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HUSBANDRY AND MEDICAL CARE OF CALLITRICHIDS

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Abstract

Callitrichids, marmosets and tamarins are small Central and South American nonhuman primates. All are considered threatened in the wild and many are on the endangered species list (Convention on International Trade in Endangered Species of Wild Fauna and Flora: Appendix 1). Because of their small size and anthropomorphic appeal, people are interested in owning callitrichids as pets. Hand-raised bottle-fed babies are quite charming until sexual maturity, at which time they often become aggressive and unpredictable to humans, including their owners. Consequently, people should be discouraged from keeping callitrichids as pets. If a veterinarian is consulted about callitrichids by a potential owner before purchase, it may be possible to offer encouragement toward a more suitable pet (e.g., ferret and sugar glider). Copyright 2014 Elsevier Inc. All rights reserved.

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Before making a decision to care for callitrichids in one's practice, it is very important that he or she checks all requirements from regulatory agencies to ensure compliance, especially regarding waste and biohazard management. Ownership of nonhuman primates (NHP) may be illegal in certain states, counties, or cities/towns, with additional regulations implemented at any level of government. To determine regulations regarding NHP ownership, one should contact their state Division of Wildlife or Fish and Game Department (names vary for each state), and for specific restrictions, one should examine local animal ordinances and zoning laws as well as homeowners association ordinances. Moreover, certain species of NHP may be allowed or prohibited (i.e., based on the species, weight, and length of ownership). The United States Department of Agriculture (USDA) requires a license for exhibiting and breeding NHP.¹

Choosing to treat NHP is a decision that requires serious deliberation and a thorough understanding of the legal implications of treating these animals, both for the owners and for hospital personnel. A veterinarian is required to be the doctor of record for any NHP owner who has a USDA permit for his or her animal. This entails writing a veterinary plan, enrichment criteria and activities, means of euthanasia, periodic visitation and examination of animals at the facility, plans for periodic testing, and applicable vaccinations. Being a veterinarian for a USDA facility that houses NHP requires a degree of commitment beyond what is expected for many of the more traditional pets.¹

It has been this author's experience that, as a rule, tamarins have a more stable, less volatile personality

than marmosets have. As adults, tamarins have a tendency to be less aggressive and more predictable than marmosets. Unfortunately, marmosets have very winsome features that many humans find appealing and are capable of a variety of facial expressions. Tamarins have much less facial hair (with some notable exceptions); however, they too can produce many facial expressions.

Keeping callitrichids in the home should be discouraged. They scent-mark just about everything in their environment by rubbing their perineal area on objects inside and outside of the cage, including their stewards, leaving a musky/urine odor. Callitrichids are highly intelligent and inquisitive animals that need environmental enrichment. They should be challenged with activities and new

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objects to investigate, with foraging behavior required as part of their daily activities.

In the wild, callitrichids live in family groups consisting of a dominant female and a dominant male. The dominant female secretes a pheromone that suppresses ovulation in the other females. Female callitrichids have an estrous cycle, and not a menstrual cycle, as occurs in other female primates. This cycle is approximately 15 days in most species. Callitrichids become sexually mature at approximately 16 to 25 months of age; however, copulation and masturbation may occur much earlier. The gestation period is approximately 150 days. Postpartum estrus typically occurs 9 to 10 days after parturition, along with distinct mating and birthing seasons.² Most often, callitrichids have twins, although singletons, triplets, and quadruplet births may occur.

DIFFERENCES BETWEEN MARMOSETS AND TAMARINS

Callitrichids are classified as New World NHP. New World primates are from the Americas, whereas Old World primates are native to Eurasia and Africa. Differences in marmosets and tamarins can be classified using 2 methods. Taxonomists distinguish the differences between marmosets of the genus *Callithrix* and tamarins of the genus *Saguinus* based on their teeth. The incisors of marmosets are enlarged, so that they are the same length as the canines, enabling them to gouge holes effectively in trees, so as to consume the nutritive gums and saps (called exudates). The canine teeth of the genus *Saguinus* are longer than the incisors, which enables these animals to inflict a deeper bite.² Because of the longer length of a tamarin's teeth, some governmental agencies have classified these animals as more dangerous than marmosets.

Although the tamarin's teeth may allow a deeper bite, the temperament of the innocent-faced marmoset is much more likely, in this author's experience, to aggressively attack owners, often biting the nose or ears. Some marmoset bites have resulted in owners requiring emergency medical care, including a tetanus booster and surgery, often necessitating facial plastic surgery.

One of the problems with hand-raised callitrichids is that they often become fearless around humans. These NHP may actively and aggressively defend their territory and their owner against strangers and family members. A tamarin or marmoset may quickly jump to a visitor's shoulder and attack the face or the ears, biting quickly and deeply, holding on for a prolonged

bite. They may bite multiple sites in the same area, whereas other callitrichids may attack the hands, toes, or knees as the preferred sites. Occasionally, an enraged callitrichid may bite the owner in a case of misplaced rage when it sees a person perceived to be a threat. Tamarins may also attack and bite family members and strangers. Marmosets vocalize a very specific sound, a rapid tick-tick-tick sound when angry, just before and during an attack.

Most marmosets are in the genus *Callithrix*. Depending on which taxonomist is consulted, there are 3, 9, or 12 species. Some taxonomists divide marmosets into *Callithrix* (Atlantic) marmosets and *Mico* (Amazonian) marmosets (<http://www.biolib.cz/en/taxonsubtaxa/id602590/>). Some species overlap in certain regions of South America, resulting in intergrades or hybrids (although this term is not usually used with *Callithrix*). A marmoset in the overlapping area may be considered a hybrid, a subspecies, or a separate species, depending on the taxonomist. The common or cotton-eared marmoset is *Callithrix jacchus*. The black-pencil-tuft-eared marmoset is *Callithrix penicillata*. Other marmosets are *Callithrix kuhli*, the kuhli or black-tuft-eared marmoset; Geoffroy's marmoset, *Callithrix geoffroyi*; the pygmy marmoset, *Cebuella pygmaea*; and others, for example, *Callithrix aurita*, *Callithrix flaviceps*, *Callithrix argentata*, *Callithrix humeralifer*, *Callithrix mausei*, and *Callithrix nigriceps* (Figs. 1 and 2).

The Goeldi's monkey (*Callimico goeldi*) is in a separate genus and species. This NHP differs from the *Callithrix* group, as it usually only produces a singleton and also has many anatomical and physiological differences.

Tamarins commonly treated by veterinarians are members of the genus *Saguinus*. As with marmosets, there are subspecies of tamarins that are not usually considered intergrades. The red-handed tamarin (*Saguinus midas*) is threatened in its range in Suriname. It, in this author's opinion, has the best temperament, as far as pet qualities are considered; however, that does not mean that owning this NHP species as a pet should be endorsed. The cotton-top tamarin (*Saguinus oedipus*) is endangered, as defined by Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). With its shock of white hair sticking straight up on the top of its head, it is quite arresting. The mustached tamarin (*Saguinus mystax*) is primarily black with white hair on the upper lip. Other tamarins include the emperor tamarin (*Saguinus imperator*), with spectacular white facial hair resembling a handlebar mustache; saddle-backed tamarin (*Saguinus fuscicollis*); and the white-lipped or red-bellied



FIGURE 1. The white-headed marmoset (*Callithrix geoffroyi*), also known as the tuft-eared marmoset, Geoffroy's marmoset, or Geoffrey's marmoset, is endemic to Brazil. Photo credit: Mrs. Linda Loethen

tamarin (*Saguinus labiatus*). Others include *Saguinus bicolor* and *Saguinus nigricollis*. There are additional tamarins in a completely different genus. The popular golden lion tamarin (*Leontopithecus rosalia*), black lion tamarin (*Leontopithecus chrysopygus*), black-faced lion tamarin (*Leontopithecus caissara*), and the golden-

headed lion tamarin (*Leontopithecus chrysomelas*) are endangered (Figs. 3-6).

VOCALIZATIONS

Callitrichids communicate by high-pitched tones, varying from chirps to loud, shrill whistles and



FIGURE 2. The common marmoset (*Callithrix jacchus*) is endemic to Brazil. Photo credit: Mrs. Linda Loethen



FIGURE 3. Older sibling red-handed tamarin (*Saguinus midas*) carrying a 3-day-old infant. Also known as the golden-handed tamarin and the Midas tamarin, it is native to the moist woodland areas along the Amazon River in South America. Photo credit: Mrs. Linda Loethen

screeches. Vocal communications between individuals occur in frequencies that are greater than human hearing, and they also produce audible vocalizations. The audible sounds used for communication have been studied extensively in cotton-top tamarins. As these animals are arboreal, which limits visual communication,

they have evolved complex vocal communication systems.³

BEHAVIORS

Both male and female marmosets may present genitalia from behind as a display, lifting the tail



FIGURE 4. Cotton-top tamarins (*Saguinus oedipus*) are found in tropical forest edges and secondary forests in northwestern Colombia. Photo credit: Mrs. Linda Loethen



FIGURE 5. An outdoor cage suitable for a family of callitrichids. The enrichment items in the habitat can be noted. Cotton-top tamarin (*Saguinus oedipus*) and red-handed tamarin (*Saguinus midas*) are shown. Photo credit: Mrs. Linda Loethen

and raising up and straightening out the hind legs, usually to a perceived threat. Back-arching, head-shaking, and tongue-flicking are signs of aggression and may precede an attack. Mature callitrichids can be territorial and aggressive.¹ Ovariosalpingohysterectomy or orchietomy does

not decrease aggressive behaviors and biting in NHP. These procedures do not make callitrichids better pets.

In an effort to minimize the effects of biting, owners of callitrichids may request removal of canine teeth. This is no longer considered to be



FIGURE 6. The black-tufted marmoset (*Callithrix penicillata*), also called “black-eared” marmoset, is native to Brazil. Photo credit: Mrs. Linda Loethen

appropriate veterinary care unless prescribed by the attending veterinarian for the treatment of individual medical problems concerning the teeth. Removal of canine teeth can cause considerable pain and discomfort to the animal and may result in chronic health problems, including fracture of the jaw. These procedures are no longer allowed under the Animal Welfare Act.⁴ This notice is also consistent with the current position statement issued by the American Veterinary Medical Association.⁵ Declawing should never be performed as this prevents natural climbing and may affect the animal's ability to properly hold food in the hand.

VITAL STATISTICS

The mean body temperature of callitrichids is between 37°C and 38°C (98.6°F to 100.4°F). The average life spans for marmosets and tamarins in captivity are 12 and 17 years, respectively; however, cotton-top tamarins have been known to live up to 25 years of age. The smallest marmoset is the pygmy, with an adult weighing approximately 130 g. A NHP gives birth to its first offspring when it is as young as 20 to 24 months, but sexual maturity is typically reached at 12 months for females and at 16.7 months for males.¹

Callitrichids can see in color and possess a duplex retina, consisting of rods and cones. These animals rotate the head from side to side to better estimate distance. The uterus is simplex with the placenta being labyrinthine and the attachment of the umbilical cord discoidal, or bidiscoidal in the case of twins. When pregnant with twins, usually 1 embryo is attached to each of 2 placental disks.¹

The male penis has a baculum that helps maintain stiffness during penetration. Chimerism is a normal phenomenon in callitrichids in which polyzygosity, usually dizygosity, occurs. Chimerism can be readily detected in heterosexual twins by the presence of both male and female sex cells in the tissues, especially hematopoietic and gonadal tissues.¹

One can easily determine the sex of callitrichids through visual examination of the external genitalia, even in newborns. In female primates, the urethra and vagina usually open into a common urogenital sinus. There is a shallow vulva with the urethra opening at the tip of the clitoris, with the vagina at the base.¹ Females also have a single pair of pectoral mammae.

Males have a scrotal sac that is parapenial. The testes are inguinal in juvenile or near-term fetal primates and scrotal in adults. The testes can be

retracted into the inguinal canals by all callitrichids and are often observed during the genitalia display.

Callitrichids' teeth are characterized as heterodont and diphyodont, with all deciduous teeth being replaced. The dental formula for callitrichids is $2/2 \ 1/1 \ 3/3 \ 2/2 = 32$; they normally lack the third molar.¹ Marmosets have a cecum specialized for digesting plant saps and gums (exudates).¹ The tail is not prehensile, but is useful for balancing. Callitrichids should never be caught or restrained by the tail as serious damage may occur.

DIET

An appropriate and varied diet is very important for callitrichids to remain healthy in captivity. Marmosets and tamarins are extremely intelligent and should be fed a rotating diet to prevent boredom and provide balanced nutrients.

Callitrichids are among the most omnivorous and opportunistic NHP. Most species consume gums and sweet saps produced by trees, gnaw and strip bark, and chew twigs. It seems that the gums and saps fill a nutritional requirement that is not always present in other available foods. Marmosets are considered to be gumivores and tamarins are seasonal gumivores. The common marmoset (*C. jacchus*) consumes more gums in the wild than any other marmoset does (15% of the diet).¹

Callitrichids present a challenge when we try to offer a nutritious and balanced diet in captivity because of their unique niche in feeding.

Most wild callitrichids naturally consume fruits, a high percentage of insects, small vertebrates, eggs, nectar, flowers, other types of seeds, buds, and green shoots along with $\leq 15\%$ gums and plant exudates, which contain high levels of calcium and crude protein. These animals may gorge on vegetable matter alone or on crickets, a mouse, bird, lizard, frog, or various combinations of anything considered edible.¹

The base diet for captive callitrichids should be canned marmoset diet (ZuPreem, Premium Nutritional Products, Inc., Mission, KS USA). Most callitrichids consume approximately 30 to 60 g of food daily, when offered ad lib.⁶ Canned marmoset diet can be supplemented with primate biscuits (Mazuri Primate High Fiber Sticks; Land O'Lakes, Inc., PMI Nutrition International, LLC, Richmond, IN). Vitamin C should be supplemented to the callitrichid diet.⁶ It is also recommended to supplement calcium to their diet to prevent hypocalcemic issues, especially in young, fast-growing animals. In addition to the

canned diet and primate biscuits, a variety of foods may be offered in rotation.

The following is an example of a daily diet for marmosets, recommended by the University of Nebraska, Callitrichid Research:

Day 1: 40 g of ZuPreem canned marmoset diet, approximately 20 g of orange pieces, approximately 20 g of fruit (varying: apple, pear, grape, melon, and banana), 2 Mazuri Primate High Fiber Sticks, approximately 10 g of fat-free yogurt live culture, approximately 10 g of unsweetened applesauce containing 50 mg of Tums (GlaxoSmithKline, St. Louis, MO USA) and 17 mg of vitamin C, approximately 10 g of cooked egg (chopped), and approximately 1 g of Colby-Jack cheese.

Day 2: 40 g of ZuPreem canned marmoset diet, approximately 20 g of orange pieces, approximately 20 g of fruit, 2 Mazuri High Fiber sticks, approximately 10 g of cottage cheese, and approximately 10 g of canned chicken.

Day 3: 40 g of ZuPreem canned marmoset diet, approximately 20 g of orange pieces, approximately 20 g of fruit, 2 Mazuri High Fiber sticks, approximately 10 g of fat-free yogurt, approximately 10 g of unsweetened applesauce containing 50 mg of Tums and 17 mg of vitamin C, and 10 medium mealworms. These 3 menus are rotated weekly.

Other foods that may be offered include raw peanuts, almonds, broccoli, carrots, cucumbers, yams, corn on the cob, peaches, plums, eggplant, celery, papaya, mango, cooked beans, raw string beans, cooked pasta, enriched breakfast cereals, and cooked oatmeal. Dog or cat kibble may be offered periodically. Scrambled eggs, cooked meats, deli meats, hard-boiled eggs, cottage cheese, other types of cheese, canned tuna, artificial crab, and cooked shrimp are considered good protein sources. Crickets (gut loaded with calcium), mealworms, and wax worms may occasionally be offered to the animals.⁷ It has been noted that transient diarrhea may occur from the ingestion of mealworms. Always feed high-quality insects and lizards (e.g., anoles), although callitrichids housed outdoors may catch and consume wild insects (e.g., moths and cockroaches).

A commercially available marmoset jelly (Land O'Lakes, Inc., PMI Nutrition International, LLC) that simulates the gums and saps that callitrichids would consume in the wild is available as a dry powder; it can be mixed with water to create a nutritional supplement.

Onions have been shown to cause Heinz body hemolytic anemia in many species of animals. It is best not to offer onions, food items containing

onions, or other plants in the Allium family (e.g., garlic, shallots, and chives), as these food items possess no necessary nutrients that cannot be provided by other food sources. The sulfoxides in these plants are responsible for red cell pathology.

NUTRITION ENRICHMENT

Callitrichids can easily become bored in captivity. Therefore, owners should become creative and provide nutritional enrichment through foraging by hiding insects in shredded paper, wood shavings, or dry oatmeal. In the wild, callitrichids spend as much as 60% of their day foraging and rarely encounter abundant food.¹ Distributing food throughout the day and making it more difficult to obtain helps stimulate the animal. Holes may be drilled in wooden perches or dowels for food insertion; such foraging devices simulate extractive foraging behavior.

Another device that allows increased time spent in food acquisition involves whole apples, oranges, corn on the cob, or other foods that can be speared onto the end of a stick and suspended from a branch in the cage. Food items suspended in this manner may be picked at by callitrichids as they hang by their hind legs.⁷ Treat cups on a chain with a lid and peek holes, designed for birds, may be used to hide favorite food items (e.g., mealworms). A simple cardboard canister with an appropriately cut hole in the lid may be used to hide mealworms or other treats.

TREATS AND SUPPLEMENTS

Callitrichids relish sweets and may be fed small quantities of marshmallows, gummy candies, cake, pudding, cookies, and animal crackers. It is frequently a good idea to hand-feed a small marshmallow or other sweet before sunset to ensure that the callitrichids are eating and will have some carbohydrates in their system before retiring for the evening. NHP can consume small amounts of milk chocolate products with no apparent ill effects. Many research facilities have used M&M candies (Mars, Inc., Hackettstown, NJ USA) as treats and rewards for reinforcing positive behaviors.

As a supplement, callitrichids should receive a quarter of a 250-mg chewable vitamin C tablet daily, as well as a drop of a pediatric oral liquid vitamin that contains vitamin D₃, or they may be offered a small piece of a children's chewable vitamin daily. Calcium carbonate chewable fruit-flavored tablets are an excellent source of calcium, and in most cases, they are well received by callitrichids. Nutri-Cal (Evsco Pharmaceuticals,

Buena, NJ USA) can also be offered, as it is an excellent nutritional supplement for an anorexic callitrichid.

HOUSING

Callitrichids like to sleep in an area where they feel secure. They prefer to sleep near the top of their enclosure and like to have towels, blankets, and stuffed animals for comfort. Ensure that there are no loose threads or holes in any blankets, which may result in constrictive injuries to limbs or even strangulation deaths. Most callitrichids go to sleep at sunset. Many commercially available cloth cubes designed for ferrets are appropriate as secure, warm, sleeping quarters for a singleton or a pair of callitrichids.

Callitrichids are active and require the largest cage possible, especially if they do not receive time outside the enclosure for exercise and playtime. A cage measuring 1 m × 1 m × 1.2 m would be adequate for them to jump and play. There should be at least one wooden perch or a natural tree branch in the cage for the animal to gouge holes in the wood with their teeth, performing a necessary behavior that also serves to maintain healthy teeth and gingiva.

Toys, ropes, swings, and other cage equipment should be provided for exercise and play. Callitrichids drink out of sipper tubes and water bottles. Food should be offered in a sturdy bowl. Newspaper is an adequate cage bottom substrate; however, the author uses disposable incontinence pads for better assessment of urine and feces.

If housed outdoors in warm weather, a large bowl, suitable for immersion, is often used by red-handed tamarins to keep cool.

Interaction with NHP can be supplemented with toys, but if a callitrichid was kept singly as a pet, it would rely on the human family to become its family group. However, it is not recommended that callitrichids be housed singly, unless required for a specific medical reason. Callitrichids should not be maintained alone for long periods. Although far from ideal, the cage should be housed near a window to provide visual stimulation, with other household pets, or near a fish aquarium; however, callitrichids should never be allowed direct contact with other family pets.

LIGHTING

If at all possible, marmosets and tamarins should spend some time outdoors during warm weather for exposure to natural, unfiltered sunlight. Callitrichids have very high vitamin D₃ requirements and may

suffer from nutritional secondary hyperparathyroidism (NSHP) unless this vitamin is supplemented in the diet and/or they are exposed daily to ultraviolet B light. Callitrichids housed indoors year-round should have high-quality full-spectrum fluorescent lights placed close to their cage; with the bulbs being changed every 6 months or according to the manufacturer's recommendation. However, there is no better substitute than natural sunlight; therefore, allowing the animal exposure to sunlight (not filtered through glass or plastic) is recommended, ensuring that they have access to shade and cool water and that the habitat is both escape proof and predator proof. Supplementation of vitamin D₃ in the diet should not be relied on to provide all that is necessary for optimal calcium uptake and utilization. In addition to a full-spectrum light, heat should be supplemented by providing a clamp lamp and a 60-W light bulb. These animals enjoy basking and many hang upside down to warm their bellies.

SCENT-MARKING

The use of olfactory signals and pheromones is highly developed in callitrichids, and they have numerous scent glands. The glands of the intermammary, gular, sternal, abdominal, and inguinal areas are used to mark runway branches. They use circumgenital glands to mark selected objects and their mates by swaying their posterior in a side-to-side motion. The ulnar-carpal glands leave scent on anything brushed against the arm. All glands imprint the offspring with the odor of the parents, family group, and species. Callitrichids scent-mark their areas by rubbing the perineum over many objects in their environment: toys, food dishes, bedding, stuffed animals, furniture, rugs, caging, owners, clothing, and even food items. Scent-marking is used for identification of a breeding pair and their offspring and for assertion of social status, sexual readiness, and territorial claims. It is used to invite and to repel, as well as to countersign the markings of others. Some tamarins mark by urinating into the hand and others may rub their cheeks in the urine of their sexual partners.¹ Marking in cotton-top tamarins (*S. oedipus*) occurs with much greater frequency in females than in males. Marking may vary significantly between different species. Callitrichids may be trained to defecate in a given area, and their urine does not have a very strong odor and they tend to urinate frequently in many locations.

It is impossible to prevent scent-marking, and owners should not attempt to remove all scent-marking in the habitat as this is considered normal behavior. Owners should not use diapers on these animals.

ZOONOTIC AND ZOOANTHROPONOTIC CONCERNS

An annual physical examination and stool culture evaluation should be carried out for pet callitrichids, specifically requesting cultures for *Salmonella* spp., *Shigella* spp., *Campylobacter* spp., and *Yersinia* spp. Feces should be examined for protozoan parasites too (e.g., *Giardia* spp. and trichomonads). Diagnostic blood tests may be indicated, including a complete blood count and plasma chemistry panel.

Humans with viral infections should not be allowed near marmosets and tamarins as a safety precaution in case the infection is contagious to the animals. Some tamarins have demonstrated titers against the influenza virus without becoming clinically ill. Measles can be fatal to callitrichids. If a callitrichid has contact with children, it should be vaccinated against measles (rubeola, which is a Morbillivirus). Vaccination against tetanus is recommended for all callitrichids.⁸

Human cold sores, caused by the *herpes simplex* virus (HSV), are extremely dangerous to callitrichids and may result in fatal encephalitis. It is important to realize that a human need not have an active herpetic lesion to transmit the virus to a callitrichid. In this author's experience, herpes encephalitis appears to be age related. Young marmosets and tamarins (<12 months of age) usually die within 5 days of developing signs of illness (typically 3 days after exposure). Older callitrichids do not appear as susceptible to this infection, or perhaps they develop an inapparent infection after which immunity is acquired. However, that does not mean that people should be careless. Herpes encephalitis is preventable in callitrichids, and anyone planning to own or handle these animals should be tested negative for HSV-1 and HSV-2.

People with human immunodeficiency virus or other immune system-suppressing diseases should probably not own primates because of the risk of transmission of a zoonotic disease.⁹ There is also the theoretical risk that human immunodeficiency virus may be transmitted to pet callitrichids; however, at this time there are no reports of this occurring. Other human viruses may occasionally cause disease in callitrichids, as they are susceptible

to arenaviruses and possibly some rhinoviruses. Other NHP such as squirrel monkeys (*Saimiri* spp.) and spider monkeys (*Ateles* spp.) may carry *Herpesvirus saimiri* and *Herpesvirus ateles*, respectively, which can be fatal to callitrichids.⁸

Although tuberculosis (TB) is rare in New World primates, callitrichids can be tested for TB using the intradermal skin test using mammalian old tuberculin. *Mycobacterium tuberculosis* may cause a slowly progressive respiratory disease. Old tuberculin (1500 U or 0.1 mL) is injected intradermally into the upper eyelid and the area is examined at 24-, 48-, and 72-hour intervals for the presence of edema, induration, or erythema. Depending on the situation, the NHP should be tested annually, or as recommended, depending on the risk of exposure, as callitrichids are usually exposed to TB from human contact.

There is risk of ocular damage when using the intradermal eyelid-testing site; consequently, discretion should be observed when selecting a location for TB testing (Richard Montali, oral communication, 2000).

HEALTH CONCERNS FOR CALLITRICHIDS

Callitrichids, especially juveniles, should be handled by as few humans as possible. If callitrichids are taken out in public, people should not be allowed to handle or touch the animals to limit the risk of disease exposure. Furthermore, because of the unpredictable nature of these animals, they can attack and bite strangers unprovoked, which may result in a lawsuit or rabies quarantine.

PHYSICAL EXAMINATION

Restraint methods of callitrichids are important skills to learn. Ensure that a room is secure, with 2 doors between the animal and escape. The room should have no hiding places, because if a callitrichid escapes, it will run and hide. Once hidden, it may be next to impossible to extract the animal from the hiding place until it chooses to come out.

Nets may be helpful in catching a callitrichid from a cage. If necessary, gloves may be employed, but as when handling birds, it is safer (for the callitrichid) to use bare hands with or without a towel. It is safe to grasp the patient loosely around the neck, and then restrain the hind legs. Remember that callitrichids have very dexterous hands and they grab at equipment or fingers, pulling them in toward the mouth to bite.

Inhalation anesthesia may be used if necessary, after ensuring that the callitrichid has been made to fast for an appropriate period (usually 8 to 12 hours). Make sure that the client understands the health risks related to anesthesia before performing any procedure.

Blood is usually collected from the femoral or the jugular vein, using only manual restraint. Catheters may be placed in either of the veins listed earlier, and on occasion, the cephalic or the saphenous veins are also used, although these veins are very small in callitrichids. As a rule, it is safe to remove 1.0 mL of whole blood from an adult callitrichid for blood testing; this should be adequate for routine blood testing. The femoral vein is easy to access, away from the head and the hands, is of adequate diameter for venipuncture without collapsing the vein, and easy to apply pressure to after the procedure to facilitate hemostasis.

Intraosseous catheters can be used; however, in this author's opinion, they appear to cause significant pain in callitrichids. Their use should only be considered if the animal is sedated and receives appropriate pain control medication. Consider using subcutaneous fluids with hyaluronidase (Wydase, Wyeth-Ayerst Co, Philadelphia, PA USA) at 150 U of hyaluronidase per liter of fluid to facilitate absorption.

During the annual examination, the callitrichid should be weighed and a fecal culture performed. The stool should be placed on a wet mount slide and examined for protozoa. A flotation should also be performed and the sediment examined specifically for thorny-headed worms, *Prosthenorchis elegans*, and *Trichospirura leptostoma*, a pancreatic worm that has been found in marmosets. Acid-fast staining may be performed on feces. A complete blood count and plasma chemistry panel should also be performed. Whole-body radiographic images are required for a thorough physical examination. Vaccinations should be discussed with the owner and administered.

Tetanus toxoid is required every 2 years. The rabies vaccination is controversial; a killed virus product is necessary if a decision is made to give it. Rabies vaccination is untested in callitrichids; therefore, both the veterinarian and the owner should be involved in the decision to use it. Canine killed rabies vaccines may be administered in cases where there is risk of exposure or for bite issues. Measles vaccination may be administered in cases where there is a risk of exposure to this disease.¹⁰ Measles is not naturally occurring in callitrichids and is considered an anthroponosis.

Teeth should be examined along with the oral cavity. If necessary, the teeth may have to be periodically cleaned. Tooth abscesses can result in an open infraorbital abscess draining on the face below the eye.

If the callitrichid is part of a group owned by a facility licensed by the USDA, their guidelines must be followed. Physical examination skills should be used, and an assessment of the animal from the head to tail should be performed. The abdomen can be palpated, especially for pregnancy or abdominal masses, and the chest auscultated. Check the animal for tattoos and a microchip. Cotton-top tamarins are the only NHPs that have been shown to spontaneously develop colon cancer.¹¹ However, this author has diagnosed colon cancer in several other callitrichid species.

SPECIFIC DISEASES

Bacterial infections are very common in callitrichids, including bite wounds, and they are often infected with multiple strains of bacteria. *Pseudomonas* spp. can be an important pathogen, usually causing bronchopneumonia.¹¹ *Yersinia* spp. can result in septicemia and may be transmitted to callitrichids from wild squirrels or other rodents.⁹ *Streptococcus zooepidemicus* septicemia has been reported in callitrichids.⁸ *Pasteurella* spp., *Klebsiella* spp., *Bordetella* spp., *Campylobacter* spp., *Shigella* spp., *Aeromonas* spp., *Salmonella* spp., and enteroadherent *Escherichia coli* may cause disease in NHP.

Many bacterial isolates have been associated with diarrhea, which is a very common clinical sign in callitrichids. Callitrichids with diarrhea require supportive therapy, with appropriate fluid and electrolyte therapy. Fluid therapy, even when administered subcutaneously, often makes the difference between recovery and death. Owing to their small size, and the fact that they can quickly become hypothermic when ill, it is recommended that the fluids be warmed before administration. Antimotility drugs that affect intestinal motility are often contraindicated. If the patient is vomiting, parenteral fluid therapy becomes more important, as well as parenteral antibiotics, if indicated.

Diarrhea is the most common medical problem diagnosed in NHP and may resolve spontaneously, or it may spread through a facility, causing serious, even life-threatening, dehydration or septicemia. Kaopectin (new formula: 0.2 mL, by mouth, every 6 hours: bismuth subsalicylate, Pepto-Bismol; Proctor and Gamble, Cincinnati, OH USA) and sucralfate (0.25 to 0.5 mL by mouth, every 6 hours,

Carafate Suspension; Hoechst Marion Roussel, Inc., Kansas City, KS USA) have proven effective in treating some nonresponsive diarrhea. Antibiotic suspensions, often in a pediatric formulation, are frequently palatable and accepted by callitrichids. Drug selection should be based on culture and sensitivity. Parenteral fluid therapy for affected animals may be the difference between life and death, especially in infants and juveniles.

Callitrichids with chronic diarrhea often crave protein. This author recommends offering plenty of cooked meats, cheese, scrambled egg, or other favored protein sources. Chicken sticks (Gerber Products Co., Fremont, MI USA) may be offered as an easy-to-feed protein source. Food labels should always be examined, especially baby food products, which may be enhanced with onion powder for flavor. Although a small amount of onion powder may not cause problems, continual feeding of this additive may result in Heinz body hemolytic anemia.

Hemosiderosis

Accumulation of iron pigment in the liver has been observed in some neonatal and adult callitrichids. Iron metabolism is not well understood in callitrichids. Unless otherwise indicated, it may be wise to use a baby formula that is low in iron to reduce the risk of hemosiderosis in NHP. Foods high in iron should be restricted. Moreover, fruit and vitamin C enhance gut absorption of iron, thus these food items should be fed judiciously.⁸ Vitamin C is required in the callitrichid diet; therefore, a nutritional balance of foods that pose a health risk must be achieved.

Viral Diseases

Lymphocytic choriomeningitis (LCM) is caused by an arenavirus and can affect a number of different primates. Rodents, including rats and mice, are reservoirs for the virus, which causes anemia and hepatitis in affected monkeys. LCM may be diagnosed in callitrichids maintained in cities, apartment buildings, or other suburban or rural areas where NHP may be exposed to rodents or their excretions. Transmission of the arenavirus is through aerosol contact.¹² LCM is a zoonotic disease; however, many adult humans have developed a protective titer against this disease. Callitrichids should never be fed pinky mice because of the risk of transmission of LCM.⁸

Encephalomyocarditis virus occurs most frequently in callitrichids housed in zoological collections; rats and mice are the suspected hosts of

the virus. Other viruses may also be transmitted to callitrichids from other NHP or humans.

Coronavirus and adenovirus have been isolated from these animals and are of questionable pathogenicity.⁸

Callitrichids are susceptible to eastern equine encephalitis and the other equine encephalitides. It is believed that marmosets and tamarins are susceptible to West Nile virus, hepadenovirus, and other hepatotropic viral diseases. In the laboratory setting, callitrichids have been used as viral models for other viruses, including hepatitis A.^{8,13}

Infection with Epstein-Barr virus resulted in the development of malignant lymphoproliferative disease, including lymphosarcoma, in a group of experimentally inoculated cotton-top tamarins.¹⁴ This author experienced a high correlation of lymphoma and leukemia in a group of marmosets given to our facility that had tested positive for cytomegalovirus infection.

Parasitology

Toxoplasmosis is rarely diagnosed in callitrichids; however, *Giardia* spp. occurs with greater frequency in these animals and may cause diarrhea and malabsorption. Tamarins and marmosets are exposed to spirurid nematodes and thorny-headed worms (*Prosthenorchis elegans*) through the ingestion of cockroaches and coprophagous beetles. *P. elegans* infections can cause intestinal perforation, peritonitis, abscesses, and death in callitrichids. Consequently, surgery is required to remove this thorny-headed worm.

When large numbers of *Trichospirura leptostoma*, the pancreatic worm, are identified in marmosets, affected animals may present with pancreatitis, chronic nonresponsive diarrhea, lethargy, rough hair coat, and alopecia of the tail. Initially, the overt clinical signs include weight loss, polyphagia, muscular weakness, ataxia, progressive rear limb paralysis, emaciation, and death. The number of *T. leptostoma* commonly identified in the pancreatic ducts of wild marmosets range between 1 and 31 (average < 10 worms per animal), but it may reach up to 300 worms and larvae in a single individual. Two species of cockroaches are considered the intermediate host of the pancreatic worm, and affected callitrichids are exposed to the parasite when they eat the cockroaches. The life cycle of this worm is 14 to 15 weeks, including 5 to 6 weeks in the cockroach. After ingesting an infested cockroach, the prepatent period is estimated to be 8 to 9 weeks. A definitive diagnosis for *T. leptostoma* may be difficult because worm eggs containing

fully developed larvae are excreted infrequently and at irregular intervals. Treatment for pancreatic worm infection should include supplementation with pancreatic enzymes, vitamin supplementation, supportive care (e.g., fluids and heat), and treatment for secondary infections. Fenbendazole is the recommended anthelmintic as it provides adequate therapeutic levels to reduce or eliminate the worm burden of the patient.

Human pinworms, *Enterobius vermicularis*, have been found in callitrichids. Conversely, the *Enterobius* sp. found in callitrichids also survives in a human host.¹⁵ With most NHP cases, pinworms are not considered pathogenic, although there are reports of these parasites being the underlying cause of serious enteritis by invasion of the intestinal wall, which may result in death. The raccoon roundworm, *Baylisascaris procyonis*, causes visceral larval migrans in callitrichids, including cerebral nematodiasis. The oral spirurid (*Gongylonema pulchrum*), or gullet worm, is frequently embedded in the lingual mucosa within the oral cavity of callitrichids.¹⁶ Another spirurid nematode, *Ptergodermatites nycticebi*, has been linked to serious disease in golden lion tamarins.⁸ Although callitrichids may be a host for *Entamoeba histolytica*, this parasite does not appear to cause serious disease in this group of animals.¹⁷

Toxins

Lead toxicosis is not an uncommon diagnosis in marmosets and tamarins, especially animals that live in old apartments or houses painted with lead-based paint. The small monkeys are inquisitive and ingest medications prescribed for humans and other animals. Callitrichids are very interested in anything humans ingest and may try to snatch a pill or tablet away from unsuspecting owners. They have also been known to chew through blister packs containing tablets. Other toxicoses, of any kind, are not common in callitrichids.

Hypertension

Older or overweight pygmy marmosets may suffer from hypertension and related cardiovascular diseases. The pygmy marmosets that become overweight are often fed an inadequate diet that is high in fat and cholesterol.

Urinary Tract Disease

Callitrichids have a relatively high incidence of glomerulonephropathies, renal failure in geriatric animals, and cystitis caused by bacterial

infections.⁸ Renal disease in pygmy marmosets resembles forms of hypertensive nephropathy associated with vascular lesions.⁸

Metabolic Diseases

Diabetes mellitus is diagnosed primarily in middle-aged and overweight callitrichids. Recommended treatment for the tamarin and marmoset with diabetes mellitus includes dietary changes, injectable insulin, and/or oral glycemic medications.

NSHP, metabolic bone disease, or rickets may develop in young animals that are weaned prematurely. Susceptible animals are usually housed indoors without exposure to natural unfiltered sunlight or an artificial full-spectrum light. Radiographic images of animals diagnosed with NSHP often reveal radiolucent cortices of the entire skeletal structure, especially the long bones, and pathologic or folding fractures. Deformities of the spine and lower mandible may also be noted in more severe cases with metabolic bone disease. Deformities of the carpi and tail are also observed in monkeys with rickets. Serum chemistry results of suspected patients may reveal a low serum calcium level and, in severe cases, a concurrent elevated serum phosphorus. Treatment with calcitonin-salmon injections (Calcimar, Rhone-Poulenc Rorer Pharmaceuticals, Collegeville, PA USA) has been found to be effective in tamarins and marmosets diagnosed with NHP. After pretreating with injectable and oral calcium supplementation for 2 to 3 days and providing supportive care, injections of calcitonin-salmon help repair bones by drawing calcium from the blood and making it available to the bone matrix.

Reproductive Issues

Callitrichids should not be spayed or neutered in an effort to improve their pet quality. However, when contraception is necessary or required, in most cases, organizations have begun requesting vasectomies in males instead of performing ovariopalingohysterectomy or tubal ligation in females or by attempting hormonal contraceptives. Vasectomy is easy to perform in males and there is a quick recovery time when compared with reproductive abdominal surgery in a female.

Dystocia most often occurs in primiparous females, or those carrying a large singleton. Females carrying twins, triplets, or quadruplets may also experience dystocia if the neonates become entwined.

A pregnant female marmoset or tamarin that has never carried infants, has not been raised in a family group, and/or is a first-time mother may kill and consume one or more of her infants on delivery. Some of these monkeys begin by chewing the umbilical cord and placenta, and then continue to chew off (and consume) the tail, legs, face, or any other part of the body of the newborn. It may be possible to remove an injured infant shortly after the event, and with appropriate care, successfully foster it. Surgical amputation of a mangled limb or tail can be performed quickly to minimize long-term damage. Callitrichids adapt to being raised without a tail for balance, and a 3-legged marmoset or tamarin can be as nimble as a 4-legged conspecific.

To prevent this sort of incident, the author recommends allowing young callitrichids to be introduced to stable, healthy infants (of any species), and over time, allowing them to carry babies under close supervision.

With a female callitrichid possessing 2 mammae, feeding triplet or 4 or 5 infants becomes problematic. Often, the strongest or largest infant survives, and smaller or weaker ones perish without intervention. In some facilities, it is possible to rotate the infants with parents, providing supplemental heat, stimulation, and feedings of siblings, and then returning them to the family group, and removing one or more siblings for bottle-feeding.

It must be remembered that, most of the time, the alpha male carries infants and passes them to the alpha female for nursing duties. As a family grows, older siblings are entrusted to care for and carry infants, thus teaching them valuable parental skills.

Ill or abnormal infants often become weak and are unable to cling to the parents, and they may be scraped off by adults or subadults and left to die of hypothermia and dehydration. It may be possible to retrieve weak or ill infants for treatment and bottle-feeding, or in some cases, reintroduction into the family group.

Cesarean section may be indicated for a female NHP with a dystocia. As female marmosets or tamarins often go into labor shortly after sunset, a dystocia might not be realized until 8 to 12 hours later if the animal is not monitored throughout the night. Most successful deliveries occur within 1 hour of onset of labor. By morning, the pregnant female may be exhausted and she may have stopped having contractions (uterine inertia). It is important to know whether the female has begun to experience labor or the amniotic sac has ruptured. If the amniotic sac has ruptured and the cervix is open, infection and loss of the infant(s)

may occur within 24 hours. It is possible to ascertain if the amniotic sac has ruptured by taking a sterile swab, moistened with sterile saline, and gently swabbing the vaginal canal. Roll the collected liquid onto a glass slide and examine it under a light microscope. Dried amniotic fluid appears as rainbow-hued ferning on the slide.¹⁸ If the amniotic sac has ruptured, it is likely that the female will require emergency surgery. Medical therapy may be employed if the neonates are not too large, as determined by radiographic or ultrasound images. Oxytocin (Pitocin; PAR pharmaceutical, Woodcliff Lake, NJ USA), parental calcium, fluid therapy, vitamin D₃, and antibiotics may be used to assist with the passage of the neonates through the pelvis. The dosage that the author has found to be effective for uterine inertia is 0.15 U administered intramuscularly, initially, followed by additional intramuscular injections every 20 minutes at increasing dosages of 0.2, 0.5, 1.0, and 2.0 U. To accurately dose small volumes, one can dilute the oxytocin with lactated Ringer solution⁹ (Table 1).

GENERAL INFORMATION REGARDING ILL CALLITRICHIDS

A healthy callitrichid predictably arises at sunrise if housed outdoors. These NHP settle down and enter their sleeping quarters near sunset. However, those housed indoors often adapt to the schedule of their human family. In this author's experience, tamarins still retire at sunset and stay down for the night; however, marmosets seem much more flexible regarding sleep habits.

Any change in sleeping patterns, such as sleeping during the day, not awakening at the usual time, and going to sleep early, or heat-seeking, can be a sign that an animal is suffering from a disease condition. Some callitrichids in family groups sit quietly, grooming, nursing, or caring for infants, and some, especially geriatric monkeys, may nap during the day, especially during the heat of the day. Changes in the normal routine and eating habits or other unusual behaviors should alert an owner to possible medical problems.

A sick callitrichid usually seeks heat. Ill callitrichids should be provided with a heating pad, on low, protected by a towel to prevent burns, and it should be ensured that the patient cannot crawl directly onto the heating pad. Alternatively, a 60-W light bulb with a clamp lamp may be used, although this may interfere with normal sleep cycles. A red heat lamp may also be used for warmth. A dark box should be offered as sleeping quarters. Hospitalized patients should be handled

TABLE. Reference ranges for physiological data values

Test	Units	Common Marmoset		Black-Eared Marmoset		Cotton-Top Tamarin		Red-Handed Tamarin	
		Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
White blood cell count	$\times 10^3$ per μL	7.214	3.031	11.2	4.383	10.96	4.778	15.51	8.659
Red blood cell count	$\times 10^6$ per μL	6.09	1.01	6.09	0.71	6.26	0.73	6.43	0.66
Hemoglobin	g/dL	15.2	2	14.9	1.5	15.4	2	16.1	1.9
Hematocrit	%	46.7	7.8	46.5	3.4	47.7	5.9	49.7	6.4
MCV	fL	76	10	70.7	0.5	76.8	7.5	80.9	4.1
MCH	pg/cell	25.2	3.1	23.2	0.8	24.7	2.1	25.9	1.6
MCHC	g/dL	33.2	3.7	32.3	1.1	32.6	2.7	32	1.7
Platelet count	$\times 10^3$ per μL	599	282	555	109	325	122	396	130
Nucleated red blood cells	/100 WBC	4	4	9	7	2	2	4	6
Reticulocytes	%					0.6	0.8	1.4	1.6
Segmented neutrophils	$\times 10^3$ per μL	3.54	2.075	6.13	2.448	6.783	4.04	7.623	4.511
Lymphocytes	$\times 10^3$ per μL	3.724	1.824	4.948	2.79	3.389	1.769	5.979	4.313
Monocytes	$\times 10^3$ per μL	0.255	0.265	0.415	0.253	0.627	0.567	1.122	1.168
Eosinophils	$\times 10^3$ per μL	0.183	0.137	0.379	0.427	0.214	0.166	0.427	0.333
Basophils	$\times 10^3$ per μL	0.126	0.13			0.117	0.073	0.252	0.188
Neutrophilic bands	$\times 10^3$ per μL	0.175	0.239	0.205	0.165	0.308	0.434	0.516	1.082
Calcium	mg/dL	9.3	1.1	9	0.9	8.8	0.9	8.2	0.9
Phosphorus	mg/dL	5.6	2.9	5.1		5.3	2.5	6.6	2.8
Sodium	mEq/L	149	6	158	8	151	8	154	7
Potassium	mEq/L	4.1	2	3.6	0.8	4.2	1.3	4	1.4
Chloride	mEq/L	106	8	105	4	105	9	108	4
Bicarbonate	mEq/L					12.8	7.6	23.6	5
Carbon dioxide	mEq/L	21.8	3.2	13		18.9	5.4	16.9	4.9
Osmolarity	mOsmol/L					324	31		
Iron	$\mu\text{g}/\text{dL}$	129				111	56	118	70
Magnesium	mg/dL	1.9				1.06	0.76		
Blood urea nitrogen	mg/dL	18	5	20	5	15	7	15	6
Creatinine	mg/dL	0.5	0.2	0.4	0.1	0.6	0.3	0.5	0.2
Uric acid	mg/dL	0.6	0.2			1.3	0.8	0.8	1.3
Total bilirubin	mg/dL	0.3	0.2	0.8		0.4	0.3	0.4	0.4
Direct bilirubin	mg/dL	0				0.1	0.1	0.2	0.2
Indirect bilirubin	mg/dL	0.3	0.3			0.2	0.2	0.3	0.2
Glucose	mg/dL	191	66	155	92	176	84	185	78
Cholesterol	mg/dL	163	56	403		117	42	116	62
Triglyceride	mg/dL	236	127			64	35	88	56
Creatine phosphokinase	IU/L	312	171			696	943	625	776
Lactate dehydrogenase	IU/L	511	311	631	255	465	284	899	976
Alkaline phosphatase	IU/L	107	67	136	165	210	218	189	127
Alanine aminotransferase	IU/L	30	42	16	10	45	45	41	41
Aspartate aminotransferase	IU/L	130	59	99	56	197	94	184	94
Gamma glutamyltransferase	IU/L	6	5	37		17	11	7	5
Amylase	U/L	350	288			852	661	1927	1554
Lipase	U/L					84	85	28	18
Total protein (colorimetry)	g/dL	6.6	0.7	7.1	0.9	6.6	0.8	6.4	0.7
Globulin (colorimetry)	g/dL	2.4	0.5			2.8	0.7	2.7	0.5
Albumin (colorimetry)	g/dL	4.1	0.7			3.9	0.6	3.5	0.5
Gamma globulin (electrophoresis)	g/dL							1.6	
Fibrinogen	mg/dL					250	71		
Albumin (electrophoresis)	g/dL					5.1	0.6	2.6	
Alpha-1 globulin (electrophoresis)	mg/dL							0.4	

TABLE. Continued

Test	Units	Common Marmoset		Black-Eared Marmoset		Cotton-Top Tamarin		Red-Handed Tamarin	
		Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Alpha-2 globulin (electrophoresis)	mg/dL							0.6	
Lead	µg/dL							0	
Cortisol	µg/dL					570			
Total thyroxine	µg/dL					2	0.3		
Body temperature	°F	100.2	2			101.1	1.6	101.1	1.6

MCH, mean corpuscular hemoglobin; MCHC, mean corpuscular hemoglobin concentration; MCV, mean corpuscular volume; St Dev, standard deviation; WBC, white blood cell. These values are for adult callitrichids, as values for juveniles may be different. (Courtesy: Briana Zupko.) Source: "ISIS 2002."

as little as possible, and favorite foods should be offered. If possible, owners should be allowed to treat their pets at home, as these animals become quite attached to family members and may suffer from separation anxiety.

DEATH AND NECROPSY

Any callitrichid that dies should receive a complete necropsy and any appropriate tests, including histopathology, especially if there are other monkeys in the facility or home, and also because of potential risk of zoonotic disease. Owners often anthropomorphize their pet callitrichids and often grieve deeply after the loss of their pet. Grief counseling and support for grieving owners should be considered.

Other callitrichids in the home would be curious about the deceased pet and if there is no overt risk, they should be allowed to perform a cursory examination of the corpse, as a form of closure. A postmortem intussusception should not be mistaken for true pathology, as this has been known to occur after death.¹¹

RESTRICTIONS

A federal permit or license is not needed to own a callitrichid. However, if sold or purchased across state lines, the seller is required to possess a Federal Fish and Wildlife Permit, issued by the Department of the Interior, US Fish and Wildlife Service. This permit is commonly called Captive Bred Wildlife permit.¹⁹ If a callitrichid is classified as endangered by CITES, a special permit is necessary. Some facilities bypass CITES by donating endangered animals instead of selling them.

CONCLUSIONS

Marmosets and tamarins are beautiful, intelligent monkeys. However, if a client is not familiar with

ownership of these monkeys, it should be ensured that he/she only purchase an animal from a reputable, USDA-licensed breeder and that the infant or juvenile is indeed healthy. This author has witnessed inexperienced veterinarians sign health certificates on juveniles that were underweight and undersized for their age, yet the veterinarian of record did not realize this problematic condition.

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