Husbandry Manual For Brown Capuchin/Black-capped Capuchin

Cebus apella (Cebidae)

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1 Introduction

This husbandry manual is far from a comprehensive analysis on *Cebus paella*. The intention of this document is to provide enough information on the care of Capuchins to help in maintaining adequate husbandry in captive environments. There have been numerous studies carried out on Capuchins in regards to their behaviour. Capuchins have an extremely high brain to body weight ratio and have remarkable abilities in tool use and manipulation and conditioning possibilities. Capuchins are popular in zoos because of these behaviours and their perception of a stare as an action of intimacy. Capuchins are a valuable tool in behavioural and biomedical research and further continuing studies will help to expand what little is known about such a remarkable species.

Taxonomy

1.1 Nomenclature

Class: *Mammalia*
Order: *Primates*
Family: *Cebidae*
Genus: *Cebus*
Subgenus: *Sapajus (*Capuchins with tufts)
Species: *apella*

1.2 Subspecies

Cebus apella apella (Linnaeus, 1758)
Cebus apella fatuellus (Linnaeus, 1766)
Cebus apella margaritae (Hollister, 1914)
Cebus apella macrocephalus (Spix, 1823
*Cebus apella peruanus (*Thomas, 1901)
Cebus apella tocantinus (Lonnberg, 1914)

1.3 Recent Synonyms

Table 2.3a: species and subspecies of *Cebus apella*

Rylands *et al*. (2000)	Groves (2001)	Silvia, Jr. (2001)
Cebus apella apella(Linnaeus, 1758)	*Cebus apella apella* (Linnaeus 1758)	*Cebus (Sapajus) apella* (Linnaeus 1758)
Cebus apella fatuellus (Linnaeus 1766)	*Cebus apella fatuellus*(Linnaeus 1766)	Synonym of *Cebus apella*
Cebus apella macrocepahalus (Spix 1823)	*Cebus apella macrocephalus*(Spix 1823)	*Cebus (Sapajus) macrocephalus* (Spix 1823)
Cebus apella peruanus (Thomas 1901)	*Cebus apella Peruanus* (Thomas 1901)	Synomym of *cebus* Sapajus) *macrocephalus*
Cebus apella tocantinus (Lonnberg 1939)	*Cebus apella tocantinus* (Lonnberg 1939)	Synonym of *Cebus apella*
Cebus apella margaritae(Hollister 1914)	*Cebus apella margaritae* (Hollister 1914)	Synonym of *cebus apella* (provisional)

Cebus libidinosus, Cebus xanthosternos and *Cebus nigritus* were all formerly considered a subspecies of *Cebus apella* but now have been elevated to species status.

1.4 Other Common Names

*Brown Capuchin

*Tufted Capuchin
*Black-capped Capuchin

Cebus apella

2 Natural History

2.1 Morphometrics

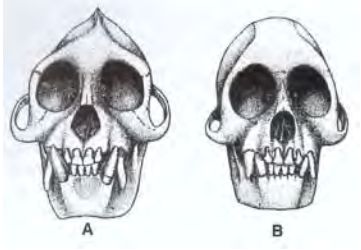
2.1.1 Mass and Basic Body Measurements

	torso	Head & torso	tail	Humerus & radius	hands	Intermembral index	weight
male	36cm*	56.5cm	56cm	24.9cm	9.2cm	81*	3.7kg
female	36cm*	48cm	51cm	22.7cm	6.9cm	81*	2.5kg

(Fleagle 99, Napier 67, Ford and Corruccini 85, Fragaszy *et al.*1989)
*intermembral index is calculated as [the length of humerus + radius/length of femur + tibia] x 100.

2.1.2 Sexual Dimorphism

Males are 34% larger in body size and have canines 22 %larger than that of females. (Emmons 90, Forbes, MacKeith and perberdy 84, kinzey 89, Nowak 91, Rowe 96). Male *Cebus apella* also have a distinctive bony crest along the top of the skull whereas females do not (Silvia jr 2001).



Above:sexual dimorphism in the skulls of male (a) and female (b) capuchins with tufts.Major differences between the sexes includes the morphology of the canine teeth and vomer and the presence in the male of a sagittal creast at the interparietal suture.

2.1.3 Distinguishing Features

The illustrations below shows coat variations in different species of the genus *Cebus*.

Cebus apella

Cebus albifrons

Cebus capuchinus

Cebus xanthosternos *Cebus kaapori* *Cebus olivaceous*

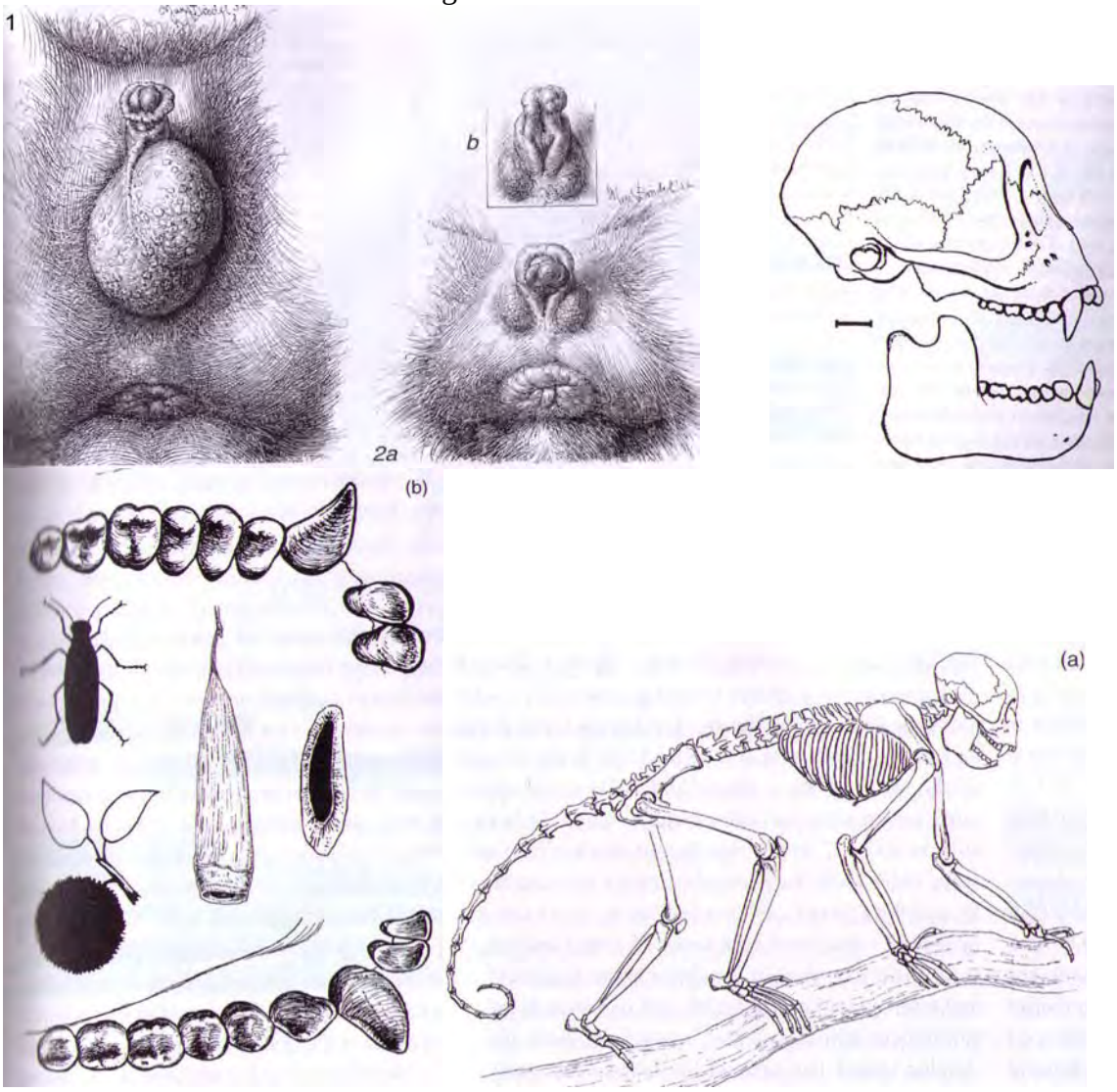
Cebus libidinosus: It has a yellow to white head, with dark sidebruns. The body is light. The underside and shoulders are yellowish or reddish. A marked black dorsal stripe is present, with limbs mainly darkish to blackish. Upper arms not lighter than body. Tail is much longer than head and body.

Cebus nigritus: It has a very dark brown to grey, or even blackish body with no (or very vague) dorsal stripe. Its limbs are darker than its body and its underside is deep reddish with black overlay. The face is white and contrasts with the rest of the body. The cap is dark and tufts are evident, tufts can be erected or directed sideways or ahead.

3. 1. 4 Basic Anatomy

The anatomy of the Capuchin is similar to those of all other New World Monkeys. *Cebus apella* has a distinctive black crown, contrasting with the body, which is gray fawn to dark brown. The face is light grey- brown; the sideburns are thick and black. The lower limbs and tail are also black. The upper arms are fawn and the underside is yellowish or red and they also have a variable well developed dorsal stripe with tufts on the crown. With respect tot heir teeth, Capuchins have robust canines, long and thickly enameled incisors and large, square molar teeth with thick enamel. Capuchins also possess a very robust jaw well adapted for the wide range of hard husked foods or foods that they remove from woody substrates. Capuchins dental formula is 2/2 1/1 3/3 3/3=36; 2 incisors, 2 canines, 3 premolars, 3 molars on top and bottom. Capuchins possess prehensile tails. i.e., they can use their tails to grasp an object or a surface (such as a branch) and to support weight. Capuchins tails are furred for their full length and no area of their tails has specialized skin or sensory bodies. Adult capuchins rarely suspend themselves solely by the tail, although youngsters often do so. The Capuchins prehensile tail is not a general adaptation to support a large body in the trees, but an adaptation for their style of locomotion and feeding (bergeson 1996). Capuchins have relatively slender palms and long fingers, and their thumbs are relatively about as long as humans thumb (Napier and Napier 1967). In many respects Capuchin eyesight is similar to human eyesight. The gut of capuchins is notable for it s exceptionally small caecum (Marint 1990). The small size of the caecum reflects the fact that capuchins, more so than any other primate except humans, specialize in eating foods that are easily digested and have relatively high energy content (Martin 1990).
The Capuchins penis contains a bone (a baculum) and it is a relatively long penis that terminates in a disc-shaped glans. Females have a very prominent clitoris which also

contains a bone like structure, in younger animals the clitoris is prominent and firm but becomes thicker and shorter with age.



1: Genetalia of a male *Cebus capuchinus*
2a: Genetalia of a female *Cebus capuchinus*, 2b: shows the erect clitoris.
Above right: lateral view of the Capuchin skull.
A: skeleton of a Capuchin
B: teeth of the upper jaw (top) and of the lower jaw (bottom) with typical foods of capuchins.

2.2 Distribution and Habitat

The map shows the distribution of *Cebus apella* in central South America.

2.2.1 Distribution of subspecies

The map below shows the distribution of subspecies of *Cebus apella* across South America

2.2.2 Habitat

Cebus Apella inhabits moist subtropical or tropical forest; it has also been seen in the dry forest, gallery forest and disturbed and secondary forest. In northwest Argentina these monkeys live in Montane forest at an elevation of 200- 1100 metres. This species prefers the under storey and mid-canopy of the forest, but often descends from the trees to forge and play,*Cebus apella* has the widest range and broadest habitat tolerances of any other *cebus* species(Forbes, Mackeith and Perberdy 1984,Kinzey 1989, Nowwak 1991, Rowe 1996)

2.3 Conservation Status

Species/subspecies	Red list category	Year assessed	assessor
Cebus apella*	Lower risk	2003	A.B Rylands *et al.*
Cebus apella margaritae	Critically endangered	2000	A.B Rylands *et al.*

The above information was obtained from the IUCN red list of threatened species.
*all subspecies of *Cebus apella*, with the exception of *Cebus apella margaritae* are considered to be in the red list category of lower risk or least concern.

Habitat destruction is considered the most significant factor in the decline of the worlds primate populations (Mittermeier *et al.*1993, 1999), including Brown Capuchins. Neotropical forests of South America have been destroyed and logged for human homes, furniture, crops and cattle ranches creating a matrix of isolated pockets of forest which are unnaturally dry for this region. Capuchins are very adaptable and opportunistic; this can envision them as a pest to crop farmers who hunt the capuchin to protect their crops. Capuchins are also hunted by humans for food, at sustenance and commercial levels, and also for ornaments and medicine. Capuchins are also threatened by the live export and trade market. Capuchins were once an animal on high demand for export as pets, or to exhibit in zoos or circuses. fortunately, laws have been imposed to outlaw such exportation and to protect the species, such as Peru's total ban on export of primates in the 1970s(Moya *et al.* 1993).although these laws are in place many communities in South America still keep capuchins as pets, which is extremely undesirable for the animal. The only species of *Cebus apella* not categorized as a lower risk conservation threat is *Cebus apella margaritae*, this critically endangered species lives only on Margarita Island where it is hunted heavily as a crop pest and for pets, while it is forced to compete with feral populations of *Cebus olivaceous.*

2.4 Diet in the Wild

The Capuchin diet is omnivorous, primarily frugivorous and insectivorous. The bulk of their carbohydrate requirements are gained from eating fruit while the invertebrates the capuchin eats provide much of the protein required. Capuchins are destructive foragers with the ability to use "combinatorial "behaviour (combining an object with the substrate to receive the protected fruit), this gives them a wider access to plants and fruits than other non-human primates. Capuchins often choose foods, both plant and animal, that requires destruction and skill to retrieve by either violently destroying the protective shell, stripping bark or breaking open a branch then carefully and skillfully removing the prize inside. Cebus apella have been recognized to eat fruit in the morning and afternoon whilst they hunt invertebrates during midday (daily activities discussed in 9.1), Terborgh (1983) stated that fruit was eaten in the morning to quickly quell the hunger and raise blood sugar. Cebus apella also possess a robust mandible and powerful canines which allow them to chew though hard fruits. Wolff and Ruppert (1991) found Cebus apella to be particularly fond of cumare and palm nut, they were also adept to catching tree frogs it extracts from bamboo trunk cavities and may exploit over 90 plant species a year. Vegetation, seeds, pith, eggs, insects, reptiles, birds and small mammals such as mouse opossums are also included in their diet; during the dry season when food is scarce the scheelea palm frond pith is critical to the brown capuchins survival. (Emmons 1990; Forbes, Mackeith, Perberdy 1984; rowe 1996).
A complete list of all plant foods eaten by *Cebus apella* can be found in *the complete capuchin* pages 261-285.

2.5 Longevity

2.5.1 In the Wild

Longevity of Capuchins in the wild is extremely difficult to measure since the Capuchins live for so long. It is assumed that wild Capuchins have a slightly shorter life expectancy than those kept in captivity.

2.5.2 In Captivity

Record	55 years
Average lifespan	40 years
Maximum value	45.1 years

2.5.3 Techniques Used to Determine Age in Adults

In most, but not all, subspecies of *Cebus apella*, gradual lengthening of the hair at the crown and along the cheeks throughout adulthood results in the prominent tufts of hair that give it its name in English," tufted capuchin". Some of the more dramatic variations of hair contours include a central ridge of hair along the skull, giving the monkey a punk-like hair style and thick raised tufts that extend far along the sides of the skull, giving a robust and well-coiffed appearance. In those subspecies of *Cebus apella* that do not develop distinctive tufts, older individuals develop longer hair around the face giving a "halo" or "crowned" look. In tufted animals the tufts begin to appear in females at about 6years of age, and a few years later in males, and continue to enlarge throughout adulthood.

4 Housing Requirements

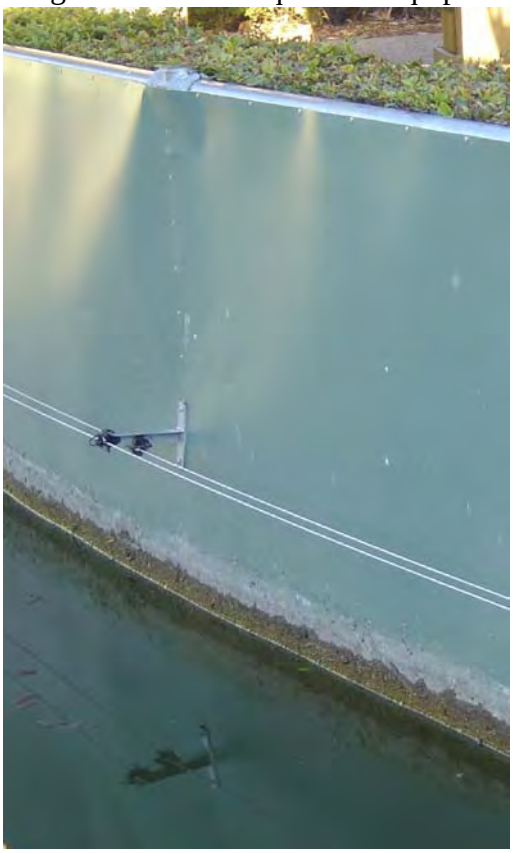
4.1 Exhibit/Enclosure Design

When designing a Capuchin exhibit it is important to remember that they are an arboreal species that also spends a considerable amount of time on the ground so they will generally use the entire exhibit.

Capuchin islands are very popular in zoos, they are aesthetically attractive and a certain way of containing captive monkeys (Capuchins cannot swim their body composition of more muscle than fat does not permit swimming). The floor of the moat should slope upwards at a constant angle from the bottom of the perimeter moat wall at the edge of the land area, to prevent monkeys from slipping into the deep end. Access to the enclosure can be provided by submerged walkways; these walkways should be approximately 20 cm below the surface and should not be visible to the animals. The minimum moat width required to house capuchins in 3 metres, at this distance the monkeys cannot leap over the moat. The moats also require a perimeter wall on its outer edge; this must be at least 55 cm above maximum water level and the wall should be smooth faced or of a surface that cannot be scaled by the Capuchin. An extra safety precaution of an electric hot-wire fence is also recommended, particularly if the moat wall or maximum moat depth is less than the measurements stated above. If an electric fence is used it is important that it is installed above the maximum water level, above overflow outlets and must not be able to be touched by members of the public.
Enclosed exhibits are also suitable for housing Capuchins assuming they are provided with access to direct sunlight to obtain their requirement of vitamin D3.If a mesh wire barrier is used; the diameter of the wire should be at least 2.5mm and the maximum mesh dimension required are 25mm by 25mm, this eliminates the possibility of infants escaping.
Open exhibits can also be used to house Capuchins, The security requirements of this type of enclosure are a smooth surface that cannot be scaled by the monkey on the perimeter wall and electric hot wire fence. These two restriction methods should be used in conjunction to provide security. A tall mesh fence is inadequate for monkeys.
In an exhibit that uses a gate or door rather than a submerged walkway (i.e. not a monkey island) an “air lock” should be used. The air lock is an area with a door leading into the exhibit and a door leading to outside of the exhibit. This safety measure eliminates the risk of animal escape upon keeper entry into the enclosure; it also provides a safe area for the keeper if they were to be attacked by a monkey.

Monkey pits are not acceptable; the enclosure should allow the Capuchins to perch above the viewing human eye level. Since Capuchins are housed socially there is always the risk of aggressive or agonistic interactions, to accommodate for this behaviour each exhibit must allow an individual to visually isolate itself. This can be achieved by shade cloths, curtains, vegetation etc.
The exhibit should be designed so that no individual can be cornered by another. Dominant members of the group may attempt to bully subordinates and the design of the enclosure must allow victims to escape these attacks. Night dens and nestboxes with 2

entrances or exits will prevent this. Runways can also be used, and they can also be useful to capture a capuchin, preventing using stressful techniques and equipment.



above left: demonstrates a submerged keeper access walkway to the exhibit.
above right: is the electric fence on the outer boundary of the moat on Capuchin Island.
Both photos are of the Capuchin Island at National Zoo and Aquarium, Canberra.

Both of the pictures above: are examples of Exhibit boundaries when a monkey island is not used. Both pictures from National Zoo and Aquarium, Canberra.

4.2 Holding Area Design

Off exhibit holding areas where animals are held for longer than 6 weeks, or routine management enclosures where animals would spend more than half of any 24 hour period, must meet the minimum space, furniture and enrichment requirements for exhibits (EAPA policy on primates clause 2.12.3) Naturalism is not essential in off-exhibit holding enclosures, but is preferred because of the benefits to the animals health and well-being.

Holding areas should follow the same principles of design as the major exhibit. No animal should be able to become cornered by an aggressive dominant animal. Structures should provide adequate vertical space and postural supports that enable all animals to move and perch with their tail hanging in a normal position of rest without touching the floor. Perches with multiple heights are desirable.

Holding area adjacent to the main enclosure with visual, auditory and olfactory contact with the main group is recommended. This can reduce the difficulty of introductions (9.8 introductions and removals).

4.3 Spatial Requirements

According the Exhibited Animals Protection Act, Policy on exhibiting primates in New South Wales the minimum spatial requirements for capuchins are as follows:

	width	length	height	Floor area
Minimum dimensions	5m	7.5m	3.5m	37.5m*

*denotes metres squared.

The above dimensions are calculated for 3 adult male animals or 2 adult 1 dependant offspring. For each additional animal a further 12 metres to the floor area is required (EAPA policy on primate's schedule 1).

4.4 Position of Enclosures

There are no reports of problems involved with capuchins being located in close proximity to other species such as predators. In fact, the position of enclosures within visual, auditory and olfactory range of other species may stimulate natural behaviours.

4.5 Weather Protection

Shade and shelter should be provided so that some animals do not prohibit others from gaining access to critical resources. Capuchins can be exhibited in fully open enclosures providing they have access to heated dens and can find shelter from the weather in vegetation or enclosure furnishings.

4.6 Temperature Requirements

Capuchins do well at normal to high temperatures of 21-29 degrees Celsius(70-84 degrees farenheight).If outdoor housing is used, warming areas are needed for most species if the ambient temperature falls below 10-15 degrees Celsius(50-59 degrees farenheight).These areas can be concrete dens with heated shelving. It should not be

assumed that animals will spontaneously seek out shelter areas when temperature falls. Animals might need to be confined in heated quarters under such conditions. The enclosure should have a humidity of 50-60%.
In enclosed environments, a ventilations rate of four or five air changes per hour is recommended. Animal rooms without natural light typically use a 12h/12h artificial circadian light cycle. Gradual light changes which simulate those which occur in nature may be beneficial. Natural light from windows or skylights will provide a low level of light during the night which will resemble the situation in the wild.
Capuchins should have constant access to heated indoor quarters.

4.7 Substrate

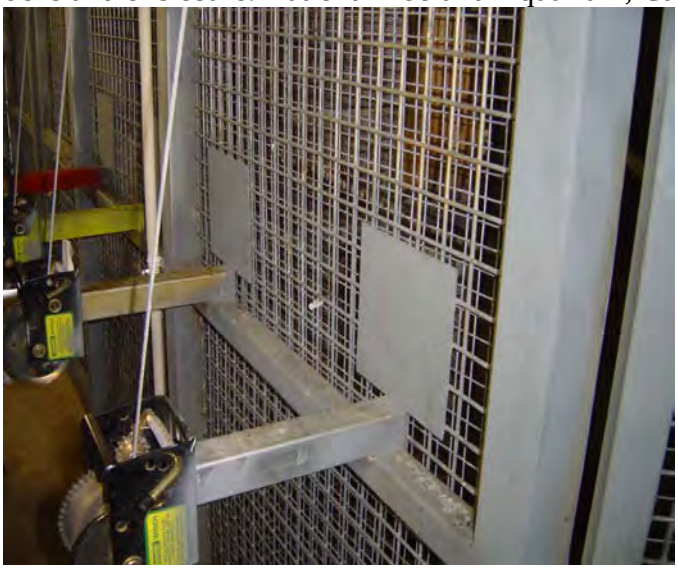
There are many kinds of substrate that can be used to house capuchins including sand, pea gravel, bark chips wool, straw and volcanic pebbles. Deep litter can be used in enclosures to encourage locomotion and foraging activities and it also provides some protection if an animal falls from en elevated structure. If deep litter is not used as a substrate, the Capuchins should be provided with a section of the enclosure, such as a small pit, that is filled with deep litter such as straw or bark chips to allow foraging .Peat is generally not recommended as a substrate because of environmental reasons and sand is particularly easy to clean and maintain.

4.8 Nestboxes and/or bedding

Each exhibit must allow access to an area such as a nestbox, raceway or night den, suitable for the physical isolation of individuals so that animals can be restricted for close examination and veterinary treatment (EAPA primate policy clause 2.5.1).

The enclosure should have a den within that has 2 sections of it that can be separated by mesh. This is important for captures and introductions. The floor of the den should be concrete and be easy to clean with a hose. Heat pads should be provided inside the den particularly if the ambient temperature falls below 10-15 degrees Celsius.

The photographs are examples of indoor areas that can be used as an area of easier restraint and night sleeping areas. Top left is a picture of the sliding door and mesh barrier separating the two sections of the indoor area. Top right is of the gate from the indoor area to the actual outdoor exhibit. Bottom left is the pulley system used to open and close the doors leading between the dens and enclosure. National Zoo and Aquarium, Canberra.



4.9 Enclosure Furnishings

Enclosure furnishings are the crucial factor in designing a Capuchin enclosure; they provide these intelligent animals with environmental enrichment preventing behavioural problems. Climbing structures within the exhibit should provide adequate vertical space and postural supports to enable all animals to move and perch with their tail hanging in a normal position of rest without touching the floor. Perches with multiple heights within the enclosure are desirable and the structures should permit jumping vertically and laterally.

The minimum exhibit furniture according to the Exhibited Animals Protection Act, policy on exhibiting primates in New South Wales as per clause 2.3.1 is:

* sitting or sleeping perches at least 2 metres above the ground and of sufficient number to allow each adult animal to be by itself but also to allow for more than one animal to sit for mutual grooming etc.
* At least 4 horizontal pathways in upper half of the exhibit of a mixture of flexible and rigid materials and of appropriate diameter for the animal to move along.
* At least 4 vertical pathways in the upper half of the exhibit, of a mixture of flexible and rigid materials such as ropes, bamboo or tree limbs.
* One elevated feeding platform for each adult in the group.
* Access to water for swimming.

Capuchins are arboreal quadrapudalists that locomote on surfaces which are vertical and horizontal, but mostly oblique. Therefore, Capuchins should be provided with oblique structures in addition to the more obvious horizontal and vertical ones. The size and flexibility of such structures should be selected in order to provide wide variety. These structures provide a means of avoiding other group members, but are excellent stimuli for physical exercise and play, and also better exploiting of available enclosure space. The obvious climbing structure that would be suitable for capuchins would be trees or similar wooden structures, but other substitutes can be used.

Examples of furnishings used in captive exhibits:

* A suspended plastic pipe with holes in it.
* Plenty of ropes with varying tension.
* Shade cloths
* Suspended baskets
* hanging tyres
*panels
*hanging screens
*PVC pipes
*Swings
*crates
*frames
*Hessian bags
*poles
*plastic mats
* firehose

Examples of exhibit furniture on National Zoo and Aquariums Capuchin Island.

It is important to note that when decorating the exhibit with ropes there should not be any loops in the rope. No slipknots should be used and each end of the rope should be tied to a stable structure. This eliminates any chance of the Capuchin being hung by loops.

5 General husbandry

5.1 Hygiene and Cleaning

On a daily basis the Capuchins should be provided with clean water and all faeces and old food should be removed from an outdoor enclosure by either raking or simply a spot clean.
Night dens and sleeping quarters must be hosed out each day to remove any traces of faeces. This cleaning of the night dens should be done while the monkeys are in their day enclosure. The animals should not have to locomote on wet floors and should not become wet in the process of cleaning. The disinfecting of dens should also be done at regular intervals

Deep litter has been found to remain hygienic for several weeks without hosing or disinfecting. However, the removal of especially soiled parts of the litter or rotten food is advisable. Wood bark within outdoor enclosures has also been found to last around 2 years before it is required to be replaced.

5.2 Record Keeping

The records shall provide the following information:
Identification number, common name, scientific name, any personal name and any distinctive markings;
Origin (details of parents and their origin and of any previous locations);
Dates of acquisition and disposal, with details of circumstances and addresses;
Date of birth;
Veterinary records, including results of physical examinations, details and dates of any treatments, results of routine health examinations;
breeding (including mating, reproductive and behavioural cycles, parenting ability) and details of any offspring;
Date of death and cause including results of post mortem results;
Normal diet;
Any other specific details pertaining to the individual such as changes in behaviour or diet.

Daily report sheets should be noted in the case of the following:
*Any deviations from normal behaviours. It is crucial in caring for capuchins that keepers have a knowledge and understanding of each individual monkeys character and normal behaviours.
*Any deviation from the normal diet
*any mating activity
*eagerness, or lack of, to feed
*abnormal amounts of food remaining
*different composition of faeces
*any transfers or acquisitions to the enclosure
*any structural or maintenance changes to the enclosure

Where an Australasian or international studbook exists for a primate species held by the exhibitor, records must be provided to the studbook keeper at least yearly or as required by the studbook. (EAPA primate policy clause 6.2)

All documents, records and other information pertaining to each animal including those from previous locations must be kept safely and maintained for the life of the primate plus five years. Animals moving to new locations must be accompanied by copies of all relevant records (EAPA primate policy clause 6.3)

5.3 Methods of Identification

Can be identified by distinct facial markings or fur coloration. Among tufted capuchins, patterns of white or lighter fur along the sides of the cheeks, on the chin, and around the

eyes, and the pattern where the black cap meets the lighter hair on the forehead all combine to give individuals a distinctive appearance. Older *Cebus apella* can have mottled patches of facial skin and less facial hair while at the same time having longer hair at the crown. Identifying species individuals can be difficult if not experienced. In general monkeys become more individually distinctive with age. Field observers typically use details around the face, such as black sideburns, clumps of white or lighter fur, slight variations in the shade of the fur, the presence and shape of tufts along the skull and jaw, and the shape of the dark cap.

Tattooing with an electric pen and ink is the most commonly used method, and we are aware of no ill effects. Collars have been tried to facilitate identification of semi-free range animals, but the animals removed most of them within a few days. Although there are no reports of the use of implanted microchips, as they have proved suitable for macaques and marmosets, it is reasonable to assume that they would also be suitable for capuchins. Other forms of identification that can be used on Capuchins include ear rages and tail tip prints.

6 Feeding Requirements

6.1 Captive Diet

Commercial pellets for South American Monkeys appear nutritionally ideal. Such diets are prepared to include requisite proportions of amino acids and minerals, etc. When commercial food is not given, mealworms, cheese, yoghurt etc. should be added to the regime to provide animal proteins. Obese Capuchins are rare; therefore food can be fed *ad libitum*. It is advisable to provide the animals with a highly preferred mixture (cottage cheese, eggs, cereals, etc) a few times a week and to use this occasion to administer medicines by mixing them with the food.

Raw eggs may be given occasionally; although there are may be an associated risk of salmonellosis, and of restricted biotin uptake due to the uncooked avidin.

The recommended diet according to the Exhibited Animals Protection Act (EAPA) is as follows: commercial primate diet, fresh fruits and vegetables, insects- mealworms, crickets, meat, chicks, eggs, nuts, seeds, browse.
Listed below are variations of a typical capuchin diet used by different institutions.

Rolling Hills Zoo, Kansas:
The following is amounts for 1 animal.
AM –
1 peanut and 8 primate biscuits soaked in juice.
Noon –
60 grams of a variety of fruit and vegetables.1 tablespoon of egg and 1 tablespoon of pinto beans.
PM –
8 primate biscuits soaked in juice.

?????????
For 1 2-3 lb animal.
Fruit and vegetables should be cut into pieces appropriate for the monkey's small hands. New world monkey chow can be soaked in marmoset jelly or fruit juice. Moist foods can be sprinkled with a vitamin mineral powder such as vionate (approximately 1/4 teaspoon per animal per day)
AM -
1-3 oz canned primate diet (cut in small pieces) Zupreem, science diet
10-12 pieces of soaked new world monkey biscuit (mazuri, spectrum, Purina etc. can be offered dry depending on the size of the monkey, soaking in fruit juice may increase palatability during conversions from poor diets.
PM Monday, Wednesday and Friday-
1/8 apple, 2 slices of banana halved, 2 grapes halved, I tablespoon of diced orange, 1/2 slice of chopped sweet potato, 1 ½ tablespoon lettuce mix (romaine, cabbage, celery), 4 primate biscuits soaked in orange juice or marmoset jelly, 8 peanuts, 1 tablespoon of sunflower seeds, 1 piece of chopped carrot, 1/8 slice of whole wheat bread cubed and 4 snow peas.
PM Tuesday, Thursday, Saturday, Sunday-
2 slices of banana halved, 1 tablespoon of diced orange, cut green beans, ¼ hard boiled egg with shell cut up, 1 tablespoon of corn thawed frozen or fresh, 5 peanuts, 1 tablespoon of sunflower seeds, 1 heaping tablespoon of avocado, a few sprigs of parsley, 1 heaping tablespoon of black eyed peas cut in small pieces, 4 primate biscuits soaked in fruit juice or marmoset jelly and ¼ slice of whole wheat bread cubed.

Occasional crickets can be provided (crickets should be dusted in vionate) as a treat. Other meats such as cooked fish, chicken, turkey, beef are sometimes enjoyed. Offer teaspoon sized portions. Minimize intake of human sweets, dessert foods, milk products, carbohydrates and fats. It is fine to give the Capuchins one human children's vitamin 2-3 times a week. Avoid foods which have been enriched with iron such as fortified cereals. Other treats occasionally: soaked raisins, other types of fruit- portion of treat per day should be less than 1 teaspoon in volume.
Courtesy of MonkeyMaddness.com

Every day at A.M.

1-3 oz canned primate diet (cut in small pieces) Zupreem, Science Diet
10-12 pieces of soaked New World Monkey Biscuit (Mazuri, Spectrum, Purina, etc.) or can be offered dry up
1/3 cup depending on size of the monkey. Soaking in fruit juice may increase palatability during conversion from poor diets.

P.M.

Mo-We-Fr 1/8 apple

2 slices of banana 1/2'd
2 grapes 1/2'd
1 TBS diced orange
1/2 slice sweet potato (chopped)
1 1/2 TBS lettuce mix* (Romaine, cabbage, & celery)
4 primate biscuits (soaked in orange juice/mjelly)
8 peanuts
1 TBS sunflower seeds
1" piece of carrot - chopped
1/8 slice of whole wheat bread cubed
4 snow peas

(*) Lettuce mix ingredients are placed in a chopper and mixed. Use long and thin pieces.

Tu-Th-Sa-Su 2 slices of banana 1/2'd
1 TBS diced orange
4 green beans cut
1/4 hard boiled egg with shell (cut up)
1 TBS corn (thawed frozen or fresh)
5 peanuts
1 TBS sunflower seeds
1 heaping TBS avocado
few sprigs of parsely
1 heaping TBS black-eyed peas (shelled)
1/2 slice turnip
1 oz canned primate diet (cut in small pieces)
4 primate biscuits (soaked in fruit juice or M.jelly)
1/4 slice whole wheat bread cubed

Occasional treats**:**

- Cricket or mealworm (dusted in vionate).
- Cooked fish, chicken, turkey or beef (teaspoon-sized portions)
- Soaked raisins, other types of fruit. Portion of treat/day should be less than 1 teaspoon in volume!

! Avoid foods which have been enriched with iron such as fortified cereals.

National Zoo and Aquarium, Canberra:
The following diet was prepared for 2 adult male capuchins.
AM: 600g of chopped vegetables (No capsicum and a small amount of sweet potato and tomato).These foods are not hazardous to the monkeys but they do not appeal as much as other vegetables and therefore may be wasteful.
Enrichment feed (see 9.7 behavioural enrichment for different types of enrichment).

Primate cake* is fed out every 2nd or 3rd day alternating on the other days with primate pellets.
PM:Mixed fruits(Mostly melons, mangoes and exotic fruits, No pineapple, strawberry or pear and only small amount of apple and kiwi fruit) and carbohydrate feed.
Capuchin carbohydrate feed:
Monday: pasta and chicken
Tuesday: porridge
Wednesday: cooked eggs
Thursday: cooked rice
Friday: Pasta and chicken
Saturday porridge
Sunday cooked rice
* Primate cake ingredients: farex, soaked primate cubes (high protein pellets), wheat germ, bran, oats, honey, vegemite, sustagen, nutrigel, sometimes sultanas and chopped bananas.
In summer the primate cake is frozen for enrichment. It is important to remember that freezing the cake will kill vitamins and minerals in pentavite, this ingredient can be added after freezing.

6.2 Supplements

Capuchins living in environments without sufficient sunlight require vitamin D3 supplementation. This should be present in commercial monkey diets. Avoid D2 or ergocalcirefol since these cannot be utilized. If not being fed commercial monkey chow, Capuchins should be fed insects such as crickets or mealworms. Vitamin D3, found in insect chitin, is important in promoting absorption of calcium and other minerals.
Although most commercial feeds have adequate levels of vitamin C at the time of packaging, after 90 days of storage, these levels decrease dramatically. Capuchins not being fed commercial monkey chow should be supplemented with fruits that are high in vitamin C such as citrus fruits (lime, lemon, orange, grapefruit).
Capuchins appear to require more folic acid than what is provided in commercial chow, particularly to support pregnancy and growth (Knapka *et al.* 1995; Rasmussen *et al.* 1982); consideration should be given to folic acid supplementation as necessary. Folic acids occurs abundantly in green leafy vegetables, fruits(e.g. apples and oranges), dried beans, avocados and sunflower seeds.

6.3 Presentation of Food

Capuchin feed should be presented in a way that in mentally stimulating and offers more than just eating to the animal. Scatter feeding is highly recommended as this will cause the Capuchins to forage for their feed as they naturally would in the wild. Hiding food in hard to reach but accessible locations within the exhibit is also effective. By spreading the food around or feeding in several places, the risk of food monopolization by a dominant individual is reduced. If the capuchins are fed from one location it is possible that a subordinate animal will be bullied away from the food

It is rarely necessary to chop up fruit and vegetables into small pieces. Capuchins like to open and peel fruits. Whole fruits allow them to spend more time in species-typical feeding behaviours. Other suitable products that provide manipulation are unshelled nuts, unshelled beans, corn on the cob, coconut and unhusked cereals.
Other method of feeding are also explained in detail as part of behavioural enrichment in chapter 9.7.

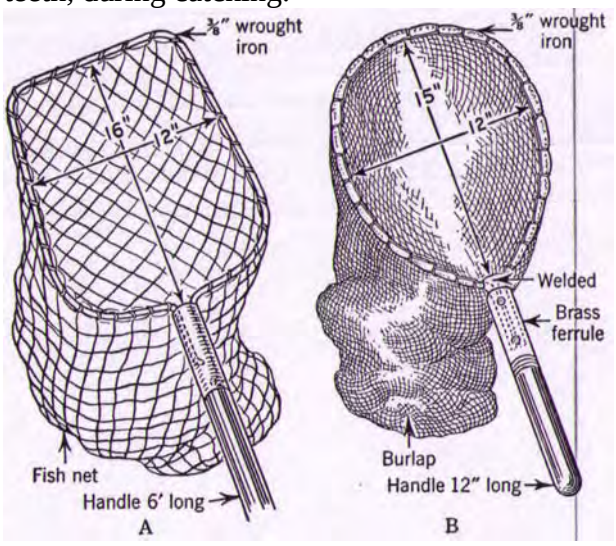
7 Handling and Transport

7.1 Timing of Capture and Handling

The best time to capture a designated Capuchin is as early in the morning as possible, In particular if the Capuchins use a night house or dens. Confining the designated monkey to the house for capture is much easier than chasing the animal throughout the enclosure as the Capuchin will climb to the heights of perches in an attempt to avoid capture. An early morning capture gives the animal the daytime rather than night to overcome the stress of the procedures undertaken.

7.2 Catching Bags

Nets should always have padded rims to prevent damage to the animal, especially its teeth, during catching.



Catching nets should have a drawstring attached to enclose the Capuchin once it has been captured

7.3 Capture and Restraint Techniques

The traditional way of capturing group living Capuchins is to use a net and/or protective gloves. The chasing involved in this method is extremely stressful, and the method is not without risk of injury to the animals. Some of the stress and most of the risk can be eliminated by shepherding the animal through a system of tunnels which leads the animal into a squeeze cage where it can be restrained for examination or treatment. In either case, the expertise of the person doing the capture is paramount. Sine stress increases over time if its source persists, rapid, efficient netting may be preferred to a prolonged wait for a frightened animal to enter the tunnel (Linn *et al.* 1995). The stress due to capture can be reduced by giving the animal a few drops of diazepam on a piece of banana or grape, 2mg/kg. Capture of one or more individuals results in the colony being highly aroused for some time afterwards. These events typically occurring on capture days often become associated with the stressful experience. For example, the arrival of the veterinarian, or the sight or noise of capture equipment such as gloves, nets or tunnel

cages come to elicit tension and/or fear. Therefore it is advisable that keepers who work with these animals on a regular basis and have developed a trusting relationship not be involved in the capture. Transport boxes have recently been used in a few laboratories. Initial coaxing of the animal to enter the box may require any number of stratagems of varying forcefulness, ranging from attracting it into the box, using treats, chasing it in by cutting off all escape routes except the entrance to the box.

Target or training or similar conditioning is highly recommended in this species. They have a remarkable brain to body weight ratio and a more than capable of learning simple conditioning techniques. These methods of control can greatly assist keepers in handling for examination or veterinary procedures and may prevent a stressful capture and restraint. Placing a restraint or transport container within the animals living quarters may help with capture. Filling this container with straw or bedding material may encourage the animal to reside in it and allow it to become familiar and comfortable with this item. The animal could also be lured into the container with food but it is important to remember that capuchins are extremely intelligent and will be aware of a capture procedure very early.

Capuchins, or any nonhuman primates, should never be handled with bare hands because of the possibility of disease transmission. Utilizing capture nets or leather mitts with gauntlets extending above the elbows, the animals should be restrained with both upper arms pinned behind the back. Handlers should never attempt to restrain the animal by one arm, as these animals will often twist rapidly resulting in a spiral fracture of the humerus. Once the animal is restrained the grip should not be relaxed, even though the animal seems to submit to handling for it may suddenly attempt to escape without warning. A Capuchin may attempt to bite handlers during capture. They are not submissive animals and have sharp canines capable of inflicting nasty wounds.

Above left: correct method of restraint for medium sized nonhuman primate with all four limbs securely grasped
Above right: Medium sized primates can be restrained by holding the arms behind the back. A finger inserted between the arms gives added security.

7.4 Weighing and Examination

Capuchins are weighed by placing the monkey inside a pet pack and placing this onto a large set of scales. Before the animal is placed captured, the pet pack should be placed onto the scales and the tare function should be used or the weight of the pet pack must be subtracted from the total weight (including the monkey). If the Capuchin is target trained or food conditioned it is much easier and less stress to ask the monkey to sit or stand on a set of scales.

7.5 Release

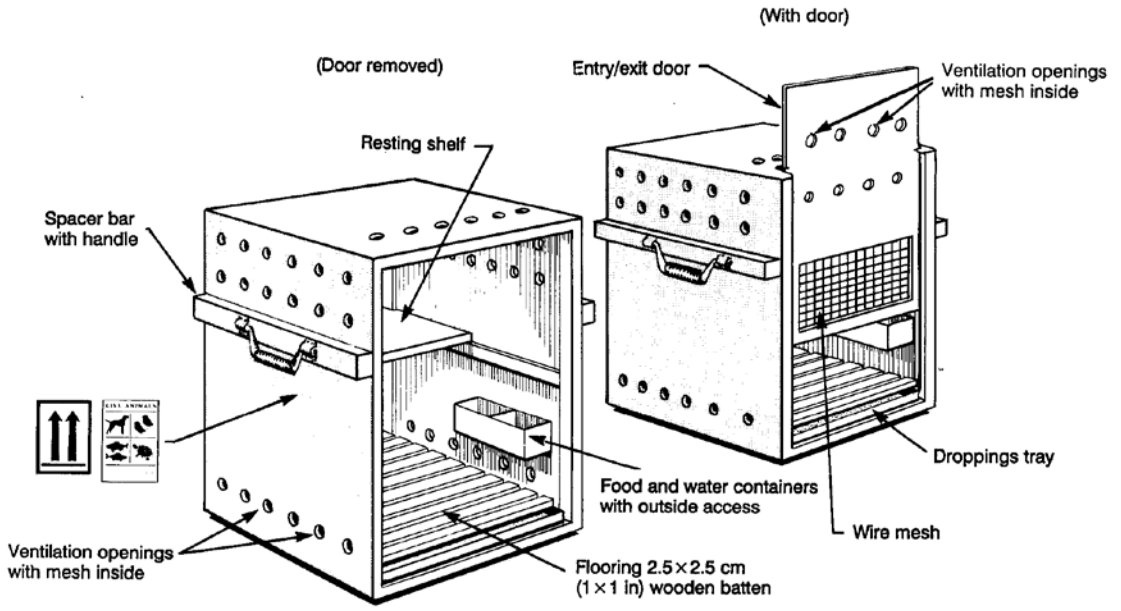
The post-anesthesia recovery patient period should follow standard monitoring and hygiene related protocols, ensuring adequate warmth, freedom from potential injury, and rapid return to the social group as soon as possible. The longer an individual is separated from the troop, the more difficult the reintroduction becomes and the higher the risk of rejection. Capuchins that are recovering from anesthetic procedures are first introduced into the den within the enclosure. The recovering Capuchin should be isolated within the den from all other members of the captive troop, if the den has 2 sections the animal should be locked into one section. The status of this animal should be monitored until the animal if fully conscious which can be determined by the Capuchins gait. If the animal appears to be stable and moving around the den, and not showing lethargy or depression it is then ready for the next step of release. The other members of the troop should then be allowed into the other section of the den to determine if the Capuchin is socially ready to renter the group. The other Capuchins should approach the mesh to interact with the partially isolated animal, which may respond by backing away or affiliatively interacting with the other troop members. If the Capuchin is avoiding contact with the others it is not ready to be released but if the response to tactile contact is positive then the Capuchin is ready to be reintroduced into the troop.

7.6 Transport Requirements

These animals instinctively fear the strange environment encountered during transportation. Therefore, in transporting these animals there are a number of basic principles with which the shipper and the carrier must comply as these effect the welfare and comfort of the animal
Pregnant females and females with suckling young must not be accepted for air transport. It is natural for these animals to investigate their surroundings and try to escape. With very few exceptions, these animals do not willingly accept confinement. They will become frustrated and will often make determined efforts to escape.
These animals are affected by temperature changes and severely affected by temperature extremes. Care must be taken to ensure that they are not subjected to drafts. Most species can withstand reasonable variations in temperature but exposure to the wind or a draft can

be fatal. Therefore, consideration must be given not only to temperature changes but also the chill factors involved. On the other hand, these animals must not be exposed to direct heat, such as placing them in sunlight or against hot radiators. Monkeys unavoidably subjected to extreme heat must be cooled so as to prevent dehydration or heat prostration. During prolonged transit stops, when the ramp temperature exceeds approximately 20 degrees Celsius (68 degrees farenheight), the aircraft compartment doors must be opened and, in extreme temperatures, ground equipment must be used to ventilate the compartments. The different climatic factors prevailing during a journey must always be considered when arranging the routing and carriage of these animals.

7.6.1 Box Design

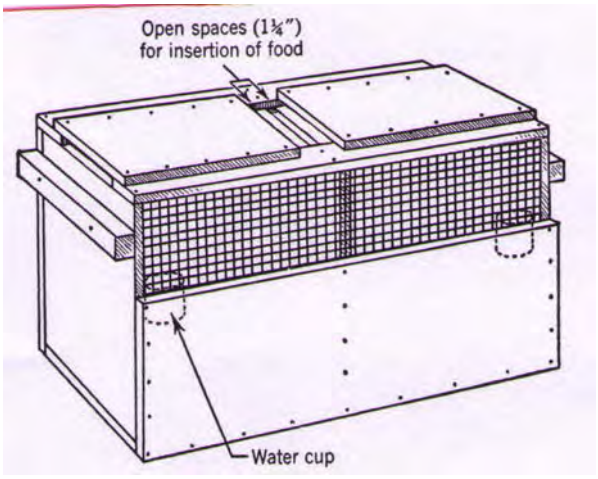


The above illustration is the appropriate transportation box for capuchins according the Exhibited Animals Protection Act, policy on exhibiting primates in New South Wales. Container 31 is used for Capuchins.

The following table is the standards of box design required to transport capuchins according to the New South Wales Department of Primary Industries.

materials	Wood, metal, wire mesh and muslin or other light material
frame	Solid wood, screwed or nailed and glued with non-toxic glue, metal or non-toxic plastic.
sides	Wood, metal or plastic. The front must consist of a 2/3 solid panel with ventilation openings above a 1/3 wire mesh
handles	Must be provided as shown in the illustration on three sides of the container

floor	The base of the container must be solid and leak proof. A slatted floor made of 2.5 x 2.5cm(1 x 1 in) battens spaced at 0.5 – 1cm (1/5 – 2/5 in) intervals and covered with absorbent bedding must be placed over a droppings tray, with a locking device, fitted into the base of the container. If a droppings tray is not provided there must be sills at both the front and the rear of the container to prevent excrete escaping.
roof	Solid but with meshed ventilation openings optional.
door	Either the front of the container can be constructed as a vertical sliding door or a rear hinged or sliding door, extending the whole height of the container, must be provided. In either case the door must be fastened with tamper proof fastenings.
interior	Optional resting shelf 1/3 the length of the container can be provided in the rear of the container.
ventilation	Meshed ventilation openings, approximately 2.5cm (1 in) in diameter must be provided along the base of the two long sides and in the upper 1/3 of the sides and the front of the container. Whenever openings are covered by mesh care must be taken that there are no sharp edges present within the container, all edges must be covered with a smooth material that is tamper proof. A muslin, or similar material, curtain must cover all ventilation opening including the front.



For shipping monkeys, any well made wooden box of appropriate size can be modified. Before inserting wooden partitions for separation, several holes should be bored at eye level so that the monkeys can see each other. One modification of such a box is shown in the figure above. The upper third is covered by half inch wire mesh, the edges of which are secured by the top and sides of the box. Cups for water are nailed in place as shown so that they can be filled from the outside through the wire. The centre top board is in sections, the removal of one section allowing release of only one animal. These sections overlap side sections and are 1 ¼ inches short toward the centre of the box to allow for

insertion of food. Metal handles of strips of wood should be placed on both ends for ease of handling.

7.6.2 Furnishings

No furnishings are required for transport of Capuchins.

7.6.3 Water and Food

Feed and water containers:
Separate food and water containers must be provided, either revolving or fixed. If fixed inside the container they must be placed at a height that does not allow the animal to sit upon it and there must be outside access for filling and emptying which does not allow the animal any chance of escape. Water containers should only be filled to demand and must be emptied after use as monkeys will splash themselves to become wet and chilled.

Animals do not usually require additional feeding or watering during 24 hours following the time of dispatch. If feeding or watering is required due to an unforeseen delay, cereal or appropriate primate food, bread and non-citrus fruit, must be provided but care must be taken not to overfeed. After offering water, the water container must be removed.

If the journey is under 36 hours, cups can be eliminated and food (apples, uncooked potatoes, carrots, bananas etc.) placed within the box. For longer journeys food must accompany the animals, the food parcel being nailed or fastened to the box. “Please water” should be painted in black on the box outside each cup. If traveling by air food for 2 extra days should be included.

7.6.4 Animals per Box

Adult monkeys must be crated individually or separated by partitions, adult monkeys resent sharing small spaces and food.
Mature males will become upset by the presence of females in heat. Therefore, accepting females in this condition for shipment must be avoided whenever possible. If it is necessary to accept male and female monkeys, each sex must be in its own container and the containers separated from each other as far as possible.
Young animals must not be separated from one another as this increases stress. They must be in partitioned containers or in separate containers loaded adjacent to each other in the aircraft. If not partitioned young animals may cling together causing eye lesions. Animals of the same species and size may be shipped together in the same container only if they have previously been contained together. Otherwise, they must be carried completely separately. Care must be taken to prevent any possibility of snapping and disturbing one another.

7.6.5 Timing of Transportation

Transportation should be organized so that the Capuchin is released in the morning rather than at night. Releasing the animal in the morning gives it the whole day to recover from the stressful incident

7.6.6 Release from Box

To release the monkeys from the box remove one section of the top board and bring the opening to the cage door. They should be released away from any objects or structures that they may run into when fleeing the transport box. After release the individual should be provided with behavioural enrichment objects to promote a speedy recovery.

8 Health Requirements

8.1 Daily Health Checks

Daily health checks of capuchins include (usually observed when feeding or servicing exhibit):
* Activity; Capuchins are a generally active species, if not moving about they are generally busy with their hands any variation from this should be examined.
* difference from normal character; it is important to understand the normal behaviours and temperament of each individual monkey. Particularly in Capuchins this is an indicator of illness, no two monkeys have the same character and any variations from what is considered to be normal should be investigated.
* Interest in food; a problem may be apparent if a normally eager feeder is not interest in the food it is offered.
* Depression; the animals should be checked for signs of lethargy and depression
If the animal is close enough a visual exam of the body should be done. This can be easier done if the Capuchin is lured to climb the mesh (if present) within the indoor quarters
* The hands and feet should be checked for any sores or abnormalities
* The anus should be checked for any signs of diarrheau
*The eyes should be checked
* The nose should also be examined for any signs of discharge
When servicing the exhibit it is also signs of health problems
* If diarrhea is present
* If there are no faeces found in the exhibit or far les than usual, constipation should be considered.
* Large amounts of food remaining in the enclosure could be an indicator of a problem.
* Amount of water remaining, if a considerable amount less than normal the animal should be examined.

8.2 Detailed Physical Examination

8.2.1 Chemical Restraint

Short term sedation can be induced with ketamine (10mg/kg). To lightly anaesthetize this dosage intramuscularly can be used and inhalation anesthetics and endotracheal techniques are indicated for surgical procedures.

8.2.2 Physical Examination

Whilst anesthetized the Capuchin should be weighed and its temperature, pulse and respiratory rate should be recorded. While under anesthetic the Capuchins teeth should be checked as well as its range of limb movement.

Both behavioural and feacal cortisol measures are recommended as non invasive techniques to incorporate into protocols to monitor the psychological well being of brown capuchins in captivity(Boinski *et al*. 1999)

8.3 Routine Treatments

Oral doses can be readily given to the animals either in fruit juice or concealed in a small fruit, such as a grape. Intravenous injections should be given in either the femoral or saphenous veins, although the latter may be more difficult.
Routine worming and vaccination are not reported to be required. Faecal examinations should be run twice a year and worm as necessary.

Before coming into contact with the Capuchins, keepers should be vaccinated against tetanus, measles, rubella, polio, hepatitis, influenza.

8.4 Known Health Problems

Health problems are broadly similar to those experienced in most primate species; they are a fairly hardy animal and can have a good resistance to disease, provided they are housed in adequate conditions. Some of the diseases Capuchins may encounter are listed below.

Rabies Virus:
Cause: Rabies is caused by a virus belonging to the lyssavirus genus of the family Rhabdoviridae.It is transmitted by contamination of a wound with infected saliva, usually by the bite of a rabid animal, respiratory and oral transmission can occur but it is rare(Geering, Forman, Nunn 1995) Rabies is a significant zoonosis and nonhuman primate to human transmission has occurred.
Signs: self mutilation, irritability and paralysis of pharyngeal and pelvic muscles.
*Diagnosis:*fluorescent antibody test.
Treatment: none available or recommended
Prevention: Killed vaccines must be used at attenuated vaccines have been implicated in vaccine induced disease. Killed vaccines have been shown to produce high antibody titres; Prophylactic post-exposure vaccination has been used (Mansfeild, King 1998).

Herpesvirus Tamarinus
Cause: Virus is spread by direct contact, aerosols or fomites.
Signs: usually asymptomatic. Rarely oral vesicles and ulcers are seen.
Diagnosis: N/A
Treatment: N/A
Prevention: contact between carriers and susceptible species should be avoided.

Influenza type A:
Cause: Capuchins only susceptible to influenza type A. The virus is highly contagious and is transmitted by aerosols. Nonhuman primates are likely to become infected through contact with humans and wildlife species. Once infected, transmission readily occurs between in-contact nonhuman primates(Mansfeild, King 1998).

Signs: Signs are nonspecific and include fever, ocunasal discharge, conjunctivitis, coughing, depression, anorexia, lethargy and gastrointestinal signs. Occassionaly death may occur due to secondary bacterial infection. The incubation period is 1-3 days and illness may last for 3-6 days (Masnfeild and king 1998, Ott-Joslin 1986).
Diagnosis: Usually based on clinical signs. Demonstration of secroconversion by haemagglutination-inhibition test is evidence of recent infection (Mansfeild and King 1998).
Treatment: usually supportive and aimed at preventing secondary bacterial infection.
Prevention: keepers and other people with colds should not come into contact with Capuchins while ill. Primate displays should be separated from the public by glass or a wide moat. Vaccines have been used and are protective (Ott-Joslin 1986).

Respiratory syncytial virus (RSV)
Cause: Belongs to the genus *Pnuemovirus.* The virus is highly contagiuous and is transmitted by aerosols. Anti-RSV antibodies are widespread in human and nonhuman primate populations. Non human primates are most likely to become infected through human contact as infection is usually anthroponotic rather than zoonotic (Mansfield and King 1998).
Signs: The disease is usually mild with non-specific upper respiratory signs such as cough, sneezing, mucopurulent ocunasal discharge, listlessness and anorexia (Mansfeild and King 1998, Ott-Joslin 1993).
Diagnosis: Antigen can be detected in nasopharyngeal secretions using an immunoflourescent test.Virus isolation using cell culture and identification using immunofluorescent staining and characteristic cytopathic effect (Mansfeild and King 1998).
Treatment: no specific treatment only supportive.
Prevention: Vaccination is not recommended as neutralizing antibodies may predispose to more severe disease. Humans showing signs of respiratory infection should not be allowed access to capuchins.

Yellow fever
Cause: Yellow fever is caused by an arbovirus group B flavivirus (Ramsay and Montali 1993).Mosquitoes are the reservoir host for yellow fever.
Signs: Capuchins exhibit highly fatal epizootics of yellow fever. Symptoms include Fever, lethargy, haemorrhages, jaundice, and haematemesis(Ramsay and Montali 1993).
Diagnosis: diagnosis is based on clinical signs and pathology (leucopaenia, albuminuria, elevates AST, ALT and billirubin. Virus can be isolated from the blood and rarely the liver (Ramsay and Montali 1993, Ott-Joslin 1993).
Treatment: none available.
Prevention: Elimination of vectors and widespread vaccination of humans has significantly reduced the incidence of disease caused by yellow fever virus (Center for Disease Control and Prevention 1990). Vaccination is recommended for animals held in captivity in endemic areas (Jungles and rainforest of Africa and south and Central America) (Ramsay and Montali 1993). Because of the short incubation period and rapid clearance of the virus in animals with no carrier state, the risk of importing infected animals is low. Animals being imported from endemic areas should be quarantined for 9

days in mosquito proof enclosures. Animals immunized against yellow fever can safely be imported.

Shigella

Cause: Nonhuman primates frequently acquire Shigella in captivity from their association with humans. The incidence of infection increases greatly after capture, transport and quarantine as stress is usually necessary for the clinical development of the disease (Gibson 1998, King 1998). Carrier animals are important in maintaining the organism as it is susceptible to inactivation by sunlight, acidic pH and temperatures of over 55 degrees Celsius for more than an hour. Vectors include cockroaches, flies, rodents and gulls.

Signs: Affected animals have charectaristic foul smelling diarrhoea that is initially watery but rapidly progresses to dysentery with or without mucus and colonic mucosa, are weak, dehydrated, febrile, have signs of abdominal pain and rapidly lose condition and body weight. This may last 1-3 days and animals may spontaneously recover and completely eliminate the organism or become carriers. Severe cases develop dysentery with mucosal fragments and pus. There may be 10-1000 bowl movements per day, tenesmus and signs of abdominal cramping. This straining may lead to rectal prolapse. These cases may rapidly progress to death if therapy is not initiated immediately. There may be oedema of the neck and face. Anorexia and depression are common. Vomiting is rare (Gibson 1998, King 1998, Mclure 1978, Paul-Murphy 1993).

Diagnosis: rectal swab or faecal sample.

Treatment: Treatment should include should include appropriate use of antibiotics based on culture and susceptibility testing, aggressive fluid and electrolyte replacement and nutritional support. Food is generally not withheld particularly in young animals, however frequent small meals of bland food such as boiled rice, and drinks of oral rehydration should be offered. Early initiation of treatment greatly increases the chance of a successful outcome. Appropriate antibiotic can stop shedding in 48-72 hours, thus reducing the transmission to other individuals. Therapy should continue for a minimum of 5 days. Shigella rapidly develops antibiotic resistance Effective antibiotics include the fluoroquinolones, nalidixic acid and combination therapy with trimethoprim-sulfamethoxazole, erythromycin and tetracycline. Treatment of the whole troop in which the clinical case/s occurs and thorough cleaning of the premises may be useful (Gibson 1998, Paul-Murphy 1993).

Prevention: Shigelllosis is a disease of poor hygiene and unsanitary conditions. Pest control and prevention are essential to eliminate insect and rodent reservoirs. Before introducing a new animal into a troupe they should be screened to prevent the introduction of shigella. If carrier animals can be identified they should be isolated and treated or removed from the colony, however the stress of separation in some species may induce clinical disease (Paul-Murphy 1993, Banish, Sims, Bush, Sack, Montali 1993).

Campylobacter

Cause: Infection usually occurs through the fecal-oral route or ingestion of contaminated food or water. Initial infection with campylobacter causes a rapid antibody response, but

is not protective against reinfection. As a group they grow at 37 degrees Celsius, however strains associated with diarrheau are thermophilic and prefer 42 degrees Celsius(Gibson 1998, Paul-Murphy 1993).
Signs: mild to moderate signs of campylobacter infection include partial anorexia and soft, semi solid faeces. In more severe cases faeces may be watery to muco-sanguino. Signs may develop over 1-2 days. Signs may be chronic and intermittent. Affected animals may lose weight and fail to thrive. Haematology may be normal or show leukocytosis with left shift, and electrolyte abnormalities, include hypoatraemia, hypochloraemia, acidosis and high anoin gap (Gibson 1998, Paul-Murphy 1993).
Diagnosis: faecal *smears* may only reveal erythrocytes, only leucocytes, both or none. Diagnosis is based on recovery of the organism from faeces, rectal swabs, intestinal biopsies or lesions at necropsy. Serologic testing for IgG and IgM has been used. Titres rise 10 days post infection and remain elevated for up to 4 weeks. Fluorescent antibody or avidin-biotin antibody staining can be used to confirm infection when only tissue samples are available. Campylobacter is frequently found in combination with other enteric pathogens (Gibson 1998, Paul-Murphy 1993).
Treatment: Rehydration therapy is important with severe cases. Many infections are self limting. The efficacy of antibiotics to treat campylobacter is debatable. Aminoglycosides, clindamycin, chloramphenicol, furazolidone, erythromycin, ciprofloxacin and enrofloxacin have good in vitro activity against campylobacter. Erythromycin has been the antibiotic of choice however resistance has been reported. Shigella and campylobacter infections frequently occur together and antibiotic regimes that affect both organisms should be used while awaiting culture and susceptibility results (Paul-Murphy 1993)
Prevention: Strict sanitation and hygiene are important.

Tuberculosis
Cause: The vast majority of cases results from exposure to infected humans, but can also acquired from other primates. Transmission is usually by aerosols; however transmission has also occurred through ingestion, direct contact, and contact with fomites (e.g. Thermometers, tattooing needles). It is highly contagious. (Gibson 98)
Signs: Clinical signs are varied and non-specific. They depend on the location of the lesions and severity of disease. Tuberclulosis in nonhuman primates is usually recognized in one of the 3 presentations (1) pulmonary disease with or without alimentary lesions,(2) alimentary disease, with or without pulmonary lesions, and (3) atypical presentations including cutaneous abcesses, spondylitis and osteomyelitis. The course of the disease is typically chronic and progressive. Clinical signs are often only apparent late in the course of the disease although death without premonitory signs can occur. Animals that succumb to fulminant disease are often in good condition and visceral lesions are often military and may be disseminated (Ialeggio 97). Signs when present may include persistent cough, fatigue, anorexia, chronic weight loss, weakness, lethargy, exertional dyspnoea, signs of abdominal pain, intractable diarrhoea, kyphosis and cutaneous abcesses(Gibson 98, Martin 86)
*Diagnosis:*ID skin test, radiograph
Treatment: Antibiotic susceptibility patterns for all pathogenic mycobacterium need to be determined if treatment is to be attempted. This is important because of the high incidence of multiple drug resistant *Mycobacterium tuberculosis* in the human population

(calle 99). Treatment should only be undertaken if the infected animal/s can be isolated during therapy and if therapy can be provided for up to a year. Animals will need to be retested once treatment has ceased to determine if there has been recrudescence of disease. Once treated, animals should never be considered free of tuberculosis, even if subsequent testing is negative. Reactions to intradermal skin testing may be reduced or negative after treatment and the animal may start shedding organisms after therapy is discontinued (Martin 86). Single drug treatment is ineffective and a multidrug regime should be used. Use of multidrug regimes decreases the possibility of drug resistance developing and allows for the grouping of agents that attack the mycobacterium at different stages of its life cycle. Effective drug combinations include isoniazid and streptomycin, isoniazid and p-aminosalicyclic acid, and isoniazid, ethambutol andrifampin. Isoniazid alone may only result in suppression of the disease not eradication (Martin 86). In all cases that therapy has been successful the organism has been isolated and antibiotic susceptibility determined (Gibson 98, Southers and Ford 95).
Prevention: Any facility holding Capuchins must maintain a tuberculosis surveillance program in both their animals and personnel. Prevention involves strict quarantine with appropriate testing so as to prevent the introduction of infected animals in to a collection. All staff that comes in to close contact must be tested at appropriate intervals and any persons showing signs of respiratory disease must not be allowed access to off exhibit facilities. All Capuchins should undergo regular testing either annually or opportunistically whenever anaesthetized for other reasons (martin 86).

8. 4. 2 parasites

Trypanosoma cruzi is the causative agent of Chagas Disease. There is a wide range of reservoir hosts including wood rats, raccoons, opossums and numerous new world primate species.
Host location: blood
Signs: oedema, anaemia, lymphadentitis, depression, anorexia, weight loss, dehydration and abortion.
Diagnosis: blood smear, organ smear, organ section, serological tests.
Treatment: none
Prevention: eliminate the vectors

Trichomonas sp. Is of the family Trichomonadidae. Transmission occurs by the faecal-oral route, or ingestion of contaminated food or water.
Host location: intestine
Signs: diarrhea
Diagnosis: fecal swabs, saline wet mount-fresh faeces
Treatment: Metronidazole 17.5-25 mg/kg, bid for 10 days
*Prevention:*strict sanitation and hygiene are important

Toxoplasma gondii causes toxoplasmosis and is of the family sarcocystidae. Transmission is through ingestion of tissue cysts in meat, or ingestion of ocysts in cat faeces.
Host location: Brain, lungs, liver, heart, kidney, lymph node, blood, intestine
Signs: Lethargy, depression, somnolence, anorexia, emesis, diarrhea, fever, cough, weakness, ocular and nasal discharge, pale mucous membranes, leucopenia, dyspnoea, tachypnoea, premature births, abortion, neurological signs, choriorentinitis and death. Death may occur without premonitory signs. In acute toxoplasmosis death may occur 3-21 days post infection. Neurological signs include circling, grasping and holding of the head, leaning against or hitting head, incoordination, paresis and terminal convulsions. The clinical picture may resemble acute toxicity (Toft and Eberhard 1998, Montali and bush 1999, Cunningham, Thomson and Buxton 1992).
Diagnosis: serology, histological section
Treatment: Sulfadiazine 100mg/kg/day, pyrimethamine (load with 2 mg/kg/day for 3 days) then 1 mg/kg/day supplement with folinic acid. Clindamycin 12.5-25 mg/kg/bid
Prevention: All meats used for food should be frozen to – 20 degrees Celsius for 2 days and/or cooked to 60 degrees Celsius for 30 minutes. Cat control around primate facilities and preventing contact between primates and cats particularly their faeces is important.(Toft and Eberhard 1998, Montali and Bush 1999)

Plasmodium brasilianum causes Malaria and is of the family Plasmodiidae. The mosquito serves as a vector.
Host location: Erythrocytes
Signs: Anaemia, fever depression. There is a 72 hour fever cycle and infection is generally not fatal.
Diagnosis: blood smear
Treatment: chlorooquine phosphate 10mg/kg orally or intramuscularly, followed by mg/kg 6 hours later, then 5 mg/kg/day for 2 days and primaquine, 0.3 mg/kg/day, for 14 days. Treatment is not usually necessary as in captive animals infection is usually self limiting in the absence of reinfection
Prevention: mosquito control is essential to prevent transmission.

Strongyloides cebus is a rhabditoid that causes strongyloidiasis. In the right conditions the larvae can develop within the faeces within 48 hours and does not hatch until shed in the feaces. Infection occurs by ingestion of larvae or percutaneous migration. Transmission from mother to offspring via milk also occurs. After ingestion the larvae migrates through the blood to the lungs and are coughed up and swallowed.
Host location: duodenum, jejunum
Signs: dermatitis, urticaria, anorexia, depression, listlessness, debilitation, vomiting, emaciation, reduced growth rate, dehydration, constipation, dyspneoa, cough, prostration and death. IN chronic cases, diarrhea may not be a feature, and progressive weight loss and weakness may be the only indication of infection. Death is usually a result of pneumonia and peritonitis.
Diagnosis: fecal flotation, baermans
Treatment: mebendazole 15mg/kg/day for 3 days; thiabendazole 50mg/kg/day for 2 days.

Prevention: strict sanitation and hygiene are important. Because of the short life cycles faeces should be removed daily and water kept free of contamination. Care must be taken to prevent the establishment of a free living breeding cycle in animal enclosures. As moisture is essential to the survival of the parasite in the environment, keeping enclosures dry is important. If eradication is not possible control programs using a monthly administration of anthelmintics reduce morbidity and mortality.

Molineus torulosus is a trichostrongylid and its transmission and life cycle are unknown.
Host location: These are small, slender pale red worms that inhabit the small intestine.
Signs: ulcerative hemorrhagic enteritis
Diagnosis: fecal flotation
Treatment: ivermectin 200 mcg/kg
Prevention: Sanitation and good hygiene

Dipetalonema sp. And Mansonella sp. Cause filariasis and are in the superfamily Filariodea. They require an intermediate blood sucking insect for transmission of infective larvae. It is not uncommon for an individual to be infected by multiple species of these parasites.
Host location: subcutaneous tissues, peritoneal and pleural cavities
Signs: infections are usually in apparent, may show plueritis or peritonitis
Diagnosis: microfilaria in blood smear, larvae in blood smear, adults in subcutaneous tissue
Treatment: diethylcarbamazine, 6-20 mg/kg daily for 6-15 days.
Prevention:

Asthesmia foxi is a common fluke in Capuchins. The eggs are ovid and golden brown with a thick shell and operculum. The life cycle is indirect with a mollusk as the host.
Host location: bile duct
Signs: biliary disease, hepatitis
Diagnosis: fecal sedimentation, adults in bile duct on necropsy
Treatment: praziquantel
Prevention: elimination of access to suitable intermediate hosts

Anoplocephalidae includes bertiela sp. Matheovataenia sp. And atriotaenia megastoma. The life cycle of these parasites is indirect with cockroaches or beetles acting as intermediate hosts.
Host location: small intestine
Signs: Infections are usually asymptomatic, however with sever infections diarrhea, anorexia, debilitation, abdominal distension, dehydration and death may occur. Often these signs are not the direct result of infection with the parasites, but rather secondary pathogens.
Diagnosis: fecal flotation
Treatment: praziquantel, 15-20mg/kg, one dose; for bertiella sp. Use niclosamide 500 mg/3kg
Prevention: strict sanitation and elimination of immediate host.

External Parasites of cebidae. No specific research has been carried out on the ectoparasites of the genus *cebus*.

parasite	**Host location**	**Clinical disease**	**diagnosis**	**treatment**	**comments**
Arthropods	-	-	-	-	-
Cuterebra sp.	Skin, subcutaneous tissue	Dermal cyst,chronic inflammation at site	Removal and identification of grub	Removal of grub	Infections commonly found around neck
Dermatobia hominus	Skin, subcutaneous tissue	Dermal cyst	Identification of grub	Removal of grub	Lesions can be persistent, care after larvae removal is important
Anoplura(blood sucking lice)	-	-	-	-	-
Pediculus sp.	Hair	None to pruritis,hair loss	Hair examination	Pyrethin based powders used for domestic pets or poultry	-
pedicunus	hair	None to pruritis, hair loss	Hair examination	Same as above	-
Gliricola pintoi	hair	None to pruritis,hair loss	Hair examination	Same as above	-
Mallophaga(Biting lice)	-	-	-	-	-
Trichodectes sp.	Hair	None reported	Hair examination	Same as above	-
Tetragynopus aotophilus	Hair	None reported	Hair examination	Same as above	-
Aotiella aotophilus	Skin	None reported	Hair examination	Same as above	-
Cebicola sp.	Skin	None reported	Hair examination	Same as above	-
Ticks	-	-	-	-	-
Ixodes loricatus	Skin	None reported	Visualization of tick	removal	Extremely rare
Mites	-	-	-	-	-
Mesostigmates *Pnuemonyssoides stammeri*	Large bronchioles, larynx, nasal cavities,	None reported	Bronchiol washes, necropsy examination	Ronnel 55 mg/kg, orally E.O.D for 4 treatments	-

	sinuses			then weekly for 3 months	
Prostigmates *Demodex sp.*	Skin, hair follicles	dermatitis	Deep skin scrape	Ronnel, applied topically; other dips recommended for mites in pet and poultry	-
Astigmates	-	-	-	-	-
Prosarcoptes pitheci, listrocarpus sp., Dunnalges lanbrechti	skin	None reported	Skin scrape	Ronnel, applied topically; other dips recommended for mites in pet and poultry	-
Audycoptes sp., rhynocoptes sp.	Hair follicles	None reported	Skin scrape	Same as above	-
Mortelmansia	Nasal cavities	None reported	Nasal examination	None reported	-

It is thought that Capuchins control levels of ectoparasite infestation through frequent social and self grooming, and through the Capuchin practice of rubbing their bodies with plants known to contain insecticidal properties (Baker 1996, Valderrama *et al*. 2000)

Vitamin C deficiency

This is a common problem in primates that are not properly supplemented.. Vitamin C deficiency typically presents as scurvy, with clinical signs including swelling of the epiphyses or long bones, hemorrhaging of the gums and periosteum and hydrocephalus. Maintenance levels of vitamin C are 1-4mg/kg of body weight daily and treatment doses are up to 25mg/kg twice daily for 5 days in severe cases.

Vitamin D3 deficiency

Monkeys deficient in vitamin D3 develop soft bone (metabolic bone disease), long bone deformities, multiple fractures and increased levels of serum alkaline phosphatase. Treatment consists of 2000 IU/kg vitamin D3 added to the diet. This treatment halts the progression of the process but the major bone deformities are irreversible. UVB or natural sunlight may be helpful in treatment and should be considered for prevention of the problem. This deficiency can sometimes be reversed by ¼ teaspoon of cod liver oil. Regular hours of sunlight are an adequate source of vitamin D3.

8.5 Quarantine Requirements

Quarantine procedures are broadly similar to those for other primates. Duration ranges from 40-90 days, during which time repeated tuberculin skin tests, serology and stool analysis are performed. Prophylactic treatment varies across institutions.

Any Capuchin that is acquired by the institution should be quarantined before being released into the resident collection. Critical information that should be recorded while Capuchins are in quarantine include the source of the animals, number of animals, dates of shipment and receipt in quarantine, tuberculin tests and results, health problems, food and water consumption and occurrence of any undesirable behaviours. For set up of quarantine area see 4.2 holding area design.

9 behaviour

9.1 activity

Capuchins are a diurnal species. The main components of an activity budget are travel, feed/forage, and rest and socialize. Capuchins are an active species, if not locomoting they are generally busy manipulating objects.

Time period	Activity
dawn	Capuchins rise and begin feeding on the nearby fruiting trees.
morning	Entire group forages through the forest feeding on fruits.
Mid-morning	Pace of foraging slows down and capuchins begin to forage for insects.
noon	During the hottest part of the day is a period of rest. Juveniles will engage in play whilst adults will conduct a grooming session. During the dry season capuchins will visit the nearby waterhole to drink.
afternoon	Foraging for fruits begins again when heat subsides, this will continue into the late afternoon.
dusk	Capuchins will look for a good sleeping tree near their most recent fruiting tree; here they will rest until the following morning.

9.2 Social Behaviour

The optimal social grouping for captive Capuchins is undoubtedly one that would be encountered under natural conditions in terms of age and sex classes (see below for age/sex composition). This is often impossible in a captive situation but effort should be made to emulate natural group composition as closely as possible. Capuchin monkeys should be kept socially, as social companions are excellent sources of interactive and ever-changing stimulation (Visalberghi and Anderson 1993).

9.2.1 Social Structure and Relationships

The following table represents age/sex composition of *Cebus apella* at various field sites.

	Mean no. groups counted	Mean group size	Proportion adult males	Proportion adult females	Proportion juvenile	Proportion infants	Adult M:F ratio	Immature: adult female ratio	Infant: adult female ratio
Iguaza National Park 1993(Di Bitetti and	6	14.4	19%	34%	28%	19%	0.56	1.38	0.56

Janson 2001)									
La Macarena 1986-98 (Izawa 1988, 1990a, 1992, 1994, 1997, 1999)	1	18	28%	28%	33%	11%	1.00	1.60	0.40
Cocha Cashu 1976-77(Terborgh 1983)	1	12.8	44%	36%	11%	9%	1:20	0.57	0.26
Caratinga 1995-97(Lynch and Rimoli 2000)	1	27	22%	33%	33%	12%	0.68	1.38	0.38

Cebus apella is a social species usually consisting of 8-15 animals within a group. The group is comprised of an alpha male and alpha female, subordinate males and females, juveniles and infants. It is relatively easy to recognize the alpha male or female but it is difficult to know the ranking of other adults as capuchins do not from linear dominance hierarchies. The alpha male is the dominant animal in the group and he has sexual preference of females and sometimes supplants other resident males form space and food. *Cebus apella* is considered to live in a uni-male system (Escobar-parmo 2000).In comparison with nature and captivity the social behaviour of *Cebus apella* can be quite different, in captivity *Cebus apella* portray a more tolerant and relaxed picture of alpha male and similarly subordinate male behaviour than they do from many field studies. Janson (1986a, b) reported that the males at his study site in Manu, Peru had rather despotic alpha males who monopolize mating and feeding and exhibit high rates of aggression towards subordinate males that remain at the periphery of the group. This type of behaviour is more common in *C.apella* than in other species of capuchins. Alpha males that are highly agonistic do not receive high amounts of support from other males when the group is under threat (Janson (1986a, b) such as rivalry from a nearby group or defense against predators. Male alliances has been found at a higher rate within groups with a tolerant alpha male, the threat of invasion from non-resident males forces the alpha male to tolerate the feeding and breeding of subordinate males. Janson (1998b) found that in socially unstable groups, groups without a despotic male, females mated promiscuously with every adult male in the group and estrous females were less active in their pursuit of the alpha male. Janson attributes these variable degrees of alpha male

monopolization of mating to differences in the ability of alpha males to provide food sources for the females and their young. Although not common, infanticide can occur after former resident males have been evicted from their group thus making it crucial for the alpha male to find a balance between dominating food and estrous females and also his need for allies in times of trouble. *Cebus apella* are a neotropical primate that exhibits female philopatry and male dispersal classifying them as a female bonded species according to Wrangham (1980). Males leave their natal group around sexual maturity; they may emigrate alone or with another sub adult or adult male. These migrant males often form friendships and sometimes even choose preference of one another's company over that of the females in their group (Jack 2001). Adult Males dispersing to another group are commonly met with fierce resistance yet entry for migrating adolescent males is not so strictly guarded. The closest affiliation in capuchin society is the female-female relationship followed by the female-male and then the male-male. Males are dominant over the females and are generally less affiliative with each other; Females form long-term affiliative bonds that knit them more closely together than do the bonds among male capuchins or between the sexes. Rose (1998) noted that male and female capuchins have remarkably asymmetrical relation ships – females frequently groom males with little or no reciprocations, and females direct most of their avoidance and submissive behaviours towards males. On the other hand, adult male capuchins only rarely direct physical aggression toward females and are quite tolerant of females resting and feeding in close proximity. The alpha female may rank immediately below the alpha male and above the other adult males of the group or she may rank below all the adult males (Robinson 1988a, Fedigan 1993, Rose 1998), while a female coalition can counteract male dominance. The social relationship between male and female capuchins may interpret conflict it also attributes many benefits to both sexes. The main conflict is instances of agonism and supplantation by males although the majority of affiliative behaviour is directed from females toward males. Males are more viligant than females, (de Ruiter 1986, van Schiak and van Noordwjik 1989, Fragaszy 1990a, Rose and Fedigan 1995) and also more active in mobbing and other forms of defense against predators and incursions by other groups and non group males (Robinson 1998b, O'Brien 1991, Perry 1996b).This defense is a significant compensation for the foraging costs males impose on them. Janson (1984) also found that adult males would acquire food inaccessible to immatures, (Scheelia nuts) due to their lack of strength, and provide the immature with the nourishment rather than monopolize the food source. Capuchins exhibit a remarkably high level of alloparenting and allonursing. For the first 3 months maternal care is dominant (Fragaszy *et al. 1991)* and "infant handling" is common, in which visual inspections, nuzzling, sniffing and low volume guttural vocalizations occur(Manson *et al.* 1999), such infant handling occurs between female dyads that frequently groom and form coalitions with one another. After 3 months of age alloparenting is relatively common and at this age the infant is often found near the alpha male, both during resting and foraging periods (Calle 1990b, Escobar-Parmo 1989). This cooperative behaviour may reflect the capuchins lifestyle; its foraging methods often separate infants from their mothers and the closest adult is always willing to briefly adopt the infant even if the adult is marginally bigger than the juvenile, female relatives, especially older siblings who are nulliparous, are the most common alloparents (Escobar-Parmo 1989, O'Brien and Robinson 1991). Allonursing is another extraordinary feature of *Cebus* social behaviour,

Infants have been known to survive after the death of its mother by suckling from other lactating females in the group (Rose 1998). The willingness of a lactating female to allow another infant to suckle from her is sometimes relates to rank or close kinship of the infants mother (O'Brien 1998, O'Brien and Robinson 1991, Perry 1995; Weaver 1999) and infants often stage tantrums when denied access to any females nipples (Weaver 1999).O'Brien and Robinson (1993) reported that rank relations among juveniles predicts their adult dominance ranks. Juveniles are mainly ignored and/or tolerated by adult males but may be supported in their agonistic interactions by adult females. O'Brien (1993b) described juveniles as seeking to develop social relations with adults by grooming them more than they are groomed in return, and by providing coalitionary aid during agonistic encounters and by providing allomothering services. MacKinnon (2002) found that juveniles show great interest in adult males, particularly their mother's partner or the alpha male, often observing their vigilance and extractive behaviour. They also initiate play with adult males, who sometimes respond positively and they seek to groom adult males. It is worth noting that while alloparenting is common in the wild it has a lesser occurrence in captivity.

9.2.2 Social Interactions

In captivity, Capuchins manage competition and conflict with minimal fuss. The relaxed nature of their social relations is evident in spacing during feeding. One animal will commonly approach another to sit next to it while feeding. Rogers (1996) found that in captive *Cebus apella,* the type and abundance of food influences social dynamics. In particular, contest competition occurs in the presence of scarce highly preferred foods but is also present when highly preferred foods are abundant because capuchins try to get access to the most food items. Scramble competition is likely when low preference foods are scarce whereas abundant low preference foods result in no detectable competition. Even in small spaces with high monkey density relative to natural settings, highly desired resources promote attempted monopolization and theft but not overt agonism. Fragaszy *et al. (1994b)* found that physical aggression is more likely to be directed down the dominance hierarchy but dominant individuals do not exhibit higher overall rates of agonism than do subordinates. Conflict also tends to occur more often between adult males and juveniles, but is infrequent among young animals and peers at all ages (Weaver 1999). Fragaszy *et al. (1994*b) and Cooper *et al.* (2001) found low rates of agonism towards newly introduced animals in captive *Cebus apella* even when new males were introduced into all female groups. When altercations do occur there are 3 levels of severity; supplantation, threats and submission and physical contact. Females tend to employ threats and counter threats more while males have lower rates of agonistic behaviour but resort to chases and physical contact more often, on occasions males can inflict lethal violence on other capuchins. Altercations are particularly vocal and participants will attempt to arouse coalitionary support from other members of the group. Weaver's observations on a group of captive *Cebus apella* show that they sometimes reconcile after quarrels and infants are more likely to do so, in the same captive group Verbeek and de Waal (1997) found that former opponents exchanged affiliative signals in 19.2% of first contacts following conflicts. Proximity gives an indication of affiliations within the group, whether the animals are sitting, sleeping or foraging near each other gives some relation to their friendship or kinship. Animals that are frequent grooming

partners will often be found in close proximity(Rose 1998) and female dyads are more likely to spend time in proximity, followed by female-male dyads and male-male dyads the least common (Perry 1995). Proximity between the alpha male and adult females is the primary indicator that the beta male is about to challenge the alpha male for dominance of the troop (Byrne *et al.* 1996, Perry 1998a). Grooming is a part of *Cebus* life and serves a variety of social functions as well as the removal of ectoparasites and the release of pleasurable beta endorphins. The pattern of grooming among capuchins tends to be directed down the dominance hierarchy (O'Brien 1993a) in particular alpha females tend to groom more than they receive (Di Bitetti 1997, Linn *et al.* 1995, Parr *et al.* 1997), although adjacently ranked individuals are more likely to groom one another (Parr *et al.* 1997).Grooming can be used to form coalitions and affiliations with other capuchins, those who groom one another generally get along better, are often found in close proximity and in females are more likely to partake in allomothering. Females are more likely to groom than males, and they often groom other adult females especially ones with infants. The second most common form of grooming is from females to males, and The alpha male is the favourite recipient of grooming. Males, on the other hand, groom less than females and are far less likely to groom other males. Playful interactions are also common in *Cebus apella* and immatures often engage in social play during adult rest periods from foraging, Freese and Oppenheimer (1981) found that play is more common when resources are abundant. Often juveniles and sometimes adult males will join in and adult males seem more playful in captivity (Visalberghi and Guidi 1998). Another notable aspect of capuchin social interactions is the performance of hand sniffing and finger sucking. This activity involves one capuchin placing its hand in another's mouth, or over its nose and mouth or even up its nostrils and inhales deeply with a trance like expression on its face (Perry *et al 2003a, b.).* This apparently soothing action is only performed by companions considered to be very close as horrific wounds can possibly inflicted by the canine teeth.

9.2.3 Communication

Capuchins use visual, vocal, tactile and olfactory signals to communicate. Capuchins have a rich repertoire of facial expressions and the visual ability to accurately interpret the meaning of these signals (Weigel 1978). The table below lists some of the common facial expressions in *Cebus apella*. Wild capuchins require a rich repertoire of vocal communication signals because of their foraging habits; they will often be out of sight of each other but will remain in contact through calls and sounds. They constantly inform each other of their internal status (fearful, contented, and aggressive) and their environment (food locations, directional movement and predator sightings).When capuchins spot a predator they may either fall completely silent or mob the creature with their threats and the breaking of branches. Capuchins use auditory signals to seek contact, avoid contact, claim ownership of food, and provide information about food (amounts and preference) and direction of movement, which is done mainly by adult females. Capuchins can also recognize individual's voices, they only respond to lost calls from one of their group and agonism involving a relative will receive intention from a capuchin close enough to hear. DiBitetti (2001b) concluded that food-associated calls in *Cebus apella,* which he terms as grgrs"and"whistles, provide information about food. Spatial differences in *Cebus capuchinus* and *Cebus olivaceous* and maintained using the

"huh" call(Robinson 1982a, 1984b, Boinski and Campbell 1996).The "trill" call in *Cebus capuchinus* was identified by Boinski(1993,1996) and Campbell(1995) as a travel coordination call while Gros-louis(2002) documented that it was used as a friendly gesture to increase the likelihood of an affiliative response.

The following table shows some of the facial expressions in *Cebus apella*. The descriptions are based on more than 200 hours of observation of captive *Cebus apella*(Valenzano and Visalberghi 2002 and unpublished data). Previous descriptions by oppenheimer (1973), Weigel (1978) and weaver (1999) are taken into account. Illustrations by Bertrand Deputte.

Facial expression	Also called	Description or illustration	Accompanying vocalizations
Silent bared teeth display (Submissive facial expression)	Grin, smile		During courtship the female performs an acute squeal ("warble"). Both sexes warble when the male mounts the female
Open mouth silent bared teeth display	Open mouth smile		A pulsed call given in bouts while head cocking
Open mouth threat face	Threat face		Bark-like staccato call, sometimes a pulsed breath
Relaxed open mouth display	Play face		Low staccato vowel sound

Scalp lift			
Lip smacking		Rhythmic lowering and raising of the lower jaw, producing an audible smacking sound. The tongue is sometimes protruded.	Smacking sound
Head cock	Head tilting	The head is rhythmically tilted from one shoulder to the other while gazing at recipient.	
Protruded lip face	Duck face	Lower jaw protrudes anteriorly; lips are tensed together and protruded.	

Cebus albifrons

9.3 Reproductive behaviour

9. 3. 1 Proceptivity, Receptivity and Social Factors

Sexual behaviour is signaled primarily by proceptive behaviours in females rather than attractivity (changes in colours/markings and odors etc.). These behaviours from the female are the first indication of following sexual behaviours. All females within the troop are proceptive though the subordinate female's proceptivity may go unnoticed due

to her status at the periphery of the group. Though psychological stress may constrain proceptivity, fertility is relatively uniform among females in a group and stress does not suppress ovarian cycles. (fragaszy and Adams-Curtis 98). Proceptivity has been has been variously estimated to last from 1-4 days(Carosi *et al.* 1999), 3-5 days(Visalberghi and Dal Secco, unpublished Data), 5-6 days (Janson 1984), to 1-7 days with strong seasonal variation and longer proceptivity in adults than in subadults (Lynch 2001). During this period the female exhibits a variety of behaviours including facial expressions, vocalizations, gestures and body posture. There is variability in these behaviours between groups and individuals. Remarkably during this period of sexuality the male shows reluctance towards her advances and even avoids her by leaving as soon as she approaches. *Cebus apella* females take the sexual initiative and direct most of their solicitations towards a target male. Both in the wild and in captivity, females direct their courtship to the dominant male in the vast majority of cases. When females court some other males, solicitations and mating may occur in full view of the dominant male without his intervention (Phillips *et al* 1994*)*; Visalberghi and Welker 1986). When a male other than the dominant is the target, he acts much the dominant initially showing little interest and avoidance toward the soliciting female (Janson 1984, Visalberghi and Welker 1986). Our impression is that when chosen by a female, a male can afford to be reluctant since she will keep soliciting him until he reciprocates and mates. It is possible by doing so the male is selecting the best time for fertilization. Males who are not chosen by the female are not reluctant, and instead exploit any opportunity to mate without having to go through the usual long courtship. Males therefore adopt different mating strategies according to whether or not the female chooses them as partners. The qualities of males that affect their attractiveness to female include age, relatedness to the female, rank, ability to form alliances, display frequency, services and resources provided to females, and resources controlled by males (Robinson 1982b). The ability of the male to control access to food has received particular attention. Subordinate males copulate during the last days of proceptivity, and occasionally on the first days of proceptivity (Janson 1984), days when the female is less likely to conceive. Although each estrous female copulates with the dominant male not all subordinate males mate with each female, females are receptive only to the males that they solicit. Sexual interactions between females and subordinate males are inhibited by the presence of the dominant male more than they are actively stopped by his intervention. Relatedness to others within the group has an impact on proceptivity and receptivity. Capuchins that are related are not attracted to each other and familiar animals are less attractive, this along with emigration from natal groups and a short tenure for residency all reduce the chance of inbreeding.

9. 3. 2 Courtship and Mating

Courtship begins with the active solicitation of an estrous female towards a target male. The female will begin with visually monitoring the male, vocalizing insistently (Di Bitetti 2001a) seeking his proximity and displaying persistent eye brow raising in his direction, positioning herself as to intercept the males gaze. Other behaviours of a proceptive female are chest rubbing and head tilting. The female will also approach the male close enough to touch him then run away, as if fearful of his reactions. The male usually avoids her at first and may even threaten her. The first indication that the females attempts to

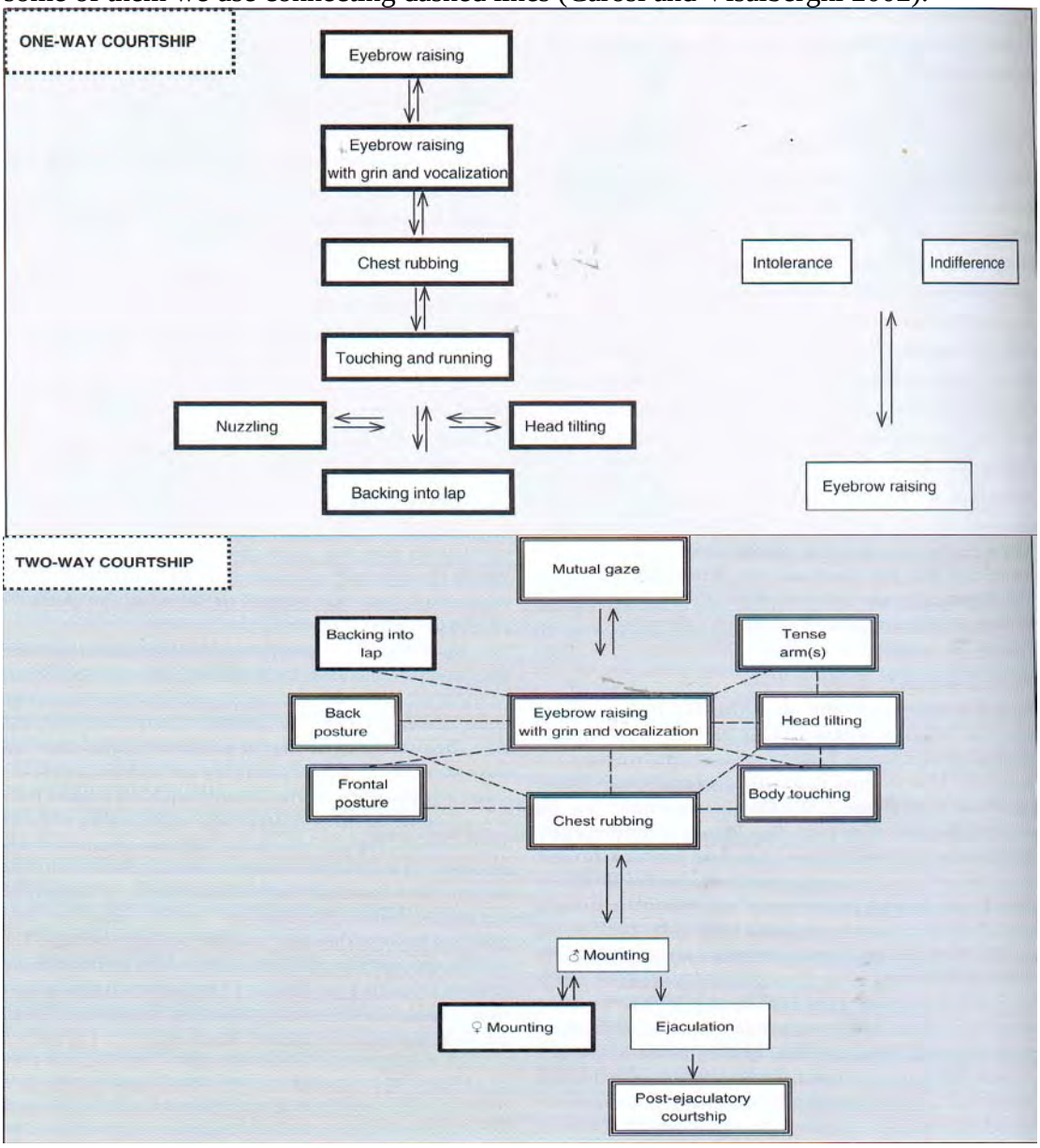
court the male are working is the occurrence of a mutual gaze between the two capuchins. The female no longer touches and runs from the male but both sexes begin to achieve and break proximity with one another. The female and male take turns in following and moving away from each other. For example the Male will achieve proximity by moving close to the female, she will move away and he will follow, when the male stops following and turns to walk away the female will begin following him. It appears that moving away is done to prompt the partner to follow rather than try to escape form the partner. At this stage of courtship the male is now interested in the female and other behaviours observed include mutual gaze, eye brow raising with grin and vocalization, chest rubbing , head tilting, tense arms, frontal posture and touching the others body. These behaviours often continue whilst mating, and mounting is often preceded by the frontal posture, the back posture and backing into lap behaviours. Once these postures have been observed the male and female are trying to position themselves for intromission. The male achieves one or more mounting bouts that are accompanied by distinctive vocalizations from both partners. While the male mounts the female they will both display grins, eyebrow raising and vocalizations, ; often the female will turn back and look at the male, females sometimes mount the male and perform pelvic thrusts. The duration of a mounting bout can last between a few seconds and up to 4 minutes, it also varies across individuals and is greater for dominant males than subordinate males, other factors include:

When the females is in periovulatory phase	93 seconds average
Non-periovulatory phase	55 seconds average
Sexually immature individuals	Less than 20 seconds (Carosi and Visalberghi 2002)

If ejaculation does not occur there is usually a period in which the partners are less sexually attracted to each other, and then the typical patterns of mutual courtship may resume. Ejaculation may occur after a single mounting bout and after a sequence of mounting bouts, though the latter is more common (Carosi and Visalberghi 2002). After ejaculation the partners may continue to carry out the same behaviours observed before mating occurred, the sexual solicitations performed by the male can be more intense than before ejaculation. This post-ejaculatory courtship can last up to 40 minutes but on average last for 40 minutes (Dal Secco 2000). After post-ejaculatory sexual interactions the interest of both partners fades. The male does not mount the females for several hours or days (Dixson 1998a). After the last mounting bouts, of an episode in which ejaculation has not occurred, sexual solicitations between partners on average last for just a few minutes. After copulation has occurred the female will remove solidified sperm from her vagina, the male's long solicitation after ejaculation can promote the chance of fertilization (Dal Secco and Visalberghi 2001).

The following figures represent the typical courtship and mating sequence in Cebus apella. Female behaviours are framed by a thick line, male behaviours by a thin line and behaviours performed by both sexes by a multiple line. The order in which the behaviours are listed top to bottom indicates the order in which the behaviours are most commonly observed. Connecting arrows in both directions between behaviours indicates the order in which the behaviours are most commonly observed. Connecting arrows in

both directions between behaviours indicate that the temporal sequence is variable. One way courtship precedes two way courtship. The courtship behaviours reported in the box below lack a discenrable temporal sequence. To indicate the simultaneous occurrence of some of them we use connecting dashed lines (Carosi and Visalberghi 2002).



Mutual gaze precedes and perhaps triggers, the other courtship behaviours listed above. Mounting, ejaculation and post ejaculatory courtship are usually preceded by the courtship behaviours listed above. Female eye brow raising usually occurs throughout the whole courtship sequence and mutual gaze through out the two way courtship (Carosi and Visalberghi 2002).

The list below contains information on the behaviours observed in sexual interactions in captive *Cebus apella.*

Eyebrow raising

Eye brows are raised up and backwards, the actor will often display this expression while watching the recipient. It is also common between all ages and sex classes in social affiliative interactions. Observed after aggression either between former opponents or directed by third party toward the loser of the aggressive interaction. Eyebrow arise is held for longer in a sexual context.

Eyebrow raising with grin and vocalization

Preformed by both sexes and the grin is performed with a closed jaw and some teeth baring. Vocalization is a continuous soft whistle that turns into a hoarse whine. It is usually performed while the actor is watching the recipient and sometimes is soft and inaudible. It is a similar facial expression to the silent bared teeth display except that the gums may be exposed in the grin along with eyebrow raising and vocalization.

Mutual gaze

This is mainained eye contact for 2-3 seconds with eye brow raising. It may last for several minutes and movement may occur, it is usually accompanied by eyebrow raising with grin and vocalizations, head tilting and chest rubbing, Also seen in affiliative solicitations between adults and infants. Capuchins may also exhibit aggressive stares but this behaviour is accompanied by agonistc actions.

Head tilting (Head cocking)

The head is tilted approximately 45 degrees to one side and may gently change side very few seconds. Most commonly occurs in males during post-copulatory display and also used in similar affiliative interaction as eyebrow raising although prominent use is in the sexual context.

Chest rubbing

Performed with either an open or closed hand rubbing upward and downwards slowly on ones own chest. Frequent in affiliative contexts in all age classes and is observed after an aggression either between former opponents, or directed by a third party towards the loser of an agonistic interaction. Janson (1984) related this behaviour to a scent producing gland. Alpha males mat occasionally rub their chest on trees and substrates.

Touching and running

This action is performed by the proceptive female, she will approach the male quickly touch him and run away, she may also attempt to nuzzle, pull the males tail or lightly bite. A similar behavior would also be a female jumping over or running past a male to gain his attention. This behaviour also occurs as an invitation to play, performed in this context by both sexes.

Nuzzling

The Actor quickly and gently contacts the body of the recipient with its face. This behaviour is performed almost exclusively by the female and almost always toward the male.

Tense arm(s) or extended arms

with the two capuchins sitting, facing toward each other with raised eyebrows the actor slowly moves a bent arm towards the recipient with out touching. This behaviour is a signal of readiness for contact. It has also been observed after an aggression directed by a third party toward the loser of an aggressive interaction.

Body touching

Close hand to body contact for at least a few seconds. It is also used an invitation to play and in affiliative contexts involving infants.

Frontal posture
The actor is usually seated facing the recipient and keeps one hand on its chest while the other is outstretched toward the recipient. The outstretched arm may also be raised to various extents. This posture is common in males after copulation, in association with head tilting and tense arm behaviours. Other situation this behaviour is observed is a friendly invitation to interact(Weaver 1999),similar social situations to eyebrow raising, head tilting, chest rubbing and tense arms as well as a mothers invitation for an infant to suckle.
Back posture
The Actor is crouched with its back towards the recipient. The actor looks back at the recipient while keeping one hand on its chest and the other on the ground for support. Performed by both sexes.
Backing into lap
Actor backs into the recipients lap. Mounting may or may no occur. Performed by both sexes however, the Actor is usually the female.
Genital display
The male's penis is erect and highly visible. There are 4 types of this behaviour: genital display with chest rubbing, genital display in frontal posture, genetal display standing bipedal and genital display whilst laying on his back.This behaviour is typically performed by a male who is not a female target of courtship. It is often seen after copulation in adult males and in playful interactions in juveniles.
Mounting attempt
The recipient moves away from the actor. Usually performed by the male.
Mounting
The actor mounts the recipient allowing for intromission, performed by both sexes. Thrusting usually occurs and mounting bouts can be isolated or a mounting sequence. Mounting may be dorso-ventral, ventro-ventral or latero-ventral. The female will also mount the male and often in multiple mount matings they will take turns in mounting one another. Male-male mounts occur during reunion displays following separations or situations of excitement or tension. Adults of both sexes may mount juveniles of both sexes, and vice versa.
Ejaculation
Ejaculation occurs during a reduction or pause in the deep thrusts and few seconds of body rigidity. After ejaculation individuals of both sexes may groom their genitals and eat solidified clumps of semen.
Turning head and reaching back
The Actor whilst being mounted by the recipient looks back and places a hand on the recipient, mutual gaze usually occurs.
Inspection of genitals
Capuchins will often inspect their own genitals, especially after ejaculation, inspecting the partner's genitals is rare.

9. 3. 3 Non reproductive sexual behaviours

Cebus apella have been observed copulating outside the periovularoty phase, including during pregnancy and postpartum amenorrhea (Dixson 1998a). Post partum proceptivity is often seen but no infants are conceived as a result of mating. Females have been commonly observed soliciting and copulating with new introduced males (Cooper et al. 2001, Fragaszy et al 1994a, Welker 1992), indicating that sexual behaviours may be involved in group formation. Masturbation is extremely rare in captive capuchins housed in mixed-sex social groups. However male *Cebus apella* housed away form females may sometimes masturbate and female housed away from males rub their genetalia on cage surfaces. Adults housed with members of the opposite sex also show elements of sexual behaviour towards same sex partners in their social groups. For example, males may mount other males and females other females. After short separations from each other, males embrace each other (Matheson et al. 1996), sometimes after this affiliative behaviour one male invited the other to mount him.

9.4 Bathing

Capuchins do not sand or dusts bathe. If provided with a water source, such as a moat around the exhibit they will play by the waters edge and often dip their arms in the water during hot weather, although they will not willingly enter the water as Capuchins cannot swim.

Capuchins will also rub pungent smelling materials into their fur. In the wild Capuchins will often rub plant materials and tissues of insects into their fur. This behavior was referred to as “peat-bathing” by Ludes and Anderson (1995); this is thought to deter insects such as Mosquitoes. In captivity, if Capuchins are provided with onions, spring onions, Citrus fruits, peat and even tobacco or garlic they will carry out this activity.

9.5 Behavioural Problems

Abnormal behavioural patterns include: excessive grooming; hair pulling; repetitive pacing; running, jumping or rocking; social withdrawal; and self mutilation.

Hand reared capuchins often have behavioural problems, particularly in a social group setting. Hand reared capuchins regularly lack to social skills to allow them to be successfully integrated into a social group. Some of these animals will crave human attention and will gain this by imitating people; the humored response by uneducated audiences encourages this undesirable behaviour. Capuchins imitating human actions are undesirable.

There are certain precautions a keeper should take to avoid aggressive encounters with Capuchins. When entering the exhibit to feed, acknowledge the dominant male first. In the wild, the dominant male would feed before the choice of feed and if subordinates are fed before him he may get jealous and become aggressive. The dominant male controls the troop so it is important to familiarize with him and “become friends”.

If two capuchins are agonistically interacting or fighting, keepers should avoid these animals or the Capuchins will quite possibly turn their aggression to the keeper. If a capuchins is threatening or flaring up at a keeper it is important to avoid eye contact and

attempt to ignore the animal, do not run or show fear as the monkey would then have achieved its outcome by this undesirable behaviour.

A gentle tone of voice should be used to talk to subordinate Capuchins even when reprimanding especially if they are family members of the dominant male. The dominant male can be very protective of his troop and may perceive an angry or raised tone of voice as a threat.

The table below lists range of behaviours considered at normal and healthy

Still	Awake, but quiescent and inactive
Alert	Still with visual and acoustic attention apparently focused outside the exhibit
locomote	Brief, directed, non-repetitive, apparently functional movements, usually walking or climbing
Object manipulation	Holding, banging or otherwise contacting toys or extracting food from enrichment objects
Structure manipulation	Holding or otherwise manipulating structures or perches
Food manipulation	Holding, playing with, banging, consuming or otherwise manipulating regular food rations
Forage regular rations	Manually search for, process and ingest fruit and other food provided
social interactions	Affiliative interactions with group members, close contact, grooming, playing
Total normal	A pooled category representing activities either commonly observed in the wild, required for self maintenance, or exploration and manipulation of objects other than the subjects own body. Including all of the above behaviour categories.

The table below lists a variety of behaviours considered abnormal and undesirable

Self groom	The animal grooms itself manually
Salute	Poking or touching a finger to the eye
Grimace	Facial expression in which the lips are pulled back and the teeth are bared
huddle	Crouching with tail closely wrapped around the body and a listless, withdrawn demeanor
aggression	Threatening observers or other capuchins, or fighting and wresting with other capuchins.
Auto-erotic	Manipulation or other stimulation of genital or anal regions
Self-clasp	Tightly hugging or holding the body with arms and, occasionally the

	tail
Self-mouth	Sucking or licking a body part
Self-bite	Biting or gnashing a body part
pacing	Repetitively walking or running the same circuit within the cage with no obvious goal
Rocking	Repetitively moving or swaying back and forth while maintaining the limbs in a fixed position
Total abnormal	A pooled category representing all abnormal activities, including auto-stimulation, stereotypic movement, aggressions, huddle, grimace and salute.

The occurrence of these behaviours can be greatly reduced with the introduction of effective social, environmental and behavioural enrichment.

9.6 Signs of Stress

Signs of stress include pacing, weight loss; self grooming or mutilation and head tossing. Terrestrial predator alarms are also an indicator of stress (Boinksi *et al*. 1999b).The terrestrial predator alarm is distinctively different to other capuchin vocalizations. Providing appropriate behavioural, social and environmental enrichment often reduces alarm vocalization and stress.

9.7 Behavioural Enrichment

The main aim is to reduce excessive inactivity in the animals, and to reduce boredom and its negative consequences, including lethargy and abnormal behaviours.

Cebus apella attempting to remove mealworms purposely placed inside a bamboo stick at National Zoo and Aquarium.

Capuchins will readily manipulate and attempt to break open any object given to them, and all objects must be checked before introduction and all hazardous parts are to be removed. The most effective strategy for maintaining the monkey's interest in these objects is to replace one type with another type every day. There is a wide variety of objects that can be used to incite natural Capuchin behaviours. Items such as puppets or a rubber snake may initially elicit alarm and mobbing by the Capuchins, especially on first introduction. These occasional brief challenging events of this type may even be beneficial to the animals, allowing them to express a natural part of their repertoire and

inducing natural physiological responses without undue risk. Capuchins do not readily enter deep water, but a container of shallow water undoubtedly stimulates exploratory and playful activities. There are many different ways in which the physical environment can be enriched. Simple objects can be baited with food treats to elicit specific feeding techniques. When deep litters contain buried food, animal devote time to sifting and searching through the litter (Westergaard and Fragaszy 1985). Furnishings can also include structures with holes or openings containing treats to encourage extractive techniques, including tool use. Structures, such as branches and ropes should be replaced and rearranged regularly to provide environmental enrichment. In the wild, Capuchins have been observed rubbing leaves, fruit and insects into their fur. Captive capuchins also readily engage in this behaviour. Preferences for which substance to be used may differ between individuals (for details of the fur rubbing behaviour see section 9.3 bathing). Given the high motivation of Capuchins for this activity, it is recommended that trial and error be used to identify the preferred fur-rubbing-eliciting object or substance for a given group, and if there are no associate drawbacks, to allow the Capuchins to perform this behaviour periodically.

Things to avoid with enrichment items:

- parts that can be swallowed
- keepers should remove the lid rings from plastic bottles as a precaution
- When placing ropes in enclosures do not use slip knots and be careful not to create any loops in the rope that a monkey may get hung on.
- No sharp objects
- If plastic edges of enrichment toys are sharp they must be filed until deemed safe.
- No soft or beaded toys that may be torn open and ingested.

Examples of behavioural enrichment are:

- Using a piece of bamboo, drill holes into the sides and fill the holes with mealworms (pictured) this activity will entertain the Capuchin and provide a food reward. Individuals will treat this novel object in different ways; some may shake or try and pick the mealworms out while others will simply bash the object to retrieve the treat inside. All bamboo enrichment objects should contain some reward inside to encourage this behaviour.
- Using a plastic bottle, drill a hole into the lid and place a food reward inside the bottle, such as half filling the bottle with oats, sultanas, raisins, bran, primate pellets etc. This activity consumes the monkeys time in extracting the reward, providing enrichment. A similar enrichment technique is used with a screw tight container with a hole drilled into the top; it can be completely filled with sawdust and mealworms. This encourages the Capuchin to pick out the treat.
- Fruit can be introduced to Capuchins frozen to increase enrichment or can be provided within an ice cube. This is popular during summer.
- Using a plastic bottle, fruit and water can be placed inside and then frozen. Although some clever capuchins may rest the bottle in the warm sun waiting for the ice to melt.
- Capuchins participate in a behaviour called fur rubbing. In nature capuchins would rub pungent smelling materials on their fur. This behaviour can be

emulated in captivity by providing the animals with materials such as garlic, onions, Spring onions, citrus fruits, peat and even tobacco.

- To enrich the capuchins response to threats, toys that capuchins may perceive as a threat can be introduced. Toys that mechanically move will provide entertainment for the curious individuals. Rubber snakes are also popular; they can either be placed in the enclosure of hidden inside boxes or then given to the capuchins. On opening or dismantling the box they will discover the snake. This activity is perceived to have a positive effect on the animals stimulating all their senses and emulating natural behaviour.
- Simple materials such as bark can be used to obscure mealworms. Capuchins are recognized as destructive foragers, they enjoy destroying objects.
- Each exhibit should have some substrate such as wood shavings, wood chips or straw. Food items can be buried inside this material.
- Plastic container filled with shallow water can be effective, even though Capuchins cannot swim, particularly in hot weather.
- A mat of synthetic grass can be scattered with sunflower seeds. The Capuchin will pick the seeds out.

9.8 Introductions and Removals

Introductions and removals in Capuchins can be difficult and pose many social problems but the risks of severe problems arising from introductions appear minimal to the disadvantages of solitary housing. In some groups the lowest ranking individual can become the target of repeated aggression, during which no other group member intervenes on its behalf. This is obviously a stressful situation for the victim, and in extreme cases removal of the unfortunate individual may be called for. However, unless serious injury or depression results from such bullying, removal have considerable drawbacks: it results in isolation, altered immune functions (Kling *et al*. 1992) and possible problematic reintegration for a socially rejected individual, and does not preclude the possibility of another member of the group becoming a new scapegoat. In such cases priority should be given to monitoring the psychological and physical health of the individual, providing temporary relief and food supplements during short separations, if necessary. No cases in which an individual has been harassed to the point of death have been reported and not only physical wounds but social wounds heal with time.

If a Capuchin must be removed from the group the period of separation should be kept to a minimum, the longer the animal is removed for the higher the risk of its return. If possible the rejected individual should be housed where they have visual, auditory and olfactory contact with the group, this is usually beneficial to the isolate even though continued contact by sight, sound and smell can be stressful to some individuals. Therefore rejected individuals should be under daily, long term monitoring. Rejected animals can also be provided with a companion to prevent solitary confinement.

Introduction and reintroduction must be undertaken with caution. All efforts should be made to integrate an individually housed animal into the resident group or at another institution since solitary housing is undesirable. Introduction should occur in a step wise manner; increasing contact from sound and smell to sight and finally physical. This

process may take several months. This process was successful for hand-reared and mother-reared infants when the full integration procedure was preceded by a period of visual contact, allowing mutual familiarization from a safe distance (Visalberghi and Riviello, 1987; Riviello 1992). Integration of a single adult demale was achieved on two different occasions through a period of visual contact, followed by periods in which the female was together with the dominant adult male, and then together with him and each of the other group members. Finally she was housed permanently with the entire group (Anderson et al. 1991, Ludes and Anderson 1995b). A similar procedure has been found to be successful when introducing a fully adult male (more than 10 years old) into a group in which the dominant male was 4 years old. The procedure involved stages similar to those just described for the adult females, but was much quicker, and the last individual to be in contact with the newcomer was the dominant resident male. Strikingly, as soon as these two males were together in the cage they made contact and performed joints threats, directed towards no particular target. The two males had a positive relationship, with the newcomer being dominant over the resident, younger male. Although all such cases of introduction involve stress for all involved, in none of t he cases described did the introduced animal have to be removed from the group because of aggression or stress related ill health.

Often the use of a neutral cage facilitates introductions/reintroductions. Fragaszy *et al*. (1994) achieved success by first allowing the newcomers to become familiarized with the residents living quarters, and only then mixing residents and newcomers. Adult males, adult females and juveniles with introduced into 3 established groups of 6-9 Capuchins in this study. No serious aggression related incidents occurred at the time of introductions or during the following months. When a new female was persistently chased by one or more individuals, partial separations were adopted whereby mixed subgroups of newcomers and residents were housed together overnight. No foolproof recipe is yet available fro group formation or introduction procedures, but the chance of success can be increased by having a knowledge of the animals involved, careful monitoring of phases preceding and following introduction, and by taking into account factors such as sex, age and the experience of newcomers(Visalberghi and Anderson 1993). It is anticipated that the introduction of a fully adult male into a group containing neonates may be risky. Also, the introduction of an adult female into a group containing more than one adult male may result in a violent challenge to the dominant male by a subordinate, especially if the former is old. Once given physical contact the group should be closely observed for 48 hours and monitored daily for at least 2 months.

9.9 Intraspecific Compatibility

Capuchin social life forms a dominance hierarchy with a distinctive dominant male and female. Capuchin groups contain multiple individuals of both sexes. Subordinates are sometimes the victims of aggression from the dominant animals, more so from males than females. The compatibility of Capuchins depends on the relationship between the individual animals, same sex and between sexes relationships can be positive and can also be negative. Dominant males will often direct aggression towards subordinate males, sometimes this can be persistent and in the worst case scenario the victim might have to be removed. Introductions of male capuchins can be difficult and agonism is to be expected from the dominant male. These introduction procedures must be taken with

caution (see 9.8 introductions and removals) and if done effectively can be successful. Males can also from strong relationships with one another, particularly if the pair was born in the same troop. Females form stronger same sex relationships than the males and are less likely to act aggressively towards one another but altercations may still occur. Male and females can coexist in captivity without much difficulty, adult males only rarely direct physical aggression towards females. The species can be housed as a pair of males or a female group. Males housed as companions can be exhibited without undue problems, without the need to dominate the group a pair of males can have an affiliative relationship.
The largest variable in determining intraspecific compatibility is the individual animals character, temperature and the current social situation. Compatibility can be achieved by simulating natural group compositions, close monitoring of aggressive behaviours, progressive introduction procedures and providing appropriate feed rations and enrichment devices.

9.10 Interspecific Compatibility

Capuchins have been used in zoos as a mixed species exhibit. Reports of successful and unsuccessful instances are reported below.
Cebus albifrons and *aloutta caraya* (howler monkey) were unsuccessfully exhibited at Omaha's Henry doorly zoo. The Capuchins were removed after 3 months because the howlers attacked them, although the capuchins usually instigated confrontations with short, aggressive attacks on the howler monkeys.
Cebus apella and *Aloutta caraya* was also unsuccessful at Santa Ana Zoo. These animals were successful for about a year when the group composition changed. The female howler attacked one of the female Capuchins causing severe injury. This Capuchin had to be removed to heal and it became impossible to introduce any Capuchins after that.
Cebus apella were successfully exhibited together with black-handed spider monkey (*ateles geoffroyi*), Squirrel Monkey (*samiri sp*.), giant anteater (*myrmacophagia trydactylus*) and Brazilian Tapir (*tapirius terrestrius*). The Capuchins rarely, if ever interact with the tapirs or the anteater. On the adult male spider monkeys was aggressive towards two of the adult male Capuchins and could not be exhibited together. The squirrel monkeys and Capuchins had a positive relationship and juveniles would often play together. Two of the female capuchins shared holding cages with the squirrel monkeys rather than enter the capuchins holding cages. In the wild these two species coexist peacefully and sometimes forage together, which is mainly beneficial to th e Squirrel monkey.A Variety of bird species was use din this exhibit but the Capuchins are opportunistic predators and have attacked ill or injured birds that have landed on the ground.
Capuchins and Squirrel monkeys exist peacefully in the wild

9.11 Suitability to Captivity

Capuchins are a popular animal in zoos. Their social attitudes and manipulative skills often impress observers. Capuchins require enrichment to be psychologically healthy in captivity; this enrichment is in social, environmental and behavioural forms. Capuchins should not be kept solitary, and a social environment is the healthiest for a Capuchin. Capuchins must be provided with forms of behavioural enrichment (see chapter 9.7 behavioural enrichment), this stimulates the mind, prevents inactivity. Capuchins have been known to turn their attention to locks and perimeters when not enriched adequately. These activities also provide valuable entertainment for onlookers. Capuchins do show signs of aggressive behaviour and introductions, removals and group formation can be complicated, but commonly a social group can coexist without any injuries from attacks or issues from over stressful situations. Capuchins are more resistant to disease than most other primates, housed in acceptable conditions the frequency of disease and health problems are low. Capuchins are particularly easy to breed; breeding programs are now set up for the endangered *Cebus xanthosternos* and *Cebus nigritus robustus.* It should be noted that Capuchins have an average life span of 40 years, the longevity of this animal must be considered when looking to keep in captivity, a long term management plan should be in place.

10.1 Mating system

The mating system of *Cebus apella* is polygamous. Females mate preferentially with the dominant male. Other males have mating opportunities when the dominant male is not present. During the last 2 days of a female's estrus cycle, the dominant male is very protective and keeps females from mating with subordinate males (Emmons 1990, Forbes Mackeith and Perberdy 1984, Kinzey 1989, Rowe 1996).

10.2 Ease of Breeding

Breeding in captivity has been successful. Capuchins are excitable and do not readily cooperate for vaginal swabbing to chart menstrual cycles. In lieu of timed mating, programs of placing females with males on alternate 14-30 day cycles have been effective. Care must be taken to ensure the compatibility of paired monkeys as fights may take place, resulting in severe injury to the female. Adult males should be maintained in a room restricted for breeding, with the females brought to them. Using these techniques, the majority of adult acclimated females become pregnant each year, with at least half of the adult females producing live babies.

It is not recommended separating pregnant females from their group, even though dead neonates are occasionally recovered. Greater importance is attached to maintaining the complex network of social relations existing in a group than to episodic breeding success if the latter implies stress due to separation and eventual reintegration of mother and infant into the group. Maternal performances may differ between primiparous and multiparous mothers, and the former sometimes abandon their infants. It is conceivable that delivery from primiparous females is particularly long and tiring, and the infant may also be compromised after such a lengthy delivery. However, after initial competencies, Capuchin females may become competent mothers with subsequent offspring. While it is not clear how this improvement is achieved, it seems likely that age and perhaps higher social status of the female and the presence of other mothers with infants in the group may be contributing factors.

10.3 Reproductive Condition

Females have no estrus swelling.

The external signs of estrous are female proceptive behaviours.

10.4 Techniques Used to Control Breeding

Breeding can be controlled by female implants. Implants such as implanon stop conception for 3 years.

10.5 Occurrence of Hybrids

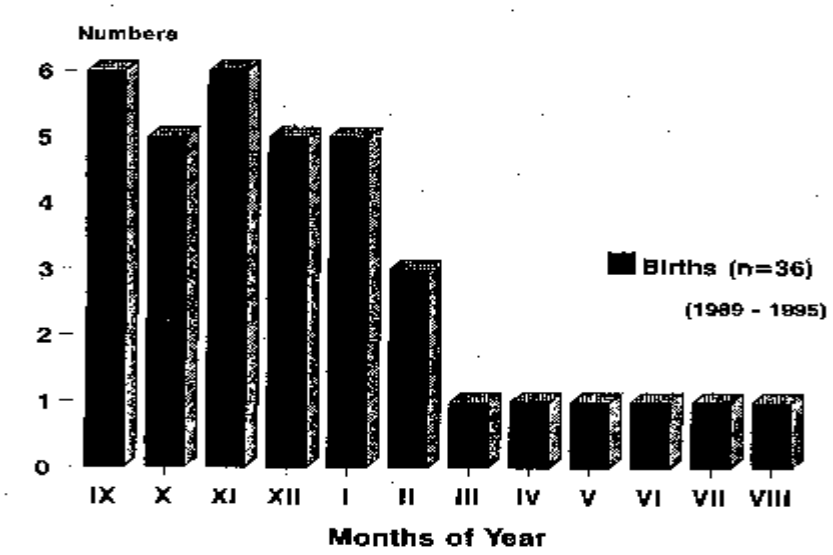
Cebus apella does have the ability to hybridize with other member of the genus *Cebus.* Hybrids of *Cebus apella* and other species of Capuchin have successfully been kept in captivity.

10.6 Timing of Breeding

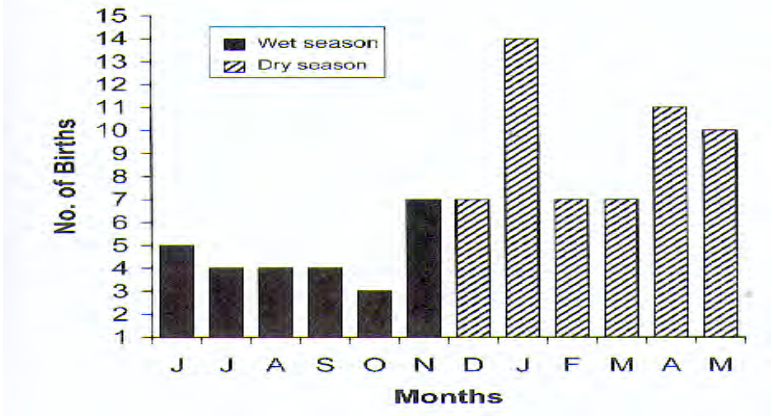
Capuchins follow the typical pattern for new world monkeys of giving birth in the period coinciding with or immediately preceding the peak in food availability. It is also possible that that birth seasons are driven at least in part by optimal physiological conditions for conception (e.g. female Capuchins at Santa Rosa become thin during the dry season when little water is available and put on a noticeable amount of weight by the middle of the rainy season at a time when most of them conceive). The complexity of food availability causes birth seasonality to vary at different sites. Populations of *Cebus apella* at La Macarena (Peru) exhibit a birth peak in the early wet season (June - July) (Izawa 1990a, 1992), whereas, *Cebus apella* residing below the equator at Iguaza(Argentina) have an actual birth season in December – January(early dry season)(Di Bitetti and Janson 2000).

Peak location at/or before fruit/insect peak. Robinson 1988, Robinson and janson 1987. Capuchins might maximize offspring survival by timing weaning to the period of peak fruit/insect abundance about 1 year after birth; infant weaning does not occur in capuchins until atleast1 year of age, although the process is highly variable and can take up to 24 months (fedigan et al 1996). Photoperiod may affect birth seasonality of populations living at high latitude

The following graph is of Seasonal births of a colony of 78 captive *Cebus apella* comprising of 48 males and 30 females between 1989 and 1995 at the Primate Center of Argentina (CAPRIM).
Between 1989 and 1995, 36 births were recorded, at all times of the year, but with a definite concentration of births (83%) between the months of September and February (spring and summer). The reproductive season (the season with the most sexual activity) lasted from March until august (autumn and winter). This is similar to what Collilas (1986) and Zunino (1990) observed in outdoor cages, and to what has been described for monkeys living in the wild by Janson (1984). Although *cebus* does not show seasonal breeding under controlled ambient conditions (i.e. in indoor colonies with lighting, etc., that does not change seasonally) but produces births throughout the year (Nagle and Denari, 1982b, it is a seasonal breeder both in the wild and in captivity when caged out doors.



The table below shows birth seasonality of *Cebus capucinus* at Santa Rosa National Park, Costa Rica, based on 83 births to individually known mothers on known dates.



Births usually occur during the night or early morning (Fragaszy and Adam-Curtis 1998)

10.7 Age at First Breeding and Last Breeding

Study site	age		
wild	7 years	Average	Di Bitetti and Janson 2001
wild	5 years	Earliest	Robinson 1998
captive	5 years 7 months	Average	Fragaszy and Adam-Curtis 1998
captive	4 years 7 months	Earliest	Fragaszy and Adam-Curtis 1998
captive	5 years 8 months	Average	Zunino 1990
captive	3 years 10 months	Earliest	Zunino 1990

First siring for captive *Cebus apella* is 4 years and 5 months (Fragaszy and Adam-Curtis 1998).

Although females may experience longer inter-birth intervals as they age, there is no evidence of menopause.

10.8 Ability to Breed Every Year

The following table shows interbirth intervals in wild and captive *Cebus apella*.

Wild	19.4 months	DiBitetti and Janson 2001
Wild	22 months	Robinson 1988
Captive	20.6 months	Fragaszy and Adam-Curtis 1998
Captive	20.4 months	Recabarren *et al.* 2000

10.9 Ability to Breed More than Once Per Year

Breeding more than once per year only occurs if the first infant is removed relatively soon after birth.

10.10 Nesting, Hollow or Other Requirements

When female Capuchins are showing indicators of a forthcoming birth, bedding such as straw should be placed inside the den for extra comfort. If the temperature in the den is artificially controlled it is advised to slightly increase the temperature, in particular if the den has 2 sections, giving the female the option of a warmer den or regular temperature.

10.11 Breeding Diet

Whilst breeding the female should b provided with extra food, preferably fatty foods, such as mealworms, to prevent weight loss when rearing an infant. Milk can be provided but only in small amounts because Capuchins are lactose intolerant. A supplement of Soya milk powder can also be given.
Capuchins appear to need more folic acid than what is provided in commercial chow, particularly to support pregnancy and growth.

10.12 Oestrous Cycle and Gestation Period

Gestation in days

wild	151-155	DiBitetti and Janson 2001
wild	160	Fragaszy and Adam-Curtis 1998
captive	149-158	Robinson and Janson 1987

Ovarian cycle:
20.8 +_ 1.2 (Linn et al 1995, Nagle and Denari 1983)
21.3 (M. Carosi, M.Heisterman, E. Visalberghi)

10.13 Litter Size

One infant is born, twins are very rare.

10.14 Age at Weaning

Age at weaning: 416 days (Fragaszy and Bard 1997).

The following table gives information on natality and mortality rates in *Cebus apella*.

	Number of infants born	Died <6 months	Died < 1 year	Survived > 1 year	Sex ratio at birth. Male: female: unknown
Wild, study site at Iguaza 1992-1999(Di Bitetti and Janson 2001)	22	-	10 (45%)	12 (55%)	12:13:4 (0:92)
Captive (Fragaszy and Adam-Curtis 1998 and Fragaszy unpubl. Data)	61	8 (13%)	-	-	68:58:15 (1:17)
Captive (Visalberghi unpubl. Data)	36	13 (36%)	-	23 (64%)	20:15:1 (1:33)
Captive (zoos)	863	155 (18%)	-	-	384:137:342 (2:8)

Note: in Visalberghi's Laboratory most infant deaths occurred when the laboratory was newly established.

Capuchin mortality rates are highest in the first year of life (Fedigan *et al*. 1996). 18-24% of infants die in the first year of life in nature and, in captivity, 13-36% of them die in the first 6 months. Only 55-68% of Capuchins survive past their first year and survival analysis on a group of *Cebus capucinus* at Santa Rosa showed that only 39% of infants survive to the age of 5 years (Fedigan *et al*. 1996).

10.15 Age of Removal from Parents

Young males leave their natal group once they reach sexual maturity. Male *Cebus apella* are considered sexually mature at 7 years of age. Females mature earlier and give birth to their first offspring as early as 4 years old. (Forbes, Mackeith and Perberdy 1984, Linn 1995, Nowak 1991, Rowe 1996). Female Capuchins remain in their natal group at adulthood while males disperse (Nowak 1991).

Male capuchins may emigrate from their natal group as early as 2 years, but the probability that they will leave their birth groups is highest when they are juveniles of about 3-6 years of age (Robinson 1988a). Jack and Fedigan(in press a) found that emigration from natal groups does not coincide with the conception season, nor does it result from eviction by resident adult males or eviction by adult males that have recently taken over the groups. Natal male dispersal coincides with periods of intense inter-group interaction (juveniles get to know their neighbours), group fissioning and occasions when older males are wandering and dispersing themselves. Multiple male emigrations are also

very common (82%) as juveniles and older siblings, juveniles and familiar male or males of the same age group.

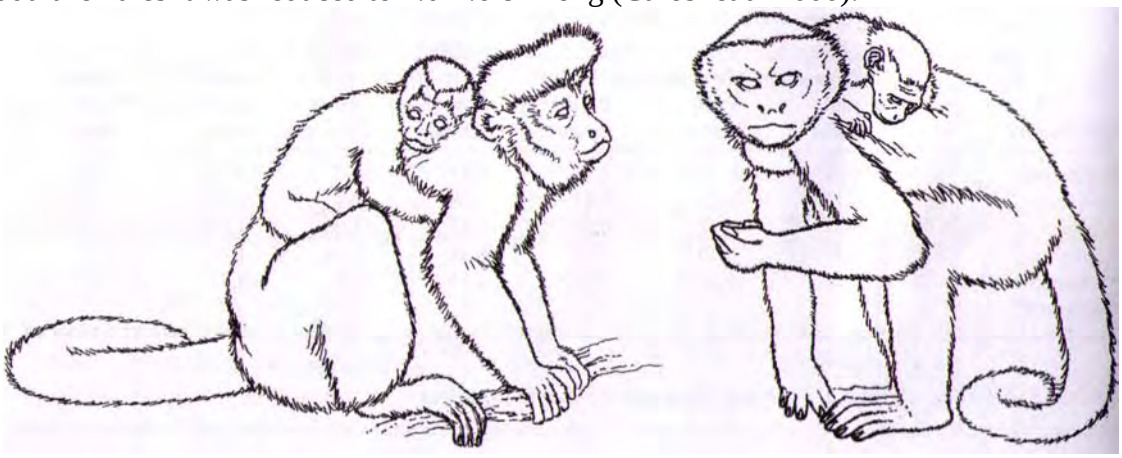
10.16 Birth & Early Infancy

The mother begins licking the face of the new infant as it emerges from her body. The infant clings to the mother unaided from the moment of birth, although many females do provide support to the infant with one hand when it is on her front. Other group members generally ignore the mother and her infant during and immediately after birth. Over the following days, however, youngsters as well as older monkeys approach the mother and smack their lips or teeth at, peer at or nuzzle the infant; adult females and sub-adults often sniff the genital area of the infant or touch its face. The infant is treated as an object of gentle interest, especially when it vocalizes or moves. Those approaching a newborn infant to inspect it often give a purring, low-amplitude vocalization (Di Bitetti 2001b). Mothers are more likely to allow siblings or other kin to come near the infant than unrelated animals. The social rank of the mother impacts how often she allows others to come near her very young infant; higher-ranking females are less tolerant of others approaching than are low-ranking females (O'Brien and Robinson 1991).

Infant transfer occurs in Capuchins. Young infants, may be held or transported (even nursed) by individuals other than their mother. Being on another individual is usually safe; however, it may carry risks when the infant is very young and/or when the mother does not retrieve it. The infant may take the initiative in passing on from its mother to a nearby individual and also another individual may facilitate transfer by adopting an inviting posture. The individual who carries it is rarely aggressive, but in certain cases of infants up to about 8 weeks (thus not yet effective at locomoting or initiating transfers) may run the risk of dehydration/starvation. The mother may not attempt to retrieve the infant; this is sometimes due to her subordinate status. In such cases, after several hours it may be necessary to intervene, either by trying to facilitate infant transfer by bringing the mother and the carrier in close proximity, for example providing a non transportable treat such as juice, or by restraining the mother and carrier in a restricted space. If these procedures fail, the carrier may need to be captured and the infant returned to its mother and then monitored to see that maternal care is adequate. Sometimes during this process the carrier (even the mother) will forcefully dislodge the infant by pulling at it or biting it. Care should be taken to keep the capture process calm so as not to endanger the infant.

Capuchins are born with hair and can also open their eyes but they are not able to maintain their body temperature on their own in ambient temperatures less than about 32 degrees Celsius, and they have limited postural control and locomotor capacity shortly after birth (Fragaszy 1990b). The essential elements that the infant requires (nourishment, support and warmth) are provided by the mother. The neonate's abdomen is nearly naked, and the mother is a convenient source of radiant heat (roughly 38 degrees Celsius). The mother affords a tight grip; her body supports the infant and she permits the infant to suckle at will. Newborn *Cebus apella* are coloured similarly to the adult with perhaps less contrast between the torso and limbs. Infants appear long and skinny, with thin, long limbs, long hands and feet and an elongated skull. They lay diagonally across the mother's neck, just in front of the shoulder blades and the tail is often wrapped tightly

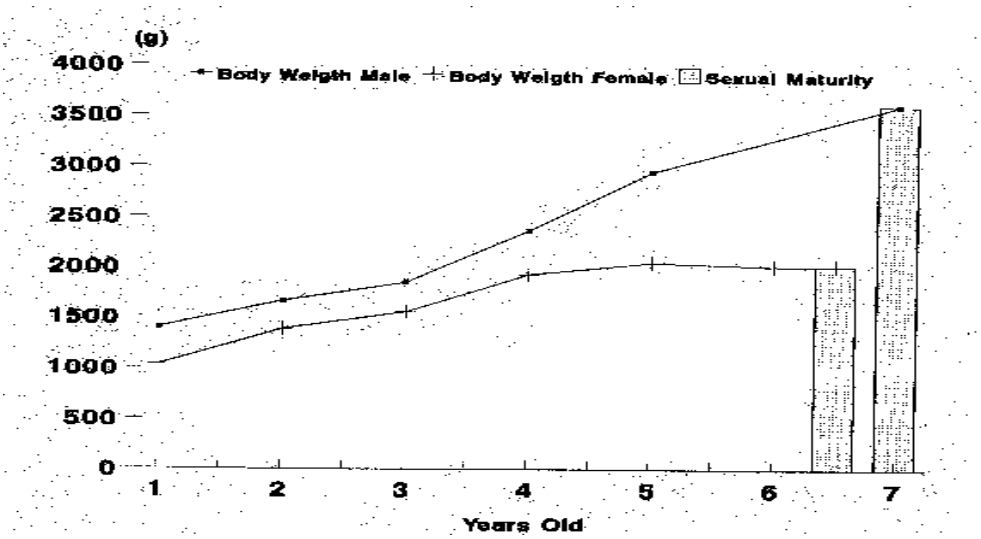
around the carrier's waist as a fifth point of contact. The external genitalia of males and females are superficially similar in appearance. At birth the clitoris looks much like the penis, and it is common for infant female capuchins to be wrongly identified as males for several months after birth. The fleshy part of the clitoris appears to become thicker and shorter with age, in juvenile and infant capuchins the clitoris is 2.0-2.8 cm long and in adult females it was reduced to 1.0-1.6 cm long (Carosi et al 2000).



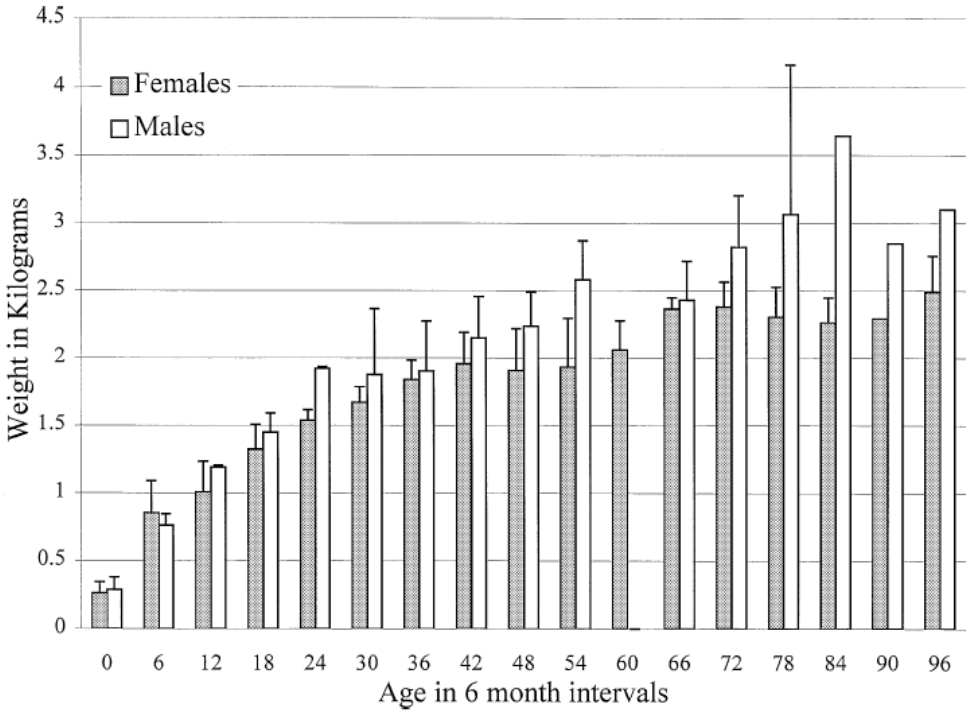
The newborn Capuchin weighs between 220-270 grams. This weight is approximately 9 % of their mother's weight at birth (fragaszy and Adam-Curtis 1998, Hartwig 1996). The Capuchin infant can open its eyes, turn its head, hiccup, cough, yawn, vocalize, lift its tail and hindquarters during elimination, and move by coordinated, if wobble, movements on all four limbs, grasping and releasing with hand and feet. They can right themselves from a supine to prone (from back to stomach) position with effort, and they will attempt to crawl on a flat surface, although without supporting the torso, from 4 days of age. Infant Capuchins cannot support the torso in a quadrapudel position until about 5 weeks after birth. If placed prone on a flat surface before this age, the arms and legs splay sideways.

10.17 Growth and Development

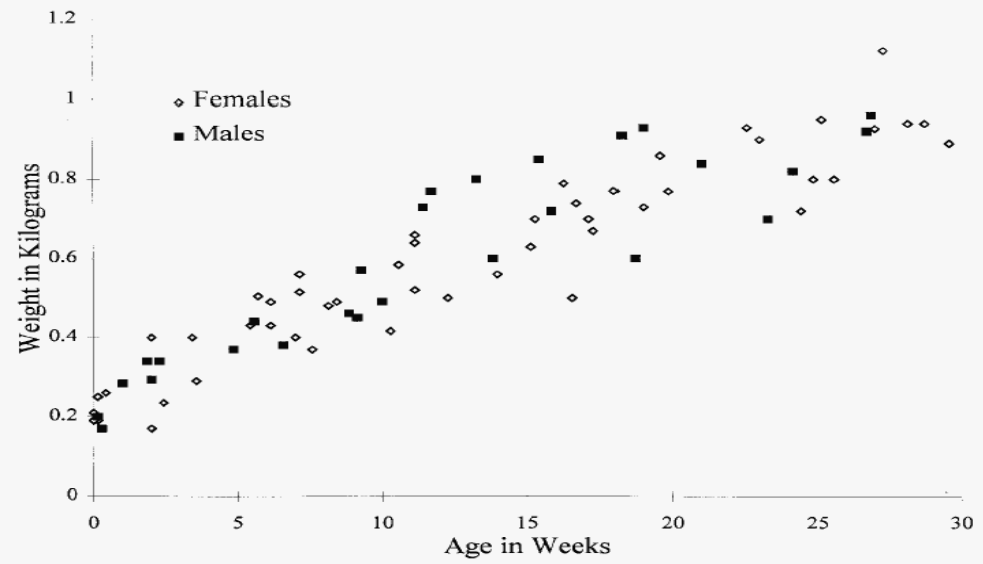
The following graph represents body weight and sexual maturity of *Cebus apella* born at the Primate Center of Argentina (CAPRIM). Exequiel M. Patino, Juan T. Borda and Julio C. Ruiz's study on sexual maturity in captive *Cebus apella* compared the body weights, chronological age, dentition, pregnancy, testicular volume and signs of previous birth in captive born and wild born *Cebus apella.* Their results showed distinct correlation between body weight and sexual maturity. The age and weights for CAPRIM's males and females with verified sexual maturity are similar to those described by Nagle and Denari (1982a) for classifying *Cebus apella* as fully adult. These authors state that Cebus apella is never sexually mature before 6 or 7 years of age, with weights of 2.0-2.8 kg for females and 2.7-3.8 kg for males.



The following graph is of average weights (and standard deviations in the line above) of male and female Capuchins per 6 month blocks. When no standard deviation is shown, a single animal contributed the data. For the first 3 blocks (through 18 months), only weights taken within in 14 days of the 6, 12 or 18 month birthday were used. For the blocks 24-66 months, weights taken within 28 days of the block age were used. For blocks 72-96 months, weights taken within 84 days of the block were used. (Fragaszy and Adam-Curtis 1998)



The following graph represents weights of male and female infant capuchins during the first 210 days of life. 49 points are given for females (taken from 26 individuals); and 29 points are given for males (taken from 18 individuals). (Fragaszy and Adam-Curtis 1998).



Developmental stage	Age
Sex distinguishable	At birth the clitoris appears much like the penis
Eyes open	At birth
Fur visible; slight tinge, medium or well developed	At birth, abdomen is nearly naked.
Appearance of teeth	First molar 1.2 years, second molar 2.2 years
Feeding on solids	6 months
Independent	2 years
Sexual maturity	5 years for females, 7 years for males

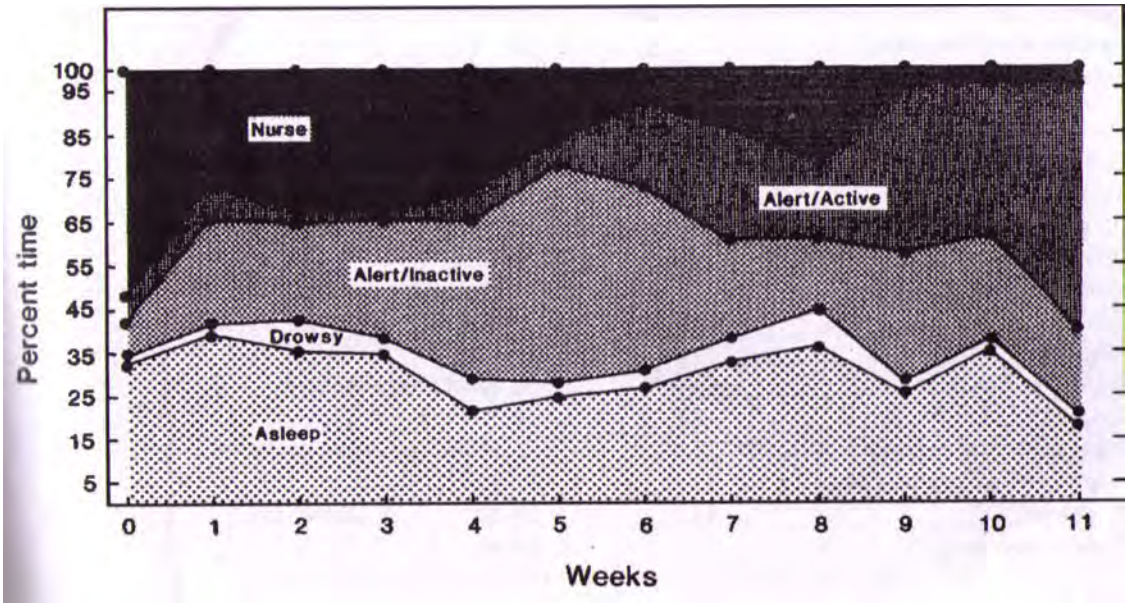
Newborn tufted capuchins typically have a uniformly dark face but within a few weeks develop markings with high contrast between light and dark areas.
Birth weight: 220-270g.

Weight at sexual maturity approx
Males 2.5kg (Nagle and Denari 1983)
Females (Nagle and Denari 1983)

Males get each of their permanent teeth 2 weeks to 2 months earlier than females (Fleagle and Schaffler 1982)

Age	
At birth	Born with deciduous incisors already visible above the gums.
30 weeks	A full set of deciduous teeth should appear, accompanied by much chewing activity.

13.5-14 months	First permanent tooth, the first molar appears.
14-18 months	Permanent incisors appear.
26-28 months	Second molar appears.
3 years	Third and fourth premolars appear.
3.6 years	Third molar appears.
4.5-6 years	Canines, the last permanent teeth to emerge.



The table above shows the proportion of time during daylight hours spent in different behavioural states across the first 11 weeks of life a Tufted Capuchin. The infant and its mother lived in a captive group(Fragaszy 1989b).

The table below shows age in weeks of first observed occurrences of selected behaviours in infant tufted capuchins in captive groups(Byrne and Suomi 1995).

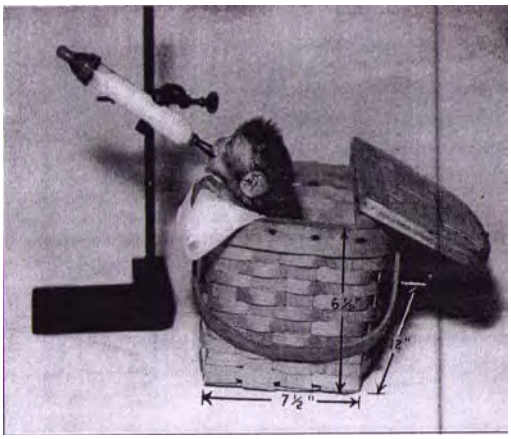
	mean	range
Tactile/oral exploration	4.2	3-7
Alert active>quiet*	5.6	4-7
Off mother, holding on	5.5	4-11
Off mother, in proximity	6.6	4-12
Mother and infant separate	7.4	4-12
Carried by others	7.5	2-20
Infant alone	7.5	4-12
Eat/explore food	6.9	4-14
Social play	8.7	6-19
Self play	10.9	7-15
Complex object manipulation	15.4	9-26
50% alone	17.5	10-28
Alone>with mother^	22.1	15-38

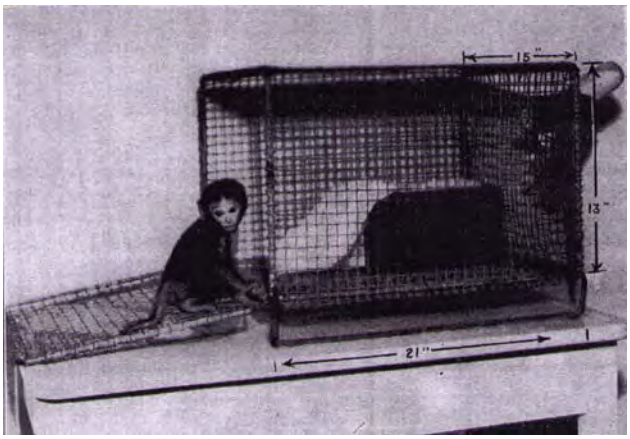
*age at which alert active scores exceeded alert quiet scores in activity stat scoring
^age at which the infant was consistently alone more than with its mother.

11 Artificial Rearing of Mammals

11.1 Housing

A glass case 26 x 26 x 30 cm with an artificial mother. The artificial mother was made of a fuzzy cloth to facilitate clinging by the infants.





If newborn or under 2 weeks the monkey should be wrapped in a towel and placed in a basket (picture above left) with the lid closed. The rough towel and closed basket mimic the texture, warmth and restriction of the mother's arms. The infant remains in the basket 2 weeks until the grasp reflex of the hands disappears. Then it is moved to a small cage, a rabbit cage (picture above right). It can now walk. It is able to life its body from the floor surface because the adductors have acquired some tone (Hines 1942). Even before this time the infant is able to climb upward by reaching and grasping; but it is necessary to limit the size of the cage to the standing height of the monkey, because although it is able at two weeks to release the hand grasp it is unable to retract its legs independently or to turn around and progress head downward. When the infant is left with its mother, she takes care of this emergency by reaching up and removing the baby whose upward progression on the cage has been prevented by the top. Although the infant monkey has passed from a basket to a cage, it still requires some protection, particularly when asleep, so body temperature must be maintained by some shelter. The ordinary metal mouse box (preferably non-rust metal because of the urine) has been useful for the bed. A towel should be draped over the side of the box to the floor of the cage so that the infant can use it climbing into the bed. After a few weeks when the baby monkey does not need the warmth of the box it will sleep outside it, always on the toweling. When a few weeks old the monkey's activity obviously increases, it will spring up and down in place, use its hands to pick up morsels of food and if the box is removed at this time, the monkey can arrange itself comfortably on the towel for sleeping. At the end of the 3 months the monkey should be provided with a larger cage and some small climbing structures such as branches.

11.2 Temperature Requirements

Neonatal capuchins are not able to maintain their body temperature on their own in ambient temperatures less than about 32 degrees Celsius. (Complete capuchin). Monkey babies will sleep on their stomachs with their head to one side, legs sprawled in all directions in a warm room, or feet and limbs folded under when cool. If too warm the infant will turn on its back, and expose its less ventral hairy surface.
There are a few recommended and proven successful methods and temperatures used to regulate an infant's body heat.
Hand rearing has been successful when infants are placed in incubators at 85 degrees farenheight for the first 2-3 weeks (universities federation of animal welfare 7th edition). 30-35 degrees Celsius by means of a 5 watt/12 volt lamp adapted for alternating current. The voltage was stepped down by a transformer (Hand rearing *Cebus apella*).
In incubators at 88-90 degrees farenheight and 50 +- 5 % relative humidity. (Nursery care of nonhuman primates)

11.3 Diet and Feeding Routine

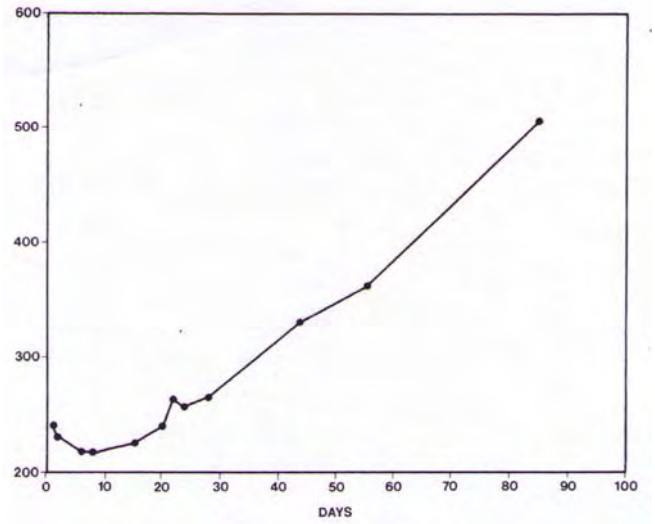
During their first 16 weeks infants can be fed milk formula S26 reg (Similac can also be used). This formula contains 80 kcal when used in a dilution of 15:1; 2g of powder dissolved in 60ml of boiled water. The milk should be provided warm.
At first the milk should be given to the infant a drop at a time, until the sucking reflex is observed. Once the sucking reflex is established, milk can be given from a plastic syringe or bottle with a rubber nipple for as long as the infant wishes to suck. The microurition and defecation reflexes can be stimulated after feeding by massaging the anus, vulva and penis with a cotton ball dipped in liquid petrolatum.
Capuchins have been successfully hand reared by feeding every two hours between 6 am and 10 pm for the first 12 weeks and fed thereafter three times a day at 6 am, 11 am and 3 pm.
Usually the monkey vocalizes when it is hungry. Since they are extremely eager to get milk, the hole in the nipple should be quite small. The monkey stops drinking when satiated, and it is advisable to keep it upright for a few minutes and facilitate burping and avoid regurgitation. Occasionally infants eat too rapidly and regurgitate their food shortly after feeding, once regurgitated the ingesta can be aspirated into the lungs. If an infant frequently regurgitates, the formula can be thickened with a small quantity of semi solid baby food, which often reduces the frequency of regurgitation (Nursery care of nonhuman primates). According to Lehner (1984) nursery-reared infants ingest about 175kcal/kg per day during the first week. The amount peaks at around 400kcal/kg per day at 2 months, then declines to a stable level of around 300kcal/kg for the rest of the first year. They grow rapidly, gaining about 100g per month for the first 10 months. They require dietary vitamin D3, as opposed to vitamin D from plant sources.

11.4 Specific Requirements

Vitamin D3 is available in pelleted diets and vitamin/mineral supplements. Sainsbury (1991) gives 100 i. u. /kg body weight as sufficient for young animals.

11.5 Data Recording

The following data should be recorded on a daily basis:
*Date
*Time when the information was recorded
*Body mass to the nearest gram if possible.
*General activity and demeanor
*characteristics and frequency of defecation and urination
*Amount and types of food offered
*Food consumption at each feed
*veterinary examination and results



Weight gain of a caesarean delivered hand reared *Cebus* infant monkey (Nursery care of nonhuman primates)

11.6 Identification Methods

Younger animals are distinctively different from adults but often more difficult to tell apart individually but often more difficult to tell apart individually. Newborn tufted capuchins typically have a uniformly dark face but within a few weeks develop markings with high contrast between light and dark areas. Individual details around the face, such as black sideburns or clumps of lighter fur, slight variations in the shade of the fur, presence and shape of tufts on the crown and shape of the dark cap are all used to identify adult and infant Brown Capuchins.

11.7 Hygiene

Fabrics and bedding should be changed over daily or as required if soiled.
Bottles should be soaked in boiling water after use.

11.8 Behavioural Considerations

Attending to infant Capuchins social needs is far greater and attending to its physical needs (Fritz and Fritz 1982). Hand rearing will seldom succeed in producing a completely psychologically normal animal. Substantial efforts will be required to provide the level of

social stimulation necessary for the development of social skills in hand reared animals. Frequent periods of interaction between young animals of similar age facilitate normal development, but continuous housing of hand reared infants together is undesirable because it prolongs infantile behavior (Mason 1991) and might make the animals more susceptible to disease through alterations of the immune system. In a normal social group of Capuchins the infant would have opportunity to socialize with other infants, juveniles and male and female adults. It is seldom possible to produce a hand reared infant with the same frequency and intensity of social contact and stimulation as provided by the natural mother and group, but every effort should be made to maximize the time that such infants are held, carried and allowed to engage in social interactions.
It is important not to allow the Capuchin to become too anthropomorphic, hand reared Capuchins often become to adapted to human interaction and behaviours and lack the social skills to be psychologically healthy in a social group. If possible the infants should be reared with other Capuchins to help it learn basic social skills that will be crucial to surviving in the troop. Unnatural behaviours such as imitating human behaviours should not be encouraged.

11.9 Use of Foster Species

Use of a foster species for rearing Capuchins has not been reported. Adult female Capuchins have adopted orphaned infants and young Capuchins have been known to survive sucking from several lactating females within the troop, other than their mother. Adult females other than the infants mother have the ability to rear an infant.

11.10 Weaning

Small pieces of solid food, such as cookies, commercial monkey pellets soaked in juice or water, banana or apple, can be given to the infant as early as 3-4 weeks. Not much is consumed, of course, but the animals lick or mouth it (ufaw7th ed). By 9 weeks of age the Capuchins should be ingesting solid foods and Commercial monkey pellets moistened with water and fruit can be given ad libitum at 12 weeks of age.
The infant is weaned at approximately 20 months old.

11.11 Rehabilitation and Release Procedures

Release into the social group can be difficult and must be taken in a stepwise manner. The Capuchin cannot just simply be placed in the troop. The infant should have opportunity to socialize with other capuchin infants to develop social skills. Introduction of a hand reared infants (ranging from 5-9 months) was successful when the full integration procedure was preceded by a period of visual contact, allowing mutual familiarization at a safe distance (Visalberghi and Riviello 1987, Riviello 1992). The infant should have contact with the resident group through mesh before it is released. The infant should not be released into the social group until affiliative interactions have been observed and determined whilst in the adjacent holding area. After introduction these animals must be closely monitored as it is important to remember that hand reared Capuchins are at a social disadvantage to mother reared Capuchins.

12 Acknowledgements

A special thanks to the team at National Zoo and Aquarium in Canberra for providing some valuable information and a chance to briefly work with Capuchins, In particular I would like to thank Simone Bailey from National Zoo and Aquarium for the review and endeavoring to provide me with information.

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15 Glossary

Agonisitc: of, relating to, or being aggressive or defensive social interaction between individuals usually of the same species.

Nulliparous: a female that does not bear an infant.

Supplant: to remove another from their space by aggression or force.

16 Appendix

Appendix I: Conditioning

Capuchins are intelligent animals and can be relatively easy to train. Training Capuchins will assist in procedures such as Capture and restraint, veterinary examinations, transport. It will also help to enrich the Capuchins behaviour and possibly create a more cooperative individual. One of the training techniques that can be used on Capuchins is target training. Target training can be done using a stick with a distinctive point on one end (Such as paint or tape), a whistle or a clicker and a preferred food item such as grapes. At first the target stick should be offered to the Capuchin in front of the animal possible near its hands. When the Capuchin touches the target, the whistle (or clicker) is blown and the Capuchin is immediately rewarded with the food treat. The whistle is blown so that the monkey recognizes that it has performed the desired behaviour. If the Capuchin does not at first grab the target, the food item can be held behind the target stick so that the monkeys grabs the target stick when reaching for the treat, upon contact the whistle should be blown and the animal rewarded. Once the Capuchin has grasped the concept of training the target can be placed at different heights and distances form the monkey in an attempt to relocate the animal by following a target, which may be the primary goal of this conditioning technique. Patience may be required while the animal is learning and small steps should be taken.