

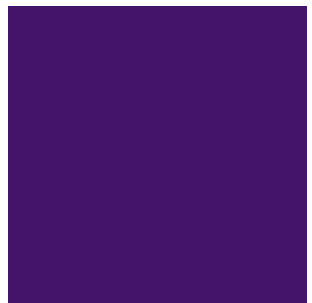
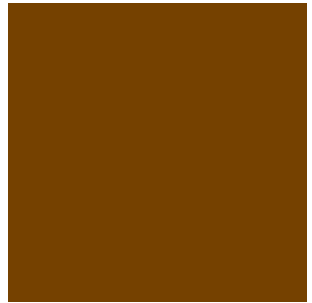
Squirrel Monkeys (Saimiri)

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enrichment
for nonhuman primates



Introduction

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Nonhuman primates maintained in captivity have a valuable role in education and research. They are also occasionally used in entertainment. The scope of these activities can range from large, accredited zoos to small “roadside” exhibits; from national primate research centers to small academic institutions with only a few monkeys; and from movie sets to street performers. Attached to these uses of primates comes an ethical responsibility to provide the animals with an environment that promotes their physical and behavioral health and well-being. Thus, an obligation is entailed that those individuals/institutions caring for captive primates should make every effort to ensure adequate veterinary care and husbandry are provided, that the animals are housed in appropriate facilities, and that as broad a range of species-typical behaviors are able to be expressed by the animals as is possible for the captive environment.

This book serves as an introduction to the basic behavior and environmental enrichment of several species of nonhuman primates that are more commonly used in education, research and entertainment. In many ways, this book is meant to be a “how to” manual; it is not intended to be a broad scientific review of the primate behavior and enrichment literature. The fundamental premise taken throughout each chapter is that for an enrichment program to be effective, there must be a basic understanding of the biology and behavior of the primate species. The species addressed in this series are: baboons, capuchins, chimpanzees, macaques, marmosets and tamarins, and squirrel monkeys. Each species-section can be read as a stand-alone document without need to reference the other sections. This then allows the user to distribute the different sections to personnel caring for the specific animals.

Each section is divided into five parts: 1) Background, comprised of the habitat of the primate, the physical features of the primate, its psychological and/or



social behavior, and its mating and reproductive behavior; 2) Social World; 3) Physical World; 4) Special Cases, describing any age-related considerations and concerns associated with individual housing; and 5) Problem Behaviors. The content of this series has been provided by members of the Association of Primate Veterinarians (APV) and the American Society of Primatologists (ASP) who have special expertise in the species addressed. This book is intended to be a primer because it is, indeed, an introduction to the subject of environmental enrichment for primates housed in a diversity of conditions. A list of references and/or other resources (principally on-line) is provided at the end of each chapter that provide additional guidance. The use of scientific references has been limited, but should the reader desire more information about a specific subject, the links at the end of the sections will provide direction to obtaining additional detailed information. Readers are also directed to the National Research Council publication, the Guide for the Care and Use of Laboratory Animals (1996) and the U.S. Department of Agriculture's (USDA) Animal Welfare Regulations to review the regulatory requirements of the Public Health Service and the USDA for the provision of environmental enrichment.

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—Kathryn Bayne, M.S., Ph.D., D.V.M., DAACLAM, CAAB
Editor, Working Group

This project is dedicated to the memory of Dr. Sylvia Taylor, Veterinary Medical Officer, Animal Care, U.S. Department of Agriculture, who was a proponent of providing enrichment to nonhuman primates and was generous in sharing her knowledge and expertise in this regard.

Squirrel Monkeys

Background

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Habitat

Squirrel monkeys are inquisitive, predominately tree-dwelling primates that spend the majority of their time in the middle level canopy of the forest. Their distribution includes an isolated population in the rainforest of Costa Rica and virtually the entire Amazon Basin of South America. In the wild, squirrel monkeys inhabit most types of tropical forest including both wet and dry forest, continuous and secondary forest, mangrove swamps, riparian habitat, and forest fragments. They are very flexible in their ability to adapt to different environments and, in some geographic areas, appear to prefer habitats that have been disturbed by humans.

Physical Features

The male squirrel monkey weighs approximately 550-1135 grams, while the female weighs from 365-750 grams. The male exhibits an increase in body weight-- particularly in the arms, shoulders and trunk of the body-- during the breeding season, referred to as the “fatted male” syndrome. This increase in body weight is accompanied by an increase in spermatogenesis. The tail of the squirrel monkey is long, but not prehensile. The legs are longer than the arms. The hair coat is short and dense, with coloring ranging from grey-green on the back of the animal to white, yellow or orange on the underside. There is typically a tuft of black hair on the tip of the tail.



Squirrel monkey in a complex, naturalistic environment (photo courtesy of C. Abee).



Wooden branch used as a perch (photo courtesy of C. Abee).

Behavior

Squirrel monkeys are omnivores that eat insects, eggs, and small vertebrate animals, in addition to various fruits, flowers, and tender leaves. In captivity, squirrel monkeys can live to be 25 years of age.

Squirrel monkeys primarily use all four limbs to move, employing their tails for balance as they navigate along tree branches. They occasionally stand on two limbs to walk short distances and to grasp food items with both hands. As a tree-dwelling species, they make use of vertical as well as horizontal space. Although they often descend to the ground or floor of their enclosure, they prefer to leap from perch to perch. Lacking the bone structure for sitting, they perch rather than sit, frequently using their tails for balance. Perches should be round in shape rather than flat shelves, as the development of pressure sores on the tail has been associated with flat shelves.

Social interactions frequently observed within squirrel monkey groups include grooming behaviors, “calling” (i.e., vocalizations), play, displays of aggression, and huddling. Vocalizations help to maintain the social organization of squirrel monkey troops. Squirrel monkeys use calls to enhance group coordination and cohesion. It has been suggested that squirrel monkeys can differentiate individuals using vocal cues and communicate within the troop even when they cannot see each other.

Communication between animals within a given social group includes olfactory, visual, and vocal signals. Olfaction is most important during the breeding and birthing seasons. Males use scent to determine the receptivity to mating of females. In addition, female monkeys use scent to identify individual infant animals. When cleaning the animals' enclosures, it is beneficial to the monkeys to avoid strong, artificially scented products.

Visual cues are of primary importance in visual displays. Squirrel monkeys make these displays in an attempt to assert dominance or reduce tension between individuals. Visual cues involving facial expressions can be associated with fear or aggression. A penile display, associated with spreading of the thighs, is considered to be a dominance gesture. Enclosures should provide a place for a submissive monkey to break the stare of a more aggressive monkey. Such places are called "hide-boxes" and can be made from a piece of a large-diameter polyvinyl chloride (PVC) pipe or another impervious material.

Vocal signals are of the utmost importance for squirrel monkeys. Infants possess a wide repertoire of sounds, including grumbles, cackling, purrs, chucks and peeps. These sounds communicate the well-being of the infant to the mother. In adults, calls are used to signal alarm, to display general disturbance or excitement, and to establish contact with the group when visually separated.

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Mating and Reproduction

Social behavior in squirrel monkeys depends on the phase of the reproductive cycle. These monkeys become sexually mature at approximately three to four years of age. While reproductive efficiency declines beginning at about 12 years of age, they can continue to reproduce for several more years. During breeding season (December through February in the northern hemisphere), male monkeys tend to be more inquisitive, aggressive, and active. At the same time, receptive female monkeys are less likely to respond with an aggressive display or facial expression when approached. After the breeding season, males become less involved in the social group, often remaining on the perimeter of the group. Females tend to perch with other females of similar age. These female-female interactions may include infant-care sharing and grooming behaviors.

The gestation period lasts approximately 168-182 days. During the birthing season (usually May to August in the northern hemisphere), older females without

infants will act as “baby-sitters” or “aunts,” often carrying infants for the mother. This maternal behavior by females other than the mother may include nursing another female’s infant. This is a common characteristic of squirrel monkey breeding groups. Occasionally, juvenile animals can pose a threat to nursing infants as they can be aggressive to the new babies. Care should be taken when housing expectant/new mothers with juvenile animals.

Social World

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Consideration of the needs of squirrel monkeys in captivity should extend beyond their basic physiologic requirements. These animals possess a host of behaviors that define their species. Putting forth the effort to enhance psychological and physical well-being of squirrel monkeys is essential to meeting the needs of this species. Through a well-conceived plan of environmental enrichment, good husbandry practices and a sound program of veterinary medical care, anxiety and boredom can be alleviated and natural behavior typical of this species can be promoted.

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*Carrying of an infant squirrel monkey
(photo courtesy of C. Abee).*

In the wild, squirrel monkeys live in large social groups (“troops”) containing 20 to 200 animals. In captivity, social group size and age and sex ratios differ depending on the limitations of the housing available and purpose for maintaining the animals.

Efforts should be made to house the highly social squirrel monkeys in pairs or small groups whenever possible. Social groups should be maintained with animals born into the social group remaining in

the group as long as is possible. Generally, it is recommended that social groups maintained in captivity include only one or two adult males per group, because



A social group of squirrel monkeys (photo courtesy of C. Abee).

fighting may develop among males if more than two are housed together within the social group. Most of the time, females of varying ages can be housed in social groups of two or more with only occasional difficulties with incompatibilities of group members. In fact, housing multiple females per group provides breeding animals the social structure necessary to reproduce efficiently. To maximize breeding efficiency, as many as 20 females can be housed with a single male. An optimal ratio, however, is one male per eight to ten females.

Groups that have access to a semi-natural environment with more living space are able to accommodate more adult males within the same groupings due to the increased complexity and size of the environment, the possibility of emigration to an adjacent group within the enclosure, and the increased provision of hiding areas.

Physical World

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Housing

Both indoor and outdoor group pens can be designed for squirrel monkeys. Physical comfort of the animals is important in reducing stress and promoting the well-being of colony members. Animals in outdoor pens have the opportunity to control aspects of their environment by moving through their pen (e.g., sun or shade). The animals are generally free to seek the place they wish to spend their time. Animals in these pens can also self-regulate the amount of exposure to other animals by moving within their pen. Perches should

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be positioned at several levels within the living area for climbing and jumping. These perches can be constructed of PVC pipe, which is impervious to water, easily cleaned and not highly thermoconductive. Wood perches can also be used as long as they are replaced once they become excessively soiled or become otherwise deteriorated. As noted previously, flat shelves should be avoided due to the potential development of pressure sores on the tail of the animal. Large PVC pipe sections can be provided for animals to “hide” in, allowing them to break eye contact with other members of their social group during aggressive encounters. Finally, certain positions within the pen allow the monkeys to view, and be viewed by, other social groups, while other positions will greatly restrict the number of other animals the individual can see or be seen by.



*A hiding area for squirrel monkeys
(photo courtesy of C. Abee).*

Animals housed in indoor cages, on the other hand, have a limited ability to regulate their exposure to animals housed in other cages by positioning themselves in such a way as to limit their ability to view other animals. Cage configuration will determine the number of monkeys that can be housed. Rack caging can be used to house small groups, pairs, or single animals.



A plastic chain swing (photo courtesy of C. Abee).

These cages should also have perches at varying heights to enable the animals to maximize their three-dimensional use of space. The *Guide for Care and Use of Laboratory Animals* (NRC 1996) and the Animal Welfare Regulations (1991) provide minimum cage space guidelines and requirements.

In the laboratory setting, it is best to allow the animals to communicate through olfactory, visual, and vocal signals. Even in singly-housed animals, this communication can be preserved by arranging the cages to enable the animals to smell, see, and hear each other. Outside noise should be kept to a minimum so that the group-housed monkeys can hear each other's vocalizations. By group-housing animals whenever possible, communication becomes an important form of social enrichment.

Each cage should be provided with swings, moving perches, or objects hanging within the cage. These can be made of either a plastic chain, looped PVC tube, or other similar materials. Smaller, rack-mounted cages will need to have at least one such device, while larger group cages should have two or more, depending on the number of monkeys in the cage. Loose hanging devices should not be included in individual cages where the room taken up by the swing would limit movement of the animal or where the swing is not appropriate for clinical reasons.

Being neotropical primates, squirrel monkeys thrive in warm temperatures. In captivity, temperatures should be maintained between 78°-85°F. Relative humidity should be maintained above 50% if possible. If relative humidity falls below 30%, squirrel monkeys can develop crusts around the nostrils and frequent sneezing. Special care must be taken in cooler climates to prevent hypothermia.

Enrichment

In all caging conditions, a number of different food items and perch arrangements can be used to vary the environment of the animals and consequently increase activity levels and sensory stimulation. Perch arrangements with hanging objects, such as infant toys and practice golf balls, should be rotated and replaced routinely.

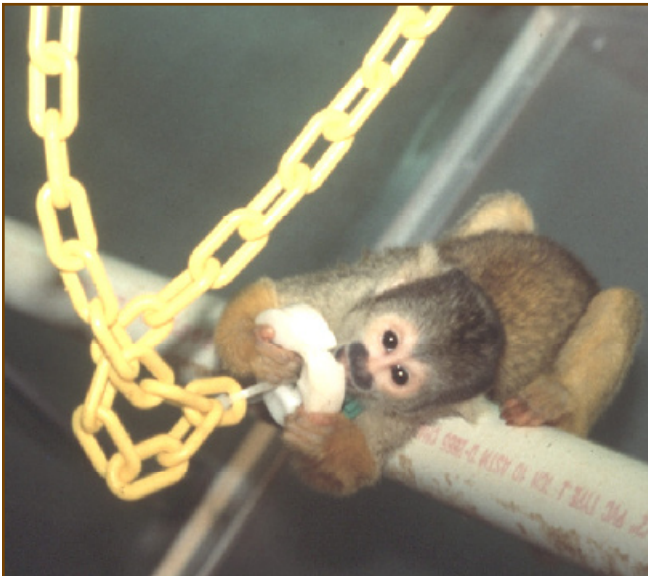
Objects must be large enough to prevent swallowing and sturdy enough not to be broken into small pieces. Food treats should be nutritious. Fruit and vegetables must be selected for quality and should be washed prior to feeding.

Occasionally, squirrel monkeys can experience anxiety when exposed to novel stimuli. Care must be taken, particularly with animals in smaller enclosures, to ensure that changes are not distressing to the animals. Animals should be observed after introduction of new objects to determine whether they show signs of fear or avoidance of the object. If this occurs, the object should be

removed. In larger enclosures, this is less of an issue, as the monkeys can move away from new objects and acclimate slowly.



An enrichment item that can be manipulated by the animals (photo courtesy of C. Abee).



Food items can be suspended, to make them more challenging to consume (photo courtesy of C. Abee).

Feeding

The animal's primary diet should be an appropriate, commercially available diet. In addition, each monkey's diet should be supplemented with fruit and vegetables according to what is seasonally available (although squirrel monkeys can have problems with their teeth associated with a high sugar diet; therefore, vegetables are preferred over sweet fruits). Items may include melon, oranges, apples (note that there is some evidence that apples may be associated with bloat, a frequently fatal disease where the stomach fills with gas), Kiwi fruit, strawberries, pears, bananas, grapes, celery, bell peppers, tomatoes, carrots, and sweet potatoes. Additional items, such as various flavors of Gatorade®, multi-vitamins, and food-pellet rewards for correct responses may be added for experimental or clinical reasons. To encourage foraging, food items can be placed in the cage or pen floor after daily cleaning. This encourages the animals to move about the cage to select their food. Additional food items can be placed in hanging PVC tubes that require the monkeys reach into the tube to find food items.

Highly desired food items should be handed out by caregivers at least twice daily, for example during daily observations of the animals. This positive interaction with caregivers allows the animals to habituate to the caregivers and allows the caregivers to interact in a non-threatening, positive way with the animals.

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Sanitation

Standards for the sanitation of caging for squirrel monkeys housed indoors are well-described in the National Research Council's *Guide for the Care and Use of Laboratory Animals* (1996). However, many squirrel monkeys are housed in semi-naturalistic environments, where they may be exposed to numerous parasite hosts, such as mollusks, frogs, and small snakes as well as soil and water that may have been contaminated by rodents carrying transmissible diseases such as leptospirosis. Sanitation programs should include diligent exclusion of slugs, snails, frogs, rodents, and as many insects as possible—particularly in tropical environments—to minimize exposure of the animals to these parasite and disease hosts.

Special Cases

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Age-related Considerations

If possible, infants and young juveniles should be housed with their mothers and remain within their natal social group. Attempts should be made to find appropriate foster-mothers for newborn infants that are rejected or orphaned. Failing this, or if the newborn is clinically compromised and unable to cling normally to a female, it can be housed in a separate nursery. Nursery infants can be housed in small, wire-mesh cages. They should be given a cloth surrogate mother approximately the same diameter as an adult female monkey to provide contact comfort. Infants in the nursery need frequent, positive contact from the caregivers as part of the feeding schedule. This contact varies from every hour to every four hours depending upon the age of the animal. As the infants grow older and strong enough to interact with other infants, they can be moved to a larger enclosure with other similarly aged infants. The cage should be equipped with multiple levels of perching and swings for the animals to move and jump from one to the next. When nursery-reared infants become old enough (6 - 12 months of age) to eat on their own and move about within a social group with adults, they can be introduced into a social group within the general colony.

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A surrogate "mother" for a nursery-reared infant squirrel monkey (photo courtesy of C. Abee).

Abnormal social behavior (e.g., over- or under-aggressiveness) that is the result of incompatible social partners can result in an individual being removed from its current social group to another social group or individual housing for a period of time. If the animal is a danger to other animals, a qualified veterinarian should determine whether the animal should be placed in an individual cage. In addition, individual housing should be considered when animals cannot defend themselves from the normal dominance-related aggression that occurs in this species and for acute or chronically sick and debilitated animals.

All individually housed animals should be provided with multiple perches, varied foods, and frequent contact with familiar caregivers. The U.S. Department of Agriculture requires that exemptions (e.g., for health or behavioral reasons) from social housing must be recorded by the attending veterinarian. In research programs, the Institutional Animal Care and Use Committee may exempt individual animals from participating in the social enrichment portion of the enrichment program when such housing is justified for experimental reasons. Every attempt should be made to ensure that there is direct visual, auditory, and/or olfactory contact with other squirrel monkeys. Animals that are unable to see and hear other squirrel monkeys may be given access to auditory stimuli from another room containing squirrel monkeys via a microphone-speaker arrangement or a pre-recorded audio tape. Extra contact with familiar caregivers should be provided. In addition to frequent visits, caregivers should provide much-desired food treats. Live prey, such as mealworms and crickets, can be used to increase the stimuli that food treats can provide. Toys, perches, swings, and other hanging devices should be rotated more frequently. Mirrors can also be used to provide sensory stimulation.

Attempts to socially house squirrel monkeys should be documented for both internal tracking purposes and for government regulatory agencies. Some animals that do poorly in large social groups can be housed together with a small number of other animals that similarly can not live in large social groups. This arrangement will allow social contact with other squirrel monkeys while reducing the level of competition for resources.

Problem Behaviors

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Abnormal non-social behavior, including stereotypical movements and self-injurious behaviors, may necessitate a change in housing structures, enrichment objects or reinforcement techniques. For example, “pacing” may be eliminated by increasing the animal’s available travel paths by installing additional perches. Self injurious behavior, such as self hair-pulling and self-biting, often are the result of unusual stress. If such behavior is seen in an animal, an evaluation should be made of the animal’s current social status and housing environment. These animals should also receive a physical examination by a veterinarian to determine their health status.

Safety Issues

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By far the most effective method for restraining squirrel monkeys is the use of leather gloves designed for handling small primates. These gloves provide protection to the human worker while preventing injury to the monkey. As with any restraint technique, technicians must be adequately trained to assure that the animal is restrained without injuring it. With practice and continued vigilance, the use of heavy leather gloves is a safe method of restraint for both the handler and the monkey. The use of nets to catch/restrain squirrel monkeys is not recommended. These animals are prone to fractures of the appendages when nets are used.

Squirrel monkeys can be trained to jump from cage to cage during rack changes. For cleaning of larger enclosures, it is not necessary to remove the animals prior to cleaning as long as noxious chemicals are not used and if the animals can perch above or away from the area being cleaned.

Chemical restraint may be considered by the veterinarian to restrain squirrel monkeys for transport and medical care in an attempt to reduce the stress and hazards associated with working with these monkeys. Ketamine hydrochloride, either with or without xylazine, can be used by the veterinarian for brief sedation.

Squirrel monkeys are wild animals and must be treated as such. They can injure caregivers through bites and scratches. But because they do not carry *Cercopithecine herpesvirus 1* (*Herpesvirus simiae* or B-virus), a bite or a scratch from a squirrel monkey can be treated much like the bite from a domestic dog or cat. Regardless, care must be taken when handling these animals to prevent injury to both the caregiver and the animal.



Use of a leather glove for manual restraint of a squirrel monkey (photo courtesy of C. Abee).

While it is unlikely that infectious diseases would transfer from squirrel monkeys to humans, and vice versa, common-sense precautions should be taken when working with any animal: immunocompromised workers should not handle animals with any known illness; masks should be worn when aerosols are present; any worker with an active upper respiratory infection should not handle animals; and consultation with a health professional may be necessary. Finally, although current human vaccination protocols include vaccination against measles, should an infection occur in any individual who resides with the animal caregiver, that caregiver should avoid any contact with squirrel monkeys until the infection has resolved. Measles spreads rapidly and is fatal in squirrel monkeys.

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Common Names of Squirrel Monkeys

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Saimiri boliviensis: Bolivian squirrel monkey, Peruvian squirrel monkey

S. oerstedii: Grey-crowned Central American squirrel monkey, Black-crowned Central American squirrel monkey

S. sciureus: Humboldt's squirrel monkey, Ecuadorian squirrel monkey, Common squirrel monkey, South American squirrel monkey

S. ustus: Bare-eared squirrel monkey, Golden-backed squirrel monkey

S. vanzolinii: Blackish squirrel monkey, Black squirrel monkey, Black-crowned squirrel monkey, Black-headed squirrel monkey

enrichment for nonhuman primates

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