

# **Husbandry Manual for the Maned Wolf**

## ***Chrysocyon brachyurus***

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## **INTRODUCTION**

A primary goal of all SSP programs is the production of a husbandry handbook outlining management procedures for the care of each SSP species. The Maned Wolf SSP produced our first Husbandry and Management Handbook in 1987, 2 years after the MWSSP was formed. Since that time there have been numerous changes in management recommendations resulting from the experiences of maned wolf managers working at institutions throughout North America.

In 1993 the MWSSP determined that new information and modifications to practices listed in the original handbook warranted the preparation of an entirely new edition. The Husbandry Handbook Update Committee was formed and work began. The committee consisted of 13 dedicated volunteers representing 13 institutions with a wide variety of experience managing maned wolves. The husbandry handbook guidelines prepared by AZA were used to outline the scope of the work, and committee members signed on to prepare the various chapters. We also relied on the expertise of MWSSP advisors Mary Allen (nutrition), Robyn Barbiere and Mitch Bush (health), Dick Montali (necropsy), and Stephanie Bestelmeyer (behavior ethogram and bibliography).

Committee Co-Chairs Norah Fletchall, Assistant Director at John Ball Zoo, and Steve Taylor, Curator of Mammals at Louisville Zoo, have worked diligently and tirelessly to pull this document together. Together with all of the chapter authors, their efforts have resulted in a practical guide representing the current state of knowledge for managing maned wolves in captivity. This handbook is a "living" document. Changes and updates will be added as needed. Anyone keeping or interested in keeping maned wolves is encouraged to read this document, and to contact any committee member or the species coordinator with questions or comments.

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September 1995

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# CHAPTER ONE

## NATURAL HISTORY

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To date there have been few long term studies of maned wolves (*Chrysocyon brachyurus*) in their wild habitats. Most knowledge is based on anecdotal evidence and two or three studies. The following is an overview of literature concerning the maned wolves habits in the wild.

### PHYSICAL CHARACTERISTICS

There is no marked sexual dimorphism in size or appearance.

Height at the shoulders=75-90cm  
Head and body length=100-125 cm  
Tail length=30-45 cm  
Weight=20-23 kg (Sheldon, 1992) In captivity average weight=30 kg

Maned wolves are atypical canids in appearance. Their legs are long and stilt-like allowing them to see above and move through the tall grasses. Pelage is a rusty red on the body; the muzzle and the lower legs are dark brown or black. There is a patch of brown or black fur on the back of the neck. This fur and that on the shoulders is longer than the rest of the body. The fur on the shoulders and neck is sometimes raised during agonistic encounters, hence the "maned" wolf. The throat, inside of the ears and the tail tip are white. There is little variation in these patterns between individuals.

### TAXONOMY

Maned wolves (*Chrysocyon brachyurus*) are members of the canid family, which encompasses 15 genera and 35 species (Sheldon, 1992). Representing the largest canid species in South America they were first described by D'Azara in 1801. Maned wolves are commonly known by several names in their native habitat, including: lobo guará, boroche, aguará guazá and lobo de crin.

The karyotype of maned wolves is similar to *Canis* but the diploid number is 76 for *Chrysocyon* and 78 for members of the genus *Canis* (Dietz, 1984). Taxonomists feel the maned wolf is most closely related to the genus *Dusicyon* (Clutton-Brock, et al, 1976). Maned wolves are believed to have evolved in the Central Highlands of Brazil during the Pleistocene era from an ancestral canid (Wayne & O'Brien, 1976).

### RANGE AND HABITAT

Maned wolves range from northeastern Brazil (except coastal areas) to northern Argentina, Paraguay, eastern Bolivia and west to the Pampas del Heath in Peru; a total of ~5

million km<sup>2</sup> (Dietz, 1985). Preferred habitat includes grasslands, cerrado, and scrub forest (Redford & Eisenberg, 1992).

## **STATUS IN THE WILD**

Accurate estimates of the wild maned wolf population are difficult to obtain due to the secretive nature of the species. Figures of 1500-2000 individuals in 650,000 km<sup>2</sup> in Brazil are indicative of the species compromised status in the wild (daSilveira, 1968). Long term recovery of viable maned wolf habitat is less likely due to ranchers converting much of their grassland to farmland thereby destroying habitat. There are an estimated 2200 individuals occupying a limited range in northern Argentina (Beccacecci, 1992).

Maned wolves are classified as Endangered by USDI, vulnerable by IUCN, endangered by the Brazilian government and are an Appendix II species under CITES (SSP fact sheet, 1990).

## **DIET**

Maned wolves in the wild are omnivorous, opportunistically feeding on a variety of different items. Seasonal changes in food availability result in changes in dietary components. Animal material consumed includes small mammals (rodents, armadillos), reptiles, gastropods and bird eggs (da Silveira, 1968). Wolves are also known to kill domestic poultry. Farmers sometimes retaliate against the wolves, resulting in a mortality rate for wolves from hunting.

The plant portion of the diet is primarily *Solanum lycocarpum*, commonly called lobeira ("Fruit of the Wolf"). This everbearing fruit is a consistent part of the wolves diet throughout the year. Lobeira, a member of the Solanaceae family, resembles a large tomato that turns yellow when ripe. Wolves are believed to consume the fruit before it is ripened (Dietz, 1984). Matera (1968) reported that the fruit plays a role in the treatment of giant kidney worm, a common parasite in maned wolves, although there is no scientific evidence to support the theory.

Dietz's 1978-1980 study of free ranging wolves in Serra de Canastra National Park in Brazil showed "58% of scat volume was lobeira, 28% was small mammals and 2.3% was birds." (Dietz, 1984).

## **SOCIAL ORGANIZATION**

Dietz (1984) determined that pairs of maned wolves occupied home ranges averaging 30 km<sup>2</sup>. Maned wolves are primarily nocturnal or crepuscular in activity patterns (Sheldon, 1992). Mated pairs do share a home range but are rarely seen together except during breeding season. Territories are marked by site specific defecation spots and landmarks that present physical barriers (roads, rivers). Same sex animals' territories do not overlap. The same home range is thought to be occupied throughout life. When an animal dies or abandons a territory a nomadic individual usually takes up residence in the range. Within territories animals are known to mark with scats and urine. Marking often takes place on elevated surfaces, such as termite mounds. (Dietz, 1984). Maned wolves are also thought to utilize a roar-bark to announce their location within their territory. Barking may serve to "promote the spacing of individuals through avoidance." (Kleiman, 1972).

Maned wolves are facultatively monogamous throughout life with pairs coming together during breeding season (April-June) for mating. Observations of captive wolves indicate males

play a role in raising pups by regurgitating food (Rasmussen & Tilson, 1984) and grooming pups (Sheldon, 1992).

Few actual observations of pups have been noted in the wild. Most information is anecdotal but suggests that females and possibly males defend nest or den sites for a period of time after parturition (Dietz, 1984).

## **REPRODUCTION**

Maned wolves in the wild are believed to be monestrus with estrus lasting approximately 5 days (Dietz, 1984). Following a 63-67 day gestation 2-5 pups are born. Births may occur as early as February, but the majority of pups are born during the dry season from June into September (Dietz, 1984).

Females will cache food at nest sites before whelping. Most denning sites utilize some type of existing topography. Maned wolves are not believed to excavate their own nests but use rocky outcroppings, low spots in grasslands, and abandoned termite mounds. Dimensions of one den were 60cm wide by 100cm deep (Dietz, 1984).

## **DISEASES**

Maned wolves in the wild suffer from two primary disease processes: parasites and cystinuria. The most debilitating parasite found in maned wolves is the Giant kidney worm (*Diocotophyme renale*). This worm is transferred via intermediate hosts (fish and mollusks) that the wolves consume. The parasite always infects the right kidney, severely damaging or destroying the organ (Matera et al, 1968).

Other parasites noted in wild maned wolves include nematodes (*Trichuris*, *Ancylostoma*, *Toxocara*) and cestodes. Ectoparasites include ticks and screw worm larvae. A noticeable lack of fleas on trapped animals may be due to the lack of underfur on adult wolves (Dietz, 1984).

Cystinuria was also found in a significant number of captured maned wolves (Dietz, 1984). This inherited condition results in excessive excretion of amino acids (primarily cystine) in the urine. The impact of this disease on wild populations is not yet known, although the disorder was found in 6 of 8 wild individuals sampled (Bové *et al*, 1981).

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# CHAPTER TWO

## CAPTIVE MANAGEMENT

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Effective management of the maned wolf requires careful planning, constant review and revision of some practices and an open line of communication at all levels of care. This chapter attempts to give guidelines and direction in several areas. Managers are encouraged to use this as a base of information and to report to the SSP coordinator new experiences that may alter these guidelines. Managers are encouraged to call on other institutions with questions before proceeding.

### **HOUSING AND ENCLOSURE REQUIREMENTS**

Housing and enclosure design are critical for effective management of the maned wolf. Exhibits should be large enough and contain adequate visual barriers to provide the occupants with a certain degree of privacy and the ability to avoid both the public and each other when desired. Managers are encouraged to contact the MWSSP Coordinator and other facilities housing maned wolves when designing an exhibit and off-exhibit holding area.

Maned wolves are typically housed in male-female pairs. Same-sex pairs or trios of siblings have also been housed together, usually on a temporary basis, but sometimes for several years. Since maned wolves give birth in the dead of winter, housing requirements vary according to climatic conditions at each institution. The average minimum daily temperature for the prime birth months for maned wolves living in the Serra da Canastra National Park, Brazil, was approximately 45 degrees Fahrenheit (Dietz, 1984). Institutions located in climates where daily minimum temperatures regularly fall below that level must provide facilities with adequate supplemental heat.

The following general guidelines should be heeded by institutions planning to house maned wolves. Zoos housing breeding pairs should read this chapter carefully, as breeding animals may require additional features:

1. In addition to the main enclosure, a backup (holding) facility must be available for separating individual members of a pair or group. Ideally, a holding facility would consist of an outdoor yard, which may be adjacent to the main enclosure, and an indoor den area.
2. Each animal in the exhibit should be provided with an indoor den area. This may consist of an individual small structure for each animal, or 1 large structure containing an enclosed "resting box" for each adult animal. The latter may be preferred by zoos in harsher climates

where animals may need to be locked in during extremely cold weather. See "Indoor Enclosure Requirements" for recommended sizes.

3. Proximity to other animals: In their native habitat, pairs of maned wolves occupy large home ranges (~30 km<sup>2</sup>). Institutions intending to house more than one adult pair of animals are strongly encouraged to separate pairs by as much physical distance as possible. If adult pairs must be housed in adjacent exhibits, a solid barrier is required. Every attempt should be made to isolate pairs recommended for breeding from other adult maned wolves. Young (<2 years old) may be housed adjacent to parents, although the potential effects on the parents' subsequent breeding/pup rearing are not clearly known at this time. An individual animal may be housed adjacent to a member of the opposite sex, although visual barriers are recommended. Solid barriers are required when individuals of the same sex are housed in adjacent exhibits. Maned wolves can be housed in proximity to other canids and other taxonomic groups, although visual barriers are recommended. Because there can be a good deal of individual variation in response to neighboring species, caution should always be exercised when introducing new "neighbors".

### **Outdoor Enclosure Requirements**

**Size:** Varies considerably between institutions. A 1986 survey by the International Studbook Keeper of 51 facilities worldwide showed an average enclosure size of 800 square meters (8600 square feet). Enclosures ranged in size from 43 square meters (463 square feet) to 4,000 square meters (43,000 square feet). A minimum size of 1/4 acre (10,860 square feet) is recommended by the SSP. As Maned wolves are somewhat secretive and apt to hide, an exhibit that is too large may be a hindrance for public viewing. Enclosures that are overly large may also hinder observations by keeper staff. Enclosure shape, topography, substrate, plantings, and proximity to the public should all be considered when designing an exhibit. No more than 50% of the circumference of the exhibit should have public viewing access.

**Structure:** Enclosures may be bounded by an open dry moat or fencing (chain link, expanded metal). Diameter of mesh should be small enough to prevent wolves from becoming entangled in the fence. Fence diameter should also prevent feral domestic or indigenous exotic mammal species (raccoons, skunks, dogs, cats, etc.) from entering the exhibit. Minimum dry moat size should be 7 feet deep by 12 feet wide. Width can be reduced slightly if public viewing is at a higher elevation than the exhibit. A wet moat requires an additional barrier in most cases as maned wolves are capable of swimming. Any type of barrier must be of adequate distance from the public to prevent members of the public from placing their hands within reach of the wolves.

If the enclosure is open topped, a minimum 7 foot tall barrier with a return around the circumference is recommended. As maned wolves are good climbers, any perimeter barrier must prevent the animals from achieving a foothold that would allow them to climb. A footing buried a minimum 18 inches (36 inches is recommended) in the ground is crucial to discourage wolves from digging out and other animals from digging in. A good method to utilize is fencing buried at a 45 degree angle inward.

**Water:** A source of clean drinking water should be provided at all times within the enclosure. This could be in the form of a lick-it, water bowl or pool.

**Substrate:** A wide variety of substrates can be utilized for outdoor enclosures. Some type of natural substrate should make up 50% of the enclosure whenever possible. Natural substrate could be soil, grass, sandy topsoil, etc. Other potential artificial substrates include gunite or concrete. Natural substrate areas should be examined regularly for evidence of digging.

**Topography:** Exhibits may be terraced, sloped, contain high and low spots, etc. An exhibit with no change in elevation should be avoided unless plantings or other structures are utilized to allow wolves areas to hide or find shelter.

**Plantings:** Natural vegetation should be provided in the exhibit. Institutions must determine which plant species are appropriate for the climate. Plants that are potentially toxic should not be used as the wolves may chew or consume them. Maned wolves also scent mark on some plantings, so hardy plant species are recommended.

**Temperature:** Maned wolves can be exhibited in a variety of temperatures and climatic conditions. Although no absolute minimum and maximum can serve all animals, care should be taken to avoid both extremes. Minimum temperatures must take into account wind, snow and or ice in the enclosure, age and coat condition of animal. Maximum temperatures must take into account degree of shade (shaded areas should be provided), humidity, age and condition of individual. Animals that are transferred to different areas of the country should be slowly acclimatized to changes in climate.

### **Indoor Enclosure Requirements**

**Type:** Ideally each wolf should have its own area off-exhibit constructed in such a way that each individual can be held in the area without access to the exhibit. This allows keepers to work in the exhibit safely. Minimum recommended dimensions for these areas are 16-25 square feet to house one animal. If an area houses more than one adult each animal must have its own resting box (16-25 square feet). These boxes provide a hiding spot for more secretive individuals. Resting boxes within these areas can be made of wood but care should be taken to monitor destructive chewing of the boxes. Resting boxes should be large enough for the animal to stand and turn around, 4' x 4' x 4' high is adequate. Whelping areas are discussed in a section later in this chapter and in Chapter Five-Reproduction.

**Structure:** Indoor enclosure areas can be made of a variety of materials. Concrete is the most predominant, but other materials can be used. Any material should be able to withstand chewing and exposure to urine, feces, etc. Access should be provided for keepers to clean and service these areas.

**Substrate:** Concrete, wood or natural substrates can be utilized. If natural substrate is used some type of litter may need to be provided (shavings, straw, grass,) to absorb urine. Bedding may also be necessary during colder weather. Whatever substrate is used should be able to withstand disinfectants, urine, feces, etc. Animals housed in concrete areas should be provided with an elevated resting bench or the floor must be covered with bedding such as hay or straw.

**Lighting:** Natural or artificial lighting should be provided for each area. Natural lighting has benefits of varying light cycles, however, on cloudy days this lighting may not be sufficient for servicing the areas. In holding areas where wolves are not exposed to natural light timers on lights are recommended to simulate natural light cycles.

**Heating:** Some type of auxiliary heating needs to be provided if temperatures in the area will fall below 40 degrees Fahrenheit for adult animals. This minimum must be 45 degrees for whelping areas but may vary between individuals. Heat may be in the form of forced air, or electrical heaters such as space heaters, radiant heaters, heat pads or panels and heat lamps.

**Ventilation:** Adequate ventilation should be provided to prevent areas from being continually wet and must also provide freshened air. Care must be taken to avoid drafts, particularly in whelping areas.

**Doors:** Animals doors in the holding area can be composed of a variety of materials. Guillotine or sliding doors can be utilized. Domestic dog doors and vinyl freezer strips can be used in areas where heat retention in the dens is important during times when animals have unrestricted access to dens. Animal access doors to the exhibit should be remotely operated.

**Special features:** If design and structure of the holding area allows a squeeze cage and/or catch crate may be beneficial. It is strongly recommended that institutions housing potential breeding pairs install remote video monitoring equipment or a blind to allow keepers to observe activities without disturbing the wolves. Video cameras must be mounted out of reach of the wolves. Cameras that have wide angle lens and can function at very low light levels are recommended.

## **MANAGEMENT DURING PREGNANCY and PUP REARING**-see also Chapter Five

The maned wolf exhibits a typical canid gestation of approximately 65 days. Although in the past males were usually separated from females for birth and pup rearing, it is now recognized that a pair bond does exist, and most males will invest a good deal of parental care in pups. The strength of the pair bond, and the degree of compatibility exhibited by a pair will influence the manager's decision whether to leave the male in for the birth. Recently, several zoos have successfully experimented with separating a sire to an adjacent area where all but physical contact can be maintained, and reintroducing him to dam and pups once the young begin emerging from the den at 5-6 weeks of age. Consultation with managers whose maned wolves have successfully parent-reared pups is highly recommended.

### **Whelping Areas**

Since maned wolves give birth during the winter, adequate heat must be provided in whelping dens to maintain temperatures above 45 degrees Fahrenheit. Whelping areas should also be free from drafts. Managers should keep in mind that floor temperatures will affect neonates. The dens and rest/hide boxes used throughout the year may suffice for use during whelping, as long as they meet the specifications listed in this chapter section. Institutions anticipating births during winter months should contact management group members for advice regarding temperatures.

Maned wolves will usually move pups, therefore more than one nest box should be provided. Dams seem to prefer a small space with a low ceiling, therefore a typical nest box measures 4' x 4' x 4' high. Even smaller spaces may be preferred, although the design should take technical requirements for video monitoring into account. Designs incorporating a partition or L-shaped entry may provide more security to a dam with newborn pups. Whether nest boxes are contained within a larger structure or constructed as separate individual units depends on climatic conditions at the institution.

In cold climates, it is recommended that the whelping den be a large heated structure, e.g. 15' x 15' or larger, furnished with 2 or more nest boxes measuring 4' x 4'. The dam and pups could then be locked in during extreme weather.

Parents and pups should be discouraged from digging under the den or nest box, both because of the resulting inability to monitor the pups and the risk of injury to pups.

Most adult maned wolves become defensive of pups and will display very aggressive behavior towards human "intruders". It is recommended that nest boxes be equipped with a door, e.g. guillotine, that can be operated remotely so that keepers can access feeding areas safely. The ability to separate the dam/sire from pups for routine weighing and inoculations should also be addressed when designing a whelping den/nest box.

Neonatal mortality rates have historically averaged around 50% for the global captive population. Mortality most frequently occurs during the first week of life. It is therefore highly recommended that nest boxes be equipped for remote video monitoring.

Nest boxes may contain bedding of straw, carpet, or cedar chips. Hay is not recommended because of the risk to pups of inhaling small particles.

### **Changes in Keeper Routine and Public Access**

During the first weeks after a birth, some institutions close the exhibit to public viewing. Most managers try to limit care of new litters to a few individuals who are familiar to the parent(s). Consistency in procedures and observations are also enhanced by limiting the number of individuals dealing with the animals. Other zoos make no changes in routine for new litters. Although it is generally accepted that dams with new litters prefer solitude and seclusion, the degree of isolation provided will be up to individual managers and should be based on the temperament of the individual animals.

Weighing of the pups when being mother/parent raised should only be done when removing the pups for regularly scheduled vaccinations.

Reintroducing the male has been done between the ages of 6-12 weeks. Again, when making the decision as to whether to reintroduce male, rely on the history of behaviors between the pair: are they highly compatible or are agonistic/aggressive behaviors common? Introducing the male through a fence barrier for a minimum of one week is recommended. Pay special attention to both the female's reaction and the reaction of the puppies.

## **RECORDKEEPING**

The foundation of any successful management program is the establishment of information gathering and recording policies and procedures. Institutions have a variety of methods for gathering information on specimens within the collection, daily reports, unit logs, etc., but the value of this information is lost if it is not centralized in some form. The availability of ISIS/ARKS/MedARKS programs provides what should be considered the minimum format for creating a permanent centralized record for individual specimens.

Specific information that should be collected includes:

- **Medical**--Health problems, treatments (including medication, dosage amount and duration, results, etc.), tranquilizations (type, amount, effect, etc.)
- **Reproductive Data**--Dates and signs of breeding behavior, copulation dates and frequency, birth dates, survivorship, parent or hand-reared, etc.
- **Diet**--Ingredients, amounts fed, times of day fed, favorite food items, "treat" foods.

- **Behavioral**--Interactions with conspecifics (especially during an introduction), abnormal or unusual behavior(s), seasonal variations, what seems to constitute normal behavior for the individual.
- **Enrichment**--Successes and failures of items offered for behavioral enrichment, types of items, food, toys, "furniture," plant species, etc.

The captive management of maned wolves will continue to rely on the routine movement of individuals to ensure the genetic fitness of the population. In order to make the transition from one facility to another as stress free as possible for the animal we cannot underestimate the value of the records that accompany that individual. Institutions that receive an animal must ensure that information sent with the animal reaches the appropriate staff. Minimum information/records that should accompany an animal are:

- ISIS/ARKS specimen report
- MedARKS specimen report
- AAZK Animal Data Transfer Form
- Specimen records; copies of unit or master and veterinary

## **IDENTIFICATION**

Permanent identification of individual specimens is an absolute necessity. The International studbook number is to be tattooed on the inner thigh of each animal, the protocol of left for female and right for male should be followed. Transponder implants are recommended for this species. Currently CBSG "is of the opinion that the Trovan system is still the most appropriate choice for conservation applications." Transponders are to be inserted to the right of midline in the shoulder area.

Observable physical uniqueness must be entered in the permanent records of each animal. Deformed or partially missing ears or tail, scars, limp, etc. must be entered as well as any uniqueness in coat pattern.

Behavioral characteristics are also an excellent aid to individual identification as well as pertinent to the management of the individual and are to be included in the permanent records.

## **CAPTURE AND RESTRAINT**

The use of a catch box should be considered a standard management tool. Having an easily transported box, with access ports, which can be placed at routinely used animal transfer doors will facilitate many handling needs that arise with this species. Conditioning, coercing, or crowding an animal into a crate can reduce the stress associated with routine vaccinations, administration of tranquilizer, transport, or preparation for some other procedure. Catch nets, crowding boards (to pin an animal in a corner or against a fence or wall), catch poles and tranquilization (for any procedure) are other methods used with this species.

See Chapter Seven for data regarding tranquilizers.

## **TRANSPORT PROCEDURES**

Crate training prior to shipment should be considered as a standard management procedure. The routine use of a catch box will aid in conditioning an animal to be familiar with being confined.

The primary concerns regarding a shipping crate are that it is of adequate size (animal must be able to stand, sit and lie down naturally and turn about freely) and strength, equipped with rims (to keep other cargo at least 3/4" away from crate) and handles for lifting. The crate must be leak proof, the inside free of projections or material that could cause injury. Crates must meet USDA and/or IATA (International Air Transport Association) guidelines for live animal transport. Manufactured plastic "sky-kennels" have been used for shipments, other than international, as long as the two halves are securely bolted together. It is highly recommended to cut threads (via the use of a die) on the ends of the hinge rod and the locking rod and use self locking nuts to prevent the door from being forced open. Many air cargo facilities will use IATA guidelines for domestic shipments and will not accept plastic kennels for shipment of this species. Managers should contact local airlines prior to designing crates. Exceptions may be made for pups, but plastic kennels should not be considered for adults.

Animals having access to food and water prior to shipment should not require feeding for 24 hours or watering for 12 hours once the animal is shipped. The delay of a shipment is always a possibility so food and water containers should always be provided.

IATA regulations must be followed for international shipments. Some specifics of note are: plastic kennels are not acceptable; food and water containers are required; a dropping tray with absorbent material must be provided.

NOTE: IATA Live Animals Regulations is an annual publication that is routinely updated and, therefore, subject to changes which can affect animal shipments. This publication should be considered as a mandatory tool for proper shipping of live animals and is ordered from:

Publications Assistant  
IATA  
2000 Peel Street  
Montreal, Quebec  
CANADA H3A 2R4  
(514) 985-6326

Pre-shipment physicals are discussed in Chapter Seven but one must be aware that requirements do vary between institutions and those requirements must be met.

Some states require an import permit or state license that must be obtained prior to shipment.

Maned wolves are listed as Endangered under the Endangered Species Act and, therefore, require an USFWS export or import permit for any international shipment. Many countries also require import permits for animals entering their country that you must obtain from recipient prior to a shipment. Maned wolves are listed as Appendix II under CITES which necessitates an export permit from the CITES representative of the country exporting the animal.

### **ENVIRONMENTAL/BEHAVIORAL ENRICHMENT**

This area of management responsibility cannot be over emphasized and must become as routine as feeding and cleaning. The rewards of enrichment will far outweigh whatever effort is expended. Physical and psychological stimulus of an otherwise static environment will have obvious benefits to the overall well being of the individual(s).



### ***Exhibit enrichment considerations***

- Varied topography.
- Plantings: trees, shrubs/bushes, tall growing grasses (let a few areas grow to maturity rather than mow the whole exhibit if long grass is a specific zoo concern).
- Furniture: large rocks, stumps, brush pile, logs and branches, pile of leaves. Use items that can easily be moved in and out, or around the exhibit to provide change.
- Water features, pool, stream.

### ***Food items:***

- Large bones.
- Rabbit (with fur left on), whole mice or rats, chicken or quail (feathered), live crickets, and fish.
- Seasonal fruits and vegetables.

### ***Olfactory stimulants, (only small amounts needed):***

- Common herbs and spices.
- Perfume (veterinary approval should be obtained).
- Commercial "animal scents/lures" such as supplied for trappers.
- Feces or urine from other species (veterinarian approval should be obtained).

***Toys:*** Encourage staff members to use their imagination.

- Large bones.
- Large Rawhide chew toys.
- Ice blocks containing food items.
- "Boomer" or other safe balls.
- Coconuts.
- PVC pipe with small rocks or seeds inside.
- Sticks and small branches.
- Feathers.

**PEST CONTROL** (Adapted from Chapter 2: Medical Management of Tigers, Management and Conservation of Captive Tigers, edited by Ronald Tilson, Gerald Brady, Kathy Traylor-Holzer, and Douglas Armstrong).

An obvious need for pest control exists in any animal holding facility. Feral animals serve as sources of additional problems for maned wolves. Rodents, birds, domestic cats or dogs, or other pests that have access to the maned wolf or its enclosure may serve as a source of contamination for microorganisms or parasites.

Well maintained perimeter fencing provides an initial deterrent to larger feral animals, particularly dogs. However, climbing animals, such as feral cats, can easily defeat such barriers; therefore, areas around maned wolf enclosures should be monitored regularly for feral animal activity. Live trapping provides a method of removing feral animals. Local animal shelters may assist in removal of captured domestic animals. Removal of captured wildlife may be coordinated through state agencies or local rehabilitation groups. Trapping does not provide a total eradication of pests; therefore, the design of the maned wolf enclosures should reduce exposure to feral animals. The use of "hot wire" on the outside of enclosure fences can provide an effective deterrent to feral species intent on climbing.

### **Rodent Pests**

Rodent pests must be handled through a well planned, supervised, continuous pest control program. Safe rodenticides are available for use around maned wolves when applied according to their directions. Care must be taken in choosing compounds that are effective, yet not highly toxic, especially when considering secondary toxicities. A number of effective anticoagulant rodenticides are available with little or no secondary toxicity potential, e.g., warfarin, diphacinone, cholecalciferol. Extreme caution should be exercised to assure that maned wolves do not consume rodents who have ingested these rodenticides. When rodent populations become unmanageable or resistant to anti-coagulants, other more toxic compounds, such as zinc phosphide may be needed, requiring extra care in their application. It may seem too obvious, but it should be emphasized that **at no time should maned wolves have primary access to any rodenticide.**

### **Insect Pests**

Good sanitation aids in reducing insect populations, but all zoological situations experience insect pests, particularly cockroaches. Insecticide applications can be made around maned wolf enclosures with chemicals that are safe when applied in a proper manner. There are many chemicals available, both primary insecticides and newer growth regulator compounds that have low toxicity potential when used correctly. (Examples of insecticides include: diazinon, piperonyl butoxide, natural and synthetic pyrethrins, carbamates, chlorpyrifos; example of growth inhibitor is *Gencor*.) Maned Wolf enclosures are treated by removing the maned wolves, applying chemicals safe to use in primary enclosures, and then cleaning the enclosure to avoid exposure to returning maned wolves. The residual chemicals in cracks and crevices should have no contact with the maned wolves but, if so, exposure levels should be minimal. All personnel involved with the maned wolves must participate in the planning stage of the pest control program so everyone is aware of the compounds being used, where and how they are applied, and become knowledgeable of the safety of the compounds. Safety of the maned wolves is utmost in any program.

**Inadvertent use or misuse of insecticides (and herbicides and miscellaneous toxic compounds not intended for use around animals) can lead to accidental exposure of maned wolves and possible fatal results.** This can be avoided by carefully planned pest control programs and subsequent correct applications of pesticides. This is an obvious concern regarding maned wolves and other animal species.

Besides the aesthetic reasons for eliminating pests, a more important reason is eliminating potential diseases found in feral mammals, birds, rodents and insects. The ectoparasites of mammals such as fleas, ticks, and mites, can be transmitted to maned wolves; as well, internal parasites of these same feral animals can be acquired by maned wolves and cause infection. Feral animals also serve as potential sources of pathogens such as rabies, yersiniosis, leptospirosis, salmonellosis, toxoplasmosis, parvovirus, canine distemper, and others.

# **CHAPTER THREE**

## **MANED WOLF NUTRITIONAL MANAGEMENT**

**Mary E. Allen, Ph.D.  
National Zoological Park**

### **BACKGROUND AND CURRENT RESEARCH EFFORTS**

The difference between facultative and strict carnivores may be illustrated by comparing the domestic dog and the domestic cat. Many canids have broad feeding habits, including a variety of fruits and other plant parts in their natural diets. By contrast, felids show no tendency to omnivory; they are all essentially predators. Nutritional studies indicate that the domestic dog and the domestic cat differ markedly in nutrient requirements and in nutrient metabolism. The cat requires higher levels of essential amino acids, the building blocks of protein. Cats also require more nitrogen from non-essential amino acids to compensate for high obligatory nitrogen losses. Canids can conserve dietary nitrogen when dietary levels are low. Cats are especially sensitive to arginine deficiency and must receive a dietary source of taurine.

These unique features of the cat may be viewed as derived traits associated with an extreme degree of carnivory. Canids appear to retain a broader array of metabolic pathways for the processing of nutrients, indicating a greater degree of dietary flexibility. Facultative carnivores need the diversity of metabolic pathways that is characteristic of species that feed on a broad array of foods.

Until recently, many canid species in U.S. zoological collections have been fed the same raw, meat-based products that are offered to exotic felids. The results of a 1985 survey revealed that most U.S. zoos fed commercially available raw, horsemeat-based diets (Nebraska Brand Feline/Canine; Western Plateau Carnivore Diet) to maned wolves. Out of 14 zoos, 11 offered commercial, meat-based diets (frozen horsemeat or beef commercial diets) in addition to a variety of other items. Fruits, vegetables, bread, whole prey and rice were also commonly fed items. Since domestic canids, and probably other facultative carnivores, do not require the high levels of fat and protein characteristic of commercial meat-based diets, the feeding of these products is neither necessary or appropriate. Diets currently fed to maned wolves in most U.S. zoos now consist of dry dog food or omnivore biscuits, with supplemental fruits, vegetables and prey.

Compared to U.S. zoos, European, Australian and South African zoos have fed lower protein, higher carbohydrate diets to maned wolves. Dietary information was obtained (mid-late-1980's) from the Frankfurt Zoo (Germany), the National Zoo of South Africa and the National Zoological Park (Washington, DC). The following table includes the nutritional composition of diets offered to maned wolves at those zoos with a comparison to Nebraska Brand Feline and Canine Diets and whole prey (rat).

NUTRIENT CONTENT <sup>o</sup> OF DIETS FED TO MANED WOLVES								
DIETS <sup>5</sup>	DM	CP	FAT	ASH	CHO	CA	P	CA:P
NZP (US) 1985	33.4	54.4	23.7	10.6	11.2	3.95	1.62	2.1:1
SOUTH AFRICA	36.4	43.2	13.7	5.3	37.8	0.88	0.43	2.1:1
FRANKFURT	43.9	36.1	11.2	4.5	47.2	0.64	0.45	1.4:1
CANINE DIET;	41.6	37.2	39.6	9.1	<14.0	2.7	1.2	2.3:1
FELINE DIET;	31.9	49.4	24.7	11.3	<15.0	2.0	1.7	1.2:1
DRY DOG FOOD <sup>4</sup>	92.5	27.0	9.4	6.8	56.8	1.6	0.7	2.3:1
ADULT RAT	34.0	59.7	23.6	15.7	<1.0	4.0	1.8	2.2:1

<sup>o</sup> Based on offered (not all items necessarily consumed) diets. Dry matter basis; DM=dry matter; CP=crude protein; CHO=carbohydrate; CA=calcium; P=phosphorus.

<sup>5</sup> Nutrient levels of all diets were calculated using the Zoo Diet Analysis Program (David J. Baer). Information on the composition of foods used at the NZP is relatively complete. Since complete information of foods used in foreign zoos was not provided, nutrient estimates for Frankfurt and South African diets were based on similar foods in the computer data base. To complete a more thorough analysis (including vitamins and minerals) of these diets, detailed product information is required. The calcium and phosphorus levels for South Africa and Frankfurt diets are minimum values only, since specific information on the supplements used was not provided.

; Nebraska Brand, Animal Spectrum

<sup>4</sup> Ralston Purina Hi-Pro Dog Chow

A significant health problem of maned wolves is cystine stone formation, which leads to kidney, bladder and urethral stones. The stones in the kidney and bladder can predispose maned wolves to urinary tract infection, and the urethral stones in males can lead to obstruction and secondary rupture of the bladder. In studies with captive and free-ranging maned wolves, 80% have been shown to excrete cystine and other dibasic amino acids in the urine. This unusual pattern is believed to be due to a metabolic defect.

In domestic dogs, it is now believed that a partial control of cystine stone formation may be accomplished by reduction in methionine and cystine in the diet, by feeding less animal protein, and by promoting more alkaline urine (by the addition of urinary alkalinizers). Urinary pH is typically lower (more acidic) in carnivores fed meat-based diets while the plant-based diets fed to herbivores will result in higher urinary pH. The historical use of high protein, meat-based diets for maned wolves held in U.S. zoos may have exacerbated or promoted cystine stone formation.

The use of a commercial low protein diet (Science Diet/UD) has been tried in maned wolves at CRC (in conjunction with Thiola) with limited success. We are currently attempting to follow urinary cystine output in maned wolves fed either low protein (16%) or moderate protein (25%) diets over an 18 month period. Since maned wolves fed some commercial dry dog foods appear to produce watery, semi-formed stool, we are using products that contain no soybean meal, since this has been shown in dogs to result in less well-formed stool. We are also attempting to determine water turn-over rates in maned wolves using a stable isotope marker. The tendency of maned wolves to excrete excess water in stool, instead of via the renal route, may also exacerbate cystine precipitation because a more concentrated urine would result. It has been observed that when wolves are fed meat-based diets and/or whole prey, stool quality is improved. Consultation with dog nutritionists at the Waltham Centre for Pet Nutrition in England is ongoing in an attempt to find more suitable feed ingredients that will result in well-formed stool.

For reasons given above, lower protein dog foods may be helpful in reducing the likelihood of stone formation in maned wolves. However, commercial dog foods that are low in protein (16%) compared to the requirement (using practical diets) for the domestic dog of 22% are also typically low in fat (less than 9%). In addition, unless started as pups, maned wolves are often reluctant to accept dry dog foods or omnivore biscuits. Maned wolves are usually lean and maintaining body mass is difficult. The low protein dog foods, since they are also low in fat (energy) often require the addition of vegetable oil to increase the caloric content of the diet. One of our goals is to formulate a palatable, low protein, high fat diet with ingredients that promote the formation of well-formed stool.

## **RECOMMENDATIONS**

### **Nutrient Content of Diet**

Current knowledge supports the feeding of diets:

- 1) of low to moderate protein content, between 20-25% protein, DMB (dry matter basis) to reduce the amount of cystine that the kidneys must excrete
- 2) that promote oral health (dry feeds vs. soft)
- 3) that result in well-formed stool (soybean meal may exacerbate loose stool)
- 4) that result in more alkaline urine (foods with higher carbohydrate, lower animal protein will promote alkaline urine)

Maned wolves in many non-U.S. zoos are fed small amounts of animal protein in the form of meat, prey or eggs but the bulk of the diets consist of cooked rice and other grains, fruits and vegetables. Such "home-made" diets require supplementation with vitamins and minerals. Unless the complete diet is evaluated and analyzed it is impossible to know which supplement and how much supplement should be applied to balance such diets. These diets may be preferred over the meat-based diets of 10-15 years ago, but nutrient balance in home-made diets that consist of multiple food items is difficult to achieve. Unless supplements are applied homogeneously to the total diet, animals have the opportunity to preferentially select some food items over the others. Maned wolves may not receive all of the supplement and thus may consume vitamin or mineral deficient diets. It is therefore recommended that nutritionally complete commercial products (e.g., dry dog foods, omnivore biscuits) represent at least 60-70% of the dry matter intake for maned wolves. If this guideline is adhered to, vitamin and mineral supplements are not necessary and additional dietary items such as chopped fruits and vegetables and small amounts of prey may be fed without risk of dilution of the nutrients in the commercial product.

Adult maned wolves (body mass 30 kg) should maintain body mass by consuming approximately one pound of dry matter per day. Lactating females and growing pups may consume 1.5 to 2 times that amount.

Because low protein dog foods are often low in fat, the addition of vegetable oil or cooked chicken fat will increase the energy density of the diet and may help improve palatability. Growing maned wolves (under the age of 15-18 months) should be offered diets formulated for growing puppies. Lactating females should not be offered diets with lower than 22% (DMB) crude protein since the nutrient demands on the female during milk production may not be met. Because domestic dogs fed diets containing soybean meal may produce poorly formed stool, commercial diets with rice or other non-soy plant products are recommended. The maned wolf should be able to be maintained on commercial products that are formulated to meet the requirements of the domestic dog. High performance dog foods, because they are often in excess of 28% protein and excessive meat or prey should be avoided. It is probably safe to supplement the basal diet with one or two mice (40 g) fed daily or 3 rats per week. Medicating or shifting maned wolves is often facilitated by the use of prey.

To promote oral health, prey (rats, mice, chicks) may be fed in small amounts. Oxtails or horse bones with some meat attached are also used to stimulate gums and teeth. The extent to which soft diets promote gingivitis and dental problems seen in some maned wolves has not been determined.

### **Feeding Schedules/Locations:**

If dry dog food or dry omnivore biscuits are fed they may be offered free choice since they will not spoil readily and over-consumption is generally not of concern with maned wolves. The daily ration should be placed in the feeding bowl(s) and completely emptied on a daily basis. Food bowls or containers should be thoroughly washed and rinsed daily.

If fresh fruits, vegetables, cooked rice, whole prey, bones with meat attached or other perishable foods are offered they should be offered early or late in the day to minimize spoilage under high ambient temperatures. All uneaten perishable foods should be removed from the enclosure as soon as is practical to avoid risks associated with bacterial proliferation. Since maned wolves likely forage for food throughout much of the day, it may be advisable to offer food at least 2 or 3 times per day. More frequent feeding of smaller amounts may also promote more normal gastrointestinal function and create less demand on the GI tract. The extent to which one-meal feeding (daily allotment of food presented in one feed) promotes loose stool has not been objectively studied.

Feeding locations should be protected from the elements. There should be at least one feeding location per maned wolf for those wolves housed together. Feeding stations should be spatially, and perhaps visually separated to discourage dominant animals from taking control of the food and to encourage food consumption by subordinate animals.

Feeding smaller amounts more frequently throughout the day may promote more normal activity. Maned wolves with access to outdoor yards are often seen eating insects, small rodents, birds and grass. The feeding of 20-30 crickets once or twice per week also stimulates feeding activity and offers some diversity. Grass eating is seen in domestic dogs and does not necessarily indicate GI tract problems or a nutrient deficiency. "Grass stool" produced by maned wolves may be voided as soon as 30 minutes after consumption. Such stool boluses are often coated in foamy mucous and may not contain any other food material, other than grass.

## **NUTRIENT REQUIREMENTS AND DEFICIENCIES/TOXICITIES**

As discussed above, maned wolves should be fed diets formulated to meet the requirements of the domestic dog. There is likely some value in offering diets that do not exceed 28% crude protein since protein (amino acids) in excess of requirement must be excreted. Much of the excess dietary cystine is probably excreted via the kidneys. It is thus prudent to restrict cystine (and methionine) (See Chapter Seven).

## **DIETS THAT HAVE CAUSED PROBLEMS**

As noted above, some commercial dry dog foods and omnivore biscuits appear to result in poorly formed stool. The extent to which feeding frequency (more frequent feeds in smaller amounts) may help to alleviate loose stool has not been studied. The addition of prey (rats, mice, etc.) appears to result in firmer stool.

# **CHAPTER FOUR**

## **BEHAVIOR AND SOCIAL ORGANIZATION**

**Fran Lyon**  
**Oklahoma City Zoo**

**Mary Jo Stearns**  
**Fossil Rim Wildlife Center**

Information concerning maned wolves social behavior in the wild is not yet definitive. The following recommendations are based upon the collective experience of several animal managers who have worked with maned wolves. Any institution receiving maned wolves should discuss and obtain as much information about the individual wolves past history as possible. This information can be crucial to successful introductions and subsequent reproduction. Items to consider include: individual variation in temperament; early experience (hand vs. mother rearing, group vs. solitary rearing); prior social grouping. Please refer to the ethogram at the end of this chapter for a description of maned wolf behavior patterns.

### **SOCIAL GROUPING**

Maned wolves are normally housed as opposite sex pairs as adults. Animals may be housed together 24 hours a day or may be separated into individual dens at night. Maned wolves can be housed together throughout the year. Little is known about dispersal of young maned wolves in the wild. In captivity, siblings may be housed together until they are yearlings and in some cases until the onset of their second breeding season. Opposite sex sibs should be separated before they reach 2 years of age in order to prevent reproduction. Same sex siblings may be housed together longer without problems but should be monitored closely for signs of tension and aggression. This is particularly true for males. Traditionally, males siblings have been separated before they are 2 years old, however, efforts are currently underway to manage pairs and small groups of same-sex sibs for longer periods of time.

Parent reared offspring are usually separated from the dam and sire before the onset of the following breeding season. An attempt will be made during the 1995 breeding season to maintain 2.0 pups with parents. The dam in this situation will receive an MGA implant to prevent reproduction. Recommendations regarding grouping of maned wolves may be modified pending the outcome of the ongoing trials.

Compatible pairs may be housed together 24 hours a day. Several houses or dens should be made available as pairs may choose to sleep together or separately. This can also change according to season and temperature. Separate feeding stations should also be available at all times. Marginally compatible pairs may tolerate each other during the day, but should be separated for the night. Although rare, there have been instances of pairs that are only compatible during the breeding season and are housed separately the remainder of the year.



## **INTRODUCTIONS**

A set protocol for introductions of maned wolves should be in place before the process is started. Visual and olfactory contact through a wire mesh barrier for a period of time prior to physical access is critical. The length of time this limited access should occur is dependent upon the wolves' behaviors, but 1-2 weeks is usually long enough for the individuals to become familiar with each other. Each individual maned wolf should have access to the new enclosure (exhibit or holding area) before introductions take place. This allows the new individual(s) time to become familiar with the enclosure. If both maned wolves are new to the enclosure, sufficient time should be allowed for both animals to learn the enclosure prior to introduction.

Maned wolves should be physically introduced in an area that facilitates quick and safe separation of the pair if undue aggression occurs. Behaviors such as lunging, growling, gaping and chasing CAN be expected during the initial introduction period. Wrestling and biting is also seen and may occur until dominance is established. Following the initial introductions some zoos continue to separate pairs at night for a period of time.

Very few pairs have not been successfully introduced. Brief fighting may occur until dominance is established by one individual. Any continued severe aggression should not be allowed. Little aggression is normally encountered during the introduction process. However, animals should be watched closely for signs of wounds and other injuries.

## **SEASONAL CHANGES IN BEHAVIOR**

In North America maned wolves breed primarily from late September through January, with a mean estrus date of November 16 (Rodden *et al*, in prep). Females cycle only once during the season. An increase in the frequency of interactive behaviors such as reclining and moving together, male following female (or vice versa), and male sniffing and licking female's ano-genital area have been observed as indicators of the onset of estrus. Keepers should observe the maned wolves outside the breeding season in order to establish baseline levels of interactions. Pairs should be observed more frequently as breeding season approaches. An ethogram and data sheet with accompanying instructions was prepared in 1988 by Species Coordinator Melissa Rodden and Devra Kleiman (NZP), and has been used by many MWSSP participants. We strongly recommend that all potential breeding pairs be observed during the season, beginning in late September. Copulations may not be observed, so it is crucial that affiliative behaviors be noted to aid in predicting a parturition date.

Pairs with young should be isolated from all other maned wolves by at least visual and tactile barriers. In cases where a breeding pair has been separated for management purposes, the sire can be housed adjacent to dam and pups. Sires have been successfully reintroduced to dam and pups at several institutions, primarily when pups are between 5-10 weeks old.

For additional information about reproductive behavior, please refer to Chapter Five: Reproduction.

## **COMMUNICATION**

Maned wolf communication involves visual, auditory, and olfactory cues. Since adult maned wolves occupy large home ranges and interact infrequently, one would anticipate the development of mechanisms for long-range communication. It would also be expected that close-up communication would involve a few distinctive displays leaving little room for

misunderstanding. Indeed, visual displays such as the friendly tail-up approach and play invitation bow, and the agonistic pilo-erect pace, gape, and submissive crouch convey a clear message to the recipient.

Olfactory information is communicated via urine and feces, which are deposited at ground level and on elevated objects throughout the exhibit, particularly along boundaries. Urine marking increases prior to and during the breeding season, with both partners showing an interest in each other's urine marks (Brady and Ditton, 1979). Presumably information about reproductive status is ascertained from sniffing and tasting the partner's urine. In close-up interactions, both sexes frequently sniff and lick the partner's ano-genital area. Feces are often deposited in specific areas, usually around the perimeter of the exhibit. Since almost all the hormonal metabolites are excreted in feces (see Wasser *et al*, 1995), information about sex and reproductive status may be transmitted via this route as well.

The vocal repertoire of the maned wolf was described by Brady (1981). The most commonly heard vocalizations in captive maned wolves are the submissive whine, the repetitive (or "pulsed") whine, growls of varying intensity, and the roar-bark. All convey information about the mood of the individual. Submissive whines and growls are heard during aggressive interactions between adults and are also used by pups in interactions with each other and with parents. The repetitive whine is used in two contexts: by a male directed at a female in estrus, and by dams before nursing young pups or to solicit food begging from older pups. The roar-bark can be heard over long distances and may function as a spacing mechanism between same-sex adults (Kleiman, 1972). Additionally, the roar-bark may occasionally be heard in a sexual context: directed by a male to his female partner, invariably when she is in estrus and has moved out of the male's sight.

# MANED WOLF ETHOGRAM

**Stephanie Bestelmeyer**  
**Colorado State University**

**Mike Kinsey**  
**Denver Zoo**

## **BEHAVIORAL STATES**

Lying down: mid-section of body in contact with the ground  
Sit: back part of body in contact with the ground, usually occurs when animal is scratching  
Stand: stationary upright position  
Walk: locomotion without in-air phase  
Trot: locomotion with in-air phase where hindlegs do not extend forward past the midline of the body  
Run: locomotion with in-air phase where hindlegs extend forward past the midline of the body  
Pace: walk back and forth over the same, small area  
Eat: consume solid food  
Drink: consume water or other liquid

## **BEHAVIORAL EVENTS**

### *Solitary Behaviors*

Self-groom: lick own body  
Scratch: scratch own body with hindleg  
Stalk: ears erect and forward, body tense and either standing or moving slowly with attention focused forward  
Dig: scratch ground with one or both front paws to make a depression  
Cache: bury food in hole or cover food with substrate

### *Elimination/Marking*

Leg lift: urination with hindleg lifted off the ground  
Squat: urination using a squatting posture, sometimes one hindleg may be lifted slightly off the ground  
Urinate over: urinate in the same spot another wolf urinated or defecated within five minutes  
Taste urine: lick urine of another wolf, usually accompanied by flehmen  
Flehmen: teeth chatter; lips often pulled back  
Straddle: stand over and rub genitals on bush, grass, or other object  
Face rub: rub face or neck on a surface  
Defecate: self-explanatory

### *Friendly*

Sniff: investigate another wolf anywhere except the anogenital region  
Sniff/lick anogenital region: sniff or lick another wolf's anogenital region  
Tail out: tail lifted or held horizontally along line of back  
Tail up: tail raised above level of back  
Play invitation: stamp or bow on forelegs with ears up, facing other animal, or use foreleg to paw at shoulder of another animal  
Play chase: chase another animal, usually with ears forward and not piloerect

Open mouth: head and ears up, alert, mouth open with tongue out  
Wrestle: stand together on hind legs, front legs on other's shoulders, usually silent and with open mouth  
Present: female stands or walks with anogenital region oriented to male's face, back often slightly arched, base of tail deflected up or to the side  
Pulse whine: rapidly repeated soft whine  
Attempt mount: male attempts to mount female  
Mount: male mounts female and exhibits pelvic thrusts  
Tie: occurs after the mount and lasts a minimum of 60 seconds

#### Agonistic

Charge/lunge: advance towards other wolf, piloerect, stiff forelegs, ears back  
Growl: growl at conspecific  
Gape: open mouth, ears back, oriented toward other wolf; often accompanies charge  
Agonistic chase: chase another animal, usually with ears back and piloerect  
Piloerect pace: walking with stiff forelegs, head down, piloerect, ears usually back, often moving parallel to other animal  
Submissive crouch: body in crouch or semi-crouch and oriented sideways to other animal, head rolled sideways while looking at other animal and often whining  
Submissive whine: long, high-pitched whine usually accompanying the submissive crouch  
Bite: snapping jaws shut  
Bark: short, loud, hoarse vocalization; not necessarily an agonistic behavior

#### Parental Behaviors

Regurgitate: disgorge partly digested food to mate or pups  
Regurgitation solicitation: animal crouches low to the ground, approaches another wolf with ears flattened and tail wagging, and nudges the body or mouth area with the muzzle  
Muzzle bite: bite the muzzle of another animal, usually in response to a regurgitation solicitation  
Nurse: suckle; female may be lying down or standing  
Groom: lick part of body of pup or mate  
Repetitive whine: bouts of short, loud whines usually emitted by an adult wolf with a closed or slightly open mouth; often followed by nursing or regurgitation  
Carry pup: carry pup with mouth around pups neck or midsection  
Attempt carry: open mouth around pups neck or midsection; sometimes the pup is dragged but it is never lifted off the ground

# CHAPTER FIVE

## MANAGEMENT OF REPRODUCTION

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**Melissa Rodden**  
**Conservation & Research Center-Front Royal**

Reproduction in the maned wolf was once an area of great mystery and frustration for zoological institutions. In the past few years we have made great strides in all aspects of the management of this species, reproduction in particular. Many reasons can be attributed to this, but increased research and observation have answered many of the questions. The following information concerns what the management group has found as the norm for maned wolves. The philosophy that we, as animal managers, must realize is that these are general criteria. There will be individual variation, particularly in the area of reproduction, and modifications to management practices should be made to meet the needs of these animals.

**NOTE: INSTITUTIONS PRODUCING LITTERS ARE REQUESTED TO COMPLETE AND RETURN THE BIRTH SURVEY FOUND AT THE END OF THIS CHAPTER.**

### **CHARACTERISTICS OF THE BREEDING CYCLE**

Maned wolves are monestrous; females cycle once a year. The onset of the breeding season appears to be a response to a decreasing light cycle. In the northern hemisphere breeding typically occurs from late September through early January. The first copulations can occur in the age range of 2-5 years, pregnancy can result from the first breeding. The oldest maned wolves to produce pups in North America were 10 years old.

#### ***Estrus***

Visible signs of estrus in the maned wolf are vaginal swelling (pink in color) and discharges (discharges appear pink or bloody before, clear during, and thick yellow at the end of estrus), male sniffing and licking the female in the genital area, obvious mounting and coupling, and the female moving her tail to the side when the male approaches. The male frequently following the female and maintaining close proximity to her may also indicate estrus.

Sexual behavior (e.g. female "presenting" and copulation) is not observed outside of the estrus period.

#### ***Physical Measures of Reproductive Cycle***

Measures of reproductive steroids excreted in feces have been reported by Wasser et al. (1995) and Gross et al (1991). Both studies indicate that fecal steroid measures can be used to assess the reproductive status of female maned wolves. Cycling females show an estrogen surge followed by a sustained rise in progesterone levels. Further analysis is currently underway to more accurately characterize conceptive cycles from non-conceptive cycles (i.e.

pseudopregnancy), and to distinguish male fecal steroids from female (A.L. Velloso, unpublished data).

## **PAIRING SPECIMENS**

In their native habitat, pairs of maned wolves occupy large home ranges (~30 km<sup>2</sup>). Institutions intending to house more than one adult pair of animals are strongly encouraged to separate pairs by as much physical distance as possible. If adult pairs must be housed in adjacent exhibits, a solid barrier is required. Every attempt should be made to isolate pairs recommended for breeding from other adult maned wolves. Young (<2 years old) may be housed adjacent to parents, although the potential effects on the parents' subsequent breeding/pup rearing are not clearly known at this time. An individual animal may be housed adjacent to a member of the opposite sex, although visual barriers are recommended. Solid barriers are required when individuals of the same sex are housed in adjacent exhibits. Maned wolves can be housed in proximity to other canids and other taxonomic groups, although visual barriers are recommended. Because there can be a good deal of individual variation in response to neighboring species, caution should always be exercised when introducing new "neighbors".

Most maned wolf pairs are exhibited together year round. In the few institutions that put them together only for breeding, the wolves have access to each other by visual and auditory means. They are then put together when the female shows signs of estrus, making for an easier introduction with some pairs.

Introductions usually begin with the maned wolves in pens next to each other, then progresses to a barrier between the animals that allows visual access for a period of one to two weeks. Subsequently each animal is separately given access to the same common area for a few days. Animals are then allowed access to the common area together during the day and separated overnight for 1-2 weeks. Once this is achieved the animals may remain together. It should be noted this is a very conservative approach to an introduction. Depending on the animals involved, the introduction could progress at a more rapid rate.

Aggressive behavior such as males chasing females, males being aggressive to females, and females being distressed by the males presence have been documented in limited amounts during introductions. Once again delaying or canceling an introduction due to excessive aggression is a judgment call on the animal manager's part. Some pairings have proven to be incompatible.

Moving maned wolves around for breeding recommendations does not seem to negatively impact breeding success. If animals are to be moved for breeding it is advisable to move them in the middle of spring so these animals have plenty of time to pass quarantine and adjust to new areas and keepers, before introducing them to new mates. It has been noted that some pairs, if kept together for an extended period of time at the same institution, do seem to have trouble making the adjustment to new surroundings and mates.

## **COPULATION**

The time of copulation varies from 1-6 minutes (untied) to 5-25 minutes tied. Observation periods have documented only one-two ties per day. Breeding may or may not occur in the presence of caretakers.

## **PREGNANCY CONFIRMATION**

Pregnancy can be very difficult to determine in a maned wolf because there are usually only minor changes in physical appearance. In addition, there have been numerous instances of "pseudopregnancy" in which mating is observed, the female's abdomen appears to get larger and she produces colostrum, but there is no birth. Since a great deal of effort is expended by zoo staff preparing for a birth, (e.g. setting up video equipment, restricting public access, night watches), some managers have opted to radiograph or use ultrasound to determine pregnancy. Ultrasound has been used successfully 30 days post-copulation, while radiographs should be done during the final 3 weeks of pregnancy when bone formation is occurring. There have been no reports of problems associated with the use of ultrasound or radiographs, although these techniques are not commonly used.

## **HUSBANDRY FOR PREGNANT FEMALES**

The gestation period for maned wolves is between 58-72 days (avg. 65), most institutions use 63-65 days after breeding to obtain the birth date.

Behavioral changes in pregnant females may include restlessness 2-3 days prior to birth, aggression to males and possible aggression towards keepers.

Physical changes can include abdominal swelling in the last 4-6 weeks, nipple development, milk in teats 2 weeks pre-delivery and hair loss around nipple area.

Although in the past males were usually separated from females for birth and pup rearing, it is now recognized that a pair bond does exist, and most males will invest a good deal of parental care in pups. The strength of the pair bond, and the degree of compatibility exhibited by a pair will influence the manager's decision whether to leave the male in for the birth. Recently, several zoos have successfully experimented with separating a sire to an adjacent area where all but physical contact can be maintained, and reintroducing him to dam and pups once the young begin emerging from the den at 5-6 weeks of age. Consultation with managers who have successfully parent-reared pups is highly recommended.

### ***Whelping Areas***

Since maned wolves give birth during the winter, adequate heat must be provided in whelping areas to maintain temperatures above 45 degrees Fahrenheit. Whelping areas should also be free from drafts. Managers should keep in mind that floor temperatures will affect neonates. The dens and rest/hide boxes used throughout the year (see Chapter 2) may suffice for use during whelping, as long as they meet the specifications listed in this chapter section. Institutions anticipating births during winter months should contact management group members for advice regarding temperatures.

Neonatal mortality rates have historically averaged around 50% for the global captive population. Mortality most frequently occurs during the first week of life. It is therefore highly recommended that nest boxes be equipped for remote video monitoring.

Maned wolves will usually move pups, therefore more than one nest box should be provided. Whether nest boxes are contained within a larger structure or constructed as separate individual units depends on climatic conditions at the institution. In cold climates, it is recommended that the whelping area be a large heated structure, e.g. 15' x 15' or larger, furnished with 2 or more nest boxes. The dam and pups could then be locked in during

extreme weather. Dams seem to prefer a small space with a low ceiling, therefore a typical nest box measures 4' x 4' x 4' high. Even smaller spaces may be preferred, although the design should take technical requirements for video monitoring into account. Designs incorporating a partition or L-shaped entry may provide more security to a dam with newborn pups.

Nest boxes may contain bedding of straw, carpet, or cedar chips. Hay is not recommended because of the risk to pups of inhaling small particles. Floor covering in the whelping area should provide good traction for pups.

Parents and pups should be discouraged from digging under the den or nest box, both because of the resulting inability to monitor the pups and the risk of injury to pups.

Most adult maned wolves become defensive of pups and will display very aggressive behavior towards human "intruders". It is recommended that nest boxes be equipped with a door, e.g. guillotine, that can be operated remotely so that keepers can access feeding areas safely. The ability to separate the dam/sire from pups for routine weighing and inoculations should also be addressed when designing a whelping den/nest box.

The management of pregnant maned wolves is varied, and should be decided by the individual institution. Decisions should be guided by the comfort level of the female. Pairs recommended for breeding should be isolated from other adult pairs. Young (<2 years old) may be housed adjacent to parents. Some situations have warranted that the sire be the only other animal in visual contact with the female, whereas, other females have given birth in buildings holding differing taxonomic groups. In cases where females cannot be isolated from other taxonomic groups visual screening should be provided. The MWSSP management group should be consulted in any areas of question.

### ***Diet Changes*** - See also Chapter 3, Nutrition

Pregnant females typically do not require changes in the diet; a high quality dog chow should constitute the bulk of the diet. Excess weight is rare in maned wolves, so a pregnant animal should be offered plenty of chow, and the amount can be increased should she demonstrate an increase in appetite. Once pups are born and the female begins lactating, additional chow will probably become necessary.

Appetite changes during pregnancy can be observed in many ways: not changing at all, small changes, rapid consumption of food, increased appetite 2 weeks before birth then dropping off to almost nothing 1-2 days before and after birth. Females usually resume eating 2-4 days post partum. Special attention should be paid to maternal nutrition during lactation especially females with larger litters. Lactating females should be fed chow containing a minimum of 22% (DMB) crude protein. Lactating females and growing pups may consume up to 1.5-2 lbs. chow each per day.

Parents begin regurgitating to pups when they are about 5-6 weeks old, and pups begin eating solids at this age. It is recommended that puppy chow be added to the diet at this time. Food pans should be provided in several locations to reduce competition and aggression at feeding time. Pups can be offered small whole feed items, e.g. small mice, beginning at about 6 weeks of age. The size of whole feed items can be increased as the pups grow.

## **HUSBANDRY OF PUPS**

### **Removing pups for hand-rearing**



Breeding recommendations based on genetic and demographic analyses of the population are distributed each year to all participants in the MWSSP. Each year certain pairs are designated as "Priority" animals based on their genetic value, age, and breeding history. Pups born to these pairs should be very closely monitored and pulled for hand rearing if trouble develops. Criteria for pulling pups and hand rearing methods are covered in **Chapter 6, Hand Rearing & Development**.

Indicators used to determine whether or not a female may cause harm to pups include any type of restlessness on the part of the female, excessive carrying, or obsessive licking of pups.

Indicators used for the pulling of the pups from the females (besides SSP recommendations) have been past history of the female with pups, observing (via videotape) any type of restlessness on the part of the female, excessive carrying of pups, and obsessive licking of the pups.

### **Changes in keeper routine and public access**

During the first weeks after a birth, some institutions close the exhibit to public viewing. Most managers try to limit care of new litters to a few individuals who are familiar to the parent(s). Consistency in procedures and observations are also enhanced by limiting the number of individuals dealing with the animals. Other zoos make no changes in routine for new litters. Although it is generally accepted that dams with new litters prefer solitude and seclusion, the degree of isolation provided will be up to individual managers and should be based on the temperament of the individual animals.

### **Development of pups (See also Chapter Six)**

Pups nurse approximately every 2 hours for several minutes during the first 2-3 weeks. Pups lay on their stomach, back and or side to "snuggle" up to a teat. During the first 2-3 weeks after birth females will spend a majority of their time with the pups, leaving only to feed and defecate.

Weighing of the pups when being mother/parent raised should only be done when removing the pups for regularly scheduled vaccinations.

Reintroducing the male has been done between the ages of 6-12 weeks. Again when making the decision as to whether to reintroduce male rely on the history of behaviors between the pair: are they highly compatible or are agonistic/aggressive behaviors common? Introducing the male through a fence barrier for a minimum of one week is recommended. Pay special attention to both the female's reaction and the reaction of the puppies.

### **Weaning**

Most zoos separate pups from parents when they are approaching 10 months of age, to prevent interference with the subsequent breeding season. Since the population is nearing capacity in North America, the MWSSP is experimenting with group composition. Future recommendations will depend on the outcome of current management trials.

## **ARTIFICIAL REPRODUCTION**

The canid family presents a real challenge in terms of the development of techniques for artificial reproduction (a Canid TAG priority). In females, the ovaries are surrounded by a bursa that must be surgically removed in order to observe follicular development using the laparoscopic techniques developed for other carnivores, e.g. felids. In addition, immature oocytes do not respond well to hormonal stimulation, thus making it extremely difficult to predict the exact time of ovulation in female canids.

During the 1990 and 1991 breeding seasons, a number of males in the MWSSP were electroejaculated in order to obtain baseline information about semen quality. The results of the 2 studies were distributed to all participating institutions in 1991 and 1992, and are available upon request from Melissa Rodden, MWSSP Species Coordinator (D. Wildt *et al.*, unpublished report; D. Schmitt, unpublished report). A total of 12 males were electroejaculated. Semen was collected once from 10 animals, and 4 times evenly spaced over a 2 month period from the other 2 males. In general, the quality of the ejaculates obtained was lower than that observed in other canids in terms of total sperm counts and percent of structurally abnormal sperm cells, although most of the animals evaluated during the survey were spermatogenic. There were no clear differences in ejaculate quality between proven breeders and unproven males. Urine contamination of the ejaculate was a recurring problem.

## **CONTRACEPTION**

Until recently, contraception has not been an issue for the MWSSP, since the population was faced with a shortage of young animals. However, now that numbers are close to carrying capacity, the annual breeding recommendations include numerous restrictions on breeding less genetically valuable animals. The development of safe, reversible methods for contracepting over-represented animals is a research priority for the Canid TAG. However, there are very few options at this time other than physical separation during the breeding season. The most widely used reversible contraceptive in carnivores, the progestin melengestrol acetate (MGA) implant, has been implicated in a number of cases of uterine and mammary cancers, particularly in large felids (Munson, 1993). However, in the absence of alternative options, the AZA Contraception Committee recommends MGA implants for short term (breeding season) use in canids.

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**Life Tables for MANED WOLF - Based on NORTH AMERICA from 1980 - 1995**

**FEMALES**

-----ACTUAL-----				MODEL (Smoothed)-----				
AGE	p(x)	l(x)	m(x)		p(x)	l(x)	m(x)	
0	0.540	1.000	0.000	r=0.099	0.540	1.000	0.000	ESTIMATES
1	0.980	0.540	0.000		0.975	0.540	0.048	
2	1.000	0.529	0.190		0.995	0.527	0.225	r=0.094
3	1.000	0.529	0.520	lambda=1.104	1.000	0.524	0.438	lambda=1.098
4	0.950	0.529	0.540		0.993	0.524	0.520	Ro=1.648
5	1.000	0.503	0.460		0.978	0.520	0.520	T=5.335
6	0.970	0.503	0.520	Ro=1.718	0.948	0.508	0.520	N at 20 years= 306
7	0.880	0.488	0.610		0.903	0.482	0.448	
8	0.850	0.429	0.230		0.878	0.435	0.300	
9	1.000	0.365	0.210	T=5.464	0.868	0.381	0.220	
10	0.840	0.365	0.220		0.855	0.331	0.170	EULER RESULTS
11	0.870	0.306	0.000		0.850	0.283	0.073	
12	0.850	0.267	0.040	Current	0.805	0.240	0.010	r= 0.098
13	0.630	0.227	0.000	SSP pop.= 44	0.705	0.194	0.000	lambda=1.103
14	0.670	0.143	0.000		0.483	0.136	0.000	T= 4.880
15	0.000	0.096	0.000		0.158	0.066	0.000	
16	0.000	0.000	0.000		0.000	0.010	0.000	
17	0.000	0.000	0.000		0.250	0.000	0.000	

**MALES**

-----ACTUAL-----				MODEL (Smoothed)-----				
AGE	p(x)	l(x)	m(x)		p(x)	l(x)	m(x)	
0	0.560	1.000	0.000	r=0.049	0.560	1.000	0.000	ESTIMATES
1	0.920	0.560	0.030		0.918	0.560	0.083	
2	0.930	0.515	0.270		0.993	0.514	0.223	r=0.055
3	0.960	0.479	0.320	lambda=1.050	0.945	0.479	0.343	lambda=1.057
4	0.950	0.460	0.460		0.950	0.453	0.425	Ro=1.347
5	0.930	0.437	0.460		0.955	0.430	0.460	T=5.405
6	0.970	0.406	0.190	Ro=1.301	0.965	0.411	0.468	N at 20 years= 128
7	0.970	0.394	0.540		0.960	0.396	0.483	
8	0.930	0.382	0.490		0.938	0.381	0.413	
9	0.890	0.356	0.180	T=5.391	0.915	0.357	0.243	
10	0.920	0.316	0.120		0.898	0.326	0.105	EULER RESULTS
11	0.890	0.291	0.000		0.795	0.293	0.030	
12	0.460	0.259	0.000	Current	0.593	0.233	0.000	r= 0.057
13	0.510	0.119	0.000	SSP pop.= 47	0.370	0.138	0.000	lambda=1.058
14	0.050	0.061	0.000		0.140	0.051	0.000	T= 5.111
15	0.000	0.003	0.000		0.013	0.007	0.000	
16	0.000	0.000	0.000		0.000	0.000	0.000	
17	0.000	0.000	0.000		0.250	0.000	0.000	

## **Definitions of Demographic Terms used in Life Table**

Lambda-the annual rate of population growth or decline.

Range: 0.0 to unlimited (usually less than 2). A value greater than 1.0 indicates growth and a value less than 1.0 indicates decline.

$L_x$ -Age specific survivorship. Probability of a newborn surviving to the beginning of a age class x. Range: 0 to 1. The higher the value the greater the average survival from birth to age class x.

$M_x$ -Age specific fertility. Average number of same sex offspring produced by a parent in age class x. (e.g. the average number of daughters born to mothers of age x). Range: 0 to maximum number of offspring produced in age class x by an individual.

$P_x$ -Age specific survival. Probability that an animal of age x will survive to the next age class. Range: 0 to 1. The higher the value the greater the average survival through an age class x.

r-the instantaneous rate of change in the population. A value greater than 0 indicates growth and a value less than 0 indicates decline.

$R_0$ -The net reproductive rate of the rate of change per generation. A value greater than 1.0 indicates growth and a value less than 1.0 indicates decline.

T-generation time. This value is calculated as the average age at which an animal produces offspring. This is calculated separately for each sex.

Source: Foose, T. and Ballou, J. Management of small populations. INTERNATIONAL ZOO YEARBOOK. 27:26-41, 1988.

## Maned Wolf Birth Survey

Date \_\_\_\_\_

Institution \_\_\_\_\_

Survey filled out by \_\_\_\_\_

Position: \_\_\_\_\_

Please complete a survey for **each litter** & return to Karen Hughes at White Oak Conservation Center.

Circle dam or pair where appropriate.

Date litter was born \_\_\_\_\_/\_\_\_\_\_/\_\_\_\_\_ sex ratio \_\_\_\_\_.  
month day year Male Female Unk

Sire studbook# \_\_\_\_\_

Previous litters: #of **pair** reared \_\_\_\_ #of **dam** reared \_\_\_\_ #of **hand-reared** \_\_\_\_ #**eaten** \_\_\_\_

Dam studbook# \_\_\_\_\_

Previous litters: #of **pair** reared \_\_\_\_ #of **dam** reared \_\_\_\_ #of **hand-reared** \_\_\_\_ #**eaten** \_\_\_\_

Most recent *vaccinations and dates*: (include brand names)

Sire:

Dam:

When was this pair **first** introduced? \_\_\_\_\_

Is this pair:

\_\_\_\_ kept together all year - 24 hrs./day

\_\_\_\_ kept together all year - separated at night

\_\_\_\_ together during breeding season only - *dates* \_\_\_\_\_

\_\_\_\_ together during estrus only

\_\_\_\_ other - *describe*

"Home" enclosure measurements \_\_\_\_\_ On exhibit? Y/N

List all carnivores that are adjacent to the maned wolf exhibit, and if they have visual contact.

List all additional carnivores, including other maned wolves, within close proximity (give approx. distance), and indicate if they have visual contact.

Was the sire separated from the dam for whelping? Y/N *date* \_\_\_\_\_

If the sire was separated from the dam for whelping, give *date* when he was re-introduced to participate in the pup rearing \_\_\_\_\_.

If he was not re-introduced was he allowed fence contact? Y/N *date* \_\_\_\_\_

Was the dam / pair corralled in a smaller area within the **familiar** enclosure for whelping?  
Y/N *date* \_\_\_\_\_

Was the dam / pair moved to an **unfamiliar** enclosure for whelping?  
Y/N *date* \_\_\_\_\_

After whelping, give *date* when dam/pair were given access to a larger enclosure for pup rearing. \_\_\_\_\_

Provide *whelping pen* measurements \_\_\_\_\_ On exhibit? Y/N

*Describe* the **whelping pen & pup rearing pen** enclosures: (i.e., grass, trees, shelters, terrain etc.)

How many **whelping** boxes were provided? # \_\_\_\_\_ length \_\_\_\_\_, width \_\_\_\_\_, height \_\_\_\_\_

After whelping, were they given access to other houses or dens boxes? Y/N *date* \_\_\_\_\_

What material was the whelping box **floor** made of?

Did the pups have adequate traction? Y/N

Was bedding provided? Y/N *describe*

Whelping box heat source? Y/N *describe*

Whelping box light source? Y/N *describe*

Was the whelping box temperature and / or humidity monitored? Y/N *describe*

Pregnancy confirmed by: (*check all that apply and give dates*)

\_\_\_\_\_ observed copulation

\_\_\_\_\_ weight gain

\_\_\_\_\_ X ray

\_\_\_\_\_ ultrasound

\_\_\_\_\_ fecal steroid / assays

\_\_\_\_\_ the birth itself

\_\_\_\_\_ other - *describe*

*Describe & date* any changes in dam **during pregnancy**:

appetite:

activity level:

behavior towards keepers:

behavior towards pen mate:

other:

Describe & date any changes in Dam **during lactation:**

appetite:

activity level:

behavior towards keepers:

behavior toward pen mate:

other:

Describe & date any changes in Sire **during dam's lactation:**

appetite:

activity level:

behavior towards keepers:

behavior towards pen mate:

other:

Describe current diet:

diet items:

diet amounts:

feeding frequency:

supplements:

other:

Describe diet changes and dates provided:

**during pregnancy**

**during lactation:**

diet items:

diet amounts:

feeding frequency:

supplements:

other:

Was keeper routine changed prior to and following whelping? If so, note changes & when they were made.

Indications that birth was imminent: (check all that apply)

\_\_\_\_\_ dam off food? *when?*

\_\_\_\_\_ circling nest box

\_\_\_\_\_ digging in nest box

\_\_\_\_\_ in & out of the box

\_\_\_\_\_ pacing

\_\_\_\_\_ direct attention to hindquarters - AG licking

\_\_\_\_\_ contractions

\_\_\_\_\_ increased interest by male - *describe*

\_\_\_\_\_ other - *describe*

How was birth observed?

- \_\_\_\_\_ not observed
- \_\_\_\_\_ direct
- \_\_\_\_\_ through peephole
- \_\_\_\_\_ through one-way glass
- \_\_\_\_\_ via video monitor
- \_\_\_\_\_ other - *describe*

Was the birth video taped? Y/N

Was there audio coverage? Y/N *describe method*

What *time* was straining first observed \_\_\_\_\_ contractions first observed? \_\_\_\_\_

What *time* was first pup born?

Note *time* each pup was born:

- 1 \_\_\_\_\_
- 2 \_\_\_\_\_
- 3 \_\_\_\_\_
- 4 \_\_\_\_\_

Date & time sire was **first** allowed in the whelping box \_\_\_\_\_.

Number of pups, if any, eaten by dam \_\_\_\_\_ sire \_\_\_\_\_ unknown \_\_\_\_\_

At what *time* was the dam **first** observed cleaning a pup? \_\_\_\_\_

At what *time* was the sire **first** observed cleaning a pup? \_\_\_\_\_

At what *time* was nursing **first** observed? \_\_\_\_\_

Give *date & time* the dam **first** leaves the whelping box without a pup \_\_\_\_\_  
with a pup \_\_\_\_\_

Give *date & time* the sire **first** leaves the whelping box with a pup \_\_\_\_\_

*Describe & date* how often the dam / sire moved the entire family to another location in the enclosure. (for the first six weeks)

After giving birth when was dam first **offered** food? *date* \_\_\_\_\_

When did dam first **eat** after giving birth? *date* \_\_\_\_\_

Were pups pulled for hand-rearing? Y/N *date* \_\_\_\_\_

What **indicators** were used to determine that hand-rearing was necessary?  
\_\_\_\_\_ restless behavior? *describe*



- \_\_\_\_\_ neglect
- \_\_\_\_\_ disappearance of a pup
- \_\_\_\_\_ traumatic injury to a pup
- \_\_\_\_\_ death of a pup
- \_\_\_\_\_ SSP recommendation
- \_\_\_\_\_ Zoo policy
- \_\_\_\_\_ other - *describe*

Reason for **first** human physical contact with pups: (*check all that apply & give date*)

- \_\_\_\_\_ sexing
- \_\_\_\_\_ weight
- \_\_\_\_\_ vaccinations
- \_\_\_\_\_ pulling for hand-rearing
- \_\_\_\_\_ other - *describe*

Give *date* when dam was first observed regurgitating to pups: \_\_\_\_\_

Give *date* when sire was first observed regurgitating to pups: \_\_\_\_\_

What would you like to change for next year's breeding season?

Other comments?

# CHAPTER SIX

## HAND REARING AND INFANT DEVELOPMENT

**Melissa Rodden**  
NZP Conservation Center

**Mark Rosenthal**  
Lincoln Park Zoo

### **BACKGROUND**

When maned wolves were added to the AZA's Species Survival Plan program in 1985, hand rearing was not an immediate priority. Our knowledge at that time was based on a few published accounts describing hand rearing procedures at institutions in North America and abroad (Acosta, 1972; Encke, 1970; Hora *et al.*, 1975; Rodden & Blakely, 1987). However, for reasons that are still unclear, the 1986-1988 breeding seasons proved disastrous with regard to both reproduction and neonatal mortality. By 1989, the age structure of the captive population of maned wolves in North America resembled an inverted pyramid, with the majority of animals approaching post-reproductive age and only a few replacements coming up through younger age classes. Our concern for the genetic and demographic implications resulting from a lack of young animals prompted a decision in 1989 to hand-rear every litter born during the next few breeding seasons in order to assure recruitment of young animals into the SSP population.

The program has been extremely successful. Since 1989, a total of 19 litters of 40 pups have been hand reared at 13 institutions. A hand-rearing protocol was developed by John Lewis, Director, John Ball Zoo in 1989. Several members of the MWSSP have assisted in preparing updates and revisions, including John Collette (Dickerson Park), Mike Blakely (Kansas City), John Lukas (White Oak Conservation Center) and Melissa Rodden. A video and accompanying booklet describing hand-rearing techniques and growth and development of a litter of 2.1 pups born in February 1991 was prepared by Lincoln Park Zoo, Chicago with funding from the Institute of Museum Services. In addition to the Lincoln Park litter, the booklet also summarizes growth and feeding information for maned wolves hand-reared at six MWSSP participating institutions. The video and booklet, entitled *Maned Wolf Diaries: Growth and Development of Hand-Reared Pups* (Lincoln Park Zoological Society, 1993), was distributed to all MWSSP institutions in November 1993. Additional copies are available free of charge to new members of the MWSSP and to other interested parties for a nominal fee. With Lincoln Park Zoo's permission, portions of this chapter are excerpted from *Maned Wolf Diaries*, and readers are strongly urged to consult the video and booklet to supplement the information presented here.

### **CURRENT HAND-REARING POLICY**

The recruitment of young animals into the MWSSP resulting from the success of the hand-rearing program has now allowed us to shift our focus away from hand-rearing toward management changes that will promote successful parent-rearing of young. Beginning with the 1993 season, the hand-rearing policy was revised to encourage all MWSSP participants to focus on determining management factors resulting in successful parent rearing. In 1994, Karen Hughes, White Oak Conservation Center, prepared a Birth Survey for the purpose of collecting information from all institutions experiencing births (See Chapter 5, Reproduction).

Pairs should be monitored closely to ensure observations of breeding so that preparations for births can be made. Whelping dens should be equipped with video cameras so that births and neonatal events can be closely monitored. Although parent-rearing is preferred, the young of pairs designated as "Priority" animals based on their genetic value to the population should be pulled and hand-reared if trouble develops. "Non-priority" pairs should be allowed to rear young. In all cases, the Species Coordinator should be kept well-informed of all breeding or suspected breeding dates, birth dates and pup death dates.

Every effort will be made to place singleton pups with another hand reared litter to ensure proper socialization.

## **HAND-REARING PROTOCOL**

**Removing pups:** If at all possible, do not remove newborn pups from the dam until the entire litter has been born. There is typically a 1-3 hour interval between births, although up to 8 hours is not unusual. We have recorded one instance of 24+ hours from the birth of a stillborn pup to the subsequent live birth of a sibling (OKC 1993 season). It is extremely important that priority litters be closely monitored for at least the first 3 days, since trouble most commonly develops during this time. Below is a list of typical behaviors that indicate a problem may be developing. Managers must use their own judgment and knowledge of their animals to determine when the survival of a litter is seriously jeopardized.

1. Dam becomes restless; up & down frequently, in & out of den repeatedly.
2. Dam begins to persistently carry pups in & out.
3. Dam begins to lick and mouth pups frequently and persistently.
4. Dam lays apart from pups and makes no effort to pull them close to her body.
5. Pups should appear strong and vigorous. If they appear lethargic and make no attempt to move close to dam, it indicates they are getting cold and weak. Nursing activity should be observed every 2 to 3 hours (Brady & Ditton, 1979).

**Immediate care:** A hot water bottle or other heat source is recommended during transport from the den area to the nursery. Once at the nursery, weigh and sex each pup, take rectal temperature, and examine for injuries. Use natural markings or specific fur clip patterns to individually identify each pup. Veterinary staff should be on hand to ascertain the medical status of each individual and determine the appropriate immediate action. This may include warming the pup, administering 5% Dextrose orally, electrolyte replacement, beginning a course of antibiotics, etc.

**Passive immunity:** In the domestic dog, a small amount of maternal antibodies are transferred through the placenta during fetal development. However, studies have demonstrated that this immunity is short-lived, and that domestic dogs receive the bulk of passive immunity through colostrum (Bouchard *et al.*, 1992). However, in a study of domestic dog puppies, Bouchard *et al.* found that "intestinal absorption of immunoglobulins is minimal after 12 hours and thus, another route of administration should be used." Subcutaneous injection of 16 ml of serum at birth provided the greatest increase in the hand-reared pups' serum immunoglobulins, although concentrations were lower than in the control group (pups left with dam).

The MWSSP recommends that institutions holding potential breeding pairs collect a small supply of adult maned wolf serum opportunistically prior to the birth season. The serum should be filtered and frozen for up to 6 months. To maximize effectiveness, it is recommended that serum be administered both orally and by SQ injection: 1cc SQ when pups are pulled, followed by 5 .5cc oral doses spaced evenly over the next 24 hours (2.5cc total). Give another 1cc serum SQ 24 hours after the last oral dose.

**Formula:** Esbilac, domestic dog replacement formula manufactured by Pet-Ag, Inc., has been recommended since the inception of the hand-rearing policy in 1989. Liquid or powdered formulations have been used with equal success up until 1994. However, the formulation for powdered Esbilac was modified in 1994 to make it more soluble and thus easier to mix. Although the new formula provides adequate nutrition for maned wolves, preliminary testing by nutritionists Mary Allen and Olav Oftedal (NZP) revealed that the new formulation is very easily over mixed, causing fat molecules to come out of solution and form large particles. Accordingly, the MWSSP does NOT currently recommend Esbilac powder for hand rearing maned wolves. Zoologic 33-40, also manufactured by Pet-Ag, Inc. and identical to the pre-1994 powdered Esbilac formulation, or liquid Esbilac are the recommended formulas.

It is also recommended that the enzyme Lactaid (McNeil Consumer Products Co.), which aids in the digestion of milk sugars, be added to the formula according to the manufacturer's directions (~4 drops per quart added 24 hours in advance of feeding).

Formula should be diluted with sterile water or an electrolyte replacement, e.g. Pedialyte (Ross Products Division, Abbott Laboratories), for the first several days. If powdered formula is used, it is recommended that it be prepared by weight rather than volume. Dilute to an 8-10% concentration on the first day, e.g. to make 100g of formula, mix 10g powder with 90g. sterile water. Increase the concentration by 2% per day up to the manufacturer's recommended full strength concentration of 20%. At the first sign of gastrointestinal upset, substitute or dilute formula with an electrolyte replacement until symptoms disappear. Liquid Esbilac should also be diluted by at least 50% on the first day and the concentration gradually increased up to full strength over the next 5-7 days.

### **Feeding Schedule and Amounts**

**First feeding:** It is recommended that the first bottle offered to pups contain 5% Dextrose or Pedialyte in order to safely determine whether pups can nurse and swallow effectively, thus preventing potentially fatal problems resulting from inhalation of formula. If pups nurse well, begin offering formula at the next feeding. If, however, pups do not respond or nurse correctly, tube feeding may be indicated (CONSULT VETERINARIAN). Attach a size 8 French feeding tube to a 12cc syringe containing formula. Estimate the length of tube needed by measuring it from the tip of the pup's nose to the level of the last rib. Lubricate the tube with a small amount of K-Y jelly. Hold pup upright with one hand and gently guide the tube down the throat with the other hand until the predetermined distance is reached. Once tube is in place, depress the plunger slowly and steadily. If tube feeding is indicated, it is best to use no more than half the calculated volume for the first few tubings. Avoid injecting air into the stomach.

**Formula feeding:** It is recommended that pups be weighed at the same time each day, and the weight used to calculate the amount of formula to be offered over the next 24 hours. Offer each pup 20-25% of its body weight spaced evenly over the 24 hour period. Avoid sudden jumps in amounts fed from one feeding to the next. Feedings every 3 hours are recommended for the first 5-7 days; the number of feedings/day can then be gradually reduced. For example, 3 week old pups should be fed about 5 times per day. Table 1 presents feeding schedules and amounts fed for one representative hand reared litter. Please refer to Lincoln Park Zoo's *Maned Wolf Diaries* for additional feeding information.

Several zoos have successfully used human premie nipples for very young pups. Once the pups are about 10 days old, the nipple holes can be enlarged or the premie nipple replaced with a regular human infant nipple. Young pups need to be stimulated to urinate and defecate. Keepers can emulate mother's tongue by gently rubbing the anogenital area with moistened cotton immediately before and after each feeding. Pups begin to occasionally

urinate and defecate on their own as early as 10 days, although manual stimulation should be continued through the first month.

Solids should be introduced relatively early, at about 20 days of age, to prevent cataracts and enhance coat development (Vainisi *et al.*, 1981). Small amounts of ground puppy chow, e.g. Purina ProPlan (Ralston Purina), Science Diet Growth (Hill's Pet Nutrition, Inc.), commercial brand beef baby food, and pureed calf liver have all been successfully added to bottled formula.

**Weaning:** The MWSSP strongly recommends pups be weaned to a commercial brand of puppy chow; chicken based brands are preferred to soy based because they are more easily digested. Wean pups gradually beginning around 4 weeks of age. It has been noted that pups will frequently begin to resist taking a bottle when they are between 3 and 4 weeks old. Although there is considerable variation in the procedures used successfully to wean pups, generally speaking nursery staff begin by offering pups a small bowl of ground or whole puppy chow soaked in water or diluted formula once or twice a day. Many pups adjust to the change more easily if the gruel mixture is presented on keeper's fingers. Most pups are observed lapping water at 30-40 days of age; discontinue formula by the time pups are 5-6 weeks old. Offer pups free choice dry puppy chow along with chow soaked in water. Weight and hydration should be monitored daily to ensure that pups are ingesting adequate amounts of solids and liquids. Pups usually begin to prefer the dry chow by 7-8 weeks of age.

### **Housing**

Care should be taken at all times to isolate young pups from exposure to canid disease agents, including keepers' or nursery staffs' pet dogs. It is recommended that newborn pups be housed in an incubator maintained at 85 F. and 50% humidity. Higher temperatures and/or humidity may result in fur loss. Cotton sheets or towels provide comfortable bedding while reducing the potential for snagging claws or ingesting material. Pups may be removed from incubator by 3 weeks of age; during the final week, begin reducing the incubator temperature to room temperature.

Once removed from the incubator, house pups in an area large enough to allow adequate physical activity. Non-abrasive, non-slip, easily-cleaned surfaces are recommended. Provide one or more shelters, e.g. small boxes or carry-all crates, and a cloth-covered hot water bottle for comfort. Heating pads are not recommended because of the potential electrical hazard.

### **Immunizations**

All maned wolf pups should be vaccinated against canine distemper, parvovirus and rabies (in rabies endemic areas).

**Parvovirus:** use **KILLED** product, e.g. Vanguard or Parvocine, every 2 weeks beginning at 6 weeks of age and ending at 16 weeks. Do a follow up titer and send results to Robyn Barbiers. If titer is acceptable (> 1:80), begin using a modified live product at 6 months of age and continue using MLV product every 6 months. If titer is unacceptable (< 1:80), continue using killed product at 6 months of age, and check titer again. Switch to MLV product at 1 year of age and continue immunizing adults with MLV every 6 months.

**Canine Distemper:** Currently recommended brand is **Galaxy-D** (Solvay Co.). Vaccinate every 3 weeks, beginning at 6-8 weeks of age and ending at 16 weeks. Vaccinate again at 6 months, and check titer at this time. A titer >1:30 is considered protective. Vaccinate again at 1 year and annually thereafter. Please send titer results to Robyn Barbiers along with brand name and vaccine schedule information.

Rabies: Immunize pups with a killed product , e.g. Imrab, at 16 weeks, 6 months, 1 year and annually thereafter.

**Please refer to Chapter 7, MEDICAL MANAGEMENT,  
for additional information about immunizations**

## **Reporting Requirements**

Daily logs should be maintained of feeding schedules, amounts offered and consumed, feeding methods (e.g. bottle, bowl), and weight gain. Complete records of all medical procedures should be kept. Clear and concise records of physical and behavioral development should be maintained.

A report covering the first 16 weeks of life should be prepared and sent to the Species Coordinator by the time the pups reach 6 months of age. Include the following information:

### 1. General Information

- Pups' ISIS #s, sex, birthdate, parents' studbook numbers.
- Date pulled and reason for pulling.

### 2. Feeding Schedule

- Formula used; dilution factor; additives, e.g. Lactaid.
- Average daily food consumption summarized by weeks.
- Number of feedings per day summarized by weeks.
- Type of nipple used, and any changes.

### 3. Weaning Process

- When solids introduced.
- Method by which solids were introduced.
- What solids and in what order were they introduced.
- When were bottles discontinued.
- When was formula discontinued.

### 4. Development

- Weekly weights.
- Age eyes and ears opened.
- Age and description of changes in pelage.
- Pattern of tooth eruption.
- Motor development: when standing, walking, running etc.
- Behavioral changes: e.g. age when fear of strangers noted; development of play behavior; appearance of uninhibited fighting between littermates.
- Vocalizations: age when whine, growl, bark first noted.

### 5. Housing

- Use of incubator (temp, rel. humidity)
- Age when removed from incubator.
- Description of housing after incubator: flooring, heat source, "nest box".
- Age when put on exhibit.

### 6. Medical

- Description of any medical treatments required.
- Dates and brand names of vaccinations.

## **GROWTH AND DEVELOPMENT**

Table 2 presents mean weekly weights from birth to 12 weeks for 4 representative litters: 3 hand-reared and 1 mother-reared litter of maned wolves. Although hand-reared pups may lose small amounts of weight for the first 24-48 hours, it is quickly regained, and pups should continue to gain weight steadily.

The physical and behavioral development of hand-reared maned wolves corresponds to that reported for mother/parent-reared litters (Brady & Ditton, 1979; Pithart *et al*, 1986).

Eyes: Inner corners begin to open around Day 7-8; often accompanied by mild mucous discharge. Fully open by Day 11.

Ears: Begin to open around Day 7; fully open by Day 16. Ears fully erect around Day 33.

Pelage: Dull black at birth, with white tail tip and a few white hairs under chin. The pattern of fur changes begins at the head and moves posteriorly. The fur on the head begins to lighten around Day 7. By Day 25-30 the head and torso are grayish in color, with red fur beginning to emerge. The mane and legs remain black. The tip of the tail, under the chin and inside the ears are white. Adult coloration develops by 10 weeks, although youngsters usually remain a pale shade of red until they are adults.

Teeth: The deciduous teeth begin to erupt around Day 10, starting with the upper canines and incisors, closely followed by the lower canines and incisors. The first lower premolar appears around Day 16, followed by the first upper premolar and the 2nd lower premolar. By Day 28 the first lower molar begins to erupt. At five weeks, in addition to the incisors and canines, pups have 2 upper and 2 lower premolars (on each side) plus 1 upper and 1 lower molar. The deciduous teeth begin to shed at around 13-14 weeks of age. The incisors are lost first; permanent incisors begin to erupt at 17 weeks. Between 21-23 weeks, the canines and premolars start shedding. Adult premolars and canines begin to erupt around 24 weeks; in most cases the 4th premolar precedes the adult canines. The 2nd set of upper and lower molars also begin to appear around 24 weeks. Adult dentition is completed by 7-8 months of age displaying the typical canid pattern of 3 incisors, 1 canine, 4 premolars, 2 molars on each side of the upper jaw, and 3 incisors, 1 canine, 4 premolars, 3 molars on each side of the lower jaw.

Motor Development: Pups can roll and crawl at birth. They begin to stand briefly around Day 10, and by 21-23 days pups can walk quite well. Coordination improves steadily from that point on, and by 27-28 days the pups can climb and pounce. Pups begin to regularly urinate and defecate without stimulation after the first month.

Behavior: The first play bites appear around Day 18-20. Play behavior increases as coordination improves, and includes pouncing, scruff bites, wrestling, and other typical infant canid behaviors. The period from 5-8 weeks of age is often characterized by very rough physical play, sometimes resulting in minor cuts and scratches. The intensity of play fighting decreases after 7-8 weeks of age, although pups continue to interact frequently. In hand-reared pups, a fear response (growls, attempted biting, submissive crouch) to strange humans begins between Day 27-35.



**Table 1. Summary of growth and feeding for a litter of 1.1 maned wolf pups hand-reared at NZP-CRC.**

Stbk #1351 & #1352 born 29.Dec.91 to Sire #476 and Dam #368 were pulled approximately 6 hours after birth due to maternal trauma.

Formula = Esbilac powder mixed with boiled water. Formula was prepared by weight, not volume, beginning with an 8% solution (e.g. 8g powder in 92g water). The concentration was increased by 2% each day up to 20%. Stool quality was monitored closely. All feeding equipment was sterilized until pups were removed from the incubator at 21 days.

Date presented below are MEANS for the 2 pups:

Age (Days)	Weight (kg)	No. Feed per day	Formula Conc.(%)	Tot. Form. EATEN(cc)	Solid Food INTAKE
1	.3395	8	8	34	
7	.3725	8	20	84	
14	.6885	7	20	147	Start calf liver homogenate 3X/dy, beginning with .75cc/dy increasing by .5cc/day.
18					Begin to resist bottle. Switch from Preemie to Evenflo nipple.
21	1.075	6	20	209	3cc Liver; Begin intro GRUEL = ground Science Growth mixed w/ formula.
28	1.575	4	20	266	8cc Liver; ~2.5tsp Gruel + ~2 pinkie mice.
35	2.150	3	<20	355	8cc Liver; ~4.5tsp Gruel, 2 pinkie mice.
39					STOP Bottles.
42	2.475	3	<10	135	6cc Liver;~14 Tbsp Gruel + 1 pinkie. ** Gruel: substitute water for formula.
44					STOP Formula; STOP Liver
49	2.940	2		0	172g Gruel + 1 "fuzzy" mouse.
51					Switch to DRY Science Diet Growth Chow
56	3.899	2			144g chow + 1 mouse

**Table 2. Maned wolf growth rates for 3 hand-reared and 1 mother-reared litters.**

WEIGHTS in KG

Age (wks)	Hand Reared Litter #1	Hand Reared Litter #2	Hand Reared Litter #3	Mother Reared Litter #4
<1	.3917 (Day 2)	.3397 (Day 2)	.4565 (Day 1)	---
1	.5300	.3540	.660	---
2	.8467	.4823	1.15	---
3	1.29	.6753	1.725	1.503 (Day 23)
4	1.87	1.03	2.225	1.789
5	2.36	1.417	2.55	2.215
6	2.91	1.80	3.10	---
7	3.57	2.40	3.425	3.00
8	4.30	3.05	3.90	---
9	4.90	3.73	4.40	---
10	5.76	4.57	5.28	4.725
11	6.27	4.85	5.80	5.525 (Day 79)
12	7.12	5.48	6.25	---

Litter #1: 3.0 born 17.Dec.90 at Woodland Park Zoo.  
 Litter #2: 2.1 born 19.Feb.91 at Lincoln Park Zoo  
 Litter #3: 0.2 born 31.Dec.92 at NZP-CRC  
 Litter #4: 2.0 born 1.Feb.94 at White Oak Conservation Center.

## **REFERENCES**

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# **CHAPTER SEVEN**

## **MEDICAL MANAGEMENT OF MANED WOLVES**

**Robyn Barbiers, DVM  
Lincoln Park Zoo**

**Mitchell Bush, DVM  
NZP Conservation Center**

### **PRESHIPMENT**

Medical history should be received and reviewed by receiving institution's veterinary staff prior to shipment. Preshipment examination includes complete physical examination, CBC/chemistry, fecal examination, urinalysis, heartworm test, thoracic and abdominal radiographs. In addition, the animal should be current on all recommended vaccinations (see below). The wolf is to be permanently identified with tattoo of studbook number on the inner thigh (left for female, right for male). A transponder chip should be inserted to the right of the midline in the shoulder area. The Trovan system is recommended at this time.

A urine sample should be collected on filter paper for cystinuria screening. Label the sample with the animal's studbook number and mail sample with an accompanying sheet of information including date, species, Stbk #, sex, birthdate, and your return address to Kenneth Bovée, DVM at:

University of Pennsylvania  
School of Veterinary Medicine  
3850 Spruce Street  
Philadelphia, PA 19104-6010

### **QUARANTINE**

Quarantine should be a minimum of 30 days. Animal should not be released from quarantine until there are at least two negative fecal examinations one week apart. Any deficits in the preshipment recommendations should be corrected during quarantine.

### **PARASITE MONITORING**

It is recommended that fecal exams (flotation and direct) be done at least semi-annually. Internal parasites are only occasionally seen. These include ascarids, trichuris, cestodes, and strongyles. Standard anthelmintics at canine dosages have been successfully used. A re-check fecal examination should be done two weeks post treatment.

Ectoparasites seen include ear mites, fleas, flies, and occasionally ticks. Again, standard canine dosages of domestic animal products have been successfully used for treatment.

All maned wolves in heartworm endemic areas should be tested annually and placed on prophylaxis using ivermectin or milbemycin at standard canine dosages.

## VACCINATIONS

Maned wolves should be vaccinated against canine distemper, parvovirus and rabies (in rabies endemic areas) annually. Vaccines are preferably administered by hand to adults during the annual physical exam.

**Canine Distemper** In 1994, Solvay discontinued production of Fromm-D, an avian cell line modified live distemper vaccine that was the brand recommended by the MWSSP for several years. Fromm-D has been replaced by **Galaxy-D**, a stable cell line modified-live vaccine. Galaxy-D should not pose a threat to maned wolves, since it does not originate from canine cells, however, it has not yet been adequately tested on this species. In the absence of alternative choices, the MWSSP presently recommends Galaxy-D for use in both pups and adults.

Schedule: Pups should be vaccinated every 3 weeks, beginning at 6-8 weeks of age and ending at 16 weeks. Vaccinate again at 6 months, and check the titer at this time. A titer >1:30 is considered protective. Vaccinate again at 1 year and annually thereafter. Please send the titer results to Robyn Barbiers along with brand name and vaccine schedule information.

**Parvovirus** In 1992, Fort Dodge Laboratories discontinued manufacturing Duramune, a modified-live product that had proven safe and effective for maned wolves. Duramune was replaced with another modified-live product, **KF-11**. Since 1992, 3 zoos have reported cases of parvo-like syndrome in pups post-vaccination with KF-11 (see Backues, 1994), therefore the **MWSSP DOES NOT recommend the use of modified-live products on pups less than six (6) months of age.**

Schedule: Pups should be vaccinated with a killed product, e.g. **Vanguard, Parvocine** every two (2) weeks beginning at six (6) weeks of age and ending at 16 weeks. Do a follow up titer and send results to Robyn Barbiers, DVM.

If titer is acceptable (> 1:80), begin using a modified live product at six (6) months of age and continue using MLV product every six (6) months.

If titer is unacceptable (<1:80), continue using killed product at 6 months of age, and check titer again. Switch to MLV product at one (1) year of age and continue immunizing adults with MLV every six (6) mo.

It is important to remember that killed vaccine does not provide good protection. Every effort should be made to minimize pups' potential for exposure to infectious disease.

**Rabies** Maned wolves exhibited in endemic rabies areas should be vaccinated with a killed product, e.g. **Imrab**.

Schedule: Pups should be immunized at 16 weeks, 6 months, 1 year and annually thereafter. Adults should be immunized annually.

**Other** One case of a fatal **adenovirus** outbreak in a litter of pups was reported in 1994. Efficacy and side effects of the available adeno vaccines (modified live) are unknown so no recommendations can be made at this time. In areas where diseases such as **Lyme disease** or **Leptospirosis** are common, managers may want to consider immunizations, however, the efficacy and safety of the available products are unknown at this time.

## **ANESTHESIA**

Two commonly used anesthesia regimes are a ketamine/xylazine combination (approx. 6-8 mg/kg ketamine and 1.1 mg/kg xylazine) or telazol (approx. 3-6 mg/kg). Telazol gives a smooth induction and a relaxed state of anesthesia. It is a matter of personal preference which regime is used.

Supplemental anesthesia with Isoflurane is preferred.

Routine monitoring during anesthesia and recovery is essential.

## **ANNUAL PHYSICAL EXAMINATION**

It is recommended that animals undergo an annual physical examination. Blood is collected for CBC/chemistries and serum banked. ISIS normals are given in Table 1. Thoracic and abdominal radiographs are taken. Teeth are examined, scaled and polished as needed. Only minimal tartar and calculus has been reported. The animal is weighed; average adult male weight is 31 kg., average adult female weight is 30 kg. Urine is collected and analyzed, including pH and microscopic exam for cystine crystals.

## **DISEASES SEEN**

**Dermatitis** has been reported at several institutions -- these included Staph. aureus pyoderma, interdigital dermatitis and most commonly, acute moist dermatitis. Some of the dermatitis seen seems to have an allergic basis, possibly related to exhibits containing tall, damp grass. This type of dermatitis usually responds to corticosteroids and/or antihistamines, which may become an ongoing L during warm months.

**Virus:** Several occurrences of **canine parvovirus** have been reported in maned wolves (see Fletcher *et al*, 1979; Mann *et al*, 1980; Montali & Kelly, 1989). Vaccine-related parvoviral-type syndrome was reported by Backues (1994).

Vaccine-induced **canine distemper** was reported by Thomas-Baker (1985) in one litter of captive-born pups.

One case of **adenovirus** occurred in 1994 in a litter of 12. 5 month old parent-reared pups. The 2 female pups died as a result of the infection; the male recovered.

**Traumatic injuries** reported include foot pad lacerations, long bone fracture caused by darting and other fractures with unknown history.

**Idiopathic degenerative neuropathy** and/or myopathy has been seen in two related individuals.

**Proliferative gingivitis** with associated tooth loss in all age groups has been reported.

**Cystine calculi**, both in the kidney and bladder are commonly reported. Many institutions have been treating with Thiola, U/D diet and urine alkalization with varying success. Surgery may be indicated. Urethral obstruction due to cystine calculi does occur, particularly in males. This may present as an animal straining (like constipation) and is an emergency situation.

**Damage to or destruction of the right kidney** due to the giant kidney worm (*Diocotophyma renale*) has been seen in individuals imported from the wild, however it has never been reported in maned wolves captive born in North America.

**Ovarian tumors** are found quite frequently in adult female maned wolves (Munson & Montali, 1991).

**Adverse drug reaction:** One suspected case of bone marrow suppression thought to be induced by the antibiotic **trimethoprim/sulfadiazine (TMS)** occurred in 1992. A report prepared by Mitchell Bush, DVM, was distributed to all MWSSP participants in February 1993, (see Addendum I at end of chapter).

## **NECROPSY REPORT**

The death of any maned wolf should be reported to the SSP species coordinator immediately. A necropsy protocol prepared by Richard Montali, DVM (National Zoo) is included at the end of this chapter. All participants in the MWSSP are requested to follow the procedures outlined in the protocol; pay particular attention to the requests for tissues/information regarding current research projects.

## **REFERENCES**

For additional information about medical management of maned wolves please refer to publications listed in the Bibliography by the following senior authors:

K. Backues; R. Barbiers; M. Burton; M. Bush; K. Bovée; D. Feedback; K. Fletcher;  
V. Kumar; P. Mann; E. Matera; R. Montali; L. Munson; T. Norton; F. Soifer; B.  
Thomas-Baker.

**TABLE 1. ISIS CLINICAL PATHOLOGY NORMAL VALUES**

	<b>ISIS MEAN</b>	<b>S.D.</b>	<b>(N)</b>
WBC *10 <sup>3</sup> /ul	11.22	4.626	(141)
RBC *10 <sup>6</sup> /ul	5.400	0.986	(133)
HGB GM/DL	14.6	2.6	(133)
HCT %	43.1	6.9	(141)
MCH uug	27.3	1.6	(131)
MCHC g/dl	34.1	1.4	(131)
MCV fl	80.2	5.9	(134)
SEGS *10 <sup>3</sup> /ul	12.22	14.82	(130)
BANDS *10 <sup>3</sup> /ul	1.731	4.921	(129)
LYMPHS *10 <sup>3</sup> /ul	4.381	6.805	(132)
MONOS *10 <sup>3</sup> /ul	0.277	0.289	(129)
EOS *10 <sup>3</sup> /ul	0.577	0.537	(131)
BASOPHILS *10 <sup>3</sup> /ul	0.005	0.023	(111)
NRBC (wbc) /100	0.4	1.0	(22)
PLT CNT *10 <sup>3</sup> /ul	200.0	0.0	(1)
GLUCOSE MG/DL	121	27	(80)
BUN MG/DL	25	8	(82)
CREAT. MG/DL			
URIC ACID MG/DL	0.6	0.2	(30)
CA MG/DL	9.7	0.7	(80)
PHOS MG/DL	5.2	2.0	(78)
NA MEQ/L	146	4	(70)
K MEQ/L	4.8	0.4	(69)
CL MEQ/L	113	4	(61)
MG MEQ/L	2.5	0.0	(1)
CHOL MG/DL	2.5	0.0	(1)
T. PROTEIN GM/DL	6.4	0.7	(64)
ALBUMIN GM/DL	3.1	0.8	(50)



**TABLE 1. ISIS CLINICAL PATHOLOGY NORMAL VALUES (cont.)**

		<b>ISIS MEAN</b>	<b>S.D.</b>	<b>(N)</b>
AST (SGOT)	IU/L	36	13	(80)
ALT (SGPT)	IU/L	42	24	(32)
T. BILI	MG/DL	0.3	0.1	(65)
ALK. PHOS.	IU/DL	50	43	(75)
LDH	IU/L	262	151	(54)
CPK	IU/L	180	0	(1)
OSMO	MOSMO/L	293	5	(33)

## **Medical Management: ADDENDUM I**

### **Report Distributed to all MWSSP Participants in February 1993**

#### **From Mitchell Bush, DVM, National Zoological Park**

This is to alert veterinarians who care for maned wolves of a suspected case of bone marrow suppression in a 3 year old male thought to be induced by the antibiotic trimethoprim/sulfadiazine (TMS). The past history included dysuria with fine calculi in the urinary bladder seen on radiographs. The straining due to cystitis was controlled by oral TMS in October 1991 and again in December 1991. The wolf was also receiving Thiola, in an attempt to reduce cystine stone formation, until April 1992. In October 1992 the wolf again presented with stranguria and was again placed on TMS following a diagnostic evaluation that was unremarkable except for a moist dermatitis of the front foot. Two weeks later the wolf developed acute anorexia and depression. The hemogram showed a WBC of 500 and a HCT of 40. There was also decreased platelets on the blood smear. Despite extensive supportive care the wolf died the next day. At necropsy there was an extensive cellulitis of the front leg that had the dermatitis and bone marrow smears showed a hypoplasia of the myeloid elements.

Bone marrow suppression is reported in dogs and cats due to TMS, but it more commonly involves the erythroid elements; however, it can also effect the myeloid cells. In domestic species, discontinuation of the drug usually reverses the bone marrow suppression. Specific treatment is the administration of Leucovorin, which is an antidote to drugs like TMS that act as folic acid antagonists.

TMS is still an excellent drug for use in maned wolves, but the clinician should be aware of this potential problem since this species may be more sensitive. We have used TMS for many years in maned wolves with good therapeutic results and no previous recognized problems.

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# MANED WOLF SSP NECROPSY PROTOCOL - 1995 Update

Prepared by Richard Montali, DVM, National Zoological Park

INSTITUTION/OWNER \_\_\_\_\_

\_\_\_\_\_

ADDRESS \_\_\_\_\_

\_\_\_\_\_

STUDBOOK \_\_\_\_\_ ISIS # \_\_\_\_\_

HOUSE NAME \_\_\_\_\_

BIRTH DATE/AGE \_\_\_\_\_ SEX \_\_\_\_\_

WEIGHT (kg) \_\_\_\_\_ (actual/estimate)

DEATH DATE \_\_\_\_\_ DEATH LOCATION \_\_\_\_\_

NECROPSY DATE \_\_\_\_\_ NECROPSY LOCATION \_\_\_\_\_

PM INTERVAL \_\_\_\_\_

CAPTIVE BORN? \_\_\_\_\_ WILD CAUGHT? \_\_\_\_\_

HISTORY (include clinical signs, circumstances of death, clinical labwork, diet & housing)

## **GROSS EXAMINATION**

If no abnormalities are noted mark as normal or not examined (NE)

GENERAL EXAM (Physical and nutritional condition, pelage, subq fat stores, body orifices, superficial lymph nodes)

MUSCULOSKELETAL SYSTEM (Bones, marrow, joints, muscle)

BODY CAVITIES (Fat stores, pleura, thymus, lymph nodes)

SPLEEN

RESPIRATORY SYSTEM (Nasal passages, pharynx, larynx, trachea, bronchi, lungs, regional lymph nodes)

CARDIOVASCULAR SYSTEM (heart, pericardial sac, great vessels, myocardium, valves, chambers)

DIGESTIVE SYSTEM (mouth, teeth, tongue, esophagus, stomach, small and large intestine, anus, liver & gallbladder, pancreas, mesenteric lymph nodes)

URINARY SYSTEM (kidneys, ureters, bladder, urethra)

REPRODUCTIVE SYSTEM (testes/ovaries, uterus & cervix, penis/vagina, accessory sex organs, mammary gland, placenta)

ENDOCRINE SYSTEM (thyroids, parathyroids, adrenals, pituitary)

CENTRAL NERVOUS SYSTEM (brain, meninges, spinal cord)

SENSORY ORGANS (eyes, ears)

ADDITIONAL COMMENTS OR OBSERVATIONS:

**Prosector:** \_\_\_\_\_

**Date:** \_\_\_\_\_

SUMMARIZE PRELIMINARY DIAGNOSES:

LABORATORY STUDIES: Results of cytology, fluid analysis, urinalysis, serum chemistries, bacteriology, mycology, virology, parasitology, x-ray, photography, other

## TISSUE CHECK LIST

Where possible freeze 3-5 cm blocks of tissue from major organs (e.g., lung, liver, kidney, spleen) in small plastic bags, preferably in liquid nitrogen to be kept ultrafrozen at -70 degrees Celsius; freezing at conventional temperatures is acceptable if there is no access to an ultrafreezer.

Preserve as many of the following tissues as possible in 10% buffered formalin at a ratio of approximately 1 part tissue to 10 parts solution. Tissues should be no thicker than .5 to 1 cm. NOTE: there is generally no need to fix and label each tissue separately. Take 2 sets of fixed tissue, one for the Primary pathologist, and the other for the Regional/SSP pathologist, Dr. Richard Montali. Send tissues to Primary pathologist for histopathology and request a duplicate set of slides for the Regional/SSP pathologist who should be contacted for further instructions. Second set should be stored until MWSSP Pathologist has examined tissues/report and approved disposition. Also, freeze postmortem serum (from heart), urine and any abnormal fluid accumulations. **CONSULT SPECIAL PROJECTS PROTOCOL FOR ANY SPECIAL INSTRUCTIONS ABOUT SPECIMENS REQUESTED BY DESIGNATED RESEARCHER.**

<input type="checkbox"/> Brain	<input type="checkbox"/> Diaphragm	<input type="checkbox"/> Testis/Ovary
<input type="checkbox"/> Nerve (Sciatic)	<input type="checkbox"/> Liver	<input type="checkbox"/> Uterus
<input type="checkbox"/> Spinal Cord	<input type="checkbox"/> Gall Bladder	<input type="checkbox"/> Mammary gland
<input type="checkbox"/> Eye	<input type="checkbox"/> Spleen	<input type="checkbox"/> Ureter
<input type="checkbox"/> Tongue	<input type="checkbox"/> Pancreas	<input type="checkbox"/> Urinary bladder
<input type="checkbox"/> Esophagus	<input type="checkbox"/> Stomach	<input type="checkbox"/> Urethra
<input type="checkbox"/> Trachea	<input type="checkbox"/> Small Intestine	<input type="checkbox"/> Kidney
<input type="checkbox"/> Thyroid	<input type="checkbox"/> Large Intestine	<input type="checkbox"/> Adrenal
<input type="checkbox"/> Parathyroid	<input type="checkbox"/> Cecum	<input type="checkbox"/> Thymus
<input type="checkbox"/> Pituitary	<input type="checkbox"/> Skin	<input type="checkbox"/> Prostate
<input type="checkbox"/> Heart	<input type="checkbox"/> Aorta	<input type="checkbox"/> Lymph Node
<input type="checkbox"/> Muscle	<input type="checkbox"/> Bone with marrow	<input type="checkbox"/> Salivary gland
<input type="checkbox"/> Lung	<input type="checkbox"/> Joint Capsule	

PRIMARY PATHOLOGIST: Name: \_\_\_\_\_  
Lab: \_\_\_\_\_  
Address: \_\_\_\_\_  
Phone: \_\_\_\_\_

Please attach final (histo and gross) pathology report to:

**MWSSP Veterinary Advisor:**

Robyn Barbiers, DVM  
Lincoln Park Zoological Gardens  
2200 N. Cannon Drive  
Chicago, IL 60614

**Phone:** (312) 742-7747

**Fax:** (312) 742-7823

Will forward copy to Dr. Montali

**MWSSP Pathologist:**

Dr. Richard Montali  
National Zoological Park  
3000 Block  
Connecticut Ave. NW  
Washington, D.C. 20008

**Phone:** (202)-673-4869

**Fax:** (202)-673-4660

## **MANED WOLF SSP NECROPSY PROTOCOL: NEONATES**

The following list includes additional information that should be emphasized and obtained from neonatal animals (including aborted fetuses, stillbirths, and neonates up to 30 days of age). Examine all specimens submitted including partially consumed carcasses. Use it in conjunction with the Maned Wolf Necropsy Protocol.

1. Obtain weight, sex; estimated degree of maturity/immaturity.
2. Crown-rump and other measurements.
3. Examine skin and umbilicus (fix section of stump and surrounding skin in formalin); pelage- texture, color and amount (if any) of fur.
4. Examine for external malformations (check for cleft palate, hare lip, other facial/skull, trunk or limb abnormalities).
5. Assess state of hydration (subcutaneous and serosal surfaces dry or moist) and nutritional status,(record subcutaneous and body cavity fat stores as none, minimal, moderate, abundant).
6. Examine for internal malformations (e.g. diaphragmatic hernia, cardiac anomalies, etc.).
7. Determine if breathing occurred using the "sink test" by placing a segment of lung in 10% buffered formalin: if lung floats, animal probably breathed. If lung sinks, animal probably did not breathe (if lung proves not to be pneumonic).
8. Verify sex by examining gonads.
9. Determine nursing activity by looking for and estimating amount of milk curd (white, cottage-cheese like) present in stomach and presence of "milk stool" (yellow-white semisolid material in colon) with absence of meconium (greenish-brown pasty material throughout GI tract).
10. Proceed as with standard Maned Wolf Necropsy Protocol. Be sure to fix placenta or any fetal membranes if available.

## **MANED WOLF SSP NECROPSY PROTOCOL**

### **SPECIAL PROJECTS LIST**

The following researchers have requested samples or information for particular studies of interest to the MWSSP. Protocols for collecting the samples required for each project are attached. Your cooperation is greatly appreciated.

#### PROJECT

#### RESEARCHER

Reproductive Tracts

Dr. Linda Munson

Cystinuria

Dr. Kenneth Bovee



## **MANED WOLF REPRODUCTIVE TRACTS**

### **PROTOCOL FOR FIXATION AND SHIPMENT**

#### **FOR FEMALES:**

Remove the entire reproductive tract (ovaries, uterus, cervix, and proximal vagina). Make a longitudinal slice in the middle of each uterine horn into the uterine lumen. Fix the entire tract intact in a large volume 10% buffered formalin (10 parts formalin to 1 part tissue).

#### **FOR MALES:**

Remove testis, epididymis, and vas deferens. Make a single longitudinal midline cut into each testis. Fix the entire tract intact in a large volume 10% buffered formalin (10 parts formalin to 1 part tissue).

#### **FOR BOTH FEMALES AND MALES:**

Ship in a leak-proof container to the following address:

**FOR U.S. MAIL:** Dr. Linda Munson  
Room A226 VTH  
Department of Pathobiology  
College of Veterinary Medicine  
University of Tennessee  
P.O. Box 1071  
Knoxville, TN 37901-1071 USA

**FOR UPS OR  
FEDX:** Dr. Linda Munson  
Room A226 VTH  
Department of Pathobiology  
College of Veterinary Medicine  
University of Tennessee  
2407 River Drive  
Knoxville, TN 37996-4500 USA

# MANED WOLF CYSTINURIA STUDY

## PROTOCOL

Kenneth C. Bovee, DVM  
University of Pennsylvania  
School of Veterinary Medicine  
3850 Spruce Street  
Philadelphia, PA 19104-6010

1. Collect routine pathologic specimens of the lower urinary tract, including:

- urethra
- bladder
- ureters
- renal pelvis

2. For kidney samples:

Include a full thickness segment from the renal capsule, all the way through the cortex, medulla and papilla. Two or three of these segments, approximately 1/4" in two dimensions, should be taken from each kidney.

Fix samples in standard 10% formalin solution. Label with animal's Studbook No., zoo name, date.

**DO NOT MAIL SAMPLES TO DR. BOVEE.** Keep record of whether and to what degree the animal was affected by renal cystine calculi. Keep record of trauma to urinary tract resulting from cystine calculi.

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prepared by  
**Stephanie Bestelmeyer**  
**Colorado State University**

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