

Management critically endangered in 2008 by the

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Management Techniques of Saguinus Oedipus in

Captivity Introduction Cotton-top Tamarins are one of the most critically endangered primate species on the planet, they were announced critically endangered in 2008 by the ICUN (IUCN, 2008). Their numbers are declining rapidly due to deforestation, logging and the illegal pet trade (Savage, et al., 2016). To combat the decline in numbers and to ensure survival of the species, zoos are now trying to conserve this threatened species. An ex situ population has the opportunity to conserve and restore populations in the wild, zoos with endangered animals in captivity can raise awareness and funding to help try and prevent the wild species from becoming extinct in the future (Kleiman, Thomson, & Baer, 2010).

The correct guidelines should be followed when housing callitrichids, it is important to give cotton-top tamarins the correct diet, enrichment and housing materials which allow them to perform natural behaviours (National Research Council, 1998). Social structure and captive groupings Captive cotton-top tamarins live in groups of 2-14 individuals in the wild and are very social animals, it is important that they interact well together to survive. In captivity both tamarin parents will play an active role in rearing their infants, along with other male members of the group, who will also have their own roles to play in looking after the youngster.

They will take part in carrying the infant around and will help with the raising of them//* (Price E. , Solitaire: Issue 23 , 2002). It is important to have the right social structure when housing cotton-top tamarins, there should be two or more individuals placed inside an enclosure, there may be a bonded pair in a group who will dominate over the rest of the group, these will also be

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thereproducing pair. It is essential to house all related individuals in a group, as cotton-tops don't interact well and show aggression towards non-related individuals (National Research Council, 1998). If housing non-related individuals together, prior to mixing it is important that the individuals become familiar with each other and their surroundings, enabling them to establish dominance. Nutrition and diet (wild and captive) The cotton-top tamarin is an omnivorous primate, in captivity they will make up most of their diet with fruit, insects and small reptiles & eggs wherever possible. They will eat gum and sap, produced from the trees of the Colombian forest.

Cotton-tops get most of their water from the fruit that they consume, however will also lick moisture from leaves to keep themselves hydrated (Burton & Burton, 2002). There are various different fruits in the tropical forest that the cotton-top has access to, these including banana, starfruit, sugar apple, and papaya just to name a few, most of these fruits are not available to them in captivity (Jeff, 2017). In captivity their diet differs entirely than that of their wild diet.

They have very little fruit in captivity compared to what they would consume in the wild, their diet is made up mostly of vegetables. At the Rodbaston Animal Unit their diet is split into three stages, AM, Midday and PM. They are fed solely on pellets during their AM feed, the midday feed consists of 40g of green veg, 25g of brassica and 20g of live food. Their PM meal consists of 25g of root vegetables and 30g of fruit. The root veg can be steamed for 8-10 minutes, making it more palatable for the animal, steaming also breaks down starch, making it easier to digest. (Rodbaston, 2017). It is essential to give

captive animals supplements to make up part of a healthy diet, D3 is added into their diet, helping support healthy bones, heart and the nervous system.

Vitamin D3 is made up when the body is exposed to ultraviolet rays from the sun (Warren, 2002). As captive animals don't get enough natural sunlight to produce enough D3 in their bodies, they are given a D3 supplement weekly. Cotton top tamarins are gummivores, they naturally feed on gum and sap from the trees of the forest in the wild. Robaston will make up gum from a powder form and add it into the animals' diet, it is also used as part of their enrichment.

Adding gum into their captive diet enable them to perform similar behaviours as they naturally would. By placing the gum into logs or a gum feeder, this recreates the tamarins collecting gum from inside trees in the wild (Price E. , 1996). Housing and exhibit it is essential that all zoos have basic housing requirements for their animals, such as the right temperature, correct lighting and allow the animal to express natural behaviours. Cotton-top tamarins naturally live in humid temperatures, so it is important to try and recreate this as best as possible for them in captivity. The housing for the cotton-tops on the Robaston animal unit consists of a small enclosure which is covered in logs and ropes for the cotton tops to utilise, hanging baskets, a plant in the middle of the room, woodchips on the floor and a nest box high up in one corner. The wood chips can help protect a cotton-top if they fall from a high branch or from their nest box.

The branches and ropes inside their enclosure enable the cotton-tops to scent mark, which is a big part of their communication (Ph. D & Fite, Ph. D., 2005).

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To allow the tamarins to express natural behaviours, the branches inside their enclosure should be placed so that they can make pathways to their nest box. The nest box should be placed high up inside the enclosure as cotton-tops have a tendency to sleep all together at night.

Water should be readily available to the tamarins and food should be scattered around the enclosure to allow them to forage (National Research Council, 1998). Various different zoos will set out their enclosures differently, some will have an enriched enclosure, providing the animal with a realistic environment covered in high trees and plenty of foliage, enabling the tamarins to climb and jump through their enclosure as they would in the wild. Whereas other zoos will focus more on providing the animals with enrichment devices and having a more basic enclosure (Price E.

, Solitaire: Issue 23, 2002). Enrichment Food is used as part of enrichment programmes for most captive species. Food enrichment can keep an animal occupied and enhance their mental health by providing the animal with activities to do (Price, 2008). As cotton-top tamarins are very social animals and use scent marking as a communication method, it is important not to remove all of their scents when cleaning their enclosure.

A branch that has been scent marked could be left without cleaning, so that some of the tamarins' natural odours remain inside the enclosure.

Environmental enrichment can have great benefits for the cotton-tops by keeping them occupied and prompting natural behaviours. Popular devices such as gum logs, filled bottles or boxes with their favourite food or toilet roll cardboard can all be useful enrichment tools (Wolfe-Coote, 2005). Food can

be a great enrichment device, it is scattered inside the cotton-tops enclosure as part of their enrichment programme on the Rodbaston Animal Unit.

18g of eggs are scattered twice a week, 10g of seeds twice a week, and 10g of nuts twice a week (Rodbaston, 2017). Capture, restraint and transport Capturing callitrichids can be a difficult task, it needs to be done as gently as possible and with care. They are caught for many different reasons, they need to be caught for health checks, for weigh-ins, or for the transportation to the vets for example or if they are moving from one zoo to another. Any animal may get stressed out when trying to restrain and capture them, so the capture and restraint needs to be done quickly and efficiently to make sure that they are stressed for as little time as possible.

At Rodbaston some students are given the opportunity to capture and restrain various different animals on the unit. Callitrichids are captured every year by staff and some students for a full health examination and a weight check. Capturing the cotton-top tamarins needs to be done using thick protective gloves and a net. The net is placed over the cotton-top tamarins head, he is then held around his neck and rear area to support the animal, but this also gives the student/keeper a good grip of the animal. Once the cotton-top is held securely, their microchip is scanned to find out which animal they are, and then they are weighed. They are placed inside a cat box whilst the other tamarins are caught and weighed, and are then all released once each animal has been health examined and weighed.

It is very important that these checks are done extremely carefully and as quickly as possible as stressing an animal out too much can have detrimental

effects and can even cause death in an animal (Wolfensohn & Lloyd, 2008). Reproduction and hand rearing Cotton top tamarins are usually monogamous animals, the dominant pair will be the mating pair of a single group. Mothers will give birth to one or two non-identical twins. The father and siblings will assist in the raising of the infant/s and will do a lot of the handling and carrying of the young, handing them back to the mother when they are ready to be fed (Kostan & Snowdon, 2002). The mother needs plenty of help when it comes to looking after her infant, due to the infant being 25% of her body weight (ANGIER, 1994). Hand-rearing cotton-tops is sometimes necessary in captivity for various different reasons. For example the mother could be ill, she could reject the infant or may not be able to cope if she has a twin birth. Hand rearing is the last resort and is not encouraged due to infants needing to bond with their mother and the rest of the group, however sometimes hand-rearing is the only option for the health and safety of the infant.

Hand-rearing takes a lot of time and the infant needs to be reintroduced to the family as soon as possible. It is always advised to try and keep the infant within the group, even if it means removing them to feed them and returning them to their enclosure. Whichever way hand-rearing is done, it needs to be done with extreme care and needs to be monitored closely as callitrichids who are hand reared can show aggression and behavioural abnormalities (Anderson, Otto, Pritchett-Corning, & Whary, 2015). If it is not possible for a young cotton-top to be fed by its mother, formula feed should be made up and fed to the infant. They should be held as much as possible to feel secure and should be stimulated in order to urinate and defecate (Ruppenthal,

2013). Breeding and Care In the wild there is usually a single mating pair of a group of cotton-top tamarins, in captivity a mate is usually found for an individual to maintain genetic diversity within the captive species. Female cotton-tops will secrete a pheromone which will stop other females mating by suppressing ovulation, ensuring that she is the only female reproducing (Lang, 2005). Cotton-tops will give birth to a single individual or twins, and most members of a group will help raise the infants.

In captivity a cotton-top tamarins' gestation period is around 180 days, there is a possibility of them having up to four individuals per year in captivity as they are able to give birth every 6-7 months. With the right conditions and the correct care cotton-top tamarins can breed well, and tend to have rapid reproduction rates (Rollin, 1995). Most zoos will have a breeding programme which breeds endangered species to try and help maintain a population of a certain species. The zoo will also assist in preventing the species from going extinct by ensuring that the population in captivity is thriving. Captive breeding can boost numbers of an endangered species, with the goal of reintroducing them and replenish numbers back into the wild and into their natural habitat.

However reintroducing a species back into the wild is a very expensive and long winded process which doesn't always work as the species has become so used to its life in captivity, they rarely survive when reintroduced (MAESTAS, 2011). Population and breeding control There are only three cotton-top tamarin housed on the Rodbaston animal unit. Breeding in captivity has to be managed, to prevent inbreeding and any genetic

disorders. It is essential that there is as much genetic diversity as possible when it comes to the breeding of captive animals. A studbook is used which keeps a record of each captive individual, such as their sex and ancestry (Bell, 2001).

Many zoos will captive breed animals to try and prevent the species from becoming extinct, especially if they have a critically endangered status such as the cotton-top tamarin. A genetically healthy population needs to be maintained and if the same group of animals were to mate for long periods of time it would lead to inbreeding and a genetically unhealthy population (Kleiman, Thomson, & Baer, 2010). Zoos all work together to maintain a healthy population of animals, so breeding has to be managed carefully. Many zoos will place all female or all males in one enclosure rather than mixing sexes, this is one way a zoo can manage the population of their animals. If breeding were to take place a mate would be selected from a studbook, ensuring that the offspring has genetic diversity. Another way to control a population is by using contraception, this can be administered via injection or an implant, this way the zoo can manage and decide when the female is to have her offspring (Asa & Porton, 2005).

Rather than using contraception in the female she can have an ovariectomy or males can be castrated to prevent them from having any offspring. A more severe way of population control in zoos is euthanasia, zoos will often use this method on animals who are no longer fit to breed and there is no space for them in captivity and they are not fit to be released into the wild. Euthanasia can be used as a way of population control and healthy, surplus animals are

often killed, especially if they are no longer fit for mating purposes (Ruivo, 2010). Preventative medicine All keepers should be educated about preventative medicine and should know the signs of unusual behaviour in any animal that could mean they are unwell. The cotton-top tamarins on the Rodbaston Animal unit are worm checked regularly and are only wormed if necessary.

It is important that the cotton-tops are examined yearly and vaccinated against any diseases. Staff who are ill, have cold sores or have come into contact with anyone with measles should not go near the cotton-tops as they are very prone to pick up human disease and can become extremely ill (Rees, 2011). It is important that infant cotton-top tamarins are touched as little as possible and don't come into contact with humans often, due to being able to pick up human diseases and illnesses easily. The cotton-top tamarins should be monitored closely for signs of illness or disease, keepers at Rodbaston should be able to recognise if an animal is not displaying its usual behaviours or is acting out of the ordinary. Should this be the case a keeper should continue monitoring the animal closely and should capture the animal to undertake a full inspection to try and detect what is wrong with the animal. If the animal has a contagious illness/disease, all other animals inside the same enclosure should also be treated. During their yearly examination the cotton-top tamarins should have a full body health check. It is important that their teeth are checked as dental issues can lead to other problems such as abscesses and can cause an animal to be in a great deal of pain, they also may struggle to eat.

If any animal has signs of any dental problems, they should be taken to a vet to get them examined as soon as possible (Abee, 2012). A tetanus and rabies vaccination is recommended for captive callitrichids and should be administered around every two years. Pest control should be done regularly as most zoos have pests such as cockroaches and mice inhabiting some of their enclosures. As cockroaches and mice can transmit disease, it is important to make sure that enclosures are rid of any vermin as mice are particularly known to carry diseases that affect callitrichids (Gad, 2006).