BIODIVERSITAS
Volume 20, Number 9, September 2019
Pages: 2636-2644

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d200928

Daily activity and diet of Talaud bear cuscus (*Ailurops melanotis* Thomas, 1898) on Salibabu Island, North Sulawesi, Indonesia

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Manuscript received: 15 July 2019. Revision accepted: 22 August 2019.

Abstract. *Authors. 2019. Daily activity and diet of Talaud bear cuscus (*Ailurops melanotis *Thomas, 1898) on Salibabu Island, North Sulawesi, Indonesia. Biodiversitas 20: 2636-2644.* Talaud bear cuscus (*Ailurops melanotis*) is an endemic species in the Sangihe and Talaud Islands, North Sulawesi, Indonesia. This species is critically endangered in the IUCN Redlist, with a declining population trend. As a protected species in Indonesia, there has not been any specific research on this species. This research aimed to determine the daily activity pattern of talaud bear cuscus based on sex and age classes, and provide the first preliminary data on its dietary diversity and preference. Data collection was conducted on Salibabu Island (Talaud Islands District, North Sulawesi, Indonesia) for approximately three months (May-July 2016). The talaud bear cuscus spent most of its time resting 78.19%, moving 14.98%, feeding 3.49%, grooming 3.06%, and social 0.28%. Talaud bear cuscus fed on 22 species in its daily diet consisting of 20 tree species and 2 liana species. Cuscus fed mainly on young leaves (57.48%) followed by petioles (leaf stalk) (17.60%), mature leaves (15.33%), bud (7.19%), flowers (1.32%) and unripe fruit (1.07%). This preliminary data about the behavior, activity patterns, and diet of talaud bear cuscus, in general, can be used as supporting information in cuscus conservation efforts, especially habitat management related to the availability of feed resources and to determine the time of the survey and to understand the general behavior and ecology of this species.

Keywords: Daily activity pattern, *Ailurops melanotis*, daily activity, diet, feeding preferences, time budget

INTRODUCTION

Phalangeridae as an arboreal marsupial family consists of 29 currently recognized species in six genera and widely distributed across Australia, New Guinea, eastern Indonesia, and surrounding islands (Ruedas and Morales 2005; Helgen and Jackson 2015). According to Kealy (2018), the wide distribution and diversity in the family Phalangeridae caused a lack of information at the level of species in this family. One of the species in this family that are poorly understood is *Ailurops melanotis* (Heinsohn 2010; Flannery and Helgen 2016; Nowak 2018).

Talaud bear cuscus (*Ailurops melanotis*) was previously considered a subspecies (*Ailurops ursinus melanotis*) of Sulawesi bear cuscus (*Ailurops ursinus*). This species then listed as separated species based on morphological distinction, especially coloration (Groves 2005: Helgen and Jackson 2015) (Figure 1). This species is an endemic in the Talaud Islands, North Sulawesi and is only found on Salibabu Island (Wilson and Reeder 2005; Flannery and Helgen 2016). This species is highly hunted and continues to decline. Its populations distributed in fragmented habitats due to forest degradation and loss by logging, agricultural expansion, and human settlements (Riley 2002). According to the International Union for Conservation of Nature (IUCN), these species are listed as Critically Endangered with a declining population trend, and in 2014 was assigned to Appendix I by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

As a protected species in Indonesia, there have not been any studies on the behavioral ecology of talaud bear cuscus that have ever been carried out, in fact, there are no scientific publications that contain photos of this species (Smith et al. 2012). Research on talaud bear cuscus is only limited to general surveys and literature studies (Riley 2002; Heinsohn 2010; Smith et al. 2012; Flannery and Helgen 2016). Thus it is important to conduct research on the behavioral ecology of this species in particular, as preliminary information for the conservation efforts of this species.

Research on animal behavior can make a major contribution to conservation efforts (Sutherland 1998) and can be used specifically as a tool to achieve conservation goals (Reed 2002). In general, animal behavior is related to two things: time budget/time allocation and activity patterns. Time budget is a description and quantification of how animals divide the time available between their activities (Breed and Moore 2012). The time budget is used to measure the amount of time that animals use in carrying out various types of activities (Milis et al. 2010). While the activity pattern is a number of activities carried out by animals in a certain time dimension. By knowing the pattern of distribution of activities, researchers can find out when animals engage in certain activities. Activity patterns and time budget are two important aspects of animal behavior that can be used to investigate ecological influences on individual behavior, comparison of activity patterns and time allocation in different ecological conditions allows researchers to explore ecological influences on animal behavior, and behavioral strategies (Zhou et al. 2007). This research aimed to determine the time budget and describe the activity pattern of talaud bear cuscus and provide the first preliminary data on its dietary diversity and preference.

MATERIALS AND METHODS

Study area

Data collection was conducted on Salibabu Island, which is administratively included in the Talaud Islands District, North Sulawesi, Indonesia (296 km from Sulawesi main Island) (Figure 2). This island is 89.97 km^2, with an elevation of 0-335 meters above sea level. There is no protected area on this Island, all existing forests have the status of *other use areas*, with an area of secondary dryland forest remaining of approximately 14.40 km^2. This research was conducted in the secondary dryland forest area, with an elevation of 98-140 meters above sea level, for approximately three months (May-July 2016).

Data collection and analyses

Observation of activity was carried out using the focal animal sampling method (Altmann 1974), by following the individual target and recording its activity and duration from 06.00 to 18.00. Data collection used instantaneous sampling with an interval of 1 minute. Observations were divided into 3 periods: morning (06.00-10.00), mid-day (10.01-14.00) and afternoon (14.01-18.00). Before data collection, habituation is carried out for approximately 1 month by following the target individual.

Cuscus was classified as adult males, adult females, and subadult, no individual infant was found in the observation. Adult males were identified based on large body size and prominent genital signs, in this case, the testicles and scrotum, adult females were identified based on large size and absence of prominent genital signs (testicles and scrotum), presence of adult males or presence of infant, subadult generally have smaller body sizes than adult males and females usually still live with adult males and females (Dwiyahreni et al. 1999).

Behavior was categorized into 5 activities: resting, moving, feeding, grooming, and social. Resting activities include silent activities without movement, sleeping, standing still, sitting still, sitting while moving the head, tail, hands, and leg but not moving. Moving activities included walking or moving positions. Feeding activities included taking food and putting it in the mouth, biting, chewing and swallowing. Grooming activities included scratching and cleansing of impurities in the individual fur (auto grooming). Social activities included mutual grooming (allogrooming), nursing, or being nursed and playing behavior (Dwiyahreni et al. 1999).

Figure 1. Adult female and sub-adult of *Ailurops melanotis*

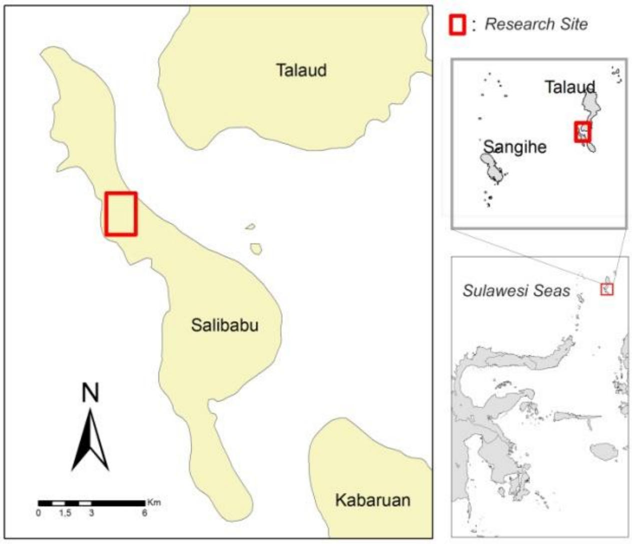


Figure 2. The map of study area of *Ailurops melanotis* in Salibabu Island (3°57'34.25''N, 126°38'57.80''E), North Sulawesi, Indonesia

Feeding data collection was carried out using the focal animal sampling method (Altmann 1974) by recording the type of diet consumed by the individual target. Data collection was carried out for each sex and age classes. The data collected is the type of diet (plant species), parts ate (fruit, leaves, flowers, etc.), feed descriptions (young leaves, old leaves, young fruit, ripe fruit, buds, etc.), and the amount of consumption of each type of diet (Dwiyahreni et al 1999). Vegetation analysis using a sample plot in the form of line compartment method, with a total of 15 plots (20 m x 20 m) was carried out to determine the diversity of vegetation species as well as the type of diet available at the study site. We also collected temperature and humidity data during the study in 3 periods; morning (06.00-07.00), afternoon (12.00-13.00) and afternoon (17.00-18.00).

Analysis of time budget is done by calculating the frequency and duration of time needed in each activity, presenting data in the form of tables and pie charts. For the analysis of the distribution of temporal activity patterns carried out qualitatively, through the presentation of tables and graphs of activity distribution within a certain time. Feeding analysis was carried out quantitatively, through the presentation of tables and pie charts, which explained the type, amount, parts eaten and the average amount of time for consumption of each type of dietary items. To find out differences in activity by age and sex, the Kruskal-Wallis test was used. To determine the significance of differences in behavior using the Mann Whitney U test. Data processing uses Microsoft Excel, and Statistical Product and Service Solutions (SPSS) program version 25.0.

RESULTS AND DISCUSSION

Time budget and activity pattern

Activity observation was carried out for 252.35 hours in each age and sex class. Data collection was performed on individuals who had been followed for approximately 1 month (1 adult female and 1 sub-adult). While male individuals, although not identified as the same individuals, because often disappear from the habituation and data collection process, we assume are the same individuals, because in the area of observation we did not find other male individuals. In this study cuscus were often found in pairs or groups (three individuals), with frequencies of encounters; in pairs: 33 times, in groups: 19 times and solitary: 11 times. Adult males were the most commonly found solitary (7 times). Kuskus used an average vegetation height of 12.39 m ± 3.37 SD.

Overall, the Talaud bear cuscus spent the most time to rest 78.19%, moving 14.98%, feeding 3.49%, grooming 3.06%, and social 0.28% (Figure 3). The time budget based on age and sex class showed differences (Figure 4.B), this was indicated by the Kruskal-Wallis test which showed significant differences in feeding, moving, resting and social activities (Table 1). Further tests using Mann Whitney U showed a significantly higher time allocation for subadult feeding activity than adult males (P = 0.004), as well as moving activity (P = 0.004), on the contrary, resting activity in adult males was significantly higher than subadult (P = 0.017). In social activities, the time budget of adult females was significantly higher than in adult males (P = 0,000). Daily observations show the distribution of bear cuscus activity differs according to time period (Table 2). The talaud bear cuscus spends the highest rest time during the day (82.96%), moves highest in the afternoon (17.70%), feeding the highest in the afternoon (4.81%), grooming is highest in the morning (3.26%) and the highest social activity in the afternoon (0.45%) (Figure 4.A).

Based on the daily pattern activities, it can be seen that moving activities were increased in the morning and declined during the day, then showed an increase in the afternoon. Feeding activities tend to follow moving activities, then followed by resting activities, cuscus was moving when foraging, and resting afterward. The highest feeding activity in the morning is recorded at 07: 30-09: 30 and in the afternoon at 15: 30-17: 30. We display the percentage of time used in every 30 minutes to show the pattern of daily activities (Figure 5.A-C).

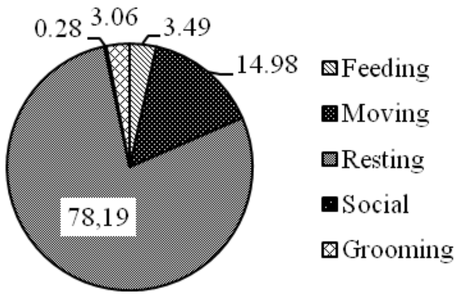


Figure 3. The percentage of the total daily activity of *Ailurops melanotis* on Salibabu Island, North Sulawesi, Indonesia

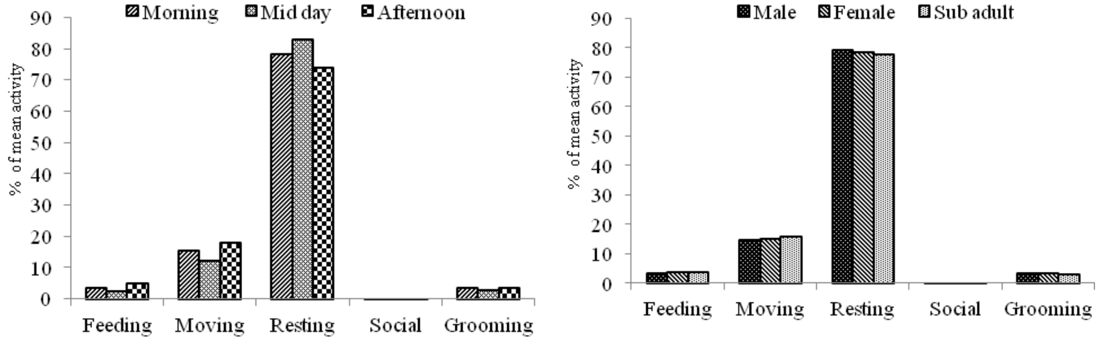


Figure 4. Percentage of activity spent by *Ailurops melanotis* in five behavioral categories according to (A) time of day and (B) age-sex class

Table 1. Comparison of time budget of *Ailurops melanotis*

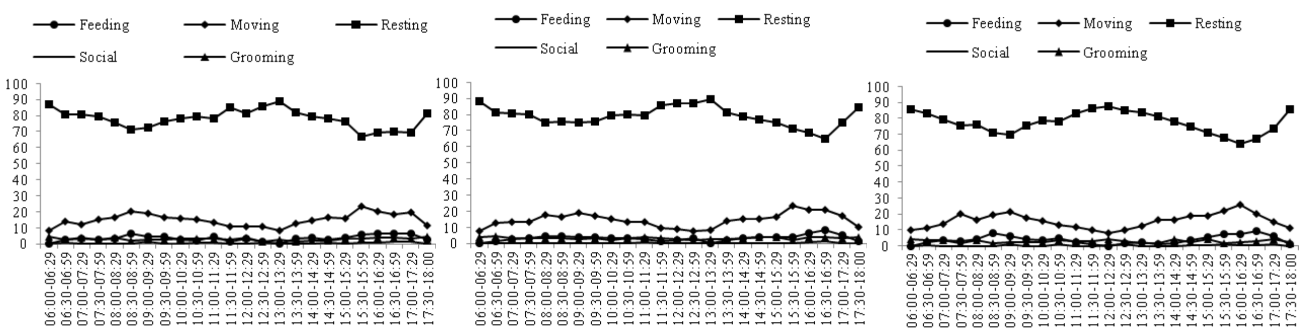
Activities	Proportion of time spent (mean ± SD)			Different time budget between all age-sex class compared by Kruskal-Wallis test
	Female	Male	Sub-adult	
Feeding	25 ±3.30	23.57 ±3.30	26.90 ±3.51	χ2=9.09; df=2; P=0.011*
Moving	107.62 ±7.92	103.76 ±8.37	112.67 ±9.29	χ2=9.08; df=2; P=0.011*
Resting	563.48 ±11.48	569.33 ±13.35	558.48 ±13.90	χ2=6.70; df=2; P=0.040*
Social	3.05 ±1.77	0.90 ±1.55	2.14 ±2.06	χ2=12.35; df=2; P=0.02*
Grooming	20.81 ±2.63	23.43 ±4.24	20.81 ±3.40	χ2=4.08; df=2; P=0.130

Note: * significantly different

Table 2. Comparison of activities based on time period of *Ailurops melanotis*

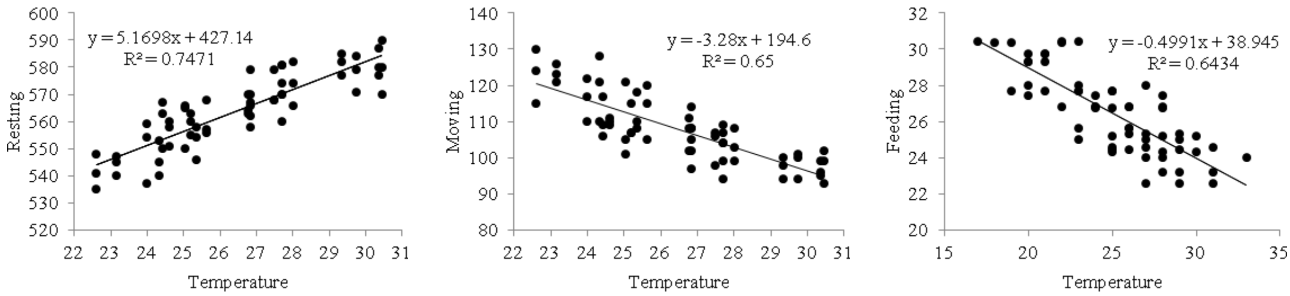
Activities	Kruskal-Wallis test (time period: morning, mid-day and afternoon)	Mann Whitney U test		
		Morning-mid day	Morning-afternoon	Mid day-afternoon
Feeding	χ2=31.80; df=1; P=0.000*	P=0.010*	P=0.000*	P=0.000*
Moving	χ2=34.99; df=1; P=0.000*	P=0.000*	P=0.002*	P=0.000*
Resting	χ2=36.51; df=1; P=0.000*	P=0.000*	P=0.000*	P=0.000*
Social	χ2=4.093; df=1; P=0.043*	P=0.428	P=0.006*	P=0.043
Grooming	χ2=13.89; df=1; P=0.000*	P=0.000*	P=0.718	P=0.000*

Note: * significantly different



A B C

Figure 5. Pattern of *Ailurops melanotis* daily activities of females (A), males (B) and sub adult (C) on Salibabu Island



A B C

Figure 6. Correlation between temperature and activity. A. Resting, B. Moving, C. Feeding

Temperature and humidity

The average temperature at the study site was 26,45°C with the highest temperature 32,10°C and the lowest 21,20°C, with an average humidity of 86.65%. Based on correlation analysis it was found that temperature has a strong positive correlation with resting; (R = 0.864. R^2 = 0.75). Conversely, temperature shows a strong negative correlation with feeding and moving activities (temperature and feeding: R = -0.802. R^2 = 0.6434; temperature and moving: R = -0.809R^2 = 0.65) (Figure 6).

Dietary items

The talaud bear cuscus was observed to consume 22 species in its daily diet consisting of 20 tree species and 2 liana species (Table 3). The 5 highest species in frequency and the amount of time allocation are *Merremia peltata* 22.46% (n = 335, f = 35), *Canarium asperum* 17.35% (n = 275, f = 24), *Cananga odorata* 12.49% (n = 198, f = 17), *Aglaia silvestris* 9.02% (n = 143, f = 35) and *Palaquium obovatum* 7% (n = 111, f = 10). Cuscus fed mainly on young leaves (57.48% of their diet) followed by petioles (leaf stalk) (17.60%), mature leaves (15.33%), bud (7.19%), flowers (1.32%) and unripe fruit (1.07%).

The 5 species with the highest level of preference based on the Neu index were *Merremia peltata* (w = 2.88), *Palaquium obovatum* (w = 2.47), *Cananga odorata* (w = 2.26), *Aglaia silvestris* (w = 2 , 25), and *Macaranga hispida* (w = 1.73) (Table 4).

Discussion

Time budget

The talaud bear cuscus (*A.melanotis*) spend the most time resting. This was similar to the study of the Sulawesi bear cuscus (*Ailurops ursinus*) in Tangkoko Nature Reserve, North Sulawesi, conducted by Dwiyahreni et al. (1999), who found that resting activity was 63.4% and also Talumepa et al. (2016) who found that resting activity was 56.86%. Likewise, with the research of Nugraha and Mustari (2017) who discovered the *A. ursinus* in Tanjung Peropa, Southeast Sulawesi, spent of 89.05% for resting.

Hume (1999) explained that the allocation of time for small mammal activities clearly depends on the digestive dynamics of the species. The high allocation at rest may be related to metabolic rate and energy conservation, so resting is an advantage because it reduces energy requirements and food intake (Boyle 1999). This is in accordance with the opinion of Nie et al. (2015) which states that arboreal folivorous animals show a number of energy-saving characteristics. The fact that a lot of wildlife consumes a high proportion of resting activities and seems to do nothing can be considered an adaptive strategy, because rest periods may be important for digestion, energy conservation or avoiding predators (Dawkins, 1988). A series of behavioral, morphological, and physiological factors including a reduction in the level of physical activity and high metabolic activity, can contribute to low energy expenditure (Nie et al. 2015). In addition, high rest periods may also be related to torpor activity reported in several marsupial species specifically the genus Diprotodontia (Geiser 1994; Geiser et al. 2008; Geiser Fritz and Körtner 2008). Although this still needs further investigation, as Geiser Fritz and Körtner (2008) stated that there has been no observation of torpor activity in the Phalangeridae family, although there is a similar pattern of torpor activity in some marsupial families and seems to be influenced by phylogenetics (Geiser 1994).

The overall proportion of moving activity is only <15% of total activity. The cuscus moved for foraging or there were disturbances such as strong winds and rain or feel threatened by the presence of humans. The moving period for foraging can last long, while if there was a threat such as the presence of humans, the cuscus moved in hiding and then showed a frozen position (Nugraha and Mustari 2017). The cuscus moved quadrupedally and used its prehensile tail to hang when changing branches. Locomotion mechanisms like this are specialties that benefit arboreal animals that can minimize energy in moving (Lammers and Biknevicius 2004; Rupert et al. 2014). While for grooming (auto grooming) activity occurs when cuscus resting or will moving, or if there were disturbances such as the presence of ants and other insects. This is common, given that grooming (auto grooming) was a normal part of the repertoire of behavior of various animals and usually functions to clean the surface of animals from parasites (Breed and Moore 2012). The smallest proportion of activity observed was social activity The highest social activity was in females, then sub adult and the lowest was males. Low social activity may be related to solitary behavior of cuscus (Talumepa et al. 2016; Nugraha and Mustari 2017).

In this study, cuscus is often found in pairs or groups. Although there is no mention of the number of frequencies, Dwiyahreni et al. (1999) in their study of *A. ursinus* found 55 individuals in pairs, 33 in groups and only 17 solitary individuals. This was different from what was stated by Grezimeck (2004) and Mckay and Winter (1989) which states that the majority of species in the Phalangeridae family are solitary.

Based on the Mann Whitney U test, it was found that the time allocation for moving and feeding activities in sub-adult was significantly higher than adult males, whereas the allocation of resting activities in adult male was higher than sub-adult. Ladine (1995) stated that in mammals it is common for young individuals to be active in a different period from adult individuals. This related to the high level of curiosity, play and high exploration in subadult individuals (Coppinger and Smith 1990; Janson and Schaik 1993; Johnson and Wilbrecht 2011). While in certain species, behavior in the adult phase showed a pattern that has been adjusted to a stable niche (Coppinger and Smith1990).

Activity pattern

Actually, there are still doubts about whether Sulawesi cuscus is nocturnal or diurnal. Jackson (2003) and Nowak (2018) citing Dwiyahreni et al. (1999) stated that the *A. ursinus* seems to be diurnal. While Feldhamer et al. (2007) stated that almost all Phalangeridae are nocturnal. However, Dwiyahreni et al. (1999) reported that they themselves were not sure whether the feeding activity of Sulawesi bear cuscus was only limited during the day, because based on observation, cuscus moved after dark. Through their research, Dwiyahreni et al. (1999) even suspect that there is a possibility that the activity of *A. ursinus* is spread throughout the 24-hour cycle, and this remains to be investigated. In this study, it was found that *A. melanotis* also moved at night, even in some observations, cuscus moved throughout the night and would rest before morning. This cathemeral activity was also reported in several marsupial species such as *Dendrolagus lumholtzi*, *Sminthopsis* and *Phascolarctos cinereus* (Lessiak 2014; Arrese et al. 2007; Kirk 2006), while *Tarsipes rostratus* were reported to be nocturnal/ crepuscular (Bradshaw et al. 2007).

Table 3. Dietary items and part of plants eaten by *Ailurops melanotis* on the Salibabu island

Species	Family	n	f	Parts ate						Total %
				Leaves				Flowers	Unripe fruit	
				Young	Mature	Petioles	Bud			
Aglaia silvestris	Meliaceae	143	13	7.44	1.07		0.50			9.02
Ailanthus integrifolia	Simaroubaceae	20	2	1.26						1.26
Albizia saponaria	Fabaceae	27	4	1.70						1.70
Calophyllum soulattri	Calophyllaceae	6	1	0.38						0.38
Cananga odorata	Annonaceae	198	17	7.07	4.10			1.32		12.49
Canarium asperum	Burseraceae	275	24	12.93	3.47				0.95	17.35
Canarium balsamiferum	Burseraceae	78	6	3.60	1.20				0.13	4.92
Dalbergia ferruginea	Fabaceae	75	9	3.85			0.88			4.73
Dracontomelon mangiferum	Anacardiaceae	13	1	0.63	0.19					0.82
Ficus variegata	Moraceae	8	1	0.50						0.50
Gnetum gnemon	Gnetaceae	5	1	0.32						0.32
Macaranga tanarius	Euphorbiaceae	49	5	3.09						3.09
Mallotus tiliifolius	Euphorbiaceae	30	3	1.26			0.63			1.89
Merremia peltata	Convolvulaceae	356	35			17.60	4.86			22.46
Palaquium obovatum	Sapotaceae	111	10	3.47	3.34		0.19			7.00
Pimelodendron amboinicum	Euphorbiaceae	17	3	1.07						1.07
Polyalthia celebica	Annonaceae	3	1	0.19						0.19
Pometia coriaceae	Sapindaceae	26	3	1.51			0.13			1.64
Pterospermum celebicum	Sterculiaceae	31	3	1.58	0.38					1.96
Syzygium acuminatissimum	Myrtaceae	44	4	2.02	0.76					2.78
Syzygium attenuatum	Myrtaceae	33	3	1.83	0.25					2.08
Trema orientalis	Cannabaceae	37	5	1.77	0.57					2.33
Total		1585	154	57.48	15.33	17.60	7.19	1.32	1.07	100

Note: n= The amount of time in consumption of each type of dietary items (minute), f= consumption frequency (times)

Table 4. Index of dietary preferences (Neu index)

Species of plant	a	p	n	u	e	w	b	Ranking
Aglaia silvestris	10	0.04	13	0.08	5.79	2.25	0.10	4
Ailanthus integrifolia	6	0.02	2	0.01	3.47	0.58	0.03	12
Albizia saponaria	15	0.06	4	0.03	8.68	0.46	0.02	18
Calophyllum soulattri	6	0.02	1	0.01	3.47	0.29	0.01	20
Cananga odorata	13	0.05	17	0.11	7.53	2.26	0.10	3
Canarium asperum	50	0.19	24	0.16	28.95	0.83	0.04	8
Canarium balsamiferum	14	0.05	6	0.04	8.11	0.74	0.03	9
Dalbergia ferruginea	12	0.05	9	0.06	6.95	1.30	0.06	7
Dracontomelon mangiferum	3	0.01	1	0.01	1.74	0.58	0.03	13
Ficus variegata	3	0.01	1	0.01	1.74	0.58	0.03	14
Gnetum gnemon	12	0.05	1	0.01	6.95	0.14	0.01	22
Macaranga hispida	5	0.02	5	0.03	2.89	1.73	0.08	5
Mallotus tiliifolius	11	0.04	3	0.02	6.37	0.47	0.02	17
Merremia peltata	21	0.08	35	0.23	12.16	2.88	0.13	1
Palaquium obovatum	7	0.03	10	0.06	4.05	2.47	0.11	2
Pimelodendron amboinicum	15	0.06	3	0.02	8.68	0.35	0.02	19
Polyalthia celebica	3	0.01	1	0.01	1.74	0.58	0.03	15
Pometia coriaceae	8	0.03	3	0.02	4.63	0.65	0.03	10
Pterospermum celebicum	9	0.03	3	0.02	5.21	0.58	0.03	16
Syzygium acuminatissimum	29	0.11	4	0.03	16.79	0.24	0.01	21
Syzygium attenuatum	8	0.03	3	0.02	4.63	0.65	0.03	11
Trema orientalis	6	0.02	5	0.03	3.47	1.44	0.07	6
Total	266	1.00	154	1.00	154	22.00	1.00	

Note: a = amount of availability, p = proportion, n = Frequency, u = proportion of presence frequency, e = expectation value, w = preference index, b = standardized preference index.

However, the study of Nawrot et al. (2019) found no tapetum lucidum in the eyes of *A. ursinus*. Tapetum lucidum as a biological reflector system, is a feature of vertebrate eyes and serves to reflect photons to the retina thereby increasing visual sensitivity at low light levels, this is an advantage for nocturnal animals (Ollivier et al. 2004; Kay et al. 2004). These findings, seem to confirm that the *A. ursinus* was a diurnal species. However, some species that are classified as nocturnal and crepuscular are also noted not to have tapetum lucidum such as *Macropus rufus* (Ollivier et al. 2004) and *Tarsius* (Kay et al. 2004; Kirk and Kay 2004). Furthermore, Kirk and Kay (2004) explain that many mammals that are regularly active during the day retain tapeta, including many diurnal strepsirrhine, cathemeral carnivores, and cathemeral ungulate. There are several hypotheses that explain how nocturnal animals can use light with the absence of a tapetum lucidum, one of which is morphological adaptation (large eye size) (Ollivier et al. 2004; Kay et al. 2004) and evolution of the fovea and macula lutea in *Tarsiers* (Kirk and Kay 2004).

Furthermore, according to Donati et al (2006) and Eppley et al. (2016), there are at least 4 hypotheses proposed to explain the determinants for cathemeral activity: thermoregulatory benefits, anti-predator strategy, competition avoidance and metabolic dietary-related needs. While based on Diete et al (2017), variation, fixity, and plasticity in activity patterns can be influenced by factors such as season and habitat (temporal resource availability). Based on this study, the assumption that the possibility of talaud bear cuscus activity may spread over 24 hours might be driven by the thermoregulatory benefits and the metabolic dietary-related needs. While the antipredator strategy and competition avoidance may not be the cause, given the absence of natural predators, and the talaud bear cuscus is the only arboreal folivores species found on Salibabu Island, which means that no other species occupy the same food niche as the talaud bear cuscus. But this still requires further research, considering that no nutritional feeding, rainfall, phenology, and moonlight data were collected.

Based on observations, it was found that the activity of moving and feeding on *A. melanotis* occurs highest in the afternoon while the highest time to rest during the day. High feeding activity in the afternoon was also observed in *A. ursinus*, where Dwiyahreni et al. (1999) stated that a significant increase in feeding activities in the afternoon allows more efficient use of time if digestion proceeds during the night. While high resting activities during the day may be related to digestion processes and temperature. Lawrance (1990) states that temperature is usually very influential on mammalian activity. Even some species can adapt their space use and distribution of activity in response to temperature changes (Brodie et al. 2017).

Based on correlation analysis it was found that temperature has a strong positive correlation with resting. This indicates that high temperatures during the day, causing cuscus to reduce activity and prefer to rest. Vieira et al. (2017) in their study of *Gracilinanus agilis* found that there was a relationship between temperature and activity, according to them the pattern shows the importance of temperature in marsupial activities, and such behavior allows marsupials to minimize energy loss due to the thermoregulation process. In addition, MacLennan (1984) also revealed that animals can reduce their activity patterns to maximize energy expenditure. Conversely, temperature shows a strong negative correlation with feeding and moving activities. This shows that the higher the temperature, the lower the activity of moving and feeding activities, and vice versa.

Diet

Cuscus on Salibabu Island consumed 30.14% (22 species) of a total of 73 plant species based on vegetation analysis. Although cuscus consumes a variety of items, there is a selective tendency towards the species eaten. Diet selectivity in animals can be associated with the digestive system. Hume (1999) explains that arboreal folivorous marsupial species are cecum fermenters (a process of digestion occurring in the cecum), including the Phalangeridae family. With this digestive system, animals will avoid species with high lignin content (Hume 1999), and choose high-nutrient food items (Munks and Green 1995).

In general, the highest type of species is consumed based on frequencies, relatively the same as the preference based on the Neu index. The difference is only found in a few species. Where the highest species consumed were *M. peltata*, *C. asperum*, and *C. odorata*. While based on the Neu index the most preferred species are *M. peltata*, *P. obovatum*, and *C. odorata*. During the observation, cuscus only consumed young fruit from *C. asperum* and *C. balsamiferum*, in several observations, cuscus was seen reaching the fruit of *Gnetum gnemon* and *Pometia coriacea* but not consuming it. Differences in preferences based on the Neu index and results of the duration of feeding use may be related to the temporal availability of young leaves (Dwiyahreni et al. 1999), or caused by differences in the amount of availability of dietary species based on vegetation analysis, which is a divider for calculating the Neu index.

Besides species, the talaud bear cuscus also shows preference for the part of the species eaten. The cuscus prefers to consume young leaves (57.48%) rather than mature leaves (15.33%). The same is found in *Ailurops ursinus* where consumption of young leaves is 54.4% (Dwiyahreni et al. 1999). By consuming young leaves that have higher water and energy content than old leaves, cuscus can increase energy, nutrition and water intake as a whole (Munks and Green 1995). In addition, young leaves have a high content of several important nutrients such as crude protein and phosphorus and low cell walls of polysaccharides and lignin (Hume 1999). But in some species, cuscus is also seen consuming mature leaves. According to Hume (1999) the selection of old leaves as part of a diet may be due to the limited availability of young leaves, while Chen and Poland (2009) in their study of *Fraxinus pennsylvanica*, found that older leaves are more nutritious with amino acids and a greater protein ratio than young leaves, especially when the tree is in the shade.

In general, the low allocation of feeding time in talaud bear cuscus may be related to basal metabolic rate, as explained by Nagy and Martin (1985) that arboreal folivores mammals have low basal metabolic rates compared to non-arboreal mammals with almost the same body size, even arboreal folivores mammals tend to have lower basal metabolic rates than non-folivorous arboreal animals. This gives two advantage, first, nutritional needs are reduced, following a reduction in the amount of food needed. Second, the overall consumption of plant secondary metabolites (such as phenolic, tannin and alkaloid) also decreases as a direct consequence of reduced food intake (Boyle 1999). In talaud bear cuscus, the allocation of low feeding time is compensated by high resting activities. In addition to maximizing energy use, this may be related to the strategy of 'maximizing retention'. Cork (1996) state that for mammals eating high-fibre diets, like tree foliage, energy requirements can be met by a 'retention-maximizing' strategy of delaying the passage of food through the gut to maximize extent of digestion by facilitating microbial degradation of dietary cell walls.

This is common for arboreal folivores species that adapt digestion and feeding behavior to maximize energy and nutrient intake from low-quality diet as one of the characteristics of energy savings (Munks and Green 1995). As is known in the species cecum fermenter or colon-cecum fermenters, dissolved substances and particles are deposited selectively in the cecum and colon, while large particles high in lignin fibers are excreted rapidly. This mechanism of colon separation minimizes nitrogen loss and maintains easily digestible parts, thus, this process can affect the amount of food consumed (Cork 1996).

Overall the activity of the talaud bear cuscus is dominated by resting. The daily activities pattern showed that the cuscus starts actively in the morning and rests during the day, then shows an increase in activity in the afternoon. The difference in activity over a period of time is caused by environmental factors in this case temperature and physiological factors of digestion which are typical in arboreal marsupial animals. Talaud bear cuscus is a follivore that consumes more than 90% of leaves in its total daily diet (young leaves, old leaves, shoots, and leaf stalks) and the rest is flowers and fruit with a small percentage. In general, cuscus prefers to consume young leaves in its diet. Although cuscus consumes a variety of plant species, there is a preference for the type of feed. This preliminary data about the behavior, activity patterns, and diet of talaud bear cuscus, in general, can be used as supporting information in cuscus conservation efforts, especially habitat management related to the availability of feed resources. This information could be valuable for researchers to determine the time of the survey and to understand the general behavior and ecology of this species. Further research focusing on nightly data collection is very important to know how much cuscus activity is spread over 24 hours and what factors that affect it.

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