africa are those that have been reintroduced to the area. *(Pappas 2002).*

Within these regions, nomadic eland roam seasonally based on availability of food and water. Eland inhabit open plains, savannahs, woodlands, sub-desert and bush. They tend to avoid forests, swamps and deserts. *(Lydon)*

Eland gather into larger herds during and after the rains and scatter into smaller groups in the dry season. For the females, this corresponds with a shift into more open country during the rains and into thickets and woodlands in the dry season. Mature males move much less and venture less into the plains. In effect, female groups form primarily as a defence and for the protection of the young. (*Kingdon 2007)*

3.3 Conservation Status

Eland populations have declined or become extinct in many parts of their range, but overall are still relatively common. Overhunting has been one cause of declining numbers.

Eland are classified as Lower Risk – Conservation Dependent on the IUCN Red List. On CITES they are classified as No special status.

3.4 Longevity

3.4.1 In the Wild

Eland live on average 8 – 10 years. (*Benoit 2008)*

3.4.2 In Captivity

In captivity, eland may live up to 25 years. *(Kingdon 2007)*

3.4.3 Techniques Used to Determine Age in Adults

As with most ruminants, the development and wear on the teeth of an eland may give some indication of age. However, the most accurate method is to compare the development of the teeth to other eland of known age. *(Torell 2003)*

4 Housing Requirements

4.1 Exhibit/Enclosure Design

Eland are large, flighty herd animals best suited to an open range concept of exhibit. They need plenty of room to move and run. They browse as well as graze, so shade trees may need to be cordoned off to prevent destruction. Sufficient shade and shelter must be provided, so that all animals can be protected. Visitors need to be able to view the animals without the eland becoming stressed. Movement of the animals to and from night yards / holding yards needs to be considered. Holding yards may be smaller and more enclosed, but still must have adequate room for the animals to run away from perceived danger. Alternatively, overnight access to the exhibit should be considered.

General principles of exhibit design include:

- Provide adequate room for the animals to move freely and without appearing enclosed.
- Provide adequate shelter from wind and rain for all animals without unnecessary aggression in the herd.

- Provide concrete or cement water troughs with floats to ensure a constant drinking water supply.
- Feed troughs, if used, should be strong, sturdy and positioned such that injury from fleeing animals is avoided. Mesh feed racks are not recommended because Eland horns may become tangled in the mesh.
- Fences should be high enough to prevent the animals jumping out, or even attempting to do so and strong enough to withstand pushing by the herd.
- All objects that could injure the animals should be removed from the enclosures before the animals are transferred to them.
- Fresh feed and water must be available daily.
- Grass tussocks, wind breaks and behaviour enrichment items such as horn rubbing poles should also be included.

(Ebedes & Van Rooyen 2002, Benoit 2008)

4.2 Holding Area Design

Holding enclosures may be smaller than exhibit areas, but need to provide adequate room and shelter for all enclosure animals without unnecessary aggression and fighting for space. Eland particularly are flighty, so need access to exhibit areas or should be kept in smaller holding enclosures for minimal time.

General principles when designing holding areas include:

- Fences should be strong enough to prevent the strongest animal escaping.
- The sides should be high enough to prevent jumping out and escaping.
- All objects that could injure the animals must be removed before Eland are given access to the enclosure.
- All enclosures should be inspected and all doors/gates and locks should be in working order before any animals enter.
- Fresh air needs to continuously circulate, so the sides of the holding yards should not be solid. If wooden posts are used, the gap should not exceed 15 mm.
- A roof offering shelter should be provided over a third of the enclosure. Run-off water should be channelled outside the enclosure.
- Free standing water troughs are unsuitable because the animals can move them, causing possible injury and spilling the water. Round cement troughs sunk into the ground and positioned against the outer wall of the enclosure are preferable. A portion of the water trough can extend beyond the enclosure to facilitate cleaning and refilling with fresh water. Alternatively a float to provide a continuous supply of fresh water is suggested.

(Ebedes & Van Rooyen 2002)

4.3 Spatial Requirements

In NSW eland are subject to the General Standards for Exhibited Animals, EAPA (Exhibited Animals Protection Act NSW, 1986). Currently there are no species-specific EAPA standards for ungulates.

In 2008 Taronga Western Plains Zoo held nineteen Eland in approximately 1062 hectares (exhibit) with access at night to three large night yards approximately 28 metres by 15 metres. *(Benoit 2008)*

General principles regarding spatial requirements include:

- Eland may be kept outside year round and require shelter from wind and harsh sun.
- In areas where eland need to be stalled for short periods, a single stall for an Eland should measure at least 9.3 square metres.
- Males may be housed individually but females may be housed together as a single social unit.
- In areas requiring long periods of confinement, indoor enclosures should be at least 14 square metres for a single eland, with 9.3 square metres added for each additional eland.
- The temperament of individual animals needs to be considered, with additional space allowed for more aggressive animals. Alternatively, these animals may be housed separately.
- Outdoor enclosures should measure at least 30 square metres for each animal.

(Ebedes & Van Rooyen 2002)

4.4 Position of Enclosures

- The exhibit should be positioned to allow easy viewing by the public, yet given the perception of privacy for the eland.
- Night yards need to be positioned away from view of the public and in quiet, sheltered areas.
- Access to both exhibits and night yards should be unobtrusive yet positioned in such a way that keeper access is not hindered for safety reasons.
- Long narrow raceways are not recommended.

(Ebedes & Van Rooyen 2002)

4.5 Weather Protection

Eland may be kept outside year round and only require shelter from prevailing winds and harsh sun or extreme weather conditions.

- All eland enclosures may be open as long as adequate shelter is provided for the animals to seek shade during the hottest part of the day.
- Shelter from the wind must also be considered.
- Shelter from rain should be considered. Many eland will not actively seek shelter from light rain, but may seek shelter from heavy rain. If the animals are to be in a small enclosure during rain, shelter should be provided. The roof of the shelter needs to be high enough so that the animals do not feel "trapped". Run-off water should be channelled to outside the enclosure to prevent foot-rot and respiratory infections.

(*Ebedes & Van Rooyen 2002)*

Figure 2. Rock and tree shelter at Taronga Western Plains Zoo.

4.6 Temperature Requirements

Eland are relatively heat tolerant and temperatures in excess of 38 degrees C are tolerated as long as adequate water and shade is provided. Shade should be enough so that all herd members are covered without forced aggressive interactions. Wind shelter should also be provided.

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Eland may be kept outside during winter. Where temperatures below freezing for more than 96 hours are expected, supplemental heating should be provided in protected areas or barns. Temperatures below -11degrees C may result in frostbite on the ears, horns or feet. Factors such as rain, snow, sleet and wind chill should also affect the decision to move animals into protected shelters. Indoor temperatures should range between 10 to 26 degrees C. Stalls should have ample bedding for comfort and insulation.

(*Ebedes & Van Rooyen 2002)*

4.7 Substrate

- Outside enclosures of soil or gravel substrates are appropriate.
- Indoor floors should have a broom-swept, or similar, finish to prevent too smooth a finish and slipping. Sand, clay or soil-filled stalls may be used.

4.8 Bedding Material

- Bedding may be straw, rice hulls, or wood shavings. All bedding should be cleaned daily and urine- or faeces-soiled bedding removed and replaced.

4.9 Enclosure Furnishings

- Eland are crepuscular, feeding early morning and evenings. They spend much of the day in shade on hot days and resting in sunny areas on windy or cold days. Thus enough trees to provide adequate shelter for all animals is needed.
- Because eland are very good jumpers, fences need to be high and sturdy enough to prevent escape.

- Concrete water troughs should be accessible for the animals and yet positioned so that keeper access for checking and cleaning can be done unobtrusively and in safety.
- Streams, ponds or moats are quite effective. Care must be taken that the whole enclosure has adequate drainage.
- Scratching / butting logs and poles can be effective, but care must be taken with positioning these to prevent injury if animals flee from perceived danger.
- Grass surfaces provide a natural pick for grazing during the early morning and evenings.
- Areas for concealment, particularly of newborn calves should be considered. These could be rocks, hollows or strategically positioned logs.

Figure 3 Water feature for eland at Taronga Western Plains Zoo

5 General Husbandry

5.1 Hygiene and Cleaning

- Faeces and urine accumulation during confinement of eland is unnatural. It is undesirable to have the animals lying in or standing in these excretions. Enclosures should be checked daily and cleaned regularly, preferably daily.
- Cleaning needs to be completed without unnecessary disturbance to the animals.
- Additional enclosures or areas must be provided for the animals while cleaning occurs.
- Outdoor enclosures with good substrates should be spot-cleaned at least weekly.
- Areas near feed stations should be raked to keep the ground clean and as parasite-free as possible.
- Food should be offered in hard surfaced pans or troughs to limit exposure to parasite-infected areas. Large outdoor areas may not need to be spot cleaned if the substrate absorbs urine and natural forces are sufficient to break down faeces.
- All food and water containers should be checked daily and cleaned as appropriate.

- No chemical agents are needed for cleaning of large enclosures. In small indoor enclosures, bleach (thoroughly removed afterwards) can be used to sanitise the area.

At Taronga Western Plains Zoo, the following cleaning regime is followed:

- All faeces and spilled chaff are raked from around feed troughs and the night yard (AFN 18/19) daily.
- Water troughs are checked daily and cleaned if needed, or weekly in winter and twice per week in summer.

5.2 Record Keeping

At Taronga Western Plains Zoo observed behaviours including breeding, births and deaths are recorded on a daily report with respective identification numbers and ARKS numbers. *(Benoit 2008)* Similar records should be kept in other institutions.

5.3 Methods of Identification

Current identification methods used are ear tags. Males are tagged in the right ear. Females are tagged in the left ear. Microchip Transponders are inserted on the left of the neck in all animals.

At Taronga Western Plains Zoo the current ear tags are small, making them hard to read at a distance. It has been suggested to alleviate this it may be possible to use a branding method such as dry ice and a dot system, with the dots being no larger than a $2 coin. *(Benoit 2008)*

5.4 Routine Data Collection

All notable events in the management of eland are recorded on the Daily Report, as per institutional policy. Standard notation is used.

Events include:

- Births
- Deaths
- Dispositions
- Breeding
- Internal movements and transfers
- Weight
- Measurements
- Treatments
- Veterinary examination and care
- Any other notable events.

6 Feeding Requirements

6.1 Diet in the Wild

Eland need a high protein diet that comprises succulent leaves from a variety of flowering plants. These include *Acacia, Combretum, Commiphora, Diospyros, Grewia, Rhus* and *Ziphus.* Eland may also eat forbs (nonwoody dicotyledons) from the family Compositae, including *Acanthospermum, Bidens, Tagestes,* and *Tarchonanthus.* Fruits from *Securinega* and *Strychnos* may also be eaten. Dominant grasses include *Setaria* and *Themeda.* Densely wooded forests are avoided.

Eland have been classified as browsers that have adapted to grazing. They may graze during the rainy season when grasses are plentiful, but browse more during the drier winter months.

Although eland drink water when it is plentiful, they obtain most of their water from their diet. *(Pappas 2002)*

Because they use a variety of food sources eland move from region to region based on season and food availability. In general, females use more habitats than males and have a larger home range. Because of their size, eland need a large area per animal in which to feed. This area can range from 174 km^2 to 422 km^2. *(Pappas 2002)* Seasonal fluctuations occur with populations tending to be larger during the wet season when food is abundant and calving has occurred.

6.2 Captive Diet

At Taronga Western Plains Zoo the following diet is provided daily:

- Approximately 5 kg Lucerne chaff per individual
- Approximately 2.5 kg oats per individual
- Grazing available on exhibit.

Bread is used for conditioning at the supervisor's discretion.

Casuarina, Kurrajong and Acacia browse is fed regularly, depending on availability.

From May through to September the Eland are placed on a winter diet which comprises the above diet plus:

- Approximately 700 g horse cubes per individual
- Approximately 700 g cracked lupins per individual

6.3 Supplements

- Calcium molasses stock blocks are available *ad lib.*
- Copper/cobalt stock blocks are available at all times.

6.4 Presentation of Food

Eland have access to grazing on exhibit during the day. In the afternoons other food as listed above is placed in different feeding stations in the night yards. Several feed stations are used so that all animals have access to the food.

On Mondays and Wednesdays Lucerne hay is offered to eland to replace the chaff in the night yards. The hay is often fed out on exhibit. This provides additional food on exhibit and assists in conditioning the eland to accept keeper vehicles and presence of keepers on exhibit.

Monitoring of food intake is carried out by keepers. This includes observing the quality of the food and amounts left over daily.

7 Handling and Transport

Warning!

Eland are very susceptible to capture myopathy. All capture, restraint and handling should be done quickly and with as minimal disruption to the herd as possible.

7.1 Timing of Capture and Handling

It is preferable to arrange capture of eland in early morning when it is cooler.

7.2 Capture and Restraint Techniques

Eland at Taronga Western Plains Zoo are handled infrequently and are not crate or chute trained. For this reason, they are very susceptible to capture myopathy, as are all eland.

Currently we are conducting a trial using Vitamin E powder sprinkled on their oats, every second day for a month before any capture occurs. This will hopefully reduce the reaction to capture myopathy. By treating the herd, it is ensured that the target animal will have consumed his/her share of the vitamin E.

Eland are chemically darted using etorphine and xylazine.

It is imperative that once a darted animal goes down that the team immediately attend to it to raise the head to prevent regurgitation or aspiration and to protect it from the rest of the herd.

For all internal capture and restraint procedures, once the animal is immobilized, it is placed onto a tandem axle trailer using a skid, ramps and petrol driven winch.

(Benoit 2008)

7.3 Weighing and Examination

Under anaesthetic, blood samples, vaccinations, treatments and examination for specific injuries or illnesses are carried out. No regular treatments, e.g. hoof trims, are required. Thus veterinary procedures are only carried out when required.

Currently Taronga Western Plains Zoo is investigating the purchase of suitable mobile scales to weigh eland (difficult due to size of animal). *(Benoit 2008)*

7.4 Release

If possible, eland should be released early in the day so that maximum time can be allowed for observation in daylight. It also allows the animal time to explore its surroundings in daylight.

Animals under general anaesthetic have the anaesthetic reversed in situ (away from visitors). As soon as the animal becomes conscious, they are left but observed closely until they are fully alert.

7.5 Transport Requirements

At Taronga Western Plains Zoo, for internal movements, eland are immobilized and placed onto a tandem axle trailer using a skid, ramps and petrol driven winch.

For external movements, the transport crate is designed to meet International Air Transport Association Regulations.

7.5.1 Box Design

- **Materials**. Wood or metal and rubber, burlap or canvas for padding and light reduction if required.
- **Principles of Design.** The following principles of design must be met in addition to the General Container Requirements outlined in IATA standards.
- **Dimension.** The height and width of the container must allow the animal to stand erect with its head extended even if horned. The size of the container must sufficiently restrict movement so that the animal cannot turn around and in so doing trap or injure itself, nor have space to kick and damage the container. The dimension of the container will vary according to the animal being shipped
- **Frame.** The frame must be made of a minimum of 2.5 cm (1 in) solid wood or metal parts, bolted or screwed together. When the weight of the container plus the animal exceeds 60 kg (132 lb), additional metal bracing must be present around the whole container.
- **Sides.** Suitable plywood or similar material must closely line the frame to a level slightly above the animal's eye over which there must be a louvered or slatted area for ventilation extending the roof. The interior must be completely smooth.

- **Floor.** The base must be solid and leak proof. There must be either pegboard or slats bolted to the solid base to give a firm foothold. A droppings tray must be provided under the peg board or slats to prevent excreta escaping.
- **Roof.** The roof must be slatted at a width that horns cannot become trapped between the slats. If padding is required, soft material such as shavings can be stuffed under the rubber, canvas or burlap covering.
- **Doors.** Hinged or sliding entry and exit doors must be provided. They must be fastened in such a way that they cannot be accidentally opened. They must have similar ventilation opening as on the sides. Hinged doors should not be used for equids.
- **Ventilation**. Ventilation louvers or slots, with 2.5 cm (1 in) spacing between the louvers/slats or holes, with a minimum diameter of 2.5 cm (1 in) must be present, above the eye level on all four sides and the roof to close boarded containers. Slots and holes must be covered with a fine mesh that will not allow any part of the animal, including horns to protrude. If mesh is on the inside of the container, all edges must be protected to prevent injury.
- **Spacer Bars/Handles.** These must be made to a depth of 2.5 cm (1 in), and formed from the frame work of the container.
- **Feed and Water Containers.** Feed and water containers must be provided with outside access from a hinged bolted flap that must be large enough for the entry of a large water dish and/or quantities of appropriate food such as grass, hay, etc.
- **Forklift Extrusions.** The must be provided if the total weight of the container plus animal exceeds 60 kg (132 lb).

(Benoit)

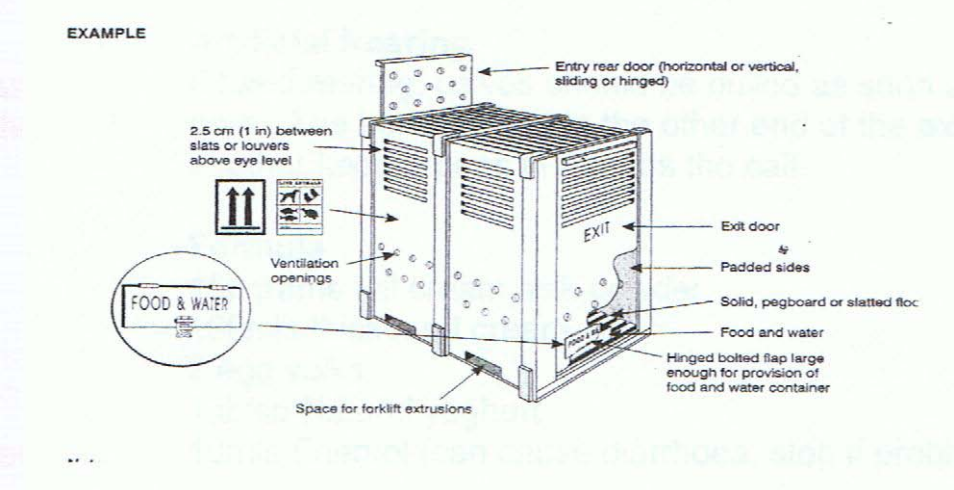

Figure 4. Example of transport crate.

7.5.2 Furnishings

- Water and feed containers should be provided for long journeys. All feed and water containers need to be securely fastened during transit.

7.5.3 Water and Food

- Most animals will not eat on short journeys, therefore will not require feeding. However, depending upon the length of journey and the weather, water breaks may need to be provided.
- Suitable feed such as hay should be provided on long journeys. Caution should be taken not to overfeed. Feed and water on road journeys are best offered on breaks to minimize potential injury.
- Appropriate containers of moulded plastic could be used.

7.5.4 Animals per Box

- Only one animal per box should be transported.
- All animals should be accompanied by appropriately qualified and experienced staff.

7.5.5 Timing of Transportation

- Transportation should be arranged to ensure that the animal will reach its destination early in the morning thus allowing maximum time for settling in of animal in daylight hours and observations by staff.
- Timing of capture, transport and release is also dependent on the type of transport being used, e.g. scheduling of air or ship transport, access to loading/unloading facilities, etc. so that minimal time is spent on the journey.

7.5.6 Release from Box

- Eland need time to settle before being released. Visual and auditory stimulation, and handling at this stage should be kept to a minimum.
- Animals should be released in a quiet, stress-free environment. For the first few days the enclosure could be surrounded with hessian, or similar, to restrict the view to the outside and to prevent the animal from being frightened by sudden movements outside the enclosure. *(Ebedes & Van Rooyen)*
- Food and water should be placed into the enclosure before release. This should be replenished over the next few days with the least possible noise and disturbance. *(Ebedes & Van Rooyen).*
- The travelling crate should be left in situ for a few days to give the animal added security and to prevent excess noise in its removal.
- The animal should be observed quietly until it is settled.
- Signs of the animal's adaptation to the new environment include eating, ruminating, defecating and urinating normally. *(Ebedes & Van Rooyen)*
- Capture myopathy may be prevented by reducing stress, fear and exertion. A stress-free environment should be provided. Dietary vitamin E and selenium may be of some value when added to the food. (*Wenker 1998)*

8 Health Requirements

8.1 Daily Health Checks

All animals at Taronga Western Plains Zoo are visually checked at least twice daily for any signs of illness or injury. Signs of illness or injury may include, but not limited to:

- Lameness
- Wounds
- Loss of condition
- Loss of hair
- Distress
- Watery faeces
- Stress

8.2 Detailed Physical Examination

Veterinary procedures are only undertaken as required. There are no regular treatments required for hoof trims or such.

8.2.1 Chemical Restraint

Eland at Taronga Western Plains Zoo are darted with etorphine and xylazine. Issues with animals under general anaesthetic include regurgitation and aspiration. The immobile animal may also need protection from the rest of the herd. For these reasons, when an animal goes down, staff must immediately tend to the animal to protect it and to keep its head raised.

8.2.2 Physical Examination

Eland at Taronga Western Plains Zoo are handled infrequently and are not crate or chute trained. For this reason, they are very susceptible to capture myopathy, as are all eland. Physical examination of an animal is therefore only conducted under general anaesthetic and only if necessary.

8.3 Routine Treatments

At Taronga Western Plains Zoo the following routine treatments occur:

- Regular parasite screening occurs twice per year in February and August.
- Drenching is dependent on the results. Drenches used are Equiban Granules and Ivomec RV.
- 5-in-1 and Coppernate are given opportunistically.

8.4 Known Health Problems

Wild eland are resistant to trypanosomiasis, a disease transmitted by tsetse flies, but are not resistant to theileriosis, a bacterial disease transmitted by ticks of the genus *Rhipicephalus*. Unlike cattle, eland are often asymptomatic or show only mild symptoms

when infected. However, the bacterium *Theileria taurotragi* is pathogenic and has caused eland deaths. Eland host a variety of ticks. One eland examined post-mortem was host to seven species of tick. *(Pappas 2002)*

Copper deficiency can be a problem in captive eland. This is managed by offering copper/cobalt stock blocks.

8.5 Quarantine Requirements

All artiodactyls are held in quarantine until results of faecal culture for *Mycobacterium avium* subspecies *paratuberculosis* are available. Two individually identified faecal samples are collected from each animal one week apart and submitted for culture. Serum is collected and submitted for Johnnes disease serological testing by the AGID and ELSIA methods. Three faecal samples are collected for faecal egg count (fec) with anthelmintic therapy as required.

Each animal undergoes immobilisation for physical examination if needed, unless the risk of anaesthesia is deemed too great. The risks involved in immobilisation would include regurgitation and aspiration. If the group is placed under pressure, there is a risk of possible escape.

Blood samples are taken for routine haematology, biochemistry and serum storage. This is collected into a lithium heparin tube and submitted to CSL Limited for Bovigam or Certigam gamma interferon assay as appropriate. Serum is submitted for Brucellosis, Bovine Viral Diarrhoea, and Enzootic Bovine Leukosis and Leptospirosis serology where appropriate. A comparative intradermal skin test should be performed at this time using 0.1 ml Avian PPD (25 000 units / mL) and 0.1 mL Bovine PPD (1 mg/mL) and read at 72 hours.

Vaccination with 5-in-1 clostradial vaccine is undertaken where appropriate.

9 Behaviour

9.1 Activity

Eland are crepuscular and feed in the early morning and in the evening. Environmental factors account for eighty per cent of the variability in daily feeding times. They spend more time in the shade on hot days and more time in sunny areas on windy days. They also spend more time in the shade where food sources are concentrated. *(Benoit 2008)*

Eland are powerful animals and superb jumpers. Young eland can clear three-metre high fences from a standing position. *(Pappas 2002, Despard Este 1992)*

9.2 Social Behaviour

Eland are gregarious but have a fluid and open system. They are non-territorial and nomadic. The eland is one of the most mobile antelopes with home ranges of between 174 and 422 square kilometres. Eland form larger herds than most bovids, with groups of up to 550 on the Serengeti plains. Herds of over 100 are common. Larger herds can be found in areas of lush green growth. *(Benoit 2008; Pappas 2002; Kingdon 2007)*

Defensive bunching in open habitats allows independent animals the benefits of herd life without forming ties. Thus no energy is expended seeking lost partners. *(Kingdon 2007)* Within the herd, every animal is alert to local events such as fires, rain, storms and danger.

Membership within a herd is variable. Individuals stay in a herd for several hours to several months. Females and juveniles tend to stay close together, whereas males form smaller herds or wander individually. Groups form most often when females are in oestrous. Intense mutual attraction among calves leads to temporary isolated groups of up to 50 juvenile animals. In these groups, mothers are to some extent interchangeable. These calf groups form the nucleus for female herds. Hierarchies form within these groups and the principle of rank by age and size remains typical of all elands of both sexes. *(Kingdon 2007)*

Unlike many antelope, eland lack territorial behaviour. Young animals, especially females, are highly nomadic. Older animals, especially males, are more residential. Neighbouring males may be found frequently in one another's company, but seldom number more than six or seven. Larger male assemblies are very temporary and tend to disperse rapidly. *(Kingdon 2007, Pappas 2002)*

Bulls experience surges of testosterone that lead to aggressive phases, known in Swahili as "ukali". Ukali may be a cyclical phenomenon, which encourages other males to disperse for their own safety. Lethal clashes sometimes occur when two bulls are "ukali". *(Benoit 2008)*

The shorted and thicker horns of males tend to be more effective during fights between males in rut, where male eland wrestle with their horns and ram heads. Females use their long, thin horns to deliver quick stabs at predators. *(Pappas 2002)*

9.3 Communication

Eland communicate by visual displays, olfactory cues and auditory signals. Most of the sounds eland make are either inaudible at any distance or infrequent. There is a mother/calf contact call that resembles a creaking door slowly opening, and a faint bleat that is emitted by calves and mothers when together.

Vocalisation is also made by a courting bull trying to mount a female. *(Benoit 2008)* Eland also have a typical alarm bark.

The most unusual sound the eland makes is the castanet-like knee clicking produced by mature bulls. This can indicate body size, a main determinant of fighting ability. *(Bro-Jorgensen & Dabelsteen 2008)*

Male dominance can also be suggested by an increase in dewlap size as the bull ages, suggesting fighting experience. Additionally, facemark darkness, frontal hairbrush size and body greyness, presumed to be androgen related, can indicate male dominance and aggression. *(Bro-Jorgensen & Dabelsteen 2008)*

Other displays of male dominance include regular rubbing of the forehead on and thrashing the ground, ploughing up soft earth and mud. The male will rub his horns on vegetation and thrash small shrubs. This behaviour enhances his odour and changes his appearance. Wet earth simulates this behaviour. Urine is the preferred wetting agent.

9.4 Reproductive Behaviour

Male eland perform flehmen, a lip curling behaviour that may transfer chemical stimuli from the mouth to the vomeronasal organ. Females will urinate to alert males of oestrous or to alert harassing males of their non-reproductive status.

A male will closely pursue a female in oestrous and will lick and nuzzles her rump to test for receptiveness. This will continue for two to four hours until the female allows the male to mate. During this time the male will chase and attack less dominant males that attempt to approach the female. The actual mating takes approximately four seconds. *(Pappas 2002)*

Before birth the cow becomes very restless and begins to show interest in other calves and in birth fluids of other cows. She will usually seek a protected area, in vegetation, in which to give birth. She lies down during delivery and stands shortly after the birth. Early maternal interactions involve nose thrusting, licking, chewing and a variety of vocalisation from both mother and calf. These vocalisations include moos, clicks and grunts from the mother. The calf may bleat and whimper. Mother and calf bond quickly. Most cows will not interact with any other calf than their own. For the first couple of days calves tend to hide in a covered area. *(Benoit 2008)*

9.5 Behavioural Problems

- Eland have an exaggerated flight response which may lead to capture myopathy during veterinary procedures or transportation.
- Calves taken for hand rearing and denied desensitization to regular environmental sights and sounds or companion animals may also develop capture myopathy.
- Bulls have been known to infanticide of calves from other sires.
- Holding of neutered males in a herd in captivity is possible if there are no breeding bulls in the group. However, more than one breeding bull may cause fighting for dominance, perhaps causing injury or death.

- Hand reared calves may become finicky, inconsistent drinkers. It is necessary for the keeper to forge a strong bond with the calf initially. However, the calves can become attached to one person and become difficult when other keepers try to feed. A solution to this potential problem is to have two to three primary keepers.
- Calves may kick, butt or challenge keepers. The calves need to be disciplined to discourage this behaviour by either a firm "no" or maybe a tap on the nose or rump.
- Eland are powerful animals and superb jumpers. They can be difficult to contain in captivity. Young eland can clear a three-metre high fence from a standing position. *(Pappas 2002; Benoit 2008)*

9.6 Signs of Stress

- Bunching
- Slobbering
- High respiratory rates or panting
- Open mouth breathing
- Lack of coordination
- Trembling.
- Fighting and injury
- Lack of interest in food or refusal to eat
- Not drinking
- Rapid deterioration of physical condition
- Poor urinary or faeces output
- Unusual faecal output, e.g. diarrhoea

9.7 Behavioural Enrichment

- Poles to rub horns on
- Dirt patches for digging or rubbing in
- Browse scattered strategically or placed in night yards
- Lick blocks
- Scratching poles

In addition to these enrichment items, at Taronga Western Plains Zoo keepers drive a vehicle onto the exhibit twice weekly when feeding hay. This is done to condition the animals to the presence of keepers and staff. It allows easier access to maintenance of the exhibit as well as allowing the vet to get closer when immobilisation darting an animal for veterinary procedures. *(Benoit 2008)*

9.8 Introductions and Removals

In captivity, all quarantine protocols must be followed.

At Taronga Western Plains Zoo, new eland are usually introduced straight into the group. Rarely is aggression seen. This occurs for both sexes and usually from weaning age upwards. Because eland in the wild have very fluid herd structures, introductions do not usually create problems.

Removal of an animal may be difficult because of the risk of capture myopathy. Usually the animal is darted with etorphine or xylazine. Conditioning eland to accept the presence of humans and vehicles may lessen the risk of capture myopathy.

In the wild, eland can be herded on horseback into catching areas or into suspended drop nets. Darting from a helicopter may also be an option. *(Pappas 2002)* Once the animal is sedated it can be transported easier but still experience a considerable risk to survival.

9.9 Intraspecific Compatibility

Lethal clashes may sometimes occur between bulls in ukali. Mature, complete bulls should be kept separate from the herd and introduced as appropriate. Younger, castrated males do not appear to pose as much of a threat and can usually remain with the herd provided there are no breeding bulls in the group.

Bulls have been known to infanticide of calves from other sires. Calves should be at least two months of age before a new bull is introduced to the group.

9.10 Interspecific Compatibility

In the wild eland are compatible with several other ungulate species such as giraffe, zebra, oryx, and buffalo.

At Taronga Western Plains Zoo, the Savannah One exhibit has held eland with giraffe, zebra, ostrich, oryx and forest buffalo. Eland have also been housed with camels in past years.

Incompatible species or animals would include non-castrated (i.e. “entire”) oryx, zebra stallions and other entire eland bulls.

9.11 Suitability to Captivity

Eland are by nature large, flighty animals. They need ample space and are difficult to confine. Whilst they have been domesticated in Africa, mortality is high due to capture myopathy from the exaggerated flight response. Thus successful transfer of eland to another institution or enclosure can be very difficult and challenging.

10 Breeding

10.1 Mating System

The eland reproduces yearly, with a single offspring. Eland tend to be polygynous. Dominant males will mate with multiple females during the breeding season. Mating and births occur most of the year but with a definite breeding and calving peak between August and November. This has been noted at Taronga Western Plains Zoo as well as in the wild. *(Pappas 2002)*

10.2 Ease of Breeding

Captive eland reproduce successfully, although calf survival is low, and some females lack mothering skills. Calves are sometimes removed from the group and hand reared to ensure they remain healthy and well fed. *(Pappas 2002)*

Taronga Western Plains Zoo has held eland since 1976. Over 130 calves have been bred during that time. Captive management protocols control the genetic base of breeding in the zoo, but the actual process is allowed to occur naturally. *(Benoit 2008)*

10.3 Reproductive Condition

10.3.1 Females

Females will urinate to alert males of oestrous or to alert harassing males of their non-receptive status.

10.3.2 Males

Male eland perform flehmen, a lip curling behaviour that may transfer chemical stimuli from the mouth to the vomeronasal organ.

A male will closely pursue a female in oestrous and will lick and nuzzle her rump to test for receptiveness. This can occur for two to four hours until the female allows him to mate.

10.4 Techniques Used to Control Breeding

At Taronga Western Plains Zoo, females have been implanted with Melengestrol implants. These proved to work well.

Entire males are held well away from females if the males are not being used immediately for breeding.

If young males are castrated at one day of age, they are left with the group. If they are castrated at weaning or older, they are removed from the group if there is a breeding bull present.

10.5 Occurrence of Hybrids

A male eland and a female greater kudu produced a male hybrid in 1977. No data exist as to the fertility of this animal. A sterile male hybrid was produced from an eland and kudu cross at the San Diego Wild Animal Park in 1976. Bongo embryos have also been successfully transferred to surrogate eland mothers. *(Pappas 2002)*

10.6 Timing of Breeding

Eland are continuous breeders but with a definite breeding and calving peak between August and November. *(Pappas 2002)*

10.7 Age at First Breeding and Last Breeding

Sexual maturity in females occurs at 2.5 years of age and in males at 4 years of age. Females are infertile after 15 years of age. *(Pappas 2002; Benoit 2008)*

10.8 Ability to Breed Every Year

It is possible, though unlikely, that females will breed every year.

10.9 Ability to Breed More than Once Per Year

As gestation period is 8-9 months, this is most unlikely.

10.10 Birth Process and Other Requirements

Before birth the cow becomes very restless and begins to show interest in other calves and in birth fluids of other cows. She will usually seek a protected area, in vegetation, in which to give birth. Thus a protected area in vegetation should be provided. Most cows will give birth naturally, so usually very little intervention or special bedding is necessary. Veterinary intervention may be necessary if the birth process does not proceed normally.

The cow lies down during delivery and stands shortly after the birth. Early maternal interactions involve nose thrusting, licking, chewing and a variety of vocalisation from both mother and calf. These vocalisations include moos, clicks and grunts from the mother. The calf may bleat and whimper.

Mother and calf bond quickly. Most cows will not interact with any other calf than their own, but may come to investigate the newborn arrival. For the first couple of days calves tend to hide in a covered area.

Calves will join a crèche within a few days after birth. If a crèche is not available the mother will conceal her calf for the first two weeks of life. After that the calf is introduced to the herd. A calf will only go to its mother when summoned (by calling) to suckle. The calf will usually venture no more than fifty metres from the crèche. Mothers readily go off for hours, even days at a time. *(Benoit 2008)*

Non-intrusive observation of the newborn is essential, as some cows lack the mothering instincts. If the decision is made to take the calf for hand rearing, this should be done as soon as possible and preferably at birth.

10.11 Breeding Diet

No changes in the diet are needed for breeding or for pregnant cows.

10.12 Oestrous Cycle and Gestation Period

Oestrous occurs at 21-26 days intervals and last for 2-3 days. Physical signs are a swollen vulva. Females exhibit oestrous two weeks after birth, but only one in eight cows conceive in this short period. *(Benoit 2008; Pappas 2002)*

Gestation is 8-9 months. Calves are mostly born during October to February but can occur at any time during the year. Frequently parturition occurs at night. *(Pappas 2002)*

At Taronga Western Plains Zoo, calving is avoided during the winter months.

10.13 Litter Size

Only one calf is born. Recently at Taronga Western Plains Zoo twins were born but neither survived.

10.14 Age at Weaning

Weaning occurs at approximately four to six months of age. After that the mother/calf bond becomes weaker. *(Benoit 2008; Pappas 2002)*

10.15 Age of Removal from Parents

Once the calf is weaned there is very little interaction between mother and calf.

10.16 Growth and Development

- Birth weight of a calf is 30-36 kg. Male calves tend to be heavier than female calves.
- Calves stand shortly after birth and move freely about their immediate area. Vocalisations are frequent.
- Calves mimic the mother's browsing behaviour almost immediately after birth, but suckling is the primary form of feeding.
- Eland calves need eland milk for the first ten days of life after which cow's milk can be used in combination with eland milk in domestic situations.
- Most calves are weaned by six months of age. *(Benoit 2008; Pappas 2002)*

11 Artificial Rearing of Mammals

If Eland are to be hand reared, calves should be taken from the herd as soon as they are born.

At Taronga Western Plains Zoo, hand rearing is not usual, but has been done in the past when necessary. To take the calf from the herd, the herd is lured to the other end of the exhibit, usually by food, whilst another keeper enters the exhibit and grabs the calf.

It is necessary for the keepers to form a strong bond with the calf. However, the calf can become too attached to one person and becomes difficult for other keepers to feed on the primary carer's day off. A simple solution to this problem is to have two to three primary keepers for raising calves.

Calves should not be allowed to kick, butt or challenge the keeper in any way. If this occurs, the calf should be disciplined by a firm "No" and maybe a tap on the nose or rump. *(Benoit 2008)*

11.1 Housing

If being hand reared, Eland calves at Taronga Western Plains Zoo are housed in part of the Veterinary Quarantine Centre for ease of management. This area provides shelter, warmth and hygienic conditions for the newborn. As the calf gets older, access is given to outside yards.

11.2 Temperature Requirements

Most calves are hardy and do not require supplementary heating or cooling. Young may need to be kept warm and away from draughts if ill. Shelter is provided at Taronga Western Plains Zoo at the Veterinary Quarantine Centre.

A bedding of straw is available, and if necessary (if a very ill newborn calf) overnight heating in winter can be provided. This is usually not necessary in summer.

11.3 Diet and Feeding Routine

- All neonates (newborn) should be given bovine colostrum for the first 24 – 48 hours where possible.
- All milk formulas should be gradually increased to 100% strength concentrations as recommended, i.e. commence at 25% - 40% concentrations supplemented with Vytrate, staged up by 25% at 24 hour intervals until 100% is reached.
- Use pre-boiled water to make up formulas.
- Young need to be fed 12 – 20% of their bodyweight in milk formula each day, divided equally between feeds. If inadequate volumes of formula are suckled then the neonate needs to be tube fed until intake is adequate from the bottle.
- Weigh initially and weight gain/loss to be monitored at least weekly.

- Routine is extremely important. Feeding times must be set and adhered to. It is usually better for one person to initiate feeding and to introduce other feeders as soon as possible to avoid neonates imprinting on one person.
- Milk temperature should be fed at body temperature.
- Offer shallow water and a variety of foodstuffs as soon as appropriate.

11.4 Specific Requirements

Eland calves are finicky, inconsistent drinkers and will require perseverance and patience.

Milk formula:

Calf formula:
150 grams Full Cream Milk Powder made up to 1 litre
Add 100 mls Thickened Cream
2 egg yolks
1 tablespoon natural yoghurt
10 mls Enervol *(NB. This can cause diarrhoea. Stop if a problem occurs)*

Teat – beige calf teats or Biolac antelope teats. Can progress to black calf teats later on.

Times fed:

- Four times per day (8.30 am, 12 pm, 4 pm and 9 pm) for the first 7 – 10 days, then decrease to three times a day.
- Three feeds per day until the calf is 40 days old.
- Two feeds per day until the calf is 70 days old.
- One feed per day until the calf is 80 – 100 days old.

Calves should then be weaned by reducing the milk intake by 200 mls per week until weaned.

11.5 Data Recording

- Record all data on milk feed charts.
- Include weights, teats used, formula consumed and anything notable.

11.6 Identification Methods

- All animals should be microchipped at birth (or as soon as practical thereafter).

11.7 Hygiene

- Hygiene is of great importance.
- Bottles and teats need to be washed thoroughly and soaked in sterilizing solution.
- Utensils should be rinsed with pre-boiled water before use.
- Face wipes must not be shared with anus wipes, etc.
- Cloths should be washed daily.

- All young should be left with a clean mouth after the feed (includes chin, lips, etc.)

11.8 Behavioural Considerations

- Provide exercise and possibly enrichment daily.
- All Eland have an exaggerated flight response, particularly during veterinary and loading procedures. Be aware that calves can jump over any fence less than 2.5 metres in height.
- Different sights and sounds should be introduced as soon as possible to desensitize the calf to the outside environment. This should be done no later than 2 – 3 days of age.
- Calves can be very finicky, inconsistent milk drinkers.
- Calves need to be reintroduced to the herd as soon as possible, usually around weaning.

11.9 Use of Foster Species

- Introduce to companion animals as soon as possible, preferably at one to three days of age.
- At Taronga Western Plains Zoo young goats have previously been used successfully as companion animals.

11.10 Weaning

- Wean to 2 feeds a day at approximately 6 weeks
- Wean to 1 feed a day at approximately 10 weeks.
- Total wean at approximately 13 weeks.

11.11 Rehabilitation and Release Procedures

- Humanising and leaving re-introduction to the herd too late can cause problems with rejection by the herd. It is important to re-introduce the calf to the herd as soon as possible, usually no later than weaning.

(Janet Gamble 1997; Benoit 2008)

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15 Glossary

Capture myopathy. An acute disease of the muscles resulting in cardiac failure as the result of stress of capture. It occurs most frequently in wild animals after a long chase or with a lot of struggling. The course is short and the death rate high.

Crepuscular. A term used to describe some animals that are primarily active during twilight, that is at dawn and at dusk.

Dewlap. A longitudinal flap of skin that hangs beneath the lower jaw or neck of many vertebrates.

Dorsal. At the back.

Flehmen. A lip curling behaviour that may transfer chemical stimuli from the mouth to the vomeronasal organ.

Sexual Dimorphism. Sexual dimorphism is the difference between male and female members of the same species. It includes differences in size, coloration, or body structure between the sexes.

Ukali. Periodic testosterone “surges” signalled by aggression.

Vomeronasal Organ. The vomeronasal organ (VNO), or Jacobson's organ, is an auxiliary olfactory sense organ that is found in many animals. It was discovered by Frederik Ruysch and later by Ludwig Jacobson in 1813. The vomeronasal organ is mainly used to detect pheromones, chemical messengers that carry information between individuals of the same species, hence is sometimes referred to as the "sixth sense."

16 Appendix

Products Mentioned.

Equiban Granules. Pfizer EQUIBAN GRANULES are for the treatment of large roundworm, large strongyles, small strongyles and pinworm infestations in horses. Also good activity against tapeworm amd lumen dwelling immature forms of Trichonema sp., Triodontophorus sp. and Strongylus vulgaris. Safe to use in preganant mares, foals over 1 week of age and debilitated horses.

Ivomec RV. Ivermectin 2g/L. For the treatment and control of ivermectin sensitive strains of internal parasites (including benzimidazole, levamisole and morantel resistant strains), nasal bot and itchmite of sheep.

Coppernate. For the prevention and treatment of copper deficiency in cattle.

Ultravac 5 in 1 Vaccine. Multicomponent adjuvant vaccine containing ultrafiltered antigens of Clostridium perfringens type D, Cl. tetani, Cl. septicum and Cl. novyi type B and a purified formol culture of Cl. chauvoei. For the prevention of enterotoxaemia (pulpy kidney disease), tetanus, black disease, blackleg and malignant oedema (blackleg-like disease) in cattle and sheep including swelled head in rams.