

The diet of spotted cuscus (*Spilocuscus maculatus*) in natural and captivity habitat

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Abstract. Saragih EW, Sadsoeitoeboen MJ, Pattiselanno F. 2010. The diet of spotted cuscus (*Spilocuscus maculatus*) in natural and captivity habitat. *Nusantara Bioscience* 2: 78-83. The ex-situ conservation of cuscus (*Spilocuscus maculatus*) under captivating condition is an alternative solution to protect cuscus from extinction. Diets became the main factor in order to support the domestication process. Particular studies on habitat and diet of cuscus have been carried out however there is still limited information on the nutrition aspects of cuscus food. This study aimed to determine the diet type, palatability, and nutrient in both natural habitat and captivating condition. The results indicated that there were 19 and 8 plant species identified as cuscus diets in both natural habitat and captivating condition. Cuscus prefers fruits with astringent and sour taste which is contained high crude fiber and low fat.

Keywords: cuscus, diets, habitat, nutrient contents, wildlife.

Abstrak. Saragih EW, Sadsoeitoeboen MJ, Pattiselanno F. 2010. Pola makan kuskus bertotol biasa (*Spilocuscus maculatus*) di habitat alami dan penangkaran. *Nusantara Bioscience* 2: 78-83. Konservasi ex-situ kuskus (*Spilocuscus maculatus*) melalui penangkaran merupakan solusi alternatif untuk melindungi kuskus dari kepunahan. Diet menjadi faktor utama untuk mendukung proses domestikasi. Studi khusus pada habitat dan diet kuskus telah dilakukan namun informasinya masih terbatas pada aspek gizi makanan kuskus. Penelitian ini bertujuan untuk menentukan jenis diet, palatabilitas dan gizi di kedua kondisi habitat alam dan penangkaran. Hasil penelitian menunjukkan bahwa terdapat 19 dan 8 jenis tumbuhan yang diidentifikasi sebagai pakan kuskus masing-masing pada habitat alam dan kondisi penangkaran. Kuskus lebih memilih buah-buahan yang segar dan terasa asam yang mengandung serat kasar tinggi dan rendah lemak.

Kata kunci: kuskus, diet, habitat, kandungan gizi, satwa liar.

INTRODUCTION

Cuscus (Phalangeridae) is marsupial's animal which has long tail, round eye and hairy. There are five species of cuscus in Papua: *Phalanger gymnotis* (ground cuscus, kuskus kelabu), *Spilocuscus maculatus* (spotted cuscus, kuskus bertotol biasa), *Phalanger orientalis* (northern common cuscus kuskus timur), *Spilocuscus rufoniger* (black-spotted cuscus, kuskus totol hitam) and *Phalanger vestitus* (Stein's cuscus, kuskus rambut sutera) (Petocz 1994). In addition, Menzies (1991) stated *Spilocuscus papuensis* (Waigeo cuscus, kuskus pulau Waigeo) is endemic species of Waigeo Island, Raja Ampat District, West Papua Province; while Aplin and Helgen (2008) stated *Spilocuscus wilsoni* (Biak spotted cuscus, kuskus totol pulau Biak) is endemic species to the islands of Biak and Supiori in the Cenderawasih Bay, Papua Province. Moreover, Helgen and Flannery (2004) reported *phalangerid* genus *Spilocuscus* are endemic to tropical forest in the Australo-Papuan region.

In Indonesia, cuscus includes in species that protected by the government regulation, Ministry of Agriculture Decree No. 247/Kpts/Um/4/1979, Government Decree No. 7 of 1999. The reduction of habitat cover lead to the decrease of food availability are the most common threats that effect cuscus population and currently, and according to the IUCN criterion cuscus belongs to the group of animal with least concern and not included as extinction species (Bailey and Groombridge 1996). However, Norris and Christopher (1999) reported that Phalangeridae is still considered to be vulnerable by virtue of restricted distribution.

Most studies on cuscus diet have been undertaken though they were more focused on cuscus habitat and type of foods. Dogomo (2004) fed cuscus with kangkong, banana and star fruit as food, Mansay (2006) reported cuscus consume shoot of *Spondias dulcis* (kedondong) and *Terminalia catappa*, fruit of *Spondias dulcis*, mango, *T. catappa*, *Musa paradisiaca* (banana), *Carica papaya* (papaya), *Persea americana* (avocado) and flower of avocado. Menzies (1991) reported cuscus to consume food

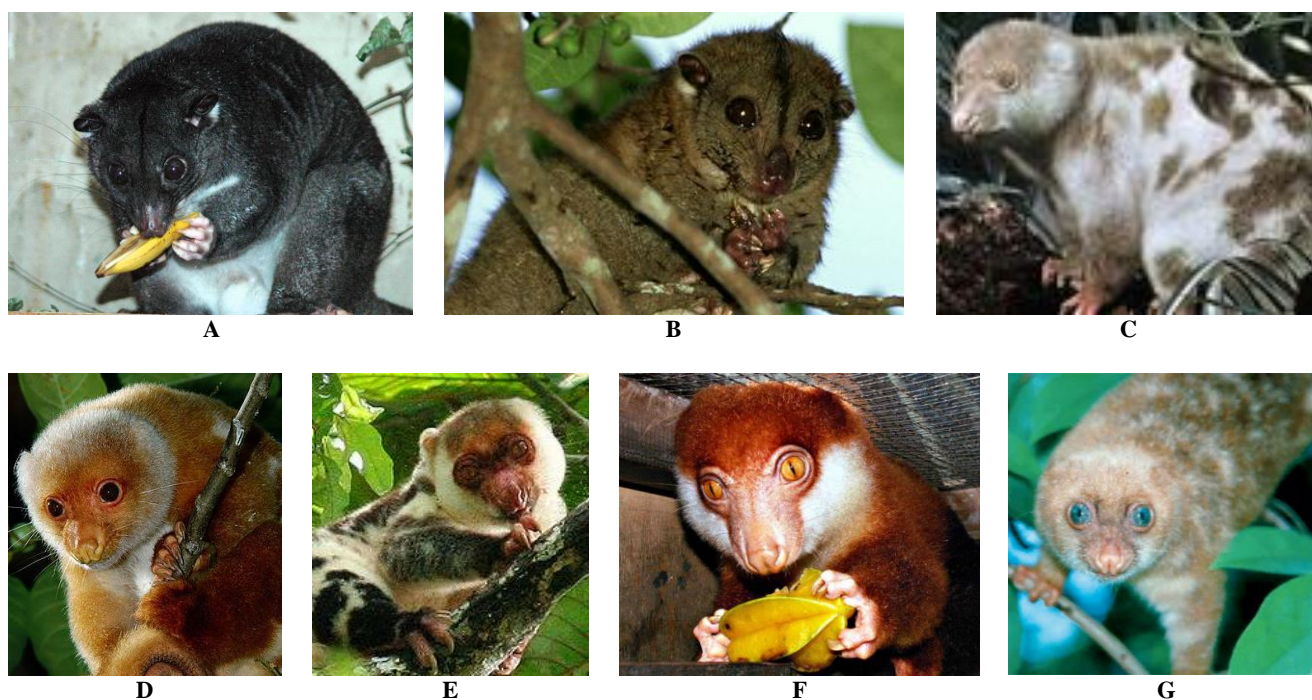


Figure 1. Cuscus diversity of Papua. A. *Phalanger gymnotis* (ground cuscus), B. *Phalanger orientalis* (northern common cuscus), C. *Phalanger vestitus* (Stein's cuscus), D. *Spilocuscus maculatus* (spotted cuscus), E. *Spilocuscus papuensis* (Waigeo cuscus), F. *Spilocuscus rufoniger* (black-spotted cuscus), G. *Spilocuscus wilsoni* (Biak spotted cuscus) (photos from several sources).

that contains high crude fiber; Flannery (1990) found cuscus in New Guinea consume *Aglaia*, *Alstonia*, *Ioanea*, *Ficus* spp., *Ficus adoardu*, *Lithocarpus*, *Elacocarpus*, *Mishocarpus*, *Pipturus*, *Pandanus*, *Oernathe*, *Rungia*, *Poikilospermum amboinase*, *Rattus exulans*, *Psysignatus lesueuri*, and *Pometia* sp. Moreover, Dimomonmau (2000) and Linthin (2000) found 32 species of plants which consists of 24 forest plant and eight of agriculture plant are consumed by cuscus in Moor Island. Sawen and Faidiban (2004) found 25 species plants are consumed by cuscus in Yamna Island. Dahrudin and Farida (2005) reported that cuscus food composition in Northern Biak Natural Reserve consists of 76.1% fruit, 13.4% foliage, 9% flowers, and 1.5% shoot. *Spilocuscus maculatus* is one of abundance species of cuscus in Ratewi Island and high life survival in captivity habitat if food availability and cage condition are suitable (Pattiselanno 2007). Fox (2007) reported that these species consume fruit and flower; however, base on tooth structure this species also carnivore.

Cuscus was one of several species considered hunting target as animal protein sources by local people in Papua. Therefore, uncontrolled exploitation of cuscus will put this species in endangered situation. Ex-situ captivating is an alternative solution to protect cuscus in one hand, and they can be harvested from captivating breeding on the other hand. To support the captivating condition, information on diets is required to improve ex-situ program beside environmental and habitat condition. Particular information about the nutrition contents, on the other hand, is still limited. In fact, information on diet content is highly important if the ex-situ captivating is seriously

programmed. This study was designed to determine the diets of cuscus included type of food, food palatability and nutrition contents in natural and captivity habitat. This information is important to formulate the diet of cuscus, particularly in ex-situ conservation program.

MATERIALS AND METHODS

Study area

This study was carried out from June to July 2009 in Ratewi (or Ratewo) Island (Figure 1), Nabire District, Papua Province. The study site was about 45 minutes by boat from Nabire, and located in 2°50'-3°00' N and 135°40'-135° E with 357 ha area consisted of primer and secondary forest. The secondary forest was the area utilized for logging activities in the past (Pattiselanno 2007).

Diet inventory

General approach is conducted through field observation by collecting and identifying plant species consumed by cuscus in natural habitat. Some transects were set up as purposive in the cuscus habitat in the secondary forest with 5 km long and 0.5 km width and 2 km range between transects. Information was also retrieved by interviewing the cuscus hunter, and observed and identified cuscus feces found in the field. Particular type of food fed to cuscus by local people in captivity was also collected and identified as well. Diets inventory was conducted between June and July 2009 in both natural and captivity.

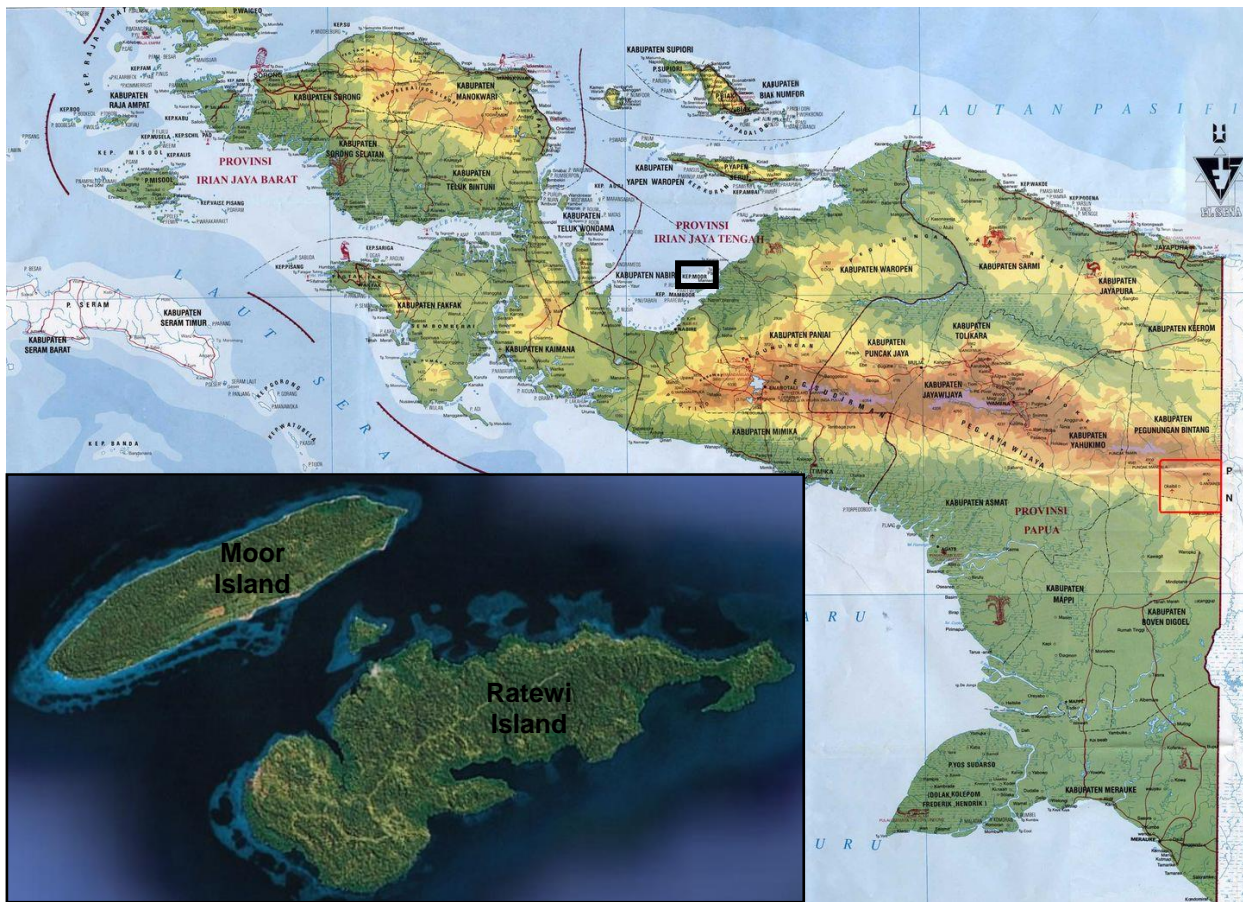


Figure 1. Study area in Ratewi Island, Nabire, Papua.

Food palatability

Food palatability test was done by identifying the most preferable plant species consumed during the study. Information was generated from the most plant species consumed by in the natural habitat, while in the captivity habitat type of food given by the owner and most preferred by the animals were observed and noted. Food palatability was also assessed by categorizing the taste of the plant species which is divided into astringent, sour, sweet and bitter tastes. The part of plants species consumed by cuscus was also observed and categorized into pulp of fruit, epidermis of fruit, shoot, and foliage. Combination of food parts was classified under certain category because it was commonly found that cuscus eats more than one category.

Nutrient contents

The nutrition contents of cuscus diets were analyzed in animal husbandry research institute (Balai Penelitian dan Pengembangan Peternakan (Balitnak) Bogor laboratory. The analysis was mainly focused on crude fiber, fat, and protein that considered important nutrient content in the diet.

Data analysis

Data were tabulated and nutrient content of cuscus diet was analysis by using SPSS 12.01 in order to figure out the difference of nutrient contents of cuscus diets in both habitats.

RESULTS AND DISCUSSION

Diet inventory

Nineteen plants species were observed consumed by cuscus in the natural habitat, common fruits and foliage. Majority of the species (13 species) belonged to *Ficus* sp. Complete list of the species consumed is presented in Table 1. Under captivity condition, there is only eight food type were given to cuscus including fruits, human food such as fish and *papeda* (traditional staple food made from sago) and plantation plant.

Number of consumed plant species found in the natural habitat was 19 species, or less than other studies conducted by Linthin (2000) 25 species of forest plant and 8 species agricultural plants considered as cuscus diets in Moor Island closed to Ratewi Island, Dimomonmau (2000) identified 32 species forest plant and agricultural plant in

Moor Island, while Sawen and Faidiban (2004) found 25 species forest plant and agricultural in another study in Yamna Island. In Mandopi, the coast site of Manokwari, 34 plant species from 28 families includes 28 forest plants and 6 crop plants are identified as cuscus diets (Fatem et al. 2008), while Nakoh et al. (2010) found 21 forest plants from 16 families as food plants at Udopi, Manokwari.

Moreover, Dwyahreni et al. (1999) found bear cuscuses fed on 31 species of plants, including 26 identified trees and lianas. Less species of plant as cuscus food are found in this study maybe due to the accessible area observed because other areas the study site considered as forbidden forest. It might be more plants species are found in forbidden forest. Different results find from different studies indicated that forest condition was the main factor affecting cuscus habitat. Forest conversions to other land use purposes such as logging concession, crop plantation, mining industries, and areas development are among the factors of forest fragmentation. In particular areas where, pristine forests still preserved might have more food plants for animals surrounding the areas. Thirteen species of forest plant belong to *Ficus* sp. and six species are *Intsia bijunga*, *Syzygium cf. versteegii* (L) Merr & Perry, *Calophyllum inophyllum*, *Merremia peltata*, *Syzygium* sp. and *Sonneratia griffithii*. Linthin (2000) and Dimomonmau (2000) reported that the most common type of cuscus diet in Moor Island of Nabire was fruits and shoot. Similarly, Dahrudin and Farida (2005) found that fruits, foliage, flowers, and shoot were identified as cuscus diet composition in Northern Biak Nature Reserve.

Table 1. Plant species and type of food consumed by cuscus in natural habitat and captivity in Ratewi island, Napan, Nabire

Latin name	Local name
Natural habitat	
<i>Ficus</i> sp.1	Makuku buah merah
<i>Ficus</i> sp.2	Makuku buah kasar
<i>Ficus myriocarpa</i> (<i>F. punguen</i>)	Surembo
<i>Ficus</i> sp.4	Makuku buah kasar daun halus
<i>Merremia peltata</i>	Tali wuraram
<i>Ficus</i> sp.5	Beringin daun lebar
<i>Ficus</i> sp.6	Beringin pantai
<i>Syzygium</i> sp	Jambu pantai
<i>Ficus</i> sp.7	Beringin daun kecil
<i>Sonneratia griffithii</i>	Bakau
<i>Ficus paka</i>	-
<i>Ficus</i> sp.9	-
<i>Ficus benjamina</i>	Beringin
<i>Syzygium cf. versteegii</i>	Jambu hutan
<i>Calophyllum inophyllum</i>	Bintanggur
<i>Intsia bijuga</i>	Kayu besi
<i>Intsia</i> sp.	Kayu besi pantai
<i>Ficus</i> sp.12	-
Captivity habitat	
<i>Carica papaya</i>	Pepaya hutan
<i>Spondias dulcis</i>	Kedondong hutan
<i>Avverhoa carambola</i>	Belimbing
<i>Musa paradisiaca</i>	Pisang
<i>Cocos nucifera</i>	Kelapa
<i>Katsuwonas pelamis</i>	Ikan
<i>Oryza sativa</i>	Padi (nasi)
<i>Metroxylon sago</i>	Sagu (papeda)

Under captivity condition, eight types of food recognized as cuscus diets, comprised of agricultural plants, plantation plants, and human food. Interviewed to the owners indicate that cuscus diets under captivity condition mostly depended on the availability of food items found in the surrounding. In this study, papaya and banana were abundant and available, so they were common food to cuscus. Human food usually fed to cuscus because the society believed that giving human food to cuscus will lead to ease of the domestication process. In domesticated trial experiment, Dogomo (2004) combined fruit and foliage (majority vegetables) as cuscus diets.

Food palatability

It was observed that in the natural habitat, *Ficus* sp. is the most preferable food consumed and we identified 13 out of 16 species. Pulp of fruits are the most part of the plant species consumed in the natural habitat beside foliage and shoot. Approximately 64.4% of cuscus diets is the combination between pulp of fruit and epidermis of fruit, while 21.1% is shoot. Another combination found in the diets is pulp, epidermis of fruit and shoot (5.3%), and combination of foliage and shoot (5.3%) which is found less favorable compared to others. Astringent and sour are dominant taste of food in natural habitat. Astringent taste is found in *Ficus* sp., bitter taste in foliage (*M. peltata*, *Intsia* sp.) and sour taste in fruit (*Syzygium* sp.). On the other hand, under captivity condition, pulp of fruits becomes the mayor diet (66.67%) mostly found in banana and papaya. Combination of pulp and epidermis of fruit become the second combination of cuscus diet. Sweet taste (*C. papaya* and *M. paradisiaca*) is dominant in cuscus diet, besides sour taste (*Spondias dulcis* and *Avverhoa carambola*).

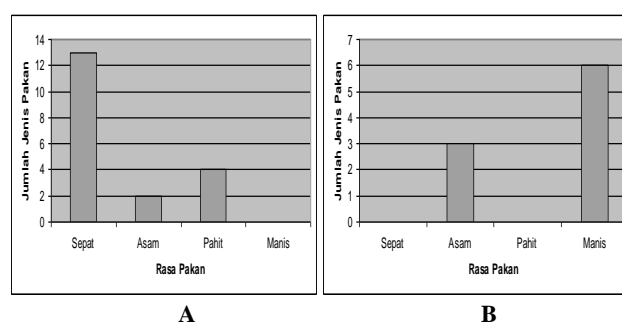


Figure 2. Taste of cuscus diet in the natural (A) and captivity (B) habitat in Ratewi island Napan, Nabire

Among sixteen of plant species consumed by cuscus in the natural habitat, thirteen were *Ficus* sp. Four species of *Ficus* were also among forest plants consumed in Mandopi, Manokwari (Fatem et al. 2008), while in Udopi, five *Ficus* species were consumed as well (Nakoh et al. 2010). This information implies that *Ficus* sp. were most commonly eaten by cuscus and becomes favorable food. Murwanto et al. (2008) reported *Ficus benjamina* is one of highly palatable food for cuscus. Detail observation has been conducted and it was clear that *Ficus* sp. were abundantly surrounding the study site. Particular parts of plant species

are most likely to be consumed are pulp and epidermis of fruit. Shoot is another part of plant consumed and found in *M. peltata*, *C. inophyllum*, and *S. griffithii*. According to Fatem et al. (2008), parts of plants being consumed are young leaves or shoots, ripe fruits, husk of fruits and inflorescence. Similarly, Nakoh et al. (2010) reported that fruits were dominantly consumed, followed by leaves. However, Dwiyahreni et al. (1999) found that bear cuscus in North Sulawesi fed mainly on young leaves (54.4%), mature leaves (22.9%), and leave buds (7.8%), whereas fruit was a minor part of the diet, and unripe were more eaten than ripe fruits. Fruits are preferred as they have a high content of fiber and water, which favors digestion.

From interview with local communities, it was recognized that shoot and foliage will be eaten during non-fruiting season. In concerned with the dominant plant species consumed in the natural habitat (*Ficus* sp.), it was found that astringent taste was a majority taste that commonly discovers in *Ficus* sp. Sour taste is the next important taste for cuscus that represented by *Syzygium* sp. and *Syzygium* cf. *versteegii*. Bitter taste in shoot and foliage is the third important taste in cuscus diet in natural habitat. From all tastes identified among the plant species, sweet taste was not encountered in cuscus diets, so it is assumed that sweet taste was not preferred taste. This situation might be caused by the selective taste based on preferred and the availability of food in the study site.

Under captivity situation, fruits become more dominant in cuscus diet followed by human food. The part of fruit that most commonly eats in the captivity habitat was pulp because prior fed to the animals the fruit has been peeled first by the owner, and this was completely different in the natural habitat when complete fruit was taken, processed and eaten by cuscus. Farida et al. (2004) stated based on feed palatability in the captivity condition, there are three kinds of feed most prefer by bear cuscus, namely ketapang leaf (*T. catappa*), and kemang leaf (*Mangifera kemanga*). In related to food taste, sweet taste was found majority in the diet and generated from fruits, rice, papeda (local staple food from sago) and coconut. Those items contained high glucose, fructose, and fat that supported the sweet taste. They were also had high energy and fat content.

The nutrient contents

The protein content of cuscus food in natural habitat was 12.60 ± 5.64 g/100 g, while crude fiber and fat were as follows 25.44 ± 11.12 g/100g and 4.74 ± 3.40 g/100g. Under captivity condition, diet of cuscus consists of 9.06 ± 3.70 g/100g of protein, 2.97 ± 5.34 g/100g of crude fiber and 8.23 ± 18.36 g/100g of fat (Table 2). Different plant species have dissimilarity on nutrient content, therefore, fed on variety of plants, and selectivity in both species chosen and items eaten reflects the needs to optimize the mix of nutrients and total bulk of diets (Westoby 1974) and choose species that contain low levels of toxic and digestion-inhibiting chemicals (Milton 1979).

The data shows that the content of protein and crude fiber in the natural habitat were higher than in the captivity. However, non-parametric test (U-test) for protein content shows that it is no difference between natural and captivity

habitat (U=33; N=24; P=0.162). Other nutrients on the other hand show there is significantly different in both habitats for crude fiber content: U=5.00; N=24; P=0.001 and fat content: U=25; N=24; P=0.05) (Figure 3).

Table 2. Nutrient content of cuscus diet in the natural and captivity habitat in Ratewi island Napan, Nabire.

Plant species	Protein	Crude fiber	Fat
Natural habitat			
<i>Ficus</i> sp.1	14.46	32.48	10.19
<i>Ficus</i> sp.2	10.46	41.6	9.4
<i>Ficus myriocarpa</i> (<i>F. punguen</i>)	10.17	37.01	7.04
<i>Ficus</i> sp.4	10.75	36.87	1.77
<i>Merremia peltata</i>	11.02	26.52	4.03
<i>Ficus</i> sp.5	22.2	12.43	2.68
<i>Ficus</i> sp.6	12.48	31.16	4.45
<i>Syzygium</i> sp	5.71	12.74	1.02
<i>Ficus</i> sp.7	7.18	13.32	1.95
<i>Sonneratia griffithii</i>	11	9.32	2.06
<i>Ficus paka</i>	10.6	27.44	6.2
<i>Ficus</i> sp.9	13.81	35.89	12.7
<i>Ficus benjamina</i>	6.55	37.81	4.13
<i>Ficus</i> sp.11	14.52	25.9	6.88
<i>Syzygium</i> cf. <i>versteegii</i>	10.94	7.91	1.91
<i>Calophyllum inophyllum</i>	7.96	34.03	5.51
<i>Intsia bijuga</i>	19.01	16.16	1.12
<i>Intsia</i> sp.	28.02	19.29	2.26
Captivity habitat			
<i>Spondias dulcis</i>	14.64	13.58	2.46
<i>Cocos nucifera</i>	11.01	5.64	45.67
<i>Musa paradisiaca</i>	4.46	0.00	0.24
<i>Carica papaya</i>	5.69	4.63	0.74
<i>Oryza sativa</i>	9.85	0.00	0.15
<i>Metroxylon sago</i>	8.70	0.00	0.12

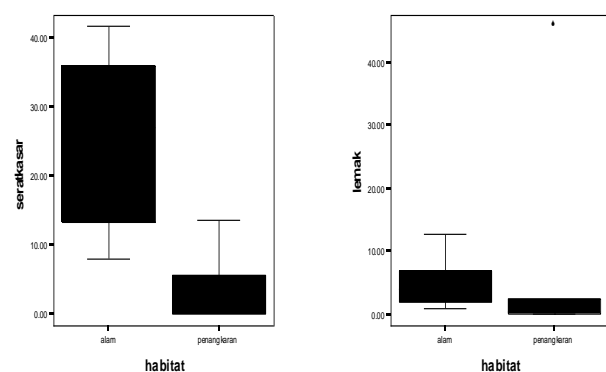


Figure 3. Boxplot average content of crude fiber and fat in diet of cuscus in Ratewi island, Napan, Nabire, Papua.

Protein and crude fiber contents of cuscus diet in the natural habitat are higher than captivity condition however fat content is higher under the captivity condition. High protein and crude fiber content in the cuscus diet might be caused by high possibility of fruit (solid fruit), shoot and foliage chosen in the natural habitat. In general, under the

captivity condition, most of cuscus diets were low in fat, and coconut was the only item contributes to the high-fat content, therefore, this might indicate the significant difference in fat content between the natural and captivity. Protein and fat content in this study were higher compared to the study of Dahrudin and Farida (2005) in Biak Nature Reserve ((10.98 g/100 g protein and (20.4 g/100g), while crude fiber in this study was relatively similar (25.08 g/100g).

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