

# Efficacy of Scent Masking and Wet Introduction Methods on At-Risk Sugar Gliders (*Petaurus breviceps*).

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## ABSTRACT

Sugar Gliders are susceptible to a variety of stress-related maladies. Gliders are given to over-grooming and in some cases self-mutilation. Lone sugar gliders with over-grooming and self-mutilation tendencies are characterized here as "at-risk" animals. At Lucky Glider Rescue & Sanctuary (LGRS), it is a best practice to introduce strange, solo sugar gliders after health checks and nutritional stabilization has been achieved. This joining lowers their level of stress and curbs over-grooming and self mutilation. LGRS has successfully joined and rehabilitated many solo sugar gliders; but there have also been many introduction failures. When more traditional introduction techniques fail, these at-risk animals will continue to deteriorate and over-groom or cause harm to themselves. Based on trial and error, we have learned that the key behavioral drivers whilst making strange glider introductions are **olfactory communication** and the **assertion of dominance**. This paper outlines how the combination of scent masking and grooming impulse may temporarily ameliorate both the assertion of dominance and the concentration on both communal and personal scent communication. This can be achieved by using non-toxic agents for the attenuation of natural scent and use of "wetting" to trigger a mutual grooming impulse.

## Background

Lucky Glider Rescue & Sanctuary (LGRS) is a non-profit public charity specializing on sugar gliders. The organization rescues, rehabilitates and re-homes exotic animals. Part of its charter is to educate the public on sugar glider husbandry, nutrition and behaviors in order to protect and improve the quality of life of these animals.

One of the biggest challenges presented at LGRS is the influx of solo sugar gliders. Gliders are surrendered as solo animals when their mates have died or have been killed by another animal. Many are still presented as solo - having been purchased singly. It is well-

known amongst exotic animal care workers that sugar gliders do not fare well as solo pets.

Many have a tendency to over-groom when alone and in some cases they will self-mutilate. For this reason, LGRS has developed a variety of methods for joining solo gliders in an attempt to reduce their stress levels over time and therefore abate or eliminate the instance of self-mutilation.

There is no commercial motivation in this research. The trial and error experiences at LGRS regarding strange glider introductions are motivated solely by a desire to improve the quality of life of these animals.

## Sugar Gliders and Stress

Captive sugar gliders exhibit a variety of stress-related disease, for example, self-mutilation of limbs and tail or genitalia. (See Table 1).

Captive gliders under significant stress may also exhibit aggressive behavior including “eating disorders (coprophagy, hyperphagy, polydipsia); cannibalism of young; fur-pulling / alopecia; stereotypic behavior/pacing.” These disorders may be associated with isolation, overcrowding, unnatural social structure, sexual frustration, unsanitary conditions, or a perceived threat. (Johnson - 2002). Grooming itself is normal; however, when associated with fur loss and bald spots, it is considered excessive. (McCarney – 2009).

By removing the causative factors of stress, self mutilation and over-grooming will often abate. Screeching birds, barking dogs, and other predatory-response stimulus should be removed. (Johnson – 2002). Gliders should also be checked for lacerations, infection, intestinal blockage and UTI as sources of self-mutilation. (Brewer – 2007).

Sugar Gliders that have no cage mates or animals with little or no human interaction will often become stressed and exhibit signs of depression. Depression triggers excessive sleep (even at night), and loss of appetite. These problems can lead to malnutrition and other serious problems. In extreme cases, sugar gliders will go beyond over-grooming and self mutilate. (MacPherson – 2007).

Causes of Stress:	Symptoms of Stress:
<ul style="list-style-type: none"> <li>• Isolation (no cage mate)</li> </ul>	<ul style="list-style-type: none"> <li>• Self-mutilation (incl. biting of cloaca, stomach, limbs)</li> </ul>
<ul style="list-style-type: none"> <li>• Lack of interaction (incl. out-of-cage play)</li> </ul>	<ul style="list-style-type: none"> <li>• Alopecia (from fur-pulling)</li> </ul>
<ul style="list-style-type: none"> <li>• Overcrowding</li> </ul>	<ul style="list-style-type: none"> <li>• Aggressive behavior (attacking other gliders, humans)</li> </ul>
<ul style="list-style-type: none"> <li>• Unnatural social structure</li> </ul>	<ul style="list-style-type: none"> <li>• Cannibalism (Killing and eating of young)</li> </ul>
<ul style="list-style-type: none"> <li>• Sexual frustration</li> </ul>	<ul style="list-style-type: none"> <li>• Stereotypic behavior (pacing, running in circles)</li> </ul>
<ul style="list-style-type: none"> <li>• Unsanitary conditions</li> </ul>	<ul style="list-style-type: none"> <li>• Priapism (prolonged extension of penis)</li> </ul>
<ul style="list-style-type: none"> <li>• Perceived threat (sounds of predator, limbs caught)</li> </ul>	<ul style="list-style-type: none"> <li>• Coprophagy (eating feces)</li> </ul>
<ul style="list-style-type: none"> <li>• Injury (laceration, infection incl. UTI)</li> </ul>	<ul style="list-style-type: none"> <li>• Hyperphagia (excessive appetite)</li> </ul>
<ul style="list-style-type: none"> <li>• Illness (blockage, cyst, tumor)</li> </ul>	<ul style="list-style-type: none"> <li>• Polydipsia (excessive thirst)</li> </ul>

Table 1: Sources and Symptoms of Stress. (Johnson – 2002), and (McCarney – 2009).

"Gliders are frequently presented due to either aggression towards their owners or other gliders, or for self-mutilation. Whereas aggression may be part of normal social behavior particularly with territory marking and reproductive activity, self-mutilation is a problem of captivity. The practitioner needs to develop a history-gathering and trouble-shooting system similar to that used with feather-picking birds. Self-mutilation is usually seen in solitary sugar gliders. Sugar gliders have been used in laboratory animal medicine as models of serotonin-deficiency depression. To clinically depress a sugar glider, the researchers found one only has to house them as single animals. Many of our pet gliders are solitary. And unfortunately, since they were removed from glider families prior to puberty, they do not know how to properly integrate into glider society." (Johnson-Delaney – 2002).

At LGRS, the preponderance of over-grooming observed in sugar gliders is with lone animals. In some extreme cases, the over-grooming has extended to a mild form of self-mutilation, in which the skin becomes lacerated and flesh is therefore exposed to infection.

Such was the case with rescue "Dizzy," a seven-year-old female glider who lost its mate and began almost immediately to over-groom upon surrender to LGRS. A temporary cage mate for Dizzy was "Bonnie" who was also over-grooming and began biting her tail. We have also observed outright self mutilation in cases of malnourishment.

Another rescue animal called "Picachu" was a lone female, who was also suffering from metabolic bone disease. Pichachu chewed off her tail midway which required several surgeries. She had also removed all of the fur on the top of her head. After proper feeding, and pairing Pichachu with another glider, all signs of over-grooming abated.

### **Olfactory Communication**

Sugar gliders in the wild are mostly arboreal. "Family groups live in tree hollows in the wild and are vocal, communicating through a series

of yaps, chatterings, and screams. They chew large holes in the bark of eucalyptus trees to get at the sap and then defend the trees from other sugar-glider groups. Predators in the wild include owls, foxes, cats, kookaburras, and lace monitors." (Pye and Carpenter – 1999).

Gliders communicate with each other through a series of vocalizations including hisses and barks, but most of their territorial behavior is associated with scent communication. While vocalizations are anonymous, olfactory communication solely establishes both individual and communal identity. (Smith – 1973).

According to observations of wild sugar gliders made by Stoddart, Bradley, and Mallick, one male in a colony emerges as the one with the higher testosterone levels versus other males. – especially during breeding season. In captivity this same dominant male is the most busy with scent-marking. (Stoddart, et. al. – 1994).

Male sugar gliders have a scent gland on the top of their head and yet another under the tail (not on, but close to the cloaca). While feeding at sap sites, gliders transfer scent to one another frequently. "Any member of the group can approach another member and rub the top of its head against the underside of the tail of the other, thereby mutually exchanging scent. Only the dominant male produces the scent and it is transferred to all members of the group by this mutual head-to-tail rubbing. He directs head rubbing to the females of higher rank more than to sub-adults and so the intensity of the odor of each member's tail is directly proportional to its rank in the group." (Tyndale-Biscoe – 2005).

This scent-swapping achieves a means of differentiation of the group versus the scent of foreign/strange gliders. If a strange female performs head-rubbing on the dominant male and he accepts the advance, she may be admitted to the group. This is not the same for strange, adult males. Males are immediately challenged by the defending, resident males – who drive off the intruders.

If chasing and loud calls do not assuage the intruder, there will be a fight in which the victor claims the feeding site for his group. This may explain why dominant males feed first at a new sap site – ostensibly to derive the energy required to both defend the site and to patrol the territory. (Tyndale-Biscoe – 2005).

In the wild, usually only one dominant male breeds, and all females reproduce. (Pye and Carpenter – 1999). In a 31-month capture-mark-recapture study, Sugar Gliders were observed living in groups of up to seven adults being multi-generational. These groups usually had three males and four females. After weaning, half of all offspring left their group of origin "by the beginning of the breeding season following their birth." (Suckling – 1984). This suggests that colony size in the wild is relatively small, half of the youngsters dispersing to join other groups or start their own colonies.

Sugar gliders possess glands associated "with the mouth, eyes, sex organs, anus, and skin." These produce chemicals used in olfactory communication. Secretions from these glands are used both for attracting newborn young (female pouches) and in communicating "community odor" in a colony (male frontal and sternal glands). (Vaughan and Ryan – 2011).

A glider community will bear the odor of the dominant male of the group. Above all other members, this dominant male marks other members of the community the most. Adult males and females can recognize each other as individuals through these odors; likewise a joey's bond with its mother is unique based on a scent gland in her pouch. Sub-adult gliders will recognize other colony members as a group and then later as individuals. (Individuals have their own personal scents, but group scent derived mainly from high-ranking males permeates body surface of all group members). (Kean – 1967).

Source of Odor	Anal	Oral	Pedal	Flank	Sternal	Partner Marking
<b>(PRIMARY ODORS)</b>						
Frontal Gland						●
Sternal Gland					●	
Anal Regions	●		●			
Plantar Glands			●			
<b>(SECONDARY ODOR)</b>						
Mixtures from:						
Saliva		●				
Fur				●		●

Figure 1. Territory Marking: Scent Gland Sources of *P. breviceps* to mark territories and partners (Schultze-Westrum – 1965, 1969); (Wilson – 2000).

## Traditional Introduction Methods

“The different odors of an individual, although perceived as different, all affect the receiver similarly depending on social attitude. The social relationship is community-specific and depends upon former chemical communication and learning. The chemical signals not only elicit immediate motor reactions, but also cause slow physiological and anatomical changes.” (Smith – 1973).

There are two significant factors to take into account when introducing strange gliders: a) the **assertion of dominance**; and b) **olfactory communication**. Figure 2 depicts the domains of influence in sugar glider introduction methods taking these factors into account.

When strange gliders are introduced they almost immediately go about establishing who amongst them is the dominant animal. This often manifests itself in growling, defensive posturing and sometimes chasing.

Schultze-Westrum observed that for wild gliders, two separate groups may integrate together, but the use of a common nest for several days is necessary. But simple knowledge of another group’s scent does not guarantee integration and aggression may still ensue. (Schultze-Westrum – 1965, 1969).

## Two-Handed Introduction

An introduction technique that Lucky Glider Sanctuary devised is to “supervise” introductions by holding one glider in one hand and one glider in the other. This is most effective when there are just two strange gliders being introduced and loses its effectiveness with more than two gliders. It is a good idea to wear gloves while doing this even if you know both gliders and they are both separately bonded to the facilitator. Preferably, a neutral / non-scented fleece is held in each hand so they can snuggle into the fleece if they get frightened during the introduction.

Introduction Methods	Un-controlled	Human Interaction	Scent Attenuation	Scent Masking	Grooming Impulse
Unsupervised Introduction	●				
Two-Handed Introduction		●	●		
Tent/ Controlled Space Introduction		●	●		
"Sleepy Pouch" Introduction		●	●		
Pouch / Cage Swapping		●	●		
Scent Masking		●		●	
Wetting & Scent Masking		●		●	●

Figure 2. Sugar Glider Introduction Methods and Domains of Influence, Data gathered by Lucky Glider Rescue & Sanctuary (2007 – 2011).

With this method, you slowly bring your hands closer together while keeping a gentle grip on each glider through the fleeces. Observe closely what the reaction is between the gliders. If they don't start fighting right away, you can slowly cup your hands together and allow them to interact while you are holding them.

If initially successful, you can put them down on a fleece together. It is important to remain diligent and alert because you may need to pull them apart immediately if they start to fight.

### **Tent Introduction**

You may also introduce them in a small tent and initially bring them together with the two-handed introduction. This still requires "supervision" with you as the facilitator. This is effective with two gliders.

It is often too hard to handle more than two especially if they start fighting during the introduction. If a tent is not available, a large shower or bathtub is suitable so long as they care of the shape and size to contain the gliders so they cannot escape during the introduction attempt.

### **Sleepy Pouch Introduction**

Another introduction technique that LGRS devised is called the "Sleepy Pouch" method. Here, a large (ventilated) pouch is used. It must have enough room to hold gliders and also your hand. It is recommended you do this in the morning when they are sleepy. Wrap a small (clean) fleece around each glider.

Put one in one corner of the pouch and then put your hand in. Then put the other one in on the other corner of the

pouch. Here, their scents will slowly intermingle while they are sleeping so when they wake up, the scent of the other glider is not a shock.

You may withdraw your hand from time to time, but keep yourself ready to put it in there if they stir and begin to awake. As they awake, you can spread your fingers apart and allow them to see each other and smell each other through your fingers. This takes a considerable amount of time so it has to be planned for in advance.

### **Scent Attenuation**

As suggested by Schultze-Westrum, strange gliders in the wild may integrate if they share a "common nest" for several days. This observation suggests the basis for a well-established form of introduction in which the nesting material of captive strange gliders is "swapped" back and forth over a period of time.

An extension of this method involves swapping the nesting boxes, pouches, and even cages of the animals over several weeks. It has nonetheless been observed by researchers, that the mere acknowledgement of another colony's scent does not necessarily curb aggression.

The *attenuation* of scent therefore does not lower the tolerance or acceptance of another colony, but only reinforces its presence.

Based on observations at LGRS between 2007 and 2011, the success rate of scent attenuation is lower than that of scent masking or grooming impulse techniques.

## Scent Masking

An alternative to scent-swapping (scent attenuation) is scent masking, in which the animal is “fooled” by the introduction of a neutral or non-native odor.

By attempting to neutralize their scent with masking agents such as (non-alcoholic) vanilla extract, or even tuna juice - their scent impulse is minimized. Using a scent masker puts them both on a level playing field so they smell like each other instead of something unknown. These techniques are a common practice as with the introduction of captive rats.

For scent masking, the use of a soft, damp cloth can be useful in wiping-down the individual and then gently applying the scent masking agent.

## Wetting and Grooming Impulse

The new concept of wetting gliders has been tried at LGRS on at-risk gliders. Although it is not obvious that caging strange gliders together while they are wet is a workable solution, we have found it to be effective.

While scent masking techniques seem to ameliorate one of the challenges in introductions (**scent**), wetting addresses the **assertion of dominance**. We have observed that gliders who are wet or damp concentrate primarily on grooming and retreating to the nest and are not focused whatsoever on asserting dominance.

Being wet activates the grooming impulse. This also allows time for the individual scents to begin merging. This merging of scents happens while the animals are busy focusing on grooming.

Several wetting techniques have been put forward including the use of a shower. This is not recommended; however, because a strong spray may upset the animals and cause undue stress. At LGRS we have tried running a tepid stream of water over gliders while holding them gently and working the wetness into their fur by hand.

This is not unlike hydrotherapy treatments used for open wounds so gliders are not likely to become over-stressed by it. Other practitioners have cited a damp cloth or even a mist sprayer as suitable wetting instruments.

After wetting, gliders are put into a small cage in the early evening. After a short time in which the gliders groom themselves, they are then given a (neutral) pouch to crawl into. The pouch should contain an ample supply of clean/neutral fleeces. The pouch acts as a neutral territory for them to groom themselves and each other.

A small lamp can be used to simulate daytime outside of the cage to encourage the gliders to stay huddled in the nest.

We also suggest withholding food until the next morning to aid in the introduction by avoiding any territorialism as described by Tyndale-Bisco in 2005. This removes the “sap site” territorialism often associated with wild gliders who defend the perimeter of a feeding area.

We have observed that captive gliders may fight over food during strange glider introductions. If the introduction is successful, each glider may be fed individually so long as they are returned immediately to the nesting area in the cage.

## Summary

We have observed that the assertion of dominance seems to abate when a glider's fur is wet because focus shifts to grooming and getting dry – not dominance.

Without scent *attenuation* or scent *masking*, strange gliders will immediately react upon ascertaining the odor of the other glider. Sometimes this reaction is favorable and gives way to mutual grooming. In other cases it results in an all-out fight. In the case of a fight, the animals must be forcibly separated because they will fight with recklessness and maim each other if left to their own devices.

Simply put, the introduction of strange animals into an existing colony can be very difficult. In the wild, established colonies are patrolled by an alpha individual who vigorously defends the territory from strange gliders. (Williams – 1995). In our observations, this defense of territory seems too transcend into the realm of captive animals as well.

## Observations on Wetting Method

At LGRS, the use of wetting has been limited to two pairs of at-risk solo gliders. The rationale for using this method was based on their exposure to stress, and the failure of more traditional introduction techniques such as scent swapping and two-handed introductions. The driving principle in these introductions, wet or otherwise, is to improve the quality of life of the animal. For this reason, the method has been used only with at-risk individuals.

Although not fully tested in a clinical setting, we have found the wetting and scent masking methods in combination

to be effective. This after traditional techniques failed. It is important to note that traditional introduction techniques succeed roughly fifty percent of the time.

Four solo gliders have been joined in two separate pairs using the combined method of wetting and scent masking. The scent masking agent used was non-alcoholic mouthwash. The wetting method was hand-holding under tepid tap water and gently rubbing of the water into the fur by hand.

## Clyde and Ginger

In the case of Clyde (three-year-old neutered male) and Ginger (two-year-old female) they both displayed typical alpha behavior in all instances, commencing to first chase, then ball up, then bite. They required instant separation each time traditional introductions were attempted. Both Clyde and Ginger were tried with other strange gliders over a one year period, but all advances from other individuals were repelled.

Ginger had been rejected from her large colony of nine gliders. She had been picked on by the others and had to be culled from her colony. Before using scent masking and wetting, she was depressed, displayed automated behavior and was biting and screeching. She started to over-groom which signaled the mounting stress of an at-risk animal.

Clyde was also culled from his all-male group of neutered gliders after cohabitating for several years. He received a large open wound on the back of his neck. He was culled from the colony after this for safety reasons.

It has been our observation that even after convalescence, it is unwise to return an attacked animal back to its group. This because the tendency to be attacked carries with the glider and he (or she) will most likely be attacked again.

After using scent masking with Clyde and Ginger, they have been cage mates for several months and seem happy together.

Ginger is no longer screeching at passerby nor is she running in circles or hiding as before.

She has become much more “normal” and interactive. Clyde and Ginger are also sleeping together in the same pouch, eating together and playing together. They did not sleep together for the first two nights; however. There was never any fighting but some light chasing and loud vocalizations.

### **Dizzy and Darla**

Dizzy is a seven-year-old female who has a tendency to over-groom when caged solo. Notably, upon her surrender to the rescue she had removed most of the fur off of her head, neck and side. This after the loss of her cage mate before arriving at LGRS.

She was temporarily joined with a cage mate Bonnie (also an over-groomer) and they were separated because of an open wound on Dizzy’s back. Upon Dizzy’s healing she returned to fur-pulling.

Dizzy was not re-joined with Bonnie because we did not know if Bonnie had attacked or over-groomed Dizzy or whether Dizzy’s wound was self-inflicted.

Darla is a four-year-old glider who had been ejected from her colony after receiving a large, open wound.

After both gliders healed, scent masking was tried and was successful. This, coupled with wetting, was effective in curbing Dizzy’s accelerated alopecia.

It is notable that all four of these animals (Dizzy, Darla, Clyde and Ginger) had suffered from open back wounds. All four individuals had been treated with hydrotherapy as part of their recovery. Specifically, they would be held under tepid tap water to flush out debris from their wounds and to promote granulation. This was done every other day. The wetting technique was a simple next step for these individuals.

### **Conclusion**

We hypothesize that joining of strange gliders will garner more success with scent masking and wetting versus traditional methods of introduction.

Four at-risk solo sugar gliders at LGRS have responded well to being joined with cage mates using scent masking and wetting techniques. Being together with another glider has eliminated their pre-existing stress-related symptoms.

Human contact is no replacement for same-species companionship amongst sugar gliders. It seems there are healthy effects from mental stimulus of colony/group interaction – even with only two gliders in the group.

We have observed a much lower rate of success in joining groups of gliders or joining one glider to an established colony. Here, as in the wild, “intruders” are often driven off (Tyndale-Biscoe – 2005).

Although anecdotal and not achieved at LGRS under controlled conditions, other practitioners have joined colonies using grooming impulse and scent masking methods.

At present, LGRS only recommends the wetting and scent masking techniques for at-risk animals, and not for “introductions of convenience” to join larger colonies.

We do not recommend keeping colonies larger than six or seven gliders, as their natural numbers in the wild do not often top seven (Suckling – 1984). It is also established that “unnatural social structure” can trigger stress in captive animals (McCarney – 2009). The joining of larger groups is therefore not recommended.

Clinical research and further study by experts is recommended as the introduction of sugar gliders is not a well-known or perfected practice. The observations in this paper are limited to several subjects for the newer introduction techniques.

We are encouraged by the results of introductions achieved with scent masking and wetting. The gliders involved are healthier and most likely happier. This makes a compelling case for continued research based on the new methods described here.

## REFERENCES

Brewer, P.; "Sugar Gliders: Living With and Caring for Sugar Gliders Is this the Right Pet for You?;" AuthorHouse, Bloomington IN, ISBN: 978-1-4259-4464-3; 2007.

Jackson, Stephen M.; “Habitat relationships of the mahogany glider, *Petaurus gracilis*, and the sugar glider, *Petaurus breviceps*;" Wildlife Research 27, 39–48; 2000.

Johnson, D. DVM; "Sugar Glider Medicine and Surgery," Proceedings of the WSAVA 2002 Congress; Avian and Exotic Animal Care, PA, Raleigh, NC, USA; 2002.

Johnson-Delaney, C. DVM, DABVP; "Marsupial Medicine and Surgery;" Proceedings of the WSAVA Congress; World Small Animal Veterinary Association (V467); 2002.

Johnson-Delaney, C. DVM, DABVP; "Practical Marsupial Medicine;" Proceedings of the AEMV Congress, Association of Exotic Mammal Veterinarians (S130); 2006.

Kean, R.I.; "Behavior and Territorialism in *Trichosurus vulpecula* (Marsupalia);" Proceedings of the New Zealand Ecological Society Forest Research, Institute, N.Z. Forest Service. Wellington; 1967.

MacPherson, C.; "Sugar Gliders: Everything about Purchase, Care, Nutrition, Behavior, and Breeding;" Barron's Educational Series, Inc., Hauppauge, NY, ISBN-13: 978-0-7641-0172-4; 2007.

Mallick, J.; Stoddart, D.M.; Jones, I.; Bradley, A.J.; "Behavioral and endocrinological correlates of social status in the male sugar glider (*Petaurus breviceps* Marsupialia: Petauridae);" Physiology & Behavior, Volume 55, Issue 6; June 1994.

McCarney, P.; "Signs of stress in sugar gliders;" Helium Exotic Pets and Animals; <http://www.helium.com/items/1357882-signs-of-stress-in-sugar-glidern>; February 27, 2009.

Nagy, K.A. and Suckling, G.C.; “Field Energetics and Water Balance of Sugar Gliders, *Petaurus Breviceps* (Marsupialia: Petauridae);” Australian Journal of Zoology 33, 683–691; 1985.

Pye, G BVSc, MSc; Carpenter, J, MS, DVM, Dipl. ACZM; "A guide to medicine and surgery in sugar gliders," Wildlife and Zoological Medicine Service Department of Small Animal Clinical Sciences College of Veterinary Medicine University of Florida; Department of Clinical Sciences College of Veterinary Medicine Kansas State University Manhattan, KS; Vet Med; 94:891-905;1999.

Schultze-Westrum, T.G.; "Innerartliche Verständigung durch Dufte beim Gliedbeutler *Petaurus breviceps papuanus* (Marsupialia, Phalangeridae) Z. Vergleich. Physiol. 50:151-220; 1965.

Schultze-Westrum, T.G.; "Social communication by chemical signals in flying phalangers (*Petaurus breviceps papuanus*)"; Pp. 269-277, in Olfaction and taste (C. Pfaffman, ed.) Rockefeller University Press, New York; 1969.

Smith, M.; "*Petaurus breviceps*"; Mammalian Species no. 30, pp 1-5, by the American Society of Mammalogists; 1973.

Stoddart, D. M.; Bradley, A. J.; Mallick, J.; "Plasma testosterone concentration, body weight, social dominance and scent-marking in male marsupial sugar gliders (*Petaurus breviceps*; Marsupalia: Petauridae);" Journal of Zoology, Volume 232, Issue 4, Blackwell Publishing Ltd.; 1994.

Suckling, G. C.; "Population Ecology of the Sugar Glider, *Petaurus breviceps*, in a System of Fragmented Habitats;" Australian Wildlife Research 11, 49-75; 1984.

Tyndale-Biscoe, H.; "Life of Marsupials;" Csiro Publishing, Collingwood, VIC, Australia, ISBN 0643062572; 2005.

Vaughan, T; Ryan, J.; Czaplewski, N.; "Mammalogy" 5<sup>th</sup> edition, p. 562, Jones and Bartlett Publishers, LLC, Sudbury, MA; ISBN 978-0-7637-6299-5; 2011.

Williams, R.; "A guide to the use of Australian native mammals in biomedical research; Section 4: Care of individual species;" Secretary, AWC-NHMRC, GPO Box 9848, Canberra, ACT 2601. [Sugar Glider Reference p. 17]; Australasian Society of Zookeepers; Zoological Board of Vic.; University of Melbourne; Cowan Field Station, University of NSW; School of Veterinary; 1995.

Wilson, E.O.; "Sociobiology, The New Synthesis," p. 205, 206, Harvard University Press, ISBN 0-674-00089-7, (c) 1975.