Forest plants selection as feed sources and nesting tree of obi cuscus (*Phalanger rothschildi* thomas, 1898) in Obi islands, North Maluku

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**Abstract.** Obi cuscus (*Phalanger rothschildi*) is an arboreal marsupial and is an endemic animal from Obi Island, Bisa Island, and Obilatu Island part of the Obi Islands, North Maluku province. In Indonesia cuscuses are protected animals. The study with the roaming method are carried out by exploring the location where the obi cuscus is visible, collecting the forest plant as feed sources and nest tree. The potential information of forest plants as a feed sources and nest tree for cuscus, is needed in strategy of cuscus conservation both in situ and ex situ. The objective of this study was to identify the species of forest plant that serve as feed sources and nesting site for obi cuscus in North Maluku. The results showed 28 species of forest plants consisting of 21 families was selected by obi cuscus as their feed sources and 11 species of plants as their nesting site. Parts of the plants being consumed was fruit. The results of the analysis of nutrient content of feed plants are crude proteins ranging from 3.67% to 14.12% with an average (7.94±3.84)%, crude fiber (5.42% - 50.12%) with an average (20.52±14.43)%, NFC (35.91 - 84.72) with an average (57.00 ± 15.01)%, and gross energy content (3,269 – 4,489) cal/g with an average (3,525.5±1,241.3) cal/g.

1. **Introduction**

Obi Island is one of the islands included in South Halmahera Regency, North Maluku Province, with an area of 2,542km² and and geographically located at1°30’S 127° 45’E. Obi Sub-District region is bordered by the Obi Strait to the north, South Obi District to the south, Arafura Sea to the East, and the Maluku Sea to the West. Obi Subdistrict consists of eight villages, namely Desa Baru, Laiwui, Buton, Jikotamo, Sambiki, Anggai, Kelo, and Sum.

Forests on Obi Island are generally lowland rain forests with flat to hilly topography. On this island, there are many cocoa, clove, nutmeg, and coconut plantations belonging to the community to the forest. Information about obi’s biodiversity is still not available, so exploration is needed to reveal it. The survey was conducted in the forests of the villages of Baru, Buton, Anggai, Sum, and Bisa Island which are located north of Obi Island.
Cuscus is one of the endemic species of marsupialia of Eastern Indonesia whose distribution includes Papua, Maluku, Sulawesi and Timor cuscus, which is classified as the family of Phalangeridae, have long been hunted for the use of meat, fur and teeth by local peoples, especially in Papua, North Sulawesi, East Nusa Tenggara [1–4].

Until now several species of Phalangeridae have been categorized as critical endangered and towards extinction (vulnerable). Most of them are legally protected and listed in Appendix II of the CITES Convention [5]. However, [6] reported that Phalanegridae is still considered to be vulnerable by virtue of restricted distribution.

Cuscuses have been protected since 1990 through the Regulation of the Wild Animal Hunting (PPBL) No. 226/1931, Law No. 5/1990 concerning Conservation of Biological Natural Resources and their Ecosystems, and Law no. 7/1999 concerning Preservation of Plants and Animals. The current status of cuscus protection is stipulated in the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.20 / MENLHK / SETJEN / KUM.1 / 6/2018 concerning protected species of plants and animals.

Obi cuscus (Phalanger rothschildi Thomas, 1898) is endemic to the islands of Obi, Bisa, Obi-Latoe in the North Central Moluccan Islands, Indonesia [7]. Hunting and capture activities in the wild and uncontrolled trade can cause the existence of this animals to be threatened in their natural habitat.

Reports that local people noted that the species had become rare in northern Bisa [8]. The biodiversity hotspot of Wallacea, Indonesia, is notable for its high rate of endemism, particularly in mammals, and its mix of fauna of both Asian and Australasian origin [9,10].

The feed choices made will be determined primarily by the animal’s regulatory phenotype, but constrained by the nutritional, chemical, and structural composition of the foods in the environment [11,12]. Quantifying the underpinnings of diet selection is challenging, especially in studies of wild animals, because it requires precise feeding observations of individuals over continuous periods, relevant analyses of all foods consumed [13].

The opening of forest and the activity of shifting cultivation still happened in Obi island that can threaten the existence of wild animal and the availability of forest plants as feed resources. The intact of the habitat of obi cuscus and the existence of plant forests as feed resources for this animal are crucial and need to be preserved. This action is need for guaranteeing the existence of this animal in its habitat.

Obi cuscus plays an important role in seed dispersal, including food selection and nutritional needs. Data obtained from this research on feed selection and nutritional composition of selected feed items will greatly inform the conservation of both wild and captive populations of this species.

The aim of this research was to identify the species of forest plant that serve as feed sources and nesting tree on obi cuscus in North Maluku.

2. Materials and Methods
Exploration to Obi Island, South Halmahera Regency has been carried out for 21 days. Surveys to the distribution area of the Obi cuscus habitat were carried out based on local community reports to observe the diversity of forest plant species as feed sources and nesting trees, as well as the condition of the habitat of the Obi cuscus. The survey with the roaming method are carried out by exploring the location where the obi cuscus is visible, collecting the forest plant as feed sources and nest tree, and interview with local people.

Every tree found as feed resources and temporary nesting site is measured its height and diameter at breast height (DBH), then is taken the samples of its trunk, branch, leaf, flower, and fruit. The samples are placed between used newspaper, moistened by methylated spirit as preservative, and arranged in orderly way. The preference of nesting tree is determined by describing and comparing the characteristics of the nest tree species with other trees around the nest tree. The identification of the forest plants, then, is conducted in Herbarium Bogoriense,
Botanic Division, Research Centre for Biology, Indonesian Institute of Sciences (LIPI), Cibinong.

The plant samples in the form of leaves, fruit, and flowers are collected as many as possible and kept in plastic bag. In the base camp, the samples were dried under the sun for 1 - 2 days to avoid decaying until sun dried weight were achieved. The fruit collected is cut to small pieces to accelerate the drying process. In the Laboratory of Nutrition Testing at the Zoology Division, Research Center for Biology - LIPI in Cibinong, all the fruit samples were oven dried at 60°C for 18 hours. The dried samples were milled and analyzed (proximate analysis) of its nutrient contents based by [14]. Crude protein was then calculated by multiplying the nitrogen value by a standard factor of 6.25. There is some uncertainty whether 6.25 is the best conversion factor for tropical fruits [15]. Gross energy was determined by compressing dried samples into pellets for analysis in an Oxygen Bomb Calorimeter (Parr 6200) with a benzoic acid standard [16].

For identification purposes, seven cuscuses captured in the Laboku forest (Buton village area), Tabuji (Baru village area), Gold mining (Anggai village area), Sum village area, and Bisa Island. Seven cuscuses (4 females and 3 males) recorded morphometric data, such as size of body’s parts and weight. Their photographs were taken, and their characteristics also noted. After all of these done, the cuscuses were released into the forest.

3. Result and Discussion

| No. | Species name                  | Family            | Local name | Height (m) | Nest height (m) |
|-----|-------------------------------|-------------------|------------|------------|-----------------|
| 1.  | *Dracontomelon dao* (Blanco) Merr. & Rolfe | Anacardiaceae     | Rau        | 48         | 44              |
| 2.  | *Asplenium nidus* L.          | Asplenium group   | Ponda sau  | 27         | 22              |
| 3.  | *Aporosa frutescens* Bl.      | Euphorbiaceae     | Nam nam    | 19         | 13              |
| 4.  | *Macaranga hispida* Muell – Arg. |                      | Maro       | 18         | 14              |
| 5.  | *Omalanthus giganteus* Zoll & Moritzi |                   | Lapimatahuri | 18       | 14              |
| 6.  | *Albizia falcataria* (L.) Forberg | Fabaceae         | Salawaku   | 37         | 31              |
| 7.  | *Erythrina variegata* L.      |                   | Ro’da      | 29         | 21              |
| 8.  | *Barringtonia racemosa* (L.) Spreng | Lecythidaceae     | Katentehawa | 19       | 13              |
| 9.  | *Ficus uncinata* Becc.        | Moraceae          | Saudama    | 29         | 12              |
| 10. | *F. minahassae* Miq.          |                   | Lapikowulu | 22         | 17              |
| 11. | *Chionanthus ramiflorus* Roxb. | Oleaceae          | Tumpa      | 24         | 18              |
Table 2. The list of forest plant as feed sources for obi cuscus

| No. | Species name                      | Family       | Local name | Part of plant eaten |
|-----|-----------------------------------|--------------|------------|---------------------|
| 1.  | *Dracontomelon dao* (Blanco) Merr. & Rolfe | Anacardiaceae | Rau        | Fruit               |
| 2.  | *Spondias novoguineensis* Kost.     |              |            | Kandoro ewa         |
| 3.  | *Parsonia buruensis* (T.et B) Boerl. | Apocynaceae  | Uwo ewa    | Fruit               |
| 4.  | *Tabernaemontana sphaerocarpa* Bl.  |              | Jempaka ewa| Fruit               |
| 5.  | *Cocos nucifera*                   | Arecaceae    | Kelapa     | Fruit               |
| 6.  | *Canarium asperum* Benth ssp.      | Burseraceae  | Saulangi jawa| Fruit             |
| 7.  | *Alaeocarpus sphaericus* (Gaerth.) K. Schum | Elaeocarpaceae | Ketapang mohane | Fruit          |
| 8.  | *Mallotus rhicinoides* Muell – Arg. | Euphorbiaceae| Sauhorogo   | Fruit               |
| 9.  | *Flacourtia inermis* Roxb.         | Flacourtia   | Tomi-tomi  | Fruit               |
| 10. | *Lea indica* (Burn. F.) Merr.      | Leeaceae     | Kawiwintonu| Fruit               |
| 11. | *Dysoxylum gaudichaudianum* (Juss.) Miq |               |            | Fruit               |
|     | *Kibara coriacea* (BL) Tul.        | Monimiaceae  | Jambo ewa  | Fruit               |
| 12. | *Ficus adenosperma* Miq.           | Moraceae     | Mataburi   | Fruit               |
| 13. | *F. minahassae* Miq.               |              | Lapikowulu | Fruit               |
| 14. | *F. septica* Burm. F.              |              | Liboye’e   | Fruit               |
| 15. | *F. variegata* Bl                   |              | Gondal     | Fruit               |
| 16. | *Musa sp.*                         | Musaceae     | Pisang utan| Fruit               |
| 17. | *Maesa tetrandra* A.DC.            | Myrsinaceae  | Saulantoro  | Fruit               |
| 18. | *Syzygium aromaticum* Merr. & Perry | Myrtaceae    | Cengkeh    | Fruit               |
| 19. | *S. jambos* (L.) Ast.              |              | Jambo uwo  | Fruit               |
| 20. | *S. pycnathum* Merr. & Perry       |              | Jambo ewa roomolewa | Fruit |
| 21. | *Piper aduncum*                    | Piperaceae   | Siri-siri  | Fruit               |
| 22. | *Timonius rufescens* Boerl.        | Rubiaceae    | Kantintimuru| Fruit             |
| 23. | *Glycosmis pentaphylla* (Retz.) Corr. | Rutaceae    | Ganemo ewa | Fruit               |
| 24. | *Pometia pinnata*                  | Sapindaceae  | Matoa      | Fruit               |
| 25. | *Theobroma cacao* L.               | Sterculiaceae| Coklat     | Fruit               |
| 26. | *Pipturus argenteus* (Forst.) Wedd. | Urticaceae   | Saurore    | Fruit               |
| 27. | *Zingiberaceae*                    |              | Galoba ewa | Fruit               |
| 28. | *) Not identified                   |              |            |                     |

Cuscuses are generally nocturnal or active at night, during the day it is difficult to be able to directly see their activity, because they usually hide or sleep in their nests in the form of piles of leaves arranged in a tree. According to information from local people who accompany us to the forest, 20 years ago there were still many cuscus on Obi Island and it was easy to find. Obi Island residents can still fulfill their daily needs from farming and the majority of the population is Muslim so they do not consume cuscus meat.

The existence of cuscus is feared because of forest clearing for fields, deforestation both legal and illegal, the existence of forest concession rights on Obi Island, as well as communities gold mining in the Anggai region, thus decreasing habitat integrity for cuscus.

From the survey results it is known that Obi's cuscus is found in lowland forest, nest in tall trees and symbiose with ponda sau plants (*Asplenium nidus*). During the fruit season, cuscus is often found in the matoa tree (*Pometia pinnata*), rao (*Dracontomelon dao*), and lapikowulu (*F. Minahassae*), which is also a temporary nesting place (Figure 3). Table 2 presents 11 species of trees chosen by cuscus as temporary nesting sites.

Nesting tree of obi cuscus is a place in between branches and built from leaves as both floor and roof which is used as a temporary place for taking a rest and hiding, especially in the day
time. According to [4], cuscus chooses its nesting tree generally on trees grown by creeping plants or on trees grow side by side with other trees which their fruit or flowers are also its feed resources. Conform to its life habit: living on the trees (arboreal) and active in the night (nocturnal), in the day time cuscus hides and sleeps [17].

It is almost impossible to see directly the activities of obi cuscus in the day time because this animal is active in the night only. The information about plants which is selected by obi cuscus as feed resources is obtained from interview with local communities. They are invited to go along with researcher into the forest to find the location where they can see cuscus. They can find and show the rests of plant parts eaten by cuscus such as traces of a jerk on leaves, bitten on fruit, and scratched on a trunk.

**Table 3. Morphometry of obi cuscus**

| Parts of cuscus body | Location and size of cuscuses |
|----------------------|-------------------------------|
|                      | Laboku | Tabuji | Anggai | Sum | P. Bisa |
| Body length (mm)     |        |        |        |     |        |
| Adult ♂              | 385    | 390    | 390    | 380 | 395    |
| Adult ♀              | 300    | 310    | 295    | 310 | 300    |
| Tail length (mm)     |        |        |        |     |        |
| Adult ♂              | 300    | 310    | 305    | 295 | 310    |
| Adult ♀              | 300    | 310    | 305    | 295 | 310    |
| Hind foot (mm)       |        |        |        |     |        |
| Adult ♂              | 48.7   | 48.3   | 50.8   | 47.0 | 49.0 |
| Adult ♀              | 20     | 15     | 18     | 15  | 18     |
| Ear (mm)             |        |        |        |     |        |
| Adult ♂              | 1250   | 1425   | 1650   | 950 | 1600   |
| Adult ♀              | 1000   | 1550   | 1550   |   |     |

From the area explored on Obi Island, seven cuscus were captured for the purpose of measuring body parts (morphometry). The results of measurements of cuscus body parts are presented in Table 3. After comparing cuscus morphometry data from obi island with cuscus specimens at Zoology Division, Research Center for Biology, Indonesian Institute of Sciences (LIPI), it is known that the type of cuscus found on Obi Island is *Phalanger rothschildi* or obi cuscus (Figure 1 and Figure 2), which is a type of endemic cuscus on Obi Island and surrounding islands [8].

Information about the type of plant chosen by cuscus obi as feed sources obtained from interviews with local people or hunters who know the location in the forest, where they often find cuscus. They can show some evidence of the remnants of the fruit eaten or bitten by cuscus and nail claw marks on tree trunks. From the results of the survey, obi cuscus in its habitat only consumed fruits (Figure 4 and Figure 5) and information from local people, that they had never seen cuscus consume leaves except only fruits. This is very different from cuscus in Papua, Sulawesi and Timor, because it consumes fruits, young leaves, bark, or stem shoots [1,2,4,10,18]. Cuscus bear (*Ailurops cuscus*), while dwarf cuscous (*Strigocuscus celebensis*) which is also endemic to Sulawesi, prefers fruits [3].

Forest plants were chosen by cuscus obi as their feed sources, consisting of 28 numbers and 27 species that were identified belong to 21 families (Table 2). Reported by [19], the selection of feed types in marsupials is related to the morphological and histological structure of the gastrointestinal tract, while [20] explains that some marsupials such as dasyurid have simple gastrointestinal tracts and do not have a caecum.

The fruits chosen by the obi cuscus as feed are generally fruits from tall trees, this proves cuscus is an arboreal animal or animal that lives in trees and eats plants (herbivores). There are no reports from communities that obi cuscus consumes animal feed. The results of previous studies report that in their habitat cuscus also consumes bird eggs [21], chicks and lizards[22], and young
mammals [23]. From table 2 it can be seen that cuscus obi only consumes fruits, no other parts of the plant are consumed. This is because fruits contain high concentrations of sugar [24] and rich in carbohydrate [25]. Cuscus often avoids unripe fruits because it is less palatable than ripe fruits [26], contain less gross energy [27], and often contain toxins or antifeedants [28] but also have higher concentrations of toxins and other secondary compounds than ripe fruit [29]. From the results of previous studies, generally cuscus (Phalanger sp.) and spotted cuscus (Spilocuscus maculatus) prefer fresh fruits and sour taste containing high crude fiber and low fat [1–4,18,30,31]. Analysis of nutrient content (dry matter, ash, protein, fat, crude fiber, NFC and gross energy) of forest fruits as feed for Obi cuscus is listed in Table 4. Eight species of fruits (matoa, sauhorogo, forest banana, mohane ketapang, Jambo ewa roomolewa, jambo uwo, saurore, and uwo ewa) have not yet been analyzed for their nutritional content, because during the survey the fruits were not in season.

Table 4. Nutrient contents of forest plants as feed sources for obi suscus (100% DM)

| Species name               | DM (%) | Ash (%) | Protein (%) | Fat (%) | Crude Fiber (%) | NFE (%) | Gross Energy (cal/g) |
|----------------------------|--------|---------|-------------|---------|-----------------|---------|---------------------|
| Piper aduncum              | 96.43  | 8.44    | 13.71       | 3.73    | 20.81           | 53.30   | 4252               |
| Dracontomelon dao          | 90.23  | 3.37    | 5.24        | 0.66    | 6.01            | 84.72   | 3269               |
| Ficus microcarpa           | 94.35  | 10.19   | 4.55        | 3.89    | 18.55           | 62.83   | 3806               |
| F. adenosperma             | 95.51  | 11.59   | 9.30        | 2.49    | 30.05           | 46.57   | 3844               |
| Tabernaemontana            | 96.34  | 4.06    | 11.18       | 3.46    | 25.93           | 55.38   | 4407               |
| Tabernaemontana            | 96.34  | 4.06    | 11.18       | 3.46    | 25.93           | 55.38   | 4407               |
| Flacourtia inermis         | 92.28  | 3.75    | 1.98        | 0.81    | 22.14           | 71.32   | 3629               |
| F. septica                 | 95.01  | 8.45    | 13.58       | 2.21    | 32.09           | 43.67   | 4051               |
| Timonius rufescens         | 93.69  | 5.80    | 5.17        | 1.49    | 46.41           | 41.14   | 4489               |
| Mahaea tetrandra           | 93.49  | 4.93    | 5.68        | 4.00    | *               | *       | *                  |
| Kibara coriacea            | 93.23  | 5.55    | 10.26       | 5.30    | 10.77           | 68.12   | 3965               |
| Galoba ewa (local name)    | 90.40  | 9.57    | 8.10        | 3.90    | *               | *       | *                  |
| Syzygium aromaticum        | 92.47  | 4.09    | 4.11        | 0.71    | 8.08            | 83.01   | 3850               |
| Syzygium aromaticum        | 92.47  | 4.09    | 4.11        | 0.71    | 8.08            | 83.01   | 3850               |
| Dysoxylum                  | 90.94  | 6.11    | 15.53       | 1.13    | 19.75           | 57.48   | 3883               |
| Canarium asperum           | 95.36  | 5.17    | 4.26        | 2.11    | 52.56           | 35.91   | 4247               |
| Glycosmis pentaphylla      | 89.29  | 4.66    | 14.53       | 1.38    | *               | *       | 3728               |
| F. variegata               | 93.36  | 12.26   | 9.04        | 4.46    | 23.64           | 50.60   | 3912               |
| Theobroma cacao            | 96.40  | 8.05    | 12.73       | 0.68    | 31.89           | 46.65   | 3782               |
| Cocos nucifera             | 94.48  | 8.78    | 10.00       | 0.18    | 40.04           | 49.99   | 3989               |

*) sample is not enough; DM = Dry matter; NFE = Nitrogen free extract.

The nutritional content of forest fruits as a source of Obi cuscus feed turns out to be very varied. Table 4 presents that ash content ranged from (3.04 - 11.45)%, with an average (6.49 ± 2.52)%; crude protein (3.67 ± 14.12)% with an average (7.94 ± 3.84)%, fat (0.17 - 4.16)% with an average (2.13 ± 1.44)%; crude fiber (5.42 - 50.12)% with an average (20.52 ± 14.43)%, NFC (35.91 - 84.72) with an average (57.00 ± 15.01)%; and gross energy (3269 - 4489) cal/g with an average (3525.5 ± 1241.3) cal/g.

The analysis results of nutrient contents shows that nutrient need of obi cuscus has contain crude protein, crude fiber, and nitrogen free extract contents range which are wide so that the preparation of feed for these animals in captive breeding (ex situ) will be relatively easier. This is also supported by the fact that plant selected by the obi cuscus as feed resources are very diverse. In addition to energy and protein, animals may select feed based on fiber and secondary compound concentrations [32]. This is perhaps to be expected, considering that feed items with
high concentrations of secondary metabolites may be difficult to digest, lack nutritional value, and can contain toxins [33–35].

The nutritional content of feed plants needs to be analyzed to meet nutritional needs if cuscus is kept in captivity for both conservation, research, and commercial purposes, so that alternative feeds that can be found close to the nutritional content in their natural habitat. In the feeding of captive animals, it is necessary to know the nutritional content of feed from their habitats to support the ex-situ breeding program. In captivity, animals have no choice of feed. Animals will consume the feed provided by breeding managers, of course, must take into account the adequacy of nutrition in order to meet the basic life and production needs (meat, milk, pregnancy, etc.). The choice of plant species eaten by animals reflects the need to optimize the nutrient mix and the total amount of feed [36], and animals will instinctively choose plants that contain low toxicity that can inhibit their digestion [37].

According to [38], in nature the availability of feed is one of the most important factors in determining animal abundance and habitat quality including its distribution.

4. Conclusion
The habitat of the Obi cuscus (Phalanger rothschildi) is generally located in low land areas where many tall trees, lush and overgrown with an epiphytic species of fern (Asplenium nidus). Eleven species of trees are often used as temporary nesting tree for Obi cuscus. Until now, the condition of cuscuses habitat in Obi Island is still quite good, but the anticipation of forest clearing for local farming needs to be supported by forest protection efforts, so that the forest area that is cleared does not expand. The forest fruits chosen by the cuscus as feed sources were identified as many as 28 species belonging to 21 families, and there are no reports of forest leaves being consumed by the Obi cuscus

Acknowledgements
Author are thankful to Head of BKSDA of North Maluku Province and all staff, Head of Forestry Services of North Maluku Province, and Head of Obi Island Sub-district for the research permit granted. Thank you to Hadi Dahruddin for the help during the field research, and also to Tri H. Handayani and R. Lia R. Amalia for analyzing the nutritional content of forest plants. This research was funded from the DIPA budget of the Research Center for Biology, Indonesian Institute of Sciences.

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Appendix 1. Position of Survey Location in Obi Island and Bisa Island

| LATD | LATM | LATS  | DIRLAT | LONGD | LONGM | LONG  | DIRLON | ALT (m ASL) | LOCATION |
|------|------|-------|--------|-------|-------|-------|--------|------------|----------|
| 0    | 47   | 95    | N      | 127   | 22    | 589   | E      | 10         | Office of BPS, Ternate |
| 0    | 45   | 580   | N      | 127   | 22    | 396   | E      | 1          | Port of Bostong, Ternate |
| 0    | 37   | 169   | S      | 127   | 23    | 487   | E      | 1          | Bai, Obi Island |
| 0    | 40   | 60    | S      | 127   | 28    | 267   | E      | 1          | Kupal, Bacan Island |
| 1    | 13   | 194   | S      | 127   | 39    | 108   | E      | 1          | Obi Island |
| 0    | 20   | 353   | S      | 127   | 39    | 241   | E      | 1          | Port of Jikotamo, Obi Island |
| 0    | 22   | 225   | S      | 127   | 38    | 161   | E      | 5          | District office of Obi |
| 0    | 20   | 188   | S      | 127   | 38    | 318   | E      | 10         | Butun village |
| 1    | 29   | 22    | S      | 127   | 38    | 475   | E      | 40         | Lawun river, Laboku |
| 1    | 23   | 31    | S      | 127   | 38    | 387   | E      | 45         | Laboku, base camp |
| 1    | 23   | 193   | S      | 127   | 38    | 438   | E      | 50         | Laboku, found 2 cuscuses (male and female) on amatao tree (daytime) and 1 female on a Kuini tree (at night) |
| 1    | 23   | 360   | S      | 127   | 38    | 547   | E      | 40         | Lamakatto |
| 1    | 23   | 387   | S      | 127   | 38    | 579   | E      | 40         | Logging path in Lamakatto |
| 1    | 22   | 470   | S      | 127   | 39    | 18    | E      | 35         | Former logging path in Kilonoo |
| 1    | 23   | 2     | S      | 127   | 39    | 63    | E      | 35         | Swamp location, Kilonoo |
| 1    | 22   | 581   | S      | 127   | 39    | 74    | E      | 40         | A great rain tree in Kilonoo |
| 1    | 27   | 335   | S      | 127   | 39    | 74    | E      | 50         | Kaba mori |
| 1    | 23   | 533   | S      | 127   | 38    | 542   | E      | 40         | Kaba sumbali |
| 1    | 24   | 141   | S      | 127   | 39    | 177   | E      | 147        | Ewa damara |
| 1    | 22   | 373   | S      | 127   | 38    | 486   | E      | 35         | Buarao kapasi |
| 1    | 24   | 85    | S      | 127   | 38    | 432   | E      | 85         | Camp of HPH in Sanjiang, Lokotonga |
| 1    | 23   | 554   | S      | 127   | 38    | 540   | E      | 70         | Found 2 cuscuses on Salawuku tree |
| 1    | 21   | 240   | S      | 127   | 36    | 358   | E      | 30         | Potholes damaged roads in Tuduku |
| 1    | 23   | 99    | S      | 127   | 36    | 8     | E      | 45         | Found 1 female cuscus on libo tree in Tabuji |
| 1    | 23   | 225   | S      | 127   | 36    | 58    | E      | 50         | Found 1 female cuscus with young in pouch on maro tree in Tabuji |
| 1    | 23   | 385   | S      | 127   | 36    | 15    | E      | 40         | Tabuji river |
| 1    | 21   | 79    | S      | 127   | 37    | 145   | E      | 1          | Akebari, Baru village |
| 1    | 20   | 457   | S      | 127   | 44    | 23    | E      | 1          | Port of Anggai village |
| 1    | 21   | 532   | S      | 127   | 43    | 415   | E      | 20         | Gold mining site in Anggai |
| 1    | 22   | 135   | S      | 127   | 43    | 437   | E      | 30         | Found 1 male cuscus on galala tree, near Anggai river |
| 1    | 22   | 173   | S      | 127   | 43    | 194   | E      | 50         | Anggai river, headed to the forest |
| 1    | 20   | 114   | S      | 127   | 42    | 392   | E      | 1          | Sambiki Island |
| 1    | 33   | 374   | S      | 128   | 6     | 305   | E      | 1          | Pot of Sum village |
| 1    | 36   | 366   | S      | 128   | 9     | 46    | E      | 28         | Sum village |
| 1    | 36   | 397   | S      | 128   | 7     | 239   | E      | 33         | Found 1 male cuscus on allapimatahari tree, km 7, Sum |
| 1    | 15   | 110   | S      | 127   | 31    | 383   | E      | 1          | Port of Lapananawa village, Bisa Island |
| 1    | 14   | 483   | S      | 127   | 31    | 214   | E      | 80         | Headed to the forest, Jurami, Bisa Island |
|       |      |       |       |       |       |       |       | E          | 85         | Found 1 female cuscus with young in pouch on tumpa tree in Jurami, Bisa Island |
|       |      |       |       |       |       |       |       | E          | 85         | Found 1 male cuscus on nam-nam tree in Jurami, Bisa Island |

* GPS failed showing coordinate position in that location
Appendix 2. Photos from survey activities

**Figure 1.** Male obi’s cuscus (*Phalanger rotschildi*)

**Figure 2.** Female obi’s cuscus with young in pouch on matoa tree (*Pometia pinnata*)

**Figure 3.** Lapikowulu (*F. minahassae*), Nesting tree of obi cuscus

**Figure 4.** Fruit of lapikowulu (*Ficus minahassae*)

**Figure 5.** Fruit of Jambo ewa (*Kibara coriacea*)