THE EFFECTS OF HAND-REARING FALLOW DEER IN A CAPTIVE ENVIRONMENT

by

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Abstract

The Effects of Hand-rearing Fallow Deer in a Captive Environment

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The European fallow deer (Dama dama dama) is an exotic animal species that originated in Europe and Asia and was brought to Texas in 1930. The European fallow deer was initially introduced as a farmed animal to be used for meat production, although this species may be used for other purposes. At Texas A&M University's Wildlife and Exotic Animal Center, the herd of fallow deer is used for educational and research purpose.

The purpose of my research was to develop a hand-rearing protocol specific for fallow deer fawns born at the Wildlife and Exotic Animal Center and to study the effects of hand-rearing fallow deer in a captive environment. This was accomplished by hand-rearing five female fallow fawns, observing their behavior, and keeping accurate and detailed records. To quantitatively assess the effects of hand-rearing, the heart rates, respiratory rates, temperatures, and weights of all fallow deer were measured. Comparisons were then made between the tame and non-tame fallow deer. Observations were also made regarding behavior. The hand-rearing protocol which was developed could be altered and used towards the hand-rearing of other animals, specifically hoofstock, in captive environments. Additionally, the effects of hand-rearing as

addressed in this research could serve to better inform personnel at other captive animal facilities of the advantages and disadvantages associated with hand-rearing.

DEDICATION

This thesis is dedicated to the memories of two fawns, Donna and Ashley. Their innocence and frailty spurned me to develop a hand-rearing protocol specific for fallow fawns born at the Wildlife and Exotic Animal Center. I can only hope that this thesis will help to prevent untimely deaths, such as theirs, from occurring again.

ACKNOWLEDGEMENTS

This research project and the culmination of this thesis could not have been possible without the help of Dr. Alice Blue-McLendon. She was a constant source of scientific knowledge and experienced advice. Dr. Blue-McLendon entrusted me with great responsibility, yet was always there when I needed guidance. Her dedication to my education and research is greatly appreciated.

I would also like to extend my appreciation to Mrs. Angie Daniel, the veterinary technician at the Wildlife and Exotic Animal Center. She was completely dedicated to the fawns and their survival. Angie Daniel provided the experience necessary to develop a hand-rearing protocol. She was an integral part of my research and, for that, I am very grateful.

Finally, I would like to thank all of the students and volunteers at the Wildlife and Exotic Animal Center. They were always there to lend a helping hand, investing their time and energy in hand-rearing the fawns and gathering data for my research.

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INTRODUCTION

The species of fallow deer (Dama dama) consists of two recognized subspecies, the European fallow deer (Dama dama dama) and the Persian fallow deer (Dama dama mesopotamica). The fallow deer is an exotic species, originating in the Mediterranean region of southern Europe. The European fallow deer has since been introduced to the British Isles and many European countries, North America, South America, Australia, New Zealand, Africa, and the West Indies. George Washington is said to have brought the first fallow deer to the United States to inhabit his Mount Vernon estate in Virginia. The first documented introduction and release of fallow deer into the state of Texas occurred in 1930. Since that time, the fallow deer population, along with other agriculturally important species of deer, has steadily increased (Willard, 1996: Table 1).

The fallow deer is a very distinctive species. They have three different coat colors, including a blonde (which ranges from white to yellow), brown (which ranges from tan to black), and spotted. Fawns' coats are soft, slightly curled, and sparsely spotted. The most prominent feature of the fallow buck is the palmated antlers, which are similar to the antlers of the caribou and the moose (Figure 1). Adult fallow deer weigh 123-139 pounds and measure 32-36 inches at the shoulder. Both sexes are in breeding condition from September to February and fawning occurs between late April and July in Texas (Willard, 1996).

There are many different reasons for hand-rearing exotic hoofstock in captive environments. These include conservation, research, education, and farming. Fallow deer are presently farmed or ranched in over thirty-five countries and are one of the

species of deer that have been semi-domesticated and managed as livestock for venison production (Willard, 1996). According to Red Oak Deer & Fence and Heart-Bar Deer Farms, Inc., the three main markets for fallow deer offspring are: 1) the venison market, which calls for young males; 2) the breeding market, which calls for yearling and mature does and enough mature bucks to service the does; and 3) the trophy market, which is primarily younger to mature males. At the Texas A&M University's Wildlife and Exotic Animal Center, the herd of European fallow deer is used strictly for educational and research purposes.

The herd consists of both deer that were hand-reared and those that were not. These groups will be referred to as tame and non-tame, respectively, although there are obvious degrees of tameness exhibited by the hand-reared fallow deer, as will be described later. In addition, the female fallow fawns hand-reared for this study were separated from the adult fallow herd. These fawns were primarily used for development of a hand-rearing protocol and qualitative assessment of the effects of hand-rearing, through observation. The adult herd was primarily used for quantitatively assessing the effects of hand-rearing fallow deer in a captive environment. It should be noted that approximately twenty fallow deer were hand-reared at the Wildlife and Exotic Animal Center in 1991. However, documentation of the protocol was inadequate. Some of the does that were hand-reared in 1991 are the mothers of the fawns used in this study.

Table 1: Population trend estimates of agriculturally important species of deer in Texas.

Species	1963	1974	1984	1988	1994
Fallow deer	220	4,483	10,507	14,163	20,133
Axis deer	2,196	19,518	38,035	39,040	51,878
Sika deer	634	3,042	7,982	11,879	12,359
Red deer	21	407	530	910	
Red-Elk hybrids		88	700	864	5,742**
TOTAL	3,071	27,538	57,754	66,856	90,112

*From Willard, 1996.
**Due to increasing numbers and uncertainty associated with the purity of individual red deer, red deer and red-elk hybrids were combined to a single category in 1994.

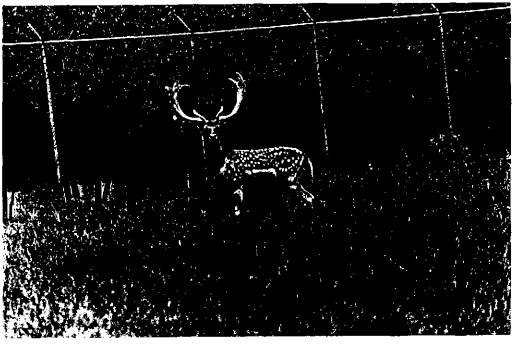

Figure 1: A fallow buck, displaying a full spread of palmated antlers.

OBJECTIVES

The purpose of my research was to study the effects of hand-rearing fallow deer in a captive environment and to develop a hand-rearing protocol specific for fallow fawns born at the Wildlife and Exotic Animal Center.

MATERIALS AND METHODS

Breeding and Pregnancy. A six-year-old spotted buck was introduced to the tame fallow does on January 22, 1998. The remaining fallow does joined this group on February 11, 1998. The buck was removed on March 17, 1998 (Figure 16). Through visual observation and ultrasonography, pregnant does were identified and moved to an area at the Wildlife and Exotic Animal Center, commonly referred to as Lot E (Figure 2), where they could be monitored more closely. The length of the estrous cycle in fallow does is approximately twenty-two days, with the duration of estrus lasting thirteen to fourteen hours and average gestation length of 234 days (Willard, 1996). Does nearing parturition exhibit a distended abdomen, reddened vulva, and enlarged teats (Figure 3).

Parturition and Cleaning. Between September 25, 1998, and November 2, 1998, ten does gave birth to ten fawns without interference from humans. Although no humans were present during parturition, most fawns were found and identified within an hour of their births. The longest delivery was at least four and a half hours (Record 8). It was noted that the does were in either a standing or lying position prior to and after parturition (Figures 4a and 4b). As soon as the fawn is born, it struggles to free itself from the fetal membranes. The doe assists the fawn by licking it. Most likely, this process dries the skin and normalizes heat exchange; it may also stimulate locomotory activity in the fawn.

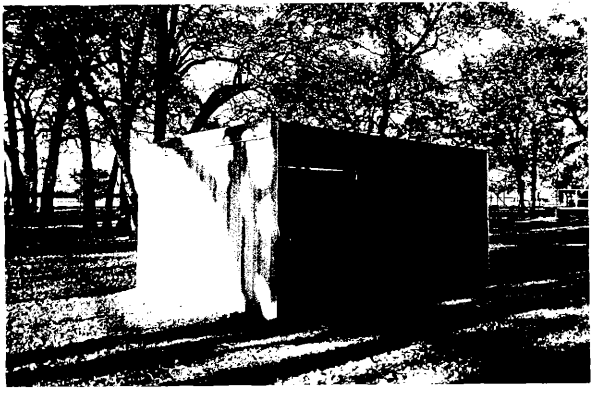

Figure 2: Lot E.

Figure 3: A fallow doe nearing parturition.

Figure 4a: A white-tailed doe during parturition. The hooves are just emerging.

Figure 4b: The fawn's legs are beginning to emerge.

In turn, maternal behavior seems to be intensified by these tactile and olfactory cues (Danilkin, 1937). Of the ten does that gave birth to fawns, one doe never even attempted to clean her fawn. In turn, this same doe did not exhibit any other maternal instincts, such as nursing (Record 4). Records were kept documenting each fawn's: sex; color and markings; and time, date, and location of birth. Records were also kept documenting each does' ear tag number/color and coat color. In addition, environmental conditions were noted.

Ear-tagging, temperature, and navel treatment. Fallow fawns were ear-tagged within hours of their birth (Figure 5). It is important to ear-tag fawns as early as possible because they become more difficult to catch as they grow older. The type of ear tag used must be carefully matched to the species, sex, and age of the animal and should be as unobtrusive as possible (Jones). We chose to use small, white plastic tags with black numbering. These tags will be easily identified through visual observation or using binoculars. Each fawn was not ear-tagged until it was seen nursing to ensure colostrum intake prior to the stress of being handled by people. Male fallow fawns were tagged in the right ear; female fawns were tagged in the left ear. All fawns were tagged at the base of their ear, with care taken not to puncture a blood vessel. Antibiotic ointment was applied to the tagging instrument prior to tagging to decrease the risk of infection. Each fawn's temperature was taken rectally and their navels were treated with iodine. Records were kept identifying each fawn's ear tag number and documenting navel treatment and temperature. The response of the doe after handling of her fawn was also noted.

Locomotive ability and nursing. Within minutes of their birth, fallow fawns attempt to stand and begin to walk (Figure 6). Often, the fawn's motor skills preceded its

Figure 5: A handler preparing to ear-tag a fawn hours after its birth.

Figure 6: A fallow fawn learning to stand and walk.

visual development. This was apparent when the fawn would begin running and collide with a tree or fence. Lying down and completely still is the fawn's main defense mechanism (Figure 7). This position and their spotted coat provide camouflage and protection against predators, especially during the first few hours of life. Does and fawns do not necessarily share bedding sites. Close contact occurs mostly during periods of nursing. Fallow does nurse standing up (Figure 8), although it is possible for them to nurse lying down. It is imperative that a newborn fawn receives colostrum from its mother in order to acquire the necessary antibodies and nutrients. If the does provided sufficient care, the female fawns were allowed to stay with them for 36-48 hours after birth. However, two does displayed inadequate mothering abilities, including deficient nursing and/or cleaning, and their fawns were removed before this time (Records 4 and 8). Records were kept regarding each fawn and doe's behavior after parturition and documenting the time at which the fawn was removed.

Male fallow deer and their antlers. At the Wildlife and Exotic Animal Center, male fallow deer are not hand-reared, as they tend to become overly familiar and often very aggressive with humans. In addition, the antlers of fallow deer are dangerous weapons. As with all cervidae males, they lose their antlers each winter and grow new ones during spring and summer. New antlers are soft and tender. Thin skin and fine hair, called velvet, grow over the antlers. This velvety skin dries up, and the deer rubs the dry skin off by scraping its antlers on the ground, or against trees and bushes (Kirkpatrick, 1980). The antlers fall off several months later. To ensure the safety of the students and volunteers at the Wildlife and Exotic Animal Center, male fallow fawns were allowed to stay with their mothers through weaning and on into the spring. In addition, the adult

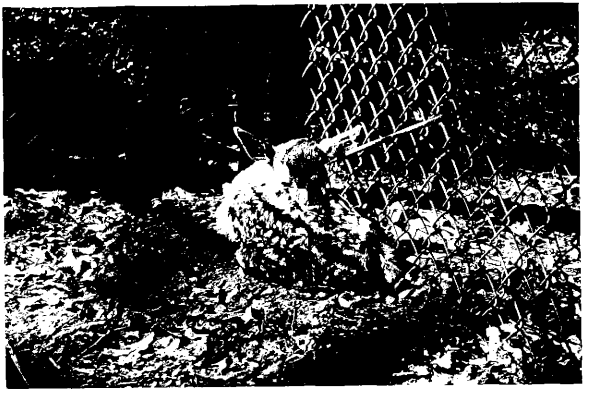

Figure 7: The fawn's only defense: lying completely still.

Figure 8: Nursing in the upright position.

fallow bucks' antlers are cut off once they have hardened to avoid unnecessary injuries due to fighting.

Removal of the fawns and introduction of the bottle. As described earlier, the female fawns were removed from their mothers in Lot E (Figure 2) and moved to a large shelter (Figure 9) where they could be protected from the environment and hand-reared by humans. Fawns were carried in such a way that their legs could hang freely and their trunk could be supported. This position resembles the animal's natural standing position and allows the fawn to struggle without hurting itself, if necessary. The fawns were constantly petted and handled during their introduction to the large shelter. Once the fawns had somewhat settled into the new environment, we attempted to introduce the bottle to begin feeding. To initiate the suckling response, the handler's finger was introduced to the fawn's mouth (Figure 10). Then, the handler would slowly attempt to replace their finger with the bottle. Records were kept regarding the entire bottle-feeding process, including which handler-fawn positions worked best, types of nipples used, and amount of milk consumed. In addition, as it grew colder outside, it was necessary to position a heat lamp in the large shelter, approximately five feet from the ground.

Stimulation to induce urination and defecation. As a protective measure, a fallow doe will lick her fawn's ano-genital region to stimulate urination and/or defecation and, consequently, ingests the fawn's urine and feces. This is a defense mechanism, used to protect the fawn from predators. Without being able to be identified through smell, the fawn's chance of survival is increased. In a hand-rearing situation, it is necessary to simulate this ano-genital licking. This was done using a moist paper towel (Figure 11). The occurrence of urination and/or defecation, including any abnormalities, was noted in

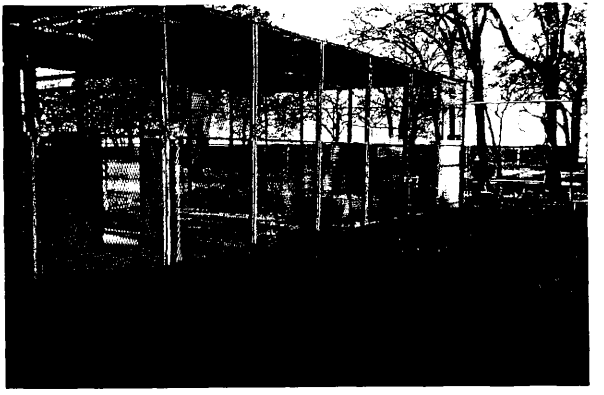

Figure 9: Large shelter.

Figure 10: Introduction of the finger to initiate a suckling response.

each fawn's official records.

Administration of fluids and/or medicine. Due to insufficient milk (either from the doe or bottle) or illness, some fawns required additional care. It was imperative that the fawns receive some type of supplemental nutrition through forced-feeding (gastric tubing), transfusion, subcutaneous fluids, or medication. The administration of fluids and/or medicines was noted in the fawns' official records (Table 6). Additionally, this information was incorporated into the hand-rearing protocol.

Milk analysis. On November 13, 1998, milk was taken from two does, Y57 and Y58. These two does were the mothers of the two males fawns and were, therefore, still nursing their fawns. The two does were herded from Lot E to the Restraint Center which is equipped with a drop-floor deer cradle which restrained the does for milk collection. The does' milk samples, along with samples of the goat milk replacer and goat's milk (which were both used in hand-rearing the female fawns) were taken to the Milk Analysis Lab at Texas A&M University for analysis.

Eating grass and solid foods. There was always a constant source of solid food, minerals (in the form of a mineral block), and fresh water in the large shelter and Lot E (after movement of fawns back into Lot E, as described below.) Also, both enclosures were relatively grassy. The solid foods, mineral block, grass, and water provided supplements to the fawns' bottle-feedings. They also served as a possible initiator of ruminant activity in the fawns. There is a relation between the anatomical development of the stomach and the beginning of the ingestion of solid foods. The ruminant stomach is a four chambered structure: the rumen, reticulum, omasum, and abomasum. In the adult, the rumen begins to digest the plant cellulose through bacterial fermentation. The

reticulum apparently serves as a fluid storage organ, and the omasum helps particulate the remaining solid material before preparations beginning to final digestion in the abomasum. However, a fawn on a milk diet is a monogastric herbivore. Milk passes directly from the esophagus to the abomasum. Ingestion of soil could serve to initiate a bacterial culture in the rumen. (Faatz, 1976). Notes regarding eating of grass and solid foods were made in each fawns' official records.

Movement of fawns back to Lot E and weaning. On November 18, 1998, all fawns were moved back into Lot E. This area provided more room for the growing fawns, as compared to the large shelter. It also serves as a "middle-ground" before being introduced to the entire adult herd in Lot A. Lot E, a ½ acre pasture is positioned next Lot F, a 1 ½ acre pasture which is home to three adult fallow bucks (including the buck who fathered all of the fawns), two adult white-tailed bucks, and one adult male llama. The fawns could have constant visual contact with these animals and become accustomed to new sights and sounds. The fawns were slowly weaned from the bottle in a process that took approximately seven weeks, starting on December 8, 1998. This weaning process correlated with an increase in the fawns' consumption of solid foods and grass (Figure 12). On January 29, 1999, the fawns were given only solid foods, mineral blocks, and water. Records were kept regarding the fawns' behavior in their new, larger environment and after not receiving any milk for the first time.

Introduction of adult fallow doe to fawns. From February 17, 1999 to March 9, 1999, a hand-reared fallow doe, Y58, shared the area of Lot E with the female fawns. Y58, the mother of W59 (a male fawn), had been experiencing weight loss. This was due to the fact that both male fawns, W59 and W58, were still nursing from the doe, long

Figure 11: Simulation of doe's ano-genital licking to stimulate urination and defecation.

Figure 12: Young fallow fawns grazing.

after the natural period of weaning. In effect, Y58 was moved to Lot E to increase her body weight (by not being subject to nursing) and to familiarize the female fawns with an adult fallow doe (Figure 13). Observations were made noting each fawn's initial reaction to Y58 and subsequent acceptance of this new, unfamiliar animal.

Qualitative assessment of the effects of hand-rearing. On March 26, 1999, and March 29, 1999, the twenty-two fallow does, four fallow bucks, and seven fallow fawns were herded from their respective areas to the Restraint Center. Here, they were kept in several paddocks and, one at a time, led through the paddock system to the drop-floor deer cradle which restrained the does for data collection. The data collection for this research correlated with the annual tuberculosis testing of the fallow herd. Each deer's heart rate was measured using a stethoscope (Figure 14) and respiratory rate was measured through visual and hands-on observation. These rates were taken in fifteen-second intervals and then multiplied by four to obtain beats per minute (heart rate) and breaths per minute (respiratory rate.) Temperatures (F) were taken rectally, using a digital thermometer. Heart rates, respiratory rates, and temperatures were all taken within the first two minutes of the floor dropping in the restraint device. Weights (lbs.) were measured on a large platform-type scale located in an alleyway. Heart rates, respiratory rates, and temperatures were measured on both days, while weights were only measured on March 29, 1999. Measurements on fallow fawns were only obtained on March 29,1999. Records were kept regarding each deer's heart rate, respiratory rate, temperature, and weight. Additionally, observations were made regarding significant behavior and exceptional stress or lack thereof.

Figure 13: Familiarization of fallow fawns with an adult fallow doe.

Figure 14: Utilization of a stethoscope to measure heart rates of fallow deer in the restraint device.

RESULTS AND DISCUSSION

Research subjects. Ten fawns, including one stillborn, were born between September 25, 1998, and November 2,1998. Information regarding the fawns was recorded in their official records (Figure 15). Of the nine live births, seven were female and two were male. As described before, the males were allowed to stay with their mothers in Lot E until November 16, 1998. At this time, both does and their male fawns were moved to Lot A to join the fallow doe herd. The female fawns, on the other hand, were removed from their mothers and served as research subjects for the development of a hand-rearing protocol and in studying the effects of hand-rearing. Of the seven female fawns that were hand-reared, two died when they were less than two weeks old (Records 2 and 3). It is suspected that both animals died as a result of inadequate milk intake. A short summary of each fawn's record (including information regarding the doe) and photographs are included on the following pages to familiarize the reader with the research subjects. A photograph and description of the buck that fathered all fallow fawns this year is also included.

Figure 15: Example of first page of official fawn record.

Fawn Record
(LACEY)

Date: 9/25/98
Time: 2:50 PM
Found by: Lisa Nichols
Location: shed in Lot E
Sex: F
Fawn's temperature: 103.1 °F
Navel treatment: Y ✓ N
Ear tag #: White 55
Color: chocolate
Animal color, markings, abnormal findings: chocolate

Environmental conditions (ants, weather, etc.): hot, sunny day - no ants

Mother's ear tag number/color: Yellow 20 (Vicki)
Mother's color, markings: spotted, white around the eyes

Mother's response after fawn handling (any suckling, cleaning, etc.): calm, alert

Feeding Record

Date	Time (am/pm)	Amount	Comments(excretions,etc.)	Initials
9/25/98	3:00PM		Nursing	LN
9/25/98	4:00PM		Nursing	AH
9/26/98	4:45PM		Fawn was seen nursing periodically. Vicki would often walk away during nursing.	AH
9/27/98	8:00AM	102	separated Vicki from fawn, trapped fawn in shelter # fed 102; stim used	CM
9/27/98	7:00PM		PULLED AT 41 HRS.	CM

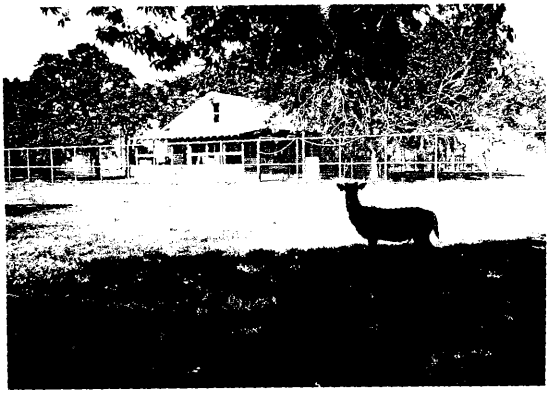

Figure 16: The non-tame buck, Y23.

BUCK
Ear tag color and number: yellow 23
Date of birth: est. 1993
Coat color: spotted

Dates of breeding
Introduced to tame fallow does: 1/22/98 (Lot A trap)
Introduced to all fallow does: 2/11/98 (Lot A)
Removed: 3/17/98

Record 1: Lacey

FAWN
Ear tag color and number: white 55
Date of birth: 9/25/98
Sex: F
Coat color: chocolate
Hours after birth when pulled from mother: 41
Date of first successful bottle-feeding: 9/28/98
Depression/frequent diarrhea (if so, when): yes; 12/10/98-12/11/98

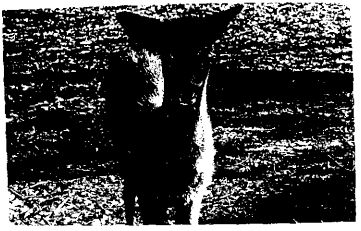

Figure 17a: The fawn, Lacey, at approximately 5 ½ months.

DOE
Ear tag color and number: yellow 20
Date of birth: 6/6/95
Coat color: spotted
Hand-reared: yes (after 6/26/95- due to fractured right distal physis)
Dates of prior fawnings: 7/2/97
Attentive mother (adequate cleaning/nursing): yes

Figure 17b: Lacey's mother, a tame doe.

Record 2: Donna

FAWN
Ear tag color and number: white 54
Date of birth: 9/27/98
Date of death: 10/9/98
Nature of death: hypoglycemia
Sex: F
Coat color: spotted
Hours after birth when pulled from mother: 38.5
Date of first successful bottle-feeding: 10/1/98 (from bowl)
Depression/frequent diarrhea (if so, when): yes; 9/29/98

Figure 18a: The fawn, Donna, at approximately one week.

DOE
Ear tag color and number: red 15
Date of birth: spring 1993
Coat color: blonde
Hand-reared: no
Dates of prior fawnings: 6/8/96; 7/1/97
Attentive mother (adequate cleaning/nursing): yes

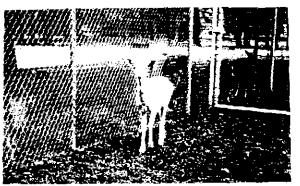

Figure 18b: Donna's mother, a non-tame doe.

Record 3: Ashley

FAWN
Ear tag color and number: white 56
Date of birth: 9/29/98
Date of death: 10/4/98
Nature of death: hypoglycemia
Sex: F
Coat color: spotted
Hours after birth when pulled from mother: 39
Date of first successful bottle-feeding: max. amt. in 24 hrs.=10 oz.
Depression/frequent diarrhea (if so, when): no

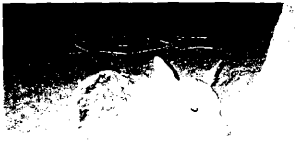

Figure 19a: The one-day-old fawn, Ashley.

DOE
Ear tag color and number: yellow 48
Date of birth: 6/9/91
Coat color: spotted
Hand-reared: yes
Dates of prior fawnings: 6/12/96; late summer 1997- acted as surrogate mother to a female fawn
Attentive mother (adequate cleaning/nursing): yes

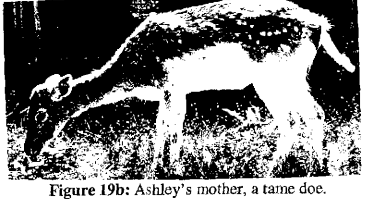

Figure 19b: Ashley's mother, a tame doe.

Record 4: Cinder

FAWN
Ear tag color and number: white 57
Date of birth: 10/11/98
Sex: F
Coat color: chocolate
Hours after birth when pulled from mother: 18
Date of first successful bottle-feeding: 10/12/98
Depression/frequent diarrhea (if so, when): no

Figure 20a: The fawn, Cinder, at approximately six months.

DOE
Ear tag color and number: yellow 28
Date of birth: 1993
Coat color: chocolate
Hand-reared: no
Dates of prior fawnings: none
Attentive mother (adequate cleaning/nursing): no

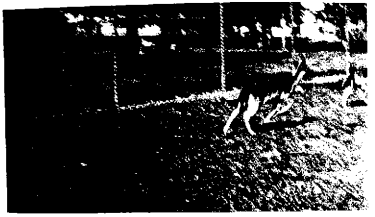

Figure 20b: Cinder's mother, a non-tame doe.

Record 5: Hansel

FAWN
Ear tag color and number: white 58
Date of birth: 10/12/98
Sex: M
Coat color: spotted
Hours after birth when pulled from mother: N/A- allowed to remain with mother (not hand-reared)
Depression/frequent diarrhea (if so, when): no

Figure 21a: The fawn, Hansel, at approximately two weeks.

DOE
Ear tag color and number: yellow 57
Date of birth: before 1993
Coat color: spotted
Hand-reared: no
Dates of prior fawnings: none
Attentive mother (adequate cleaning/nursing): yes

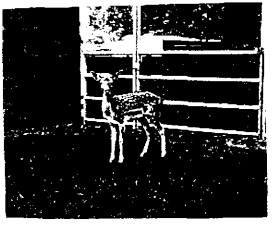

Figure 21b: Hansel's mother, a non-tame doe.

Record 6: Herman

FAWN
Ear tag color and number: white 59
Date of birth: 10/14/98
Sex: M
Coat color: spotted
Hours after birth when pulled from mother: N/A- allowed to remain with mother (not hand-reared)
Depression/frequent diarrhea (if so, when): no

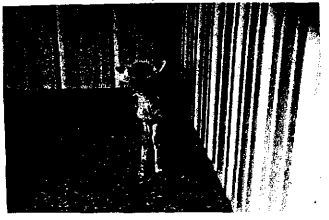

Figure 22a: The fawn, Herman, at approximately two weeks.

DOE
Ear tag color and number: yellow 58
Date of birth: 6/12/91
Coat color: blonde
Hand-reared: yes
Dates of prior fawnings: none
Attentive mother (adequate cleaning/nursing): yes

Figure 22b: Herman's mother, a tame doe.

Record 7: Unnamed (stillborn fawn)

FAWN (not pictured)
Date of birth: 10/17/98
Date of death: 10/17/98
Nature of death: stillborn
Sex: F
Coat color: spotted

DOE
Ear tag color and number: red 0024
Date of birth: spring 1993
Coat color: spotted
Hand-reared: no
Dates of prior fawnings: 7/4/97
Attentive mother (adequate cleaning/nursing): yes- cleaned fawn both before and after birth

Figure 23: The stillborn fawn's mother: a non-tame doe.

Record 8: Kieran

FAWN
Ear tag color and number: white 60
Date of birth: 10/19/98
Sex: F
Coat color: chocolate
Hours after birth when pulled from mother: 27
Date of first successful bottle-feeding: 10/22/98 (from bowl)
Depression/frequent diarrhea (if so, when): no

Figure 24a: The fawn, Kieran, at approximately one week.

DOE
Ear tag color and number: red 14
Date of birth: 1993
Coat color: blonde
Hand-reared: no
Dates of prior fawnings: none
Attentive mother (adequate cleaning/nursing): no

Figure 24b: Kieran's mother, a non-tame doe.

Record 9: Gretel

FAWN
Ear tag color and number: white 61
Date of birth: 10/21/98
Sex: F
Coat color: spotted
Hours after birth when pulled from mother: 44
Date of first successful bottle-feeding: 10/24/98
Depression/frequent diarrhea (if so, when): yes; 12/2/98-12/7/98

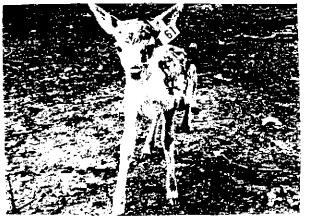

Figure 25a: The fawn, Gretel, at approximately one week.

DOE
Ear tag color and number: triple tag- yellow 12 (on left ear)
Date of birth: before 1993
Coat color: blonde
Hand-reared: no
Dates of prior fawnings: 6/6/95
Attentive mother (adequate cleaning/nursing): yes

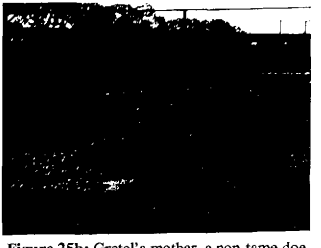

Figure 25b: Gretel's mother, a non-tame doe.

Record 10: Penelope

FAWN
Ear tag color and number: white 62
Date of birth: 11/2/98
Sex: F
Coat color: chocolate
Hours after birth when pulled from mother: 48
Date of first successful bottle-feeding: 11/4/98
Depression/frequent diarrhea (if so, when): yes; 11/6/98-11/9/98

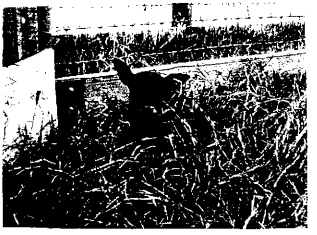

Figure 26a: The two-day-old fawn, Penelope.

DOE
Ear tag color and number: yellow 47
Date of birth: 6/14/91
Coat color: chocolate
Hand-reared: yes
Dates of prior fawnings: 6/10/96
Attentive mother (adequate cleaning/nursing): yes

Figure 26b: Penelope's mother, a tame doe.

Hand-rearing protocol. Hand-rearing five female fallow fawns at the Wildlife and Exotic Animal Center during the fall of 1998 and the spring of 1999 developed the following protocol. The main component of the hand-rearing protocol is the bottle-feeding protocol because it is the most important determining factor of survivability.

I. Fawn Bottle-Feeding Protocol

A. Doe milk substitute

1. Goat's milk: In the first couple of days after separating the fawn from her mother, goat's milk may be used as an alternative to goat milk replacer due to the:
   a. Higher fat content
   b. Higher protein content
   c. Higher percentage of solids
2. Goat milk replacer
   a. Type: Kid Milk Replacer
   b. Brand: Manna Pro
   c. Net weight: 25 lbs.
   d. Guaranteed analysis:

      Crude protein, minimum 26.0%

      Crude fat, minimum 20.0%

      Crude fiber, maximum 0.15%

      Calcium, minimum 0.75%

      Calcium, maximum 1.25%

Phosphorous, minimum 0.70%

Ash, maximum 11.0%

Sodium, minimum 0.65%

Sodium, maximum 1.1%

Copper, minimum .....10 ppm

Copper, maximum .....17 ppm

Selenium, minimum .....0.3 ppm

Vitamin A, minimum .....30,000 IU/lb.

Vitamin D3, minimum .....5,000 IU/lb.

Vitamin E, minimum .....100 IU/lb.

e. Mixing instructions: Add 1 ¼ cups of Manna Pro milk replacer to 24 ounces of warm water and mix thoroughly.

***Mixing instructions may vary if using a different brand of milk replacer.**

B. **Time intervals for feeding:** 7:00 AM, 12:00 noon, 5:00 PM, 9:30 PM

C. **Amount per feeding:** After fawn has been separated from mother (at about 36-48 hours after birth), it is crucial that she receives enough milk by any means possible. During the first few days, the fawn may have difficulty becoming accustomed to the bottle, in which case other methods of administering milk or fluids may be necessary. The following is a guide to the approximate amount of milk the fawn should consume according to her age:

First 2-3 days after separation: 20 oz./day (5 oz./feeding)

Until 3 weeks of age: 32 oz./day (8 oz./feeding)

3 weeks- 5 weeks: 34 oz./day (10 oz./first AM feeding; 8 oz/each other feeding)

5 weeks- 10 weeks: 36 oz./day (10 oz./first AM and last PM feedings; 8 oz./each other feeding)

Anytime after 6 weeks of age, handler may choose to decrease feedings to three times a day and gradually continue this decrease until fawn is weaned.

Note: If feeding multiple fawns, the handler should give a bottle to every fawn during each feeding. However, the older fawns' bottles may be diluted, as necessary.

******If fawn does not consume at least 8 oz. during any twenty-four hour period, it is absolutely necessary that she be tubed 4-8 oz. of milk replacer.***

D. **Temperature of milk replacer:** Milk replacer should be warm, but not hot. Fill a bucket or mug about halfway with water and heat until hot, but not boiling. Place bottles in the container of warm water in the upright position and allow them to warm up. Never heat milk or milk replacer directly. Always test the temperature by spraying a small amount on inside of wrist.

E. Bottles/Nipples

1. Type of nipple: Each fawn will develop a preference for a certain type of nipple to be used during bottle-feeding. However, as a general guideline, it is important to try to find a nipple which somewhat resembles a fallow

doe's teat. This is often rather difficult because of their small size, but we found that human newborn nipples are the closest in shape and size. They were also the most popular. Three of the five fallow fawns preferred this type of nipple. The other two fallow fawns preferred the basic human nipple. In the beginning, you should try as many different types of nipples as possible until you find one that suits each individual fawn.

2. Type of bottle: Standard 8-10 oz. human baby bottles were used, but any plastic container of this approximate size would suffice.
3. Positioning of bottle: Bottle should always be held almost completely upside down to ensure that fawn is not swallowing air and air bubbles. This also mimics the positioning of the doe's teats.

F. Interaction with the Fawn

1. Restraint/ positioning of handler and fawn: It is important that the handler hold the fawn in such a way to ensure her safety and security, but not to restrain her too much. If at any time the fawn appears to be extremely stressed, allow her to calm down by taking a time-out from feeding. The best method for handling the fawn during bottle-feedings is for the handler to assume a squatting position with the fawn's posterior region pressed against the handler's abdominal region. Fawns have a tendency to back up when being restrained and this positioning ensures that they won't escape this way.

2. Introduction of finger to stimulate suckling: The handler can familiarize the fawn with the action of suckling by gently introducing your finger into the fawn's mouth. As the fawn begins to suckle, slowly put the bottle in place of your finger.
3. Massaging to encourage swallowing: It is important that the fawn learn to swallow, not just suckle. Gently massage in the neck and face area to simulate the direction that the milk should flow.

G. Stimulation to induce urination and defecation. To mimic the doe's ano-genital licking, gently rub the anal and genital regions with a warm, moist paper towel. Note consistency of feces and any abnormalities.

H. Records. Keep accurate records of fawns' feedings, including amount consumed, presence of urination and defecation, and method of feeding (i. e. bottle, bowl, and tubing.) In addition, it is always better to underestimate the amount consumed, rather than overestimating.

II. Administration of Fluids and/or Medicine

A. Gastric Tubing: In situations where a fawn has not consumed at least 8 ounces of milk (or milk replacer) in a 24-hour period, gastric tubing, or another form of fluid intake, is an absolute necessity.

***Gastric tubing should only be performed by experienced personnel. Improper placement of the tube can cause aspiration of milk, leading to aspiration pneumonia and the eventual death of the animal.**

1. Supplies

a. Rubber tubing approximately 2 feet in length and ¼ inch in diameter (Red rubber urinary catheters are a suitable tube.)

b. Large syringe (capable of holding up to 2 ounces)

c. Lubricant

d. Milk

2. Positioning of handlers

a. One handler should restrain the fawn with care taken to prevent the fawn from kicking. The fawn's head should be tilted back to allow a straight passage of fluids from the mouth to the stomach.

b. The other handler should be in charge of the actual tubing procedure.

3. Procedure

a.. Lubricate the tubing along its entire length.

b. Fill syringe with milk and attach to the tube

c. Gently slide tubing down fawn's esophagus just past the thoracic inlet. (Be especially careful not to allow tubing to enter fawn's trachea because this will cause suffocation. Feel along fawn's throat to be sure tubing is in esophagus, not trachea.)

d. Slowly, push contents of syringe through the tubing and watch for any abnormal reactions.

e. Repeat process as many times as necessary to reach optimal consumption.

f. Pinch tube near syringe prior to removal.

B. Administration of Medicine: The administration of any type of medicine should be at a veterinarian's discretion only.

III. Weaning and Constant Nuzzling

A. Weaning: When fawns are between three and four months of age, they should be completely weaned and eating solid foods.

B. Constant nuzzling: This is the most important step in bottle-feeding and hand-rearing. It is absolutely necessary that the handlers pay constant attention to the fawns in their care. Petting, stroking, and close contact provide the fawns with security and comfort. Nuzzling also encourages future interaction between the deer and humans. It is the key component in hand-rearing.

Advantages. The main advantages to hand-rearing fallow deer in a captive environment are tameness and a decrease in stress when being handled for maintenance, research and medical purposes. The fallow fawns that were hand-reared for this study exhibited varying degrees of tameness. Cinder (Record 4) was the tamest fawn, followed by Penelope (Record 10), Kieran (Record 8), Lacey (Record 1), and, lastly, Gretel (Record 9). Tameness was qualitatively measured through observation during interaction. Cinder and Penelope would follow handlers around the pen, whether they had food with them or not. Both of these fawns showed no signs of stress when being petted, whether they were lying down or standing up. In addition, Cinder would often vocalize in the form of a soft rasp or a slightly louder bark. Both of these vocalizations may be associated with excitement and/or distress (Danilkin, 1937). Cinder would make these sounds when a handler was leaving the area and would run in the direction of the

handler. The fawn would become calm and cease vocalizing when petted and stroked. The fawn appeared to show greater interest in humans than other deer. This was apparent when the tame adult fallow doe was introduced to the fawns in Lot E. Cinder immediately began barking and ran up to stand the handlers. Initially, the fawn would only approach the fallow doe if a handler stood between the two deer. This close association and reliance upon human interaction is due to the fact that Cinder's mother completely neglected her. This fawn's first time to receive milk was from a bottle. Penelope's tameness is attributed to constant human interaction as a newborn, due to severe dehydration and depression. On the other hand, Lacey and Gretel were much calmer when introduced to the fallow doe. They may not be as tame due to decreased interaction with humans at an early age. Both Lacey and Gretel learned to use the bottle very quickly and, thus, not as much time was spent with them during bottle-feedings (as compared to the other fawns that did not learn so quickly.) The tamer fawns, Cinder and Penelope, had a tendency to associate closely with one another. The less tame fawns, Lacey and Gretel, also had this same tendency. Kieran appeared to go back and forth between these two groups, as she was relatively tame. Regardless of their degree of tameness, all fawns were much more approachable compared to the non-tame fallow deer. Some measures of stress are an increase in heart rate, respiratory rate, and temperature. Observation is also very noteworthy. The distance at which an animal takes evasive action when approached (by a predator) is termed flight distance (Brown 1981). The factors instigating flight or establishing flight distance are a combination of variables, these being: object size, its corresponding movement, noise without an identifiable source or in combination with the object, strangeness of the object, and,

lastly, the reaction of other deer (Faatz, 1976). Often, the deer that has discovered trouble (i. e. unfamiliar object, predator) will make a loud sound to warn the rest of the herd. Immediately, the whole herd is alert, but not necessarily frightened (Darling). Tame fallow deer, on the other hand, are less stressed during human interaction (Tables and Figures, pp. 42-44). Tame does had a lower average heart rate (123.75 bpm), respiratory rate (35 bpm), and temperature (102.15F) than non-tame does (162.21 bpm, 39.14bpm, and 102.9 F, respectively.) In addition, they weighed significantly more (97.5 lbs. v. 83.25 lbs.) This increase in weight is attributed to the fact that the tame does are not frightened during feedings and are, thus, the first ones to the feed bowls. The non-tame does, on the other hand, initiate a flight response which spreads throughout the entire group. They will not eat until there is no sign of danger (i. e. when feeders have moved a significant distance away.) The tame (female) fawns had a lower average heart rate (116.8 bpm) and respiratory rate (48.8 bpm) than the non-tame (male) fawns (164 bpm and 56 bpm, respectively.) It should be noted that nothing could be concluded from the adult fallow bucks' data due to there being only one tame adult buck. Other advantages attributed to hand-rearing are: survivability of fawns born to does with poor mothering abilities (Records 4 and 8), greater attention to health and well-being of fawns due to closer and more constant contact, and greater accountability for fawns' survival.

Disadvantages. The main disadvantage to hand-rearing fallow deer in a captive environment is the increase in cost and human labor. To feed one fallow fawn for three to four months requires at least one 25-lb. bag, priced at $35.00. Additionally, there are costs associated with bottles, nipples, fluids, and medicine. During the first couple of weeks of bottle-feeding with a new fawn, a handler may invest up to six hours a day in

bottle-feeding alone. This amount of time decreases as the fawn learns to suckle correctly from the bottle. Another factor to consider is the interference in the deer's natural behavior and survivability. The two fawns might have survived (Records 2 and 3) had they been allowed to stay with their mothers. Analysis of the goat's milk showed that it was deficient in fat content and the goat milk replacer was deficient in fat and protein content, as compared to the fallow does' milk (Table 5). The increased necessity for the administration of fluids and medicine is another disadvantage to hand-rearing. Often, fawns must be force-fed (tubed) or given fluids due to difficulty in fawns adapting to the bottle-feeding process (Table 6). Finally, tame does acquire bad habits as a result of hand-rearing. These include chewing on clothes and other objects, vocalizing, and reluctance to enter restraint devices.

CONCLUSIONS

This research has been successful in developing a hand-rearing protocol specific for fallow fawns born at the Wildlife and Exotic Animal Center and in demonstrating the effects of hand-rearing on fallow deer in a captive environment. The advantages of hand-rearing far outweigh the disadvantages if one has the time and energy to invest in the process. The decrease in stress to the animal that will remain in captivity is a major factor to consider when deciding whether or not to hand-rear. This research could apply to other facilities in which the animals are in a captive environment, such as zoos, research facilities, and parks. In situations where it is necessary to have constant and close contact with the animals, hand-rearing of female animals has a significant advantage. In animals whereby their parenting abilities are not altered by hand-rearing,

the time invested in hand-rearing will be well worth the long-term benefits. It ensures the safety and survivability of the herd.

Table 2: Heart rates (bpm), respiratory rates (bpm), temperatures (F), and weights (lbs.) of fallow does as a measurement of stress and the effects of hand-rearing.

Tame

Ear Tag #	HR-Day 1	HR-Day 2	RR-Day 1	RR-Day 2	Temp.-Day 1	Temp.-Day 2	Weight
Y20	160	136	32	36	101.5	102.4	
Y30	116	128	28	36	102	102.1	102
Y41	152	88	32	28	101.8	101	
Y44	104	160	28	36	102	103.2	100
Y47	156	168	48	32	101.8	103.1	99
Y48	76	132	32	28	101.4	101.3	
Y58	96	132	40	36	102.1	102.1	89
Y78	60	116	40	48	102.4	104.2	

	Heart Rate	Respiratory Rate	Temperature	Weight
Minimum	60	28	101	89
Maximum	168	48	104.2	102
Average	123.75	35	102.15	97.5

Non-tame

Ear Tag #	HR-Day 1	HR-Day 2	RR-Day 1	RR-Day 2	Temp.-Day 1	Temp.-Day 2	Weight
Y5	140	124	40	44	102.4	103.2	81
Y11	144	156	32	36	102.9	103.4	
Y15	156	196	44	40	102.5	102.3	
Y17	220	188	36	36	102.9	102.8	
Y23	132	212	44	56	101.7	103.5	78
Y28	148	148	32	32	103	103.3	
Y42	162	148	44	28	104	104.2	
Y46	204	124	52	36	103.2	102.4	
Y56	132	196	40	44	103.3	103.4	89
Y57	140	184	36	52	102.2	103.1	85
Y54	140	120	44	24	102.9	101.8	
Y63	156	180	44	44	102.6	102.6	
R14	196	180	32	32	102.3	103.6	
R0015	160	156	40	32	102.8	103	

	Heart Rate	Respiratory Rate	Temperature	Weight
Minimum	120	24	101.7	78
Maximum	220	56	104.2	89
Average	162.2142	39.14285	102.9035714	83.25

*Heart rates, respiratory rates, and temperatures were averaged for both days.

Figure 27: Heart rates (bpm), respiratory rates (bpm), temperatures (F), and weights (lbs.) of tame v. non-tame fallow does.

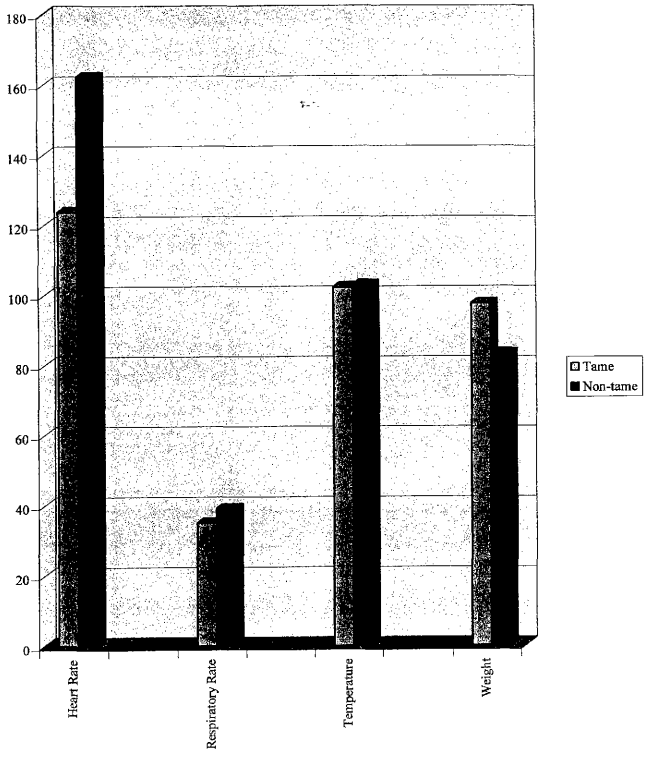

Table 3: Heart rates (bpm), respiratory rates (bpm), temperatures (F), and weights (lbs.) of fallow fawns as a measurement of stress and the effects of hand-rearing.

Tame (females)

Ear Tag #	Heart rate	Respiratory rate	Temperature	Weight
W55	152	44	104.9	45
W57	104	32	103.7	43
W60	120	40	105.2	44
W61	108	68	105.3	42
W62	100	60	105.1	41
Minimum	100	32	103.7	41
Maximum	152	68	105.3	45
Average	116.8	48.8	104.84	43

Non-tame (males)

Ear Tag #	Heart rate	Respiratory rate	Temperature	Weight
W58	156	68	102.9	47
W59	172	44	103.6	44
Minimum	156	44	102.9	44
Maximum	172	68	103.6	47
Average	164	56	103.25	45.5

*Heart rates, respiratory rates, temperatures, and weights of fallow fawns were only measured once.

Figure 28: Heart rates (bpm), respiratory rates (bpm), temperatures (F), and weights (lbs.) of tame (female) v. non-tame (male) fallow fawns.

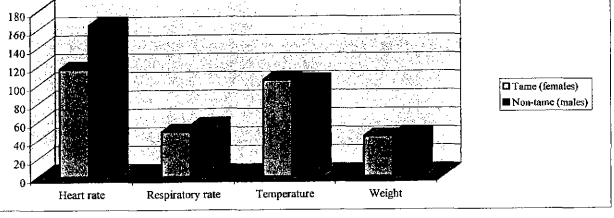

Table 4: Analysis of various milk samples (%).

	Fat	Protein	Lactose	Solids
Y58 (Kay)	5.91	6.27		
Y57	8.86	6.55		
Goat's milk	5.4	6.7	4.1	11.63
Goat milk replacer	2.57	4.5	5.64	10.99

*Insufficient data due to small sample volumes.

Table 5: Administration of fluids and/or medicine.

	Lacey	Donna	Ashley	Cinder	Kieran	Gretel	Penelope
Colostrum				X			
Tubing					X		X
SubQ Fluids		X					X
Serum					X		
Penicillin	X						X
Flunix	X						
Gastrocoate						X	X
Neomycin						X	
Loperamide						X	
Electrolytes	X					X	X
Water Enema							X
Dextrose	X	X					

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