

SUGAR GLIDERS

Natural History/Behavior

The sugar glider (*Petaurus breviceps*) is native to northern and eastern Australia, New Guinea, and surrounding islands. They inhabit woodlands and forests, are arboreal and largely nocturnal. They shelter by day in leaf-lined nests inside of tree hollows.

Sugar gliders resemble flying squirrels in form, having a large gliding membrane. They are able to glide up to 50 meters, and have been observed to leap at and catch insects in flight. Gliders are mainly insectivorous, feeding on insects, larvae, arachnids, and small vertebrates for the most of the year; sap, blossoms, and nectar only during the wet season (winter).

Sugar gliders are social and produce a variety of sounds. Wild groups nest in colonies of up to seven adult males, females, and their young. During winter gliders will huddle together to conserve energy, and may simultaneously enter a daily torpor during cold weather when food is scarce. Groups are exclusive and territorial: newly introduced individuals may be attacked by established members.

Sugar gliders are polygamous. One or two dominant, older males are usually responsible for most of the territorial maintenance as well as fathering of the young. A complex system of chemical communication exists based upon the scents produced by glands on the back of the head, chest, and genitalia. Each individual has its own characteristic scent. The dominant male actively marks other members of the group with his scent. Gliders will urine-mark their territory.

The natural breeding season for wild sugar gliders in Australia is June to November. Females are polyestrous, cycling every 29 days. A female may produce a second litter during the breeding season if the first is lost. However in tropical habitats and in captivity, there seems to be no definite breeding season. The exportation of sugar gliders has been banned in Australia since 1959.

Sugar gliders breed readily in captivity and they gained popularity in the US in the late '90s. Due to their social nature, captive gliders should be kept in groups of two or more. They are most active in the evenings and early mornings, and should get most of their social interaction during this period. Solitary gliders will require socialization periods of at least two hours a day. They will bond readily with their owners, who often carry them around in fleece glider-pouches, or close to the body, under clothing. Captive-bred joeys adopted between 7-12 weeks "out-of-pouch" are the easiest to socialize. Gliders make loud screeching noises ("crabbing") when

they frightened or excited. They also "bark" or quietly "chatter" for attention.

Anatomy

Scent glands are involved in group recognition and communication among gliders. Males have frontal and sternal scent glands. Females have scent glands in their pouch. Both have perianal glands, which produce a white oily secretion when frightened.

The tail is weakly prehensile: gliders collect leaves by hanging from the hind feet, grabbing leaves with the front feet and passing them to the tail, which can coil around and grasp leaves to be used for nest building. The tail also acts as a rudder during gliding.

A gliding membrane (patagium) extends from the forefoot to the ankle. There are five digits on each foot. All contain a sharp claw except the first digit (hallux) on each hind foot, which is opposable. Digits two and three on the hind foot are identical in length and partially fused (syndactylous) to form a grooming "comb."

Female sugar gliders have a well-developed, mid-abdominal pouch which contains four teats. The adrenal glands of females are twice the size of male adrenals on the basis of weight.

The cloaca is the common opening for the rectum, urinary, and genital ducts. The cloacal temperature averages 32°C (89.6°F), which is lower than the actual core body temperature.

Typical marsupials possess marsupial bones (ossa marsupialia) which articulate with the pelvis and serve as an attachment for abdominal musculature. These are absent in the sugar glider.

The teeth are brachydont (short crown compared to root). The dental formula is: 6 top/4 bottom (incisors), 2 top/0 bottom (canine), 6 top/6 bottom (premolar), 8 top/8 bottom (molar) = 40. The incisors are specialized for gouging the bark of trees. Sugar gliders possess an enlarged cecum that may assist in digesting gum from acacia trees.

Female sugar gliders have two uteri and two long, thin lateral vaginae that open into a single cul-de-sac divided by a septum. When engorged the bifid clitoris may be visible, protruding from the cloaca.

Testes of male are permanently descended in the pendulous, pre-penile scrotum. The penis is bifid. The prostate and Cowper's glands are large.

Physiologic/Reproductive Data

- Adult weight: 80-160 gm; females smaller than males
- Adult body length: about 12.7 cm (5 in)
- Total length, including tail: about 28 cm (11 in)
- Longevity: 12-14 years in captivity
- Body temp: average 32°C (89.6°F)
- Heart rate: 200-300 beats/min
- Respiratory rate: 16-40 breaths/min
- Sexual maturity: female at 8-12 mo; male 12-14 mo; can reproduce until over 10 yrs old
- Estrous cycle: 29 days (seasonally polyestrous); breed all year in captivity
- Mating: usually occurs in the evening
- Gestation: 16 days, fetus then migrated to pouch
- Litter size: one (19%) or two (89%)
- Litters/yr: 1-2 in the wild; up to 4 litters/yr in captivity (not recommended)

A sugar glider joey weighs only 0.19 gm and is 5 mm long at birth. It crawls to pouch (marsupium), where it stays attached to the nipple for 40 days. It first releases the nipple at 40 days, but stays inside until 70 days, when it first emerges. From 70 days on, the joey leaves the pouch for more and more time. Weaning occurs at 110-120 days of age, and joeys are independent by 17 weeks.

Marsupial metabolism is thought to be about two thirds of placental (eutherian) mammals and the heart rate is usually about one-half the rate that is seen in eutherians of similar size. During periods of cold or food scarcity sugar gliders conserve energy by going into torpor (semi-hibernation) for periods of up to 16 hours per day.

Housing

Sugar gliders need as large an enclosure as possible to allow space to climb, run, jump, and glide. A large, tall, aviary-type wire cage is ideal. Wire spacing should be no more than 2.5x1.3 cm (1x0.5 in). Warn owners that zinc-containing wire is potentially toxic if it is consumed. A hide-box or sleeping pouch should be placed high up in the cage. Gliders need non-toxic tree branches (e.g., manzanita, cholla), perches, and shelves to climb on. To provide additional enrichment place bird toys, swings, and a solid running wheel (w/out rungs, to avoid injury) at elevated positions within the cage.

Sugar gliders should be housed as pairs or groups due to their social nature. Keeping a single glider is not recommended as clinical depression may result. Placing the glider cage in a high-traffic area such as the family room will provide additional socialization.

Sugar gliders can tolerate environmental temperatures of 18.3-32.2°C (65-90°F) however the ideal range is 24-27°C (75-80°F). Do not place them in drafty areas, in direct sunlight, or where temperatures fluctuate widely. Sugar gliders that are too cold will become torpid and difficult to rouse. Most collections will need some form of supplemental heat (infrared heat lamp, ceramic heat emitter) in order to prevent cold-stress.

Cage substrate should be hardwood shavings, recycled paper, corn cob, or shredded paper. Avoid pine and cedar shavings. The cage, nest box, and bedding should be kept very clean in order to avoid fur-pulling and self-mutilation. Do not allow frayed fabric, string, rope, or towels to be placed in the cage: gliders occasionally get tangled in these.

Nutrition

The natural diet of sugar gliders includes insects, spiders, worms, small mammals, eggs, nestling birds, tree sap, nectar, and blossoms. In spite of published advice to the contrary, wild sugar gliders do not rely heavily on fruit, vegetables, nuts, grains or seeds. Pet gliders will readily accept these items, however, to the exclusion of healthy foods.

Sugar gliders are largely insectivorous. Their captive diet should include greater than 50% protein (insects, hardboiled egg with shell, newborn mice, lean meat, high quality cat food, monkey chow), and 50% fruit sugars and gums (fresh nectar, honey, acacia gum, gum Arabic, commercial lory diet, Glideraide).

A popular alternative to the above approach is to feed equal parts of a homemade diet mixture (Leadbeater's mixture) and a commercial insectivore/carnivore diet (see below).

In either case, small amounts of various fresh fruits, vegetables, baby food, dairy products and other items are occasionally offered as treats. All food should be offered fresh in the evening. A small amount of vitamin/mineral powder (i.e., Reocal, Herptivite) should be applied to any fruit or insects given. Provide additional calcium during breeding and lactation.

Provide fresh food and water daily. Place food bowls and water/nectar sippers high in the cage, not on the cage floor.

Examination/Restraint

Sugar gliders can be scruffed or held around the thorax, wedging the thumb between the sternum and chin to avoid being bitten. The examination can be accomplished in part with the glider in a towel. Once captured, the glider can be transferred over to the opposite hand, allowing the towel to be

removed. A cursory examination may be all that is possible with the glider awake. Auscultation (listening to the internal sounds of the body, usually using a stethoscope) will often be hampered by constant "crabbing" noises.

Common Conditions

Nutritional disorders

The majority of clinical problems in sugar gliders can be attributed to improper diet and husbandry. Signs include: lethargy, weakness, debilitation, hypothermia, weight loss, dehydration, muscle wasting, anemia, hypocalcemia, hypoproteinemia, blindness, cataracts, ataxia, tremor, tetany, rear-limb paresis/paralysis, neurological signs, reluctance to move, inability to support own weight, osteoporosis, pathologic fracture. Secondary infections are common. Diagnosis is by clinical symptoms, a review of diet and husbandry, and standard tests. Treatment involves general supportive care and correction of underlying dietary problems.

Hind limb paralysis syndrome appears to be a result of nutritional secondary hyperthyroidism. Affected gliders present with sudden onset of hind limb paresis or paralysis. Tremors or tetany may be observed. Spinal trauma and nutritional deficiency are differentials. Radiographs may reveal long bone, pelvic, and vertebral osteoporosis. Bloodwork may reveal hypocalcemia. Clinical history commonly consists of a diet mostly of fruit and vegetables, muscle meat and insects, without a source of supplemental calcium.

Obesity: Obesity occurs with excessive dietary fat or lack of exercise. This can lead to heart or liver disease as in other species. Treatment for obesity includes diet modification and increased exercise.

Cataracts: Juvenile cataracts can appear if the mother is pushed for breeding or fed a diet too rich in fat or sugars. The incidence of cataracts may be higher in handfed joeys. Vitamin A deficiency, genetics, and maternal pouch infection are also potentially involved. A thorough physical exam of the dam and any breeding or genetic records may help in the prevention of cataracts.

Traumatic injuries

Trauma such as cuts, punctures, and fractures are common. Falls may occur because of generalized weakness. Gliders are susceptible to bite wounds from dogs, cats, and ferrets. Secondary infections can be deadly. Household hazards include drowning in toilets/tubs, chewing on electrical cords, being stepped or sat upon, being shut in a window or door, and landing on light bulbs or other hot surfaces. Because of their prominent eyes,

corneal trauma occurs easily. Constricting injuries from frayed fabric are common; remove tattered or stringy fabrics from the glider cage. Injuries and trauma are diagnosed and treated the same as other small mammals.

Respiratory disease

Respiratory infections sometimes occur during weaning, shipping, overcrowding, change of ownership, diet/husbandry changes and other stressful periods. Many different bacteria have been associated with symptoms.

Gastrointestinal disease

Diarrhea, constipation, impaction, and rectal prolapse have all been reported. Diagnosis is based upon standard testing as in other mammals: fecal floatation and direct smear, Gram staining, stool culture, radiography. Differential diagnosis should include dietary and husbandry problems, parasites, protozoal and bacterial infections.

Treat constipation with enemas and stool softeners. Severe impactions can occur if there has been insufficient roughage in the diet (e.g., excessive dry cat food). Those that result in megacolon carry a poor prognosis. Rectal prolapses can be temporarily reduced with vertical sutures, ensuring that the urogenital slit remains patent.

Clostridium piliforme infection, Giardiasis, coccidiosis, and cryptosporidiosis have all been diagnosed in captive sugar gliders

Stress-related disease

Stress in gliders can present in numerous ways: self-mutilation of the tail, limbs, or genitalia; aggressive behavior; eating disorders (coprophagy, hyperphagy, polydipsia); cannibalism of young; fur-pulling/alopecia; stereotypic behavior/pacing. Such disorders may be associated with isolation, overcrowding, unnatural social structure, sexual frustration, unsanitary conditions, or a perceived threat.

Treatment is by removing the causative factors. Keep cats, dogs, pet birds out of the immediate cage vicinity. Provide proper nutrition and good hygiene, normal social grouping, adequate cage space, appropriate nesting areas and cage accessories. Mature males that mutilate their penis or scrotum should be castrated.

Pouch disorders

Pouch prolapse is occasionally seen. Consider mastitis, bacterial, or yeast infections. Over cleaning or other behavioral cause may be considered.

Dental disease

Periodontal disease and tartar buildup will occur in gliders fed only soft, carbohydrate-rich diets. Treat by scaling teeth while under general anesthesia, and treat gingivitis with systemic antibiotics (only under the advisement of your veterinarian). In advanced cases of tooth decay or tooth fracture, extraction may be indicated. Incisor removal risks symphyseal fracture. Adjusting diet and providing analgesia are palliative.

Parasites

A self-mutilation syndrome has been described which is associated with aberrant migration of a duodenal nematode. Central nervous system signs may result. Various nematodes, tapeworms, mites, lice, and fleas are all potential parasites of sugar gliders. Diagnosis is based upon clinical signs, fecal, and skin/fur samples.

Supportive Care

Nutritional support can be provided by hand feeding a formula of 50% chicken baby food and 50% high-calorie enteral formula (Ensure Plus). Try to tempt gliders with live gut-loaded insects or other favorites. Estimate intake needed at 2.5% of body weight and adjust upward based upon results.

Provide supplemental heat to stressed or sick gliders. Carefully regulate to between 80-85°F. Do not assume a cool or sluggish glider is in shock or near death.

Preventative Medicine

An annual checkup and examination of stool for parasites is recommended. Closely examine the oral cavity and teeth. Review the diet and husbandry. Nails will need constant trimming. Perform CBC, chemistry, radiographs as indicated.

Additional Detail

Leadbeater's mixture (should consist of 50% of dietary intake):

- 150 ml warm water
- 150 ml honey
- 1 hard-boiled with shell on
- 25 gm high protein baby cereal
- 1 tsp vitamin/mineral supplement

Mix warm water and honey. In a separate container, blend egg until homogenized; gradually add honey/water, then vitamin/mineral powder,

then baby cereal, blending after each addition until smooth. Keep refrigerated or frozen until served.

Nectar diets

- Nekton-Lori, NektonUSA, Inc., St. Petersburg, FL
813-381-5800, www.nekton.de
- Avico Glideraide, Cuttlebone Plus, San Marcos, CA
760-591-4951, www.cuttleboneplus.com

Gum Arabic

- Gum Arabic #76-3503, Country Kitchen SweetArt, Fort Wayne, IN
800-497-3927, www.countrykitchensa.com

Vitamin/mineral powder

- Rep-Cal (phosphorus free calcium with Vit. D powder), and
- Herptivite (multivitamin, multimineral supplement), RepCal Research Labs, Los Gatos, CA 800-406-6446, www.repcal.com

Sugar Glider and Insectivore diets

- Brisky Sugar Glider Diet, Brisky Pet Products, Franklinville, NY
800-462-2464, www.brisky.com
- Mazuri Insectivore Diet-5MK8, Mazuri,
800-227-8941, www.mazuri.com
- Insectivore-Fare, Reliable Protein Products, Palm Desert, CA
760-321-7533, www.zoofood.com

Summary

Pet sugar gliders often do not receive the social structure, diet, or environmental conditions necessary for maintaining optimal health. When diagnosing and treating this interesting species, the diet and husbandry should be critically evaluated.

As with all marsupials, sugar gliders exhibit unique reproductive anatomy and physiology. In most respects, however, surgical and medical treatments of sugar gliders are not very different from those in other mammals. Supportive care such as heat, fluids, and hand feeding are as important as drug therapy and surgery.