



## DIET

### Diet Composition in the Wild

After studying slow loris, Barrett (1984) concluded that fruit consumption accounted for the major portion of feeding time (time spent ingesting food), but foraging time (attempting to catch, manipulating or inspecting food item) was primarily spent searching for invertebrates (Table 14).

**Table 14:** The diet of *N. coucang* at Sungai Tekam, expressed in terms of the proportion of feeding and foraging time devoted to different food types (given in percent of 5-minute observations).

	Feed	Forage
<b>Invertebrates</b>	28.6	56.4
<b>Fruit/seeds</b>	71.4	35.9
<b>Flowers</b>	0	0
<b>Immature leaves</b>	0	0
<b>Other foliage</b>	0	0
<b>Gum</b>	0	7.7
<b>N -</b>	21	78

Slow loris feces were analyzed in the same study. Beetles and weevils (Coleoptera), caterpillars (Lepidoptera), crickets (Orthoptera) and spiders (Arachnida) were the identified invertebrate remains. The fibrous portion of a large seed was the only vegetable matter identified. There was no evidence of foliage in the feces.

**Table 15:** Identified food items in the diet of *N. coucang*, using data from site observations and fecal samples (Barrett, 1984).

Food Type	Order/Family	Genus
Invertebrates	Arachnida Heteroptera Isoptera Lepidoptera Orthoptera	
Fruit/seeds	Ebenaceae Moraceae	<i>Diospyros</i> sp. <i>Artocarpus</i> sp.
Gums	Leguminosae	<i>Albizia</i> sp.

Barrett (1984) did not see the slow loris feeding or foraging for fruit in logged forest. This type of habitat was only used for insect or gum feeding. The slow loris divided the time almost equally between feeding on fruit and insects during the early part of the night. Almost two-thirds of the later part of the night feeding involved insects.

Pygmy lorises have been observed in an area where they were most likely feeding on gum. Three

animals were found on tree trunks in a patch of forest in southern Vietnam. Gnaw marks were numerous on these trees and averaged 2.5 cm in diameter. The gnaw marks had dried exudates encrusted on them (Tan, 1994).

The slender loris feeds mainly on insects (Bertram, 1984). No evidence of green materials were found in wild slender lorises' stomachs examined by Amerasinghe, van Cuylenberg, and Hladik (1971). Experimental tests show that Lorisinae will feed primarily on insects when given a choice. Kimberly Nekaris (pers. com.), who is studying *Loris tardigradus lydakkarianus* in Tamil Nadu, has not seen the animals eat anything but insects. The animals in her study group have been observed to eat as many as 30 to 50 in one hour. The larger body-sized animals need to complement their diets to a larger extent with more accessible diet items. The lorises may feed on relatively "unpalatable" prey (tolerating, not necessarily preferring). Interspecific competition may have caused this phenomenon. Lorises' mode of locomotion also limits their hunts to relatively slow-moving victims. The prey is discovered primarily by odor (Charles-Dominique, 1977).

Fruits supply carbohydrates while animal tissue provides other essential nutrients such as protein. Gum may fulfill calcium requirements. The indications that lorises may be specialized for consuming toxic insects could explain lorises' low basal metabolic rate (Rasmussen, 1986a). The basal metabolic rate of slow-moving Lorisidae appear to be less than half of the mass-specific mammalian standard (Müller et al., 1985). Slender lorises will eat ants, noxious bugs, and butterflies refused by birds (Petter and Hladik, 1970). Termites and caterpillars have also been found in a slender loris stomach. Stomach contents of slow lorises have included many toxic and pungent insects, including ants and termites. The advantage of a "toxic" diet is an abundant and accessible food supply (Rasmussen, 1986a).

### **Diet Composition in Captivity**

Captive loris diets are currently being evaluated for nutritional content and potential health concerns. The following tables give general examples of diets that have been successfully fed to slow and slender lorises.

The slow lorises at Duke University Primate Center are fed cubed fruits, vegetables, crickets and cracked Purina High Protein Monkey Chow® mixed with applesauce. Hard-boiled eggs and lizards are occasionally given as supplements. Lactating females are given yogurt as a calcium and protein supplement (Izard et al., 1988).

Houston Zoological Gardens (per 1985) has a somewhat different diet composition for their slow lorises. Sweet potato, green beans, parsley, turnips, black-eyed peas, peanuts, and snow peas are included in their diet. Newborn mice and baby milk pap protein diet enriched with vitamins have also been supplied to some captive slow lorises in Germany (Zimmerman, 1989). However, feeding of newborn mice or hamsters is not recommended because of possible disease transmission. Skansen-Akvariet reduced fructose rich diet items like raisins and kiwi fruit since dental plaque is often a problem with lorises (H. Ribjer, pers. com).

The slender lorises at Ruhr-University Bochum will readily eat avocado and chicken; however, these items are no longer offered because of possible links to health problems such as kidney problem



**Table 16:** Nutritional information from Ruhr-University Bochum for slender lorises.

<b>Basic Diet</b>	3-5 marmoset pellets; 2 x 1 cm <sup>3</sup> of either carrot, cucumber, apple, or pear (varying items); 1/4 cm banana cut into pieces; 2 tbs. vitamin and calcium formula. Once a week less food, e.g. only vitamin and calcium formula; several locusts, no vegetables. Nursing females receive extra half portion of formula per infant.
<b>Dietary Enrichment</b>	Food preference/acceptance seems to depend on learning. Certain individuals refuse unfamiliar foods, others take new types fairly readily. Variety from day to day may “desensitize” finicky eaters.
<b>Refused Items</b>	Boiled heart muscle of pork and beef; boiled chicken liver
<b>Diet items given for dietary enrichment, accepted well or relished by most animals.</b>	Different types of lettuce (especially chicory), carrot, cucumber, apple, pear, banana, avocado, boiled chicken leg, different types of melon, papaya, grapes, bell peppers, soybean sprouts, rice with thistle and linseed oil (oil contains certain fatty acids), mealworms, crickets (not liked by all), locusts, marmoset pellets (3-5 per day), oranges, grapefruit, mango, peach, strawberry, tomato, hard-boiled egg, Malagasy hissing cockroaches.
<b>Obesity Tendencies</b>	Especially two types of individuals: inactive females and very active and curious males (active males eat because of boredom or play behavior rather than due to hunger).

(Helga Schulze, pers. com.) At Ruhr-University, at intervals a plastic foil is spread over the cage floor and urine collected on it is tested with urine dipsticks for human diabetes and kidney disease, and when there are color changes indicating sugar or protein in the urine, the diet is adapted in a reasonable way. Their slender lorises also take lettuce readily, which appears unusual since the lettuce given to slender lorises at San Diego Zoo is usually left uneaten.

**Table 17:** Daily diet of lorises at San Diego Zoo.

<b>Slow Loris</b>	<b>Pygmy Loris</b>	<b>Slender Loris</b>
16 g banana	4 g banana	4 g banana
8 g papaya	4 g papaya	4 g papaya
13 g peeled orange	4 g peeled orange	3 g peeled orange
13 g grapes	6 g grapes	4 g grapes
3 g cooked carrot	2 g cooked yam	2 g carrot
7 g cooked yam	4 g apple	2 g yam
13 g apple	4 g cucumber	2 g apple
9 g cucumber	3 g folivore biscuit, 2 pcs	1 g spinach
3 g folivore biscuit, 2 pcs	(Marion Leaf Eater®)	2 g green bean or cucumber
(Marion Leaf Eater®)	1 g mealworms (10)	.30 g mealworms
2 g mealworms (15)	1 g crickets (4)	.45 g crickets (5x weekly)
2 g crickets (8)	4 g high protein biscuit, 1/2 pc	12 g canned primate diet
13 g high protein biscuit, 1 pc	Zoopreme Monkey Chow®)	(Zoopreme Marmoset Diet®)
(Zoopreme Monkey Chow®)	3 g hard-boiled egg white	3 g hard-boiled egg white
13 g hard-boiled egg white (1/4)		1 g raisin/week

Fruit and some vegetables are peeled to remove pesticides and other artificial agents used during cultivation. Monkey chow can be coated in mashed banana or applesauce for animals who do not eat them readily (Weisenseel, 1986). Lorises can be allowed to hunt live prey if it is possible to let crickets and lizards range in the loris enclosure.

Lorises readily accept commercially available gum. This substance can be spread on branches or made available through gum feeding devices.

It is a good practice to keep a record of how much food is left each day. A decreased appetite can be the first sign of illness or psychological stress.

## **Diet Composition in Captivity for the Pygmy Loris**

*Contributed by Barbara Toddles and Kerri Slifka*

### **Introduction**

The following is a report on diet components of the Pygmy Loris in captivity. This report was prepared at the request of the Pygmy Loris Propagation Group and is intended to provide guidance for propagation group members in the formulation of diets for this species until a complete Nutrition Chapter is published. This is only a preliminary report based solely on diets currently offered at member organizations. A complete Nutrition Chapter including a literature review, intake analysis, diet related health problems, and dietary nutrient targets for maintenance, growth and reproduction will be forthcoming, expected date of completion to be announced. The Nutrition Chapter will be reviewed by the Nutrition Advisory Group prior to publication.

### **Survey Summary**

A survey of the foods used as dietary components for pygmy loris by member institutions was conducted in 1997 by the Nutrition Advisors. All eleven participating institutions responded.

### **I. Current Diet**

#### **A. Manufactured Diets**

All participating institutions use a nutritionally complete manufactured food as part of the pygmy loris diet. Ten of the eleven (10/11) surveyed offer a dry manufactured food as part of the diet, 5/11 also offer a canned Zu-preem diet.

#### **B. Produce**

All surveyed offer produce. 7/11 offer a chopped mix of fruits and vegetables - 2/6 include leafy vegetables in their mix. 4/11 offer individual fruits and vegetables - 1/4 also offer leafy vegetables.

#### **C. Supplements**

3/11 add supplements to the prepared diet. 1/3 reported adding 1/8 children's vitamin tablet with extra C 1X week/animal. 1/3 reported adding a multivitamin mineral powder to the diet. 1/3 reported adding a protein multivitamin mineral powder to the fruit and vegetable mix and additional vitamin C to the prepared diet daily.



**D. Invertebrates**

10/11 reported offering invertebrates to the diet. 10/10 reported these as being mealworms, crickets or a combination of both. 1/10 also offers super giant mealworms, waxworms, tobacco moths and larva and very occasionally June bugs.

**E. Other Items**

2/11 reported other items than listed above as part of the diet. 1/2 offers cooked egg white daily and 1/2 offers boiled ground beef 1X/wk and yogurt 6X/week.

**II. Quantification of Diet Offered**

9/11 measure the food offered. 4/11 measure the amount of each item offered each time the animals are fed. 5/8 measured the original diet, and offer amounts which they believe to be consistent with the original diet each time the animals are fed. 1/4 which measures food each feeding does so by volume, 3/4 measure food by weight.

**III. Quantification of Diet Consumed**

3/11 reported regularly measuring consumed items or leavings.

**IV. Food Presentation**

10/11 reported presentation of food either in bowls, pans or plates, 4/11 added that the feeding dishes were elevated off the floor, 6/11 did not note feed dish location. 1/11 reported that all food for the animals is hidden throughout the exhibit and the animals must forage for it.

**V. Housing**

Members reported housing the pygmy loris in a variety of ways among and within institutions. 4/11 house pygmy loris with other species including tree shrews, slender loris, galago, dwarf lemur, mouse lemur and Garnett's greater bush baby. 8/11 reported housing some of their animals as singles - 1/8 reported that singles are housed as pairs during the breeding season. 8/11 reported housing pygmy loris in family groups or pairs.

**VI. Diet Analysis**

6/11 has had either their current diet analyzed or a similar diet analyzed for nutritional content. 1/6 had their diet analyzed chemically by a feed company and 5/6 had their diet analyzed by calculation or computer analysis - 1/6 had their diet analyzed both chemically and by computer. 2/6 had diets similar to their current diet or a diet used in the past analyzed by computer - however, the diets currently in use at those institutions have not been analyzed. 1/6 reported diet analysis as standard at their institution. All reported analyzing the entire diet. Actual diet analysis is available on current diets for three institutions.

**Dietary Components**

**I. Complete Feeds**

As reported in the survey summary, a variety of manufactured nutritionally complete feeds are offered by member institutions. It is the belief of the nutrition advisors that nutritionally complete feeds are essential in the diets of captive pygmy loris. Fortunately, all member institutions currently use a manufactured complete feed. Future analysis may reveal that some

complete feeds may not be appropriate for this species; however, at this time no determination has been made.

- a) Eleven different nutritionally complete feeds (for target species not pygmy loris) are being used:
  - Zu-preem primate (canned)
  - Zu-preem marmoset (canned)
  - Zu-preem primate biscuit
  - Purina Monkey chow 5038
  - Purina Fit and Trim dog food
  - Purina Cat Chow
  - Mazuri Monkey Crunch
  - Mazuri omnivore biscuit
  - Mazuri leaf-eater biscuit
  - Marion leaf-eater biscuit
  - Marion Apple Jungle biscuit
  
- b) Of the 57 animals represented in the survey, a complete feed or a combination of complete feeds comprise an average of 35.5% of the as fed diet. The range offered was 22.5% - 68% of the as fed diet.

Adult lorises weigh between 425 and 600 g. These animals should be able to consume 5% of their body weight in dry matter or 21.25 to 30 g of dry matter daily. Survey results report that captive lorises are offered 7.94 – 28.8 g (dry matter) of complete feed. The average offered per animal (n=57) is 14.96 g (dry matter).

## **II. Produce**

Produce comprises an average of 54.9% of the diets (n=57). A variety of produce is offered including fruits, vegetables, starchy vegetables and leafy vegetables. Fruit comprises the majority of produce offered at all institutions. The range for offered produce was 27 - 77% of the as fed diet.

## **III. Insects**

All but one institution reported offering insects. Insect comprise an average of 4% of the surveyed animal diets (n=57). The range was 0.9 - 6.8% of the as fed diet.

## **IV. Miscellaneous Foods**

Miscellaneous foods were offered at three institutions and comprised 4 - 12% of the as fed diet. It is interesting to note that the majority of the miscellaneous foods offered are high in protein.

## **V. Supplements**

Only three institutions report the addition of supplements to the pygmy loris diet. One institution added approximately 30 mg Vitamin C/animal to the diet. The complete feeds chosen by this institution provided less than the average. One institution provided only one complete feed containing no vitamin C. This institution did not report any supplementation; however, the institution does offer produce rich in vitamin C.



**Table 18:** The average and range nutrient density of the total complete feeds in the captive diet (n=57 animals) of the pygmy loris: Complete Feed Component of the Diet Compared to NRC'78 Old World Primate Requirements (Energy by 2X Klieber Equation 500 g animal).

Nutrient	Average (n=57)	Range	Complete Feed Average (As Fed)	1978 Old World Primate Requirements
As Fed (g)	20.01	9 - 45		
Energy (ME) kcal	56.89	31.5 - 112		83.2 kcal
Crude Protein (g)	3.32	1.8 - 6.78	19.3 %	16.7 %
Vitamin A (iu)	436.1	238 - 822	20.6 iu/g	13.9 iu/g
Vitamin D3 (iu)	66.8	18.54 - 273	3.57 iu/g	2.22 iu/g
Vitamin E (mg)	2.35	59 - 4.95	112.2 mg/kg	55.6 mg/kg
Vitamin C (mg)	8.66	0 - 32.0	416 mg/kg	111 mg/kg
Calcium (mg)	166.9	72.9 - 265	92 %	56 %
Phosphorus (mg)	111.4	72.9 - 265	623 %	444 %
Iron (mg)	3.91	1.74 - 8.0	219.3 mg/kg	200 mg/kg
Magnesium (mg)	26.54	11.6 - 60.0	.154 %	.167 %
Potassium (mg)	126.7	67.9 - 250	.689 %	.889 %
Sodium (mg)	52.6	24.97 - 112	.308 %	.333 %

**Conclusion**

Eleven institutions housing 58 animals participated in this survey. All institutions report having animals in good health, a few report difficulty with breeding, and several report tooth and gum problems. The nutrition advisors believe that all participating members are providing the minimal nutrient levels required by their animals for maintenance at this time. Much more research is needed to determine optimum dietary components and nutrient levels.

**Feeding Guidelines**

These guidelines are intended to assist in the formulation of diets for pygmy loris. The guidelines pertain to animals at maintenance ONLY. Dietary and nutrient recommendations will be made as the information becomes available.

**1. Complete Feed**

Provide approximately 60% of the animals dry matter requirement with a complete feed (primates can consume approximately 5% of their body weight in Dry Matter).

Dry diets are approximately	90% dry
Canned diets are approximately	40% dry

**2. Produce**

Provide a variety of produce up to 50% of the offered diet as fed.

**Table 19: Nutrient Requirements** Provide a complete feed or a combination of complete feeds to achieve the following nutrient density for the entire diet:

<b>Nutrient</b>	<b>Nutrient Density (As Fed)</b>
Energy % of total diet	60
Crude Protein	16.7 %
Vitamin A	13.9 iu/g
Vitamin D3	2.22 iu/g
Vitamin E	55.6 mg/kg
Vitamin C	111 mg/kg
Calcium	.56 %
Phosphorus	.444 %
Iron	200 mg/kg
Magnesium	.167 %
Potassium	.889 %
Sodium	.333 %

### 3. Supplements

Supplements for nutrients deficient in the complete feed portion of the diet.

### 4. Insects

Up to 5% of the as fed diet can consist of insects.

