Habitat and Distribution of Cuscuses (Phalangeridae)

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Habitat and Distribution of Cuscuses (Phalangeridae)

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2.1 INTRODUCTION

Cuscus is one of the endemic species of marsupialia of Eastern Indonesia whose distribution includes Papua, Maluku, Sulawesi and Timor, which is classified as the family of Phalangeridae.

In Indonesia there are 4 genus of cuscus, namely *Phalanger*, *Spilocuscus*, *Ailurops* and *Strigocuscus*. The cuscus has a different coat color pattern based on its genus. The genus Spilocuscus consists of 3 species and the genus Phalanger consists of 8 species. Outside Indonesia, the distribution of cuscus includes Papua New Guinea and parts of Australia.

In Papua there are two genus of cuscus, namely *Spilocuscus* and *Phalanger*. The species endemic to Papua are *Spilocuscus papuensis* and *Spilocuscus rufoniger*. In the North Maluku Islands, there are several types of endemic cuscus, namely *Phalanger rothschildi*, *Phalanger ornatus*, and *Phalanger alexandrae.* Meanwhile, in Sulawesi and the surrounding islands there are 3 endemic species, namely *Ailurops ursinus*, *Phalanger pelengensis* and *Strigocuscus celebensis*. However, because the Gebe cuscus (*P. alexandrae*) is closely related to the ornate cuscus (*P. ornatus*) of adjacent Halmahera in the north Moluccas, it is treated here as a part of the oceanic Wallacean marsupial fauna (Heinsohn 2010). From the Phalangeridae family, bear cuscus (*Ailurops ursinus*), the largest and most primitive of all cuscus. Its round pupil, two-rooted second upper premolar and primitive basicranial region of the skull are not seen in other phalangerids (Flannery *et al*. 1987). Some species have even been successfully introduced to New Ireland, Solomon Islands, New Zealand (Flannery 1995a) and Timor Island (Glover 1986). The boundaries of the natural distribution of marsupials in the tropics are shown in Fig. 2.1.

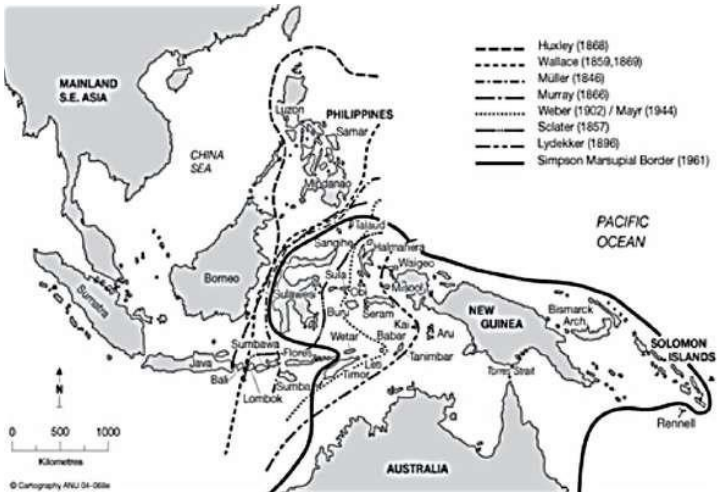

Fig. 2.1. Some traditional zoogeographic boundary lines in the Indo- Australian Archipelago (Heinsohn 2006)

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Phalangerids are medium-to large-sized mammals varying in size from 350–450 mm in head and body length and 1100–4500 g in weight. This animal has small and hairy ears, tail with half-naked distal part, and color variable. Some species are slender in appearance but most are bulky. The pelage is soft and has a dense underfur. The strongly prehensile tail has a ventral friction pad and varies between genera in the amount of fur present (McKay & Winter 1989). The tail functions to hang on the branches of the tree, gripping the branches firmly to move them from one tree to another.

Some traditional zoogeographic boundary lines in the Indo- Australian Archipelago. most of which attempt to define the demarcation between Asian and Australian faunas. Simpson's Marsupial Line (1961) is marked in bold. Simpson naively treats this boundary as the natural distributional limit of marsupials in the tropics (Heinsohn 2006).

The genus Phalanger has pupil avoid, a dorsal stripe from the head to the lower back, and never mottled in colour. The genus Spilocuscus has is characterized by pupil like a cat's eye, lacks a dorsal stripe, and male almost always mottled in colour (Flannery 1995a). Members of this family have a well developed marsupium that opens anteriorly. They usually give birth to a single young per litter. They are omnivores, foraging nocturnally or around dawn and dusk.

These animals inhabit a wide range of forest habitats from alpine woodland to eucalypt forest and tropical jungle. They are omnivores, taking meat and insects opportunistically, foraging nocturnally or around dawn and dusk. During the day they rest on tree branches high in the canopy. Cuscus does not choose certain tree species as nesting sites, the most important is that the trees are tall, leafy, covered with epiphytes with hanging roots (Farida *et al.* 1999b). In its habitat, cuscus consumes fruit, leaves, flowers, and bark, however some literatures report that cuscus, also consumes bird egg, young bird, lizard, or young of small mammal (Menzies 1991; Petocz 1994; Latinis 1996).

Habitat damage, hunting, catching, and trading which are uncontrollable can threaten the existence of this animal in its habitat. Cuscuses have long been hunted for the use of meat, fur and teeth by local peoples, especially in Papua, North Sulawesi, East Nusa Tenggara (Farida *et al.* 1999a; Farida *et al.* 1999b; Farida *et al.* 2005; Farida & Dahruddin 2008). 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 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Baillie & Groombridge 1996). However, Norris (1999). reported that Phalanegridae is still considered to be vulnerable by virtue of restricted distribution.

In Indonesia, 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.

2.2 HABITAT

Cuscuses live in eastern Indonesia, New Guinea as well as Cape York in Australia. Specifically, they live almost entirely in the canopy of trees in tropical forests, hardwood forests, and mangroves. These species rarely move down to the ground. Cuscus that live in mangroves migrates to tropical forests for the winter season. The phalangerids build homes in the hollows of trees or create platforms or nests high in the treetops where they can sleep. Other cuscus species spend much of the day sleeping in burrows, spending some time on the ground, but moving into the trees at night for foraging. They live in a warm, wet climate. The animal may sit under a large collection of leaves to cool off when it's extremely hot. Or they sometimes crawl into a hollow log for shade during the hottest part of the day.

The northern common cuscus or gray cuscus (*Phalanger orientalis*) is resitricted to tropical rainforests and thick scrub in the South West Pacific (Nowak, 1999). They have also been spotted in gardens, probably due to the high abundance of edible plants (Flannery 1995a).

Common spotted cuscus (*Spilocuscus maculatus*) are found in secondary forests, and tropical lowland forests, which are located from 500 m to 1000 m asl. Its altitudinal range of sea level is up to 1,400 m asl. (Leary et al. 2008b). Within these forests, common spotted cuscus forage in the understory, subcanopy, and canopy layers. Common spotted cuscus can also live in close proximity to human civilizations, where they inhabit agricultural matrices and coconut plantations. In Australia, common spotted cuscus also inhabit freshwater and saline mangrove forests. (Heinsohn 2002; Richards and Gamui 2011; Strahan, 1995).

The black-spotted cuscus (*S. rufoniger*) inhabits tropical forests and thick scrub areas in northern New Guinea. It inhabits undisturbed forests below 1200 meters in elevation (Flannery, 1995a; Nowak, 1999). Black-spotted cuscuses have been located in secondary forests as well.

Ground cuscus (*Phalanger gymnotis*) occupies a variety of habitats including rain forests, caves and gardens. It is found from sea level up to 2,700 m but is most common at the lower end of its altitudinal range. Primarily terrestrial, *P. gymnotis* seeks refuge in dens, which are constructed in caves, under trees, and along stream beds. It may also be found in cultivated gardens, despite close proximity to humans. (George, 1987; Leary *et al*., 2010; Majnep and Bulmer, 2007; Ramono & Nash, 1992).

The Moluccan cuscus (*P. ornatus*) can be found in forest areas with an altitude of 100 m above sea level (Leary et al. 2008e). Gebe cuscus (*P. alexandrae*) is an endemic cuscus from Gebe Island, North Maluku, which lives in forests up to 300 meters above sea level (Leary *et al*. 2008d).
Sulawesi bear cuscus (*Ailurops ursinus*) is an arboreal marsupial that lives in the upper canopy of lowland tropical rainforests in pairs or small groups of three or four individuals (Dwiyahreni et al. 1999; Lee 2000). Small Sulawesi cuscus (*Strigocuscus celebensis*) occurs in rainforests and in secondary forests and gardens around human dwellings (Flannery 1994; Nowak, 1999) and also in community gardens on the edge of the forest, sometimes sleeping on the midrib of coconut leaves.

Talaud bear cuscus (*A. melanotis*) is an animal that spends a lot of time in the tree canopy (arboreal) in secondary dryland forest (Repi *et al*. 2019). However, Talaud cuscus can also inhabit primary forest. Talaud cuscus was found more often in secondary dryland forest in the Sangihe Islands and Talaud Islands because primary forest had been damaged a lot, and secondary forest was more available.

2.3 DISTRIBUTION

The Phalangeridae are a family of mostly nocturnal marsupials native to Australia, New Guinea, eastern Indonesia, and surrounding islands (Ruedas and Morales 2005; Helgen and Jackson 2015), including the cuscuses, brushtail possums, and their close relatives. Many species have been introduced to various non-native habitats by humans for thousands of years (Schapper 2011).

Phalangeridae as an arboreal marsupial family consists of 29 currently recognized species in six genera (Phalanger, Strigocuscus, Spilocuscus, Ailurops, Trichosurus, Wyulda). Members of the Phalangeridae are very widely distributed throughout the islands east and west of New Guinea (Flannery 1995a; 1995b). Various members of the genera Strigocuscus and Phalanger are found throughout Maluku, extending as far south as Timor. The most westerly occurrence of the family is S. celenbis on Sulawesi. The most easterly occurrences of Phalangeridae are in the Solomon Islands.

Several species of cuscus have been introduced from New Guinea by humans to the islands. Most notably, human-sponsored introduction is responsible for the very wide distribution of P. orientalis. It was introduced into New Ireland and into the Solomons (Spriggs 1998), as well as into Biak-Supiori (Helgen and Flannery 2004), Timor, and other parts of southern Maluku (O'Connor 2006). There is also evidence for human-sponsored introduction of several other phalangerids. For instance, *S. maculatus* were dispersed by humans to Mussau and New Ireland, and to Salayar Island, south of Sulawesi (Winter and Leung 1995), while P. intercastellanus was introduced by humans into the Aru Islands and parts of Australia (Winter and Leung 1995). The existence of distinct species of Spilocuscus in Sulawesi, Sangir, Halmahera, and Aru suggests that these populations are long-established and not the result of human transfer (Flannery *et al*. 1995b).

The distribution of marsupials which belong to Phalangeridae covers from Australia to Papua New Guinea and eastern Indonesia. Four out of six genera which are in the family and endemic in eastern Indonesia (Flannery 1997, McNab 2008). Halmahera island is one of the regions which has a certain distribution of cuscus from Phalanger genus. Cuscus is marsupial which has a marsupium (MacDonald et al. 1993; Nowak 1999), and is a nocturnal animal (MacDonald *et al*.1993; Latinis 1996; Flannery 1997; Heinsohn 1998; Nowak 1999; Helgen 2007), arboreal (Nowak 1999; Helgen and Flannery 2004), eat leaves, fruits, flowers, barks and occasionally insects (Latinis 1996).

The Common Spotted Cuscus (*Spilocuscus maculatus*) has a range extending from Queensland (Australia), through New Guinea, to Buru and Ceram, as well as the small island of Selayar, at the tip of Sulawesi's Southeastern Peninsula; and lastly, *Strigocuscus pelengensis* with *Strigocuscus celebensis* by Flannery *et al*. (1987) but specifically distinct in Phalanger by George (1987) are restricted to the islands of Peleng and Taliabu, off the tip of Sulawesi's Eastern Peninsula. To Wallace, it thus was clear that the mammal fauna of Sulawesi was dominated by species of patent Australian affinities; the uncertainties regarding the broader biogeographic affinities lay rather with the remaining fauna, primarily insects and birds (Wallace 1869). The Banggai cuscus (*Strigocuscus pelengensis*) being considered Least Concern, but of very restricted geographic range to the islands of Peleng and Taliabu, off the tip of Sulawesi's Eastern Peninsula (Leary *et al*. 2016; Flannery 1995b). *Phalanger ornatus*, a recently described phalanger from the islands of Ternate and Tidore in the North Moluccas, also has blue eyes (Flannery and Boeadi 1995).

The northern common cuscus (*Phalanger orientalis*), also known as the grey cuscus, is a species of marsupial in the family Phalangeridae native to northern New Guinea and adjacent smaller islands, but is now also found in the Bismarck Archipelago, southeast and central Moluccas, the Solomons, and Timor, where it is believed to have been introduced in prehistoric times from New Guinea. It was formerly considered conspecific with the allopatric *P. intercastellanus* and *P. mimicus*. It is hunted for human consumption in New Guinea. *P. orientalis* is native to Indonesia, Papua New Guinea, the Solomon Islands and Timor-Leste. It is distributed from the islands of Timor, Wetar and Leti through the Kai Islands and a number of the Moluccan Islands of Indonesia including Ambon, Buru, and Seram; it is present on the islands of Misool, Waigeo, Batanta, and Salawati, and ranges over much of the northern part of the island of New Guinea, including a number of offshore islands. (Leary *et al*. 2008a; Schapper 2011).

The Common Spotted Cuscus is native to Indonesia, Papua New Guinea, and Australia. It is found through much of the southern Moluccan Islands, including Buru, Seram, Banda, and Ambon, as well as the small island of Selayar, at the tip of Sulawesi's Southeastern Peninsula; it is present on the islands of Misool and Yapen, the Kai Islands and the Aru Islands; it is distributed over much of the island of New Guinea; and is present on the Cape York Peninsula, Australia. It has been introduced to the islands of Mussau and New Ireland, and to Salayer Island, south of Sulawesi. Its altitudinal range of sea level is up to 1,400 m asl. (Leary *et al*. 2008b).

The Biak spotted cuscus (*Spilocuscus wilsoni*) is endemic to the neighboring oceanic islands of Biak-Supiori in Cenderawasih Bay. It is the smallest of the spotted cuscuses with blue-green eyes and a pure white coat in the adult male. Helgen & Flanerry (2004) considered *S. wilsoni* a highly endangered species, but more on the ground information regarding its distribution, abundance, and levels is needed to firmly establish its conservation status.

There are three endemic species in Sulawesi, namely Small Sulawesi cuscus (*Strigocuscus celebensis*), Sulawesi bear cuscus (*Ailurops ursinus*), and Talaud bear cuscus (*A. melanotis*). These species, together with at least 20 additional species, constitute the family Phalangeridae (Colgan *et al*. 1993; Flannery 1994, 1995a, 1995b; Flannery and Calaby 1987; Flannery *et al*. 1987; George 1987; Groves 1987a, 1987b, 1993; and Norris and Musser 2001). The Sulawesi Bear Cuscus is endemic to Indonesia, found only on Sulawesi and surrounding islands of Butung, the Peleng Islands, the Togian Islands, and possibly Muna (Flannery 1995b; Nowak 1999; Salas *et al*. 2008). It is the largest and most primitive species of the Family Phalangeridae (Dwiyahreni *et al*. 1999) and one of two species of this genus in Indonesia. *Strigocuscus celebensis* occurs exclusively on Sulawesi and surrounding islands. Subspecies of *S. celebensis* occur throughout this range: *S. c. celebensis* is found in southern and central Sulawesi, *S. c. feileri* is found in north Sulawesi, and *S. c. sangirensis* is found on the Sangihe Islands north of Sulawesi (Flannery, 1994; Groves, 1987a; Ruedas and Morales,

2005). The existence of Talaud bear cuscus (*A. melanotis*) is known to be distributed on Salibabu Island and possibly on Sangihe Island, with a particular stronghold on Mount Sahendaruman (Riley 2002; Flannery and Helgen 2016).

2.3.1 Northern Common Cuscus
*Phalanger orientalis (*Pallas, 1766)

The Northern Common Cuscus (*Phalanger orientalis*), also known as the brown cuscus or the grey cuscus or the white cuscus is a species of marsupial in the family Phalangeridae (Farida *et al*. 2005; Leloltery & Kunu 2013; Usmany *et al*. 2015; Handayani & Kunda 2019). The distribution of Northern Common Cuscus includes Papua, Ambon, Buru, Seram, and the Southeast and Central of Maluku, Timor Island, Wetar, Leti. Outside Indonesia, this type of cuscus is also found in Timor Leste, Papua New Guinea, Solomon Islands, and Bismarck Islands. *P. orientalis* was introduced to Timor (Glover 1971; 1986), Leti, Wetar, Sanana, Buru, Ambon, Seram, Banda, Kai, Bismarck Archipelago (Flannery and White 1991; Spriggs 1997; Summerhayes 2007); Solomon Island (Wickler 2001; Summerhayes 2007); some other oceanic New Guinea satellite islands.

Fig. 2.2. *Phalanger orientalis* from Papua (Photo by W.R. Farida)

Fig. 2.3. *Phalanger orientalis* from Timor (Photo by W.R. Farida)

Fig. 2.4. Geographical distribution

The Northern Common Cuscus is widespread and abundant in Papua, its habitat is limited in tropical rain forests from sea level to an altitude of 1,600 masl. They have also been spotted in gardens, probably due to the high abundance of edible plants (Flannery 1995a). The average body weight is about 2.1 kg. This is slightly lower in females. In adult males, the thick, wooly fur ranges in color from white to medium or dark grey (Nowak 1999). In adult females, the color ranges from reddish-brown to brownish-grey. The stomach area is com- monly white. The male has a distinct yellowish chest gland.

Usually a dark stripe runs from the head to the lower back. The young of this species are reddish-brown. (Flannery 1995a; Nowak 1999). The tail length varies from 28 to 42 cm (Grizmek 1990). The male tail is completely white but female tails are white only on the tips.

Trees used by cuscus as temporary nesting sites are generally large and above 10 m high with a diameter of more than 20 cm. The height of the nest found is generally a minimum of 5 m from the ground. Trees as temporary nests are generally overgrown with vines or a combination of host trees and banyan tree. Cuscus does not make holes for nesting but uses existing tree holes for nests (Dahruddin *et al.* 2005). In their habitat, these animals eat leaves, forest fruit, and bark. Types of fruit that are often eaten include *Diospyros* sp., *Eugenia* sp., *Pandanus* sp. dan *Gnetum gnemon.*

In Indonesia, *P. orientalis* is protected by law and it is classified as a species of Least Concern on the IUCN's Red List of Threatened Species.

2.3.2 Ornate Cuscus
Phalanger ornatus (Gray, 1860)

Ornate Cuscus (*Phalanger ornatus*) or Yellow Cuscus or Moluccan cuscus is one of the marsupials endemic to Ternate Halmahera island, Bacan island, and Morotai island, North Maluku. Its habitat is in tropical rainforests at an altitude of 100 masl. and in Ternate it is found in secondary forests and nutmeg and clove plantations. The habitat of this species is recorded by Wallace (1886). No other Phalanger species occur in these islands. The typical form is light brown in colour, with adults having large, irregular white patches in the fur, and a narrow, dark dorsal stripe present anteriorly, white ear flashes present; back and sides with a varying amount of white spotting. Furred portion of the tail short, terminating abruptly; tail rather rugose (Menzies & Pernetta 1986). Individuals from Ternate are smaller, reddish brown, and have a blue iris, no sexual dimorphism (Flannery 1995b). Ornate cuscus is listed as Least concern, lowest risk on the IUCN Red List of Threatened Species

Fig. 2.5. *Phalanger ornatus* and Geographical distribution (Photo by W.R. Farida)

2.3.3 Silky Cuscus
Phalanger sericeus (Thomas, 1907)

The Silky Cuscus (*Phalanger sericeus*) is found in Papua (Indonesia) and Papua New Guinea. Silky Cuscus inhabit the forests of high altitude in the central mountains of the islands of Papua, Indonesia, and Papua New Guinea. *P. sericeus* is commonly found in most primary mountain forests at an altitude of 1500 to 2700 masl. (Flannery 1995a). *P. sericeus* has brownish to black fur, similar to the *P. carmelitae* and some island races of *P. orientalis*. Fur silky, between 28 and 40 mm thick; ranging from light greyish milk-chocolate through chocolate-brown to dark chocolate- brown or almost black, often glossy; ventral fur pure white, usually restricted in extent and terminating in the region of the pouch; no dorsal stripe or ear flashes; tail entirely dark or with a light tip; entirely smooth in the naked portion, young not markedly different in colour from the adults (Menzies & Pernetta 1986).

In their habitat, this animal is a fruit-eating (folivorous) (Hume *et al.* 1993), while Majnep & Bulmer (1990) reported that silky cuscus ate forest foliage as well as the fruits of *Casuarina oligodon* and cordyline. When eating pandan leaves, after chewing and swallowing the juice, it will regurgitate the

fiber. Salas (2002) noted that *P. sericeus* is highland species, feed predominantly on leaves, but also consume fruit.

In Indonesia, Phalanger sericeus is protected under Regulation of the Minister of Environment and Forestry Number P.106/MENLHK/SETJEN/KUM.1/8/2018 concerning Protected Types of Plants and Animals. The Silky cuscus is listed as Least Concern on the IUCN Red List of Threatened Species.

Fig. 2.6. *Phalanger sericeus* and Geographical distribution (Photo by Bruce Beehler/ https://www.zoo.org/tkcp/wildlife)

2.3.4 Stein's Cuscus
***Phalanger vestitus* (Milne-Edwars, 1877)**

Stein's Cuscus (*Phalanger vestitus*) is a marsupial whose distribution includes Papua (Indonesia) and Papua New Guinea. Stein's cuscus occurs in a very narrow zone around 1200 masl. *P. vestitus* is not a widespread, high-altitude species but a hardly-known, middlealtitude species of west and central New Guinea (Menzies & Pernetta 1986). *P. vestitus* is characterized by a variety of hair colors because it is a combination of colors black hair mixed with white and a little brownish yellow color, and has ears that are not visible because they are covered by hair (Usmany *et al*. 2015). *Phalanger vestitus* is clearly a member of the long-haired montane group (Menzies & Pernetta 1986). In its habitat, *P. vestitus* consumes the fruits of the Lithocarpus and *Castanopsis* spp. (George, 1987).

In Indonesia, *Phalanger vestitus* is protected under Regulation of the Minister of Environment and Forestry Number P.106/MENLHK/SETJEN/KUM.1/8/2018 concerning Protected Types of Plants and Animals. The Stein's cuscus is listed as Least Concern on the IUCN Red List of Threatened Species.

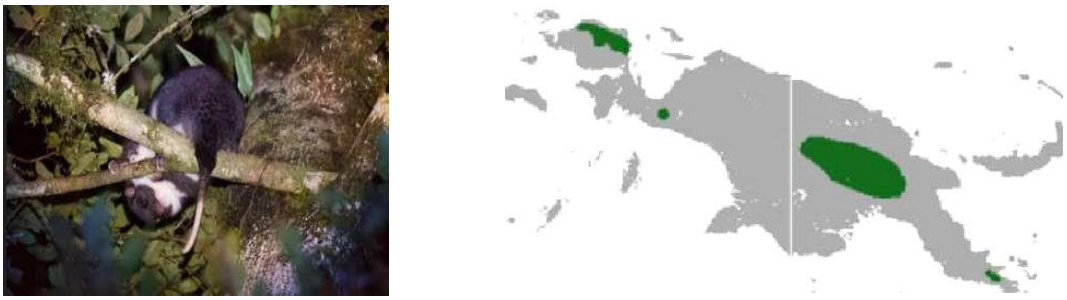

Fig. 2.7. *Phalanger vestitus* and Geographical distribution (Photo by Kristof Zyskowski & Yulia Bereshpolova)

2.3.5 Blue-Eyed Spotted Cuscus
***Phalanger matabiru* (Flannery & Boeadi, 1995)**

The blue-eyed spotted cuscus (*Phalanger matabiru*) is one of the marsupials endemic to Ternate island and Tidore, North Maluku (Leary *et al.* 2008). *P. matabiru* was identified in 1995. These arboreal and nocturnal animals live in tropical forests and have the status of being protected by Law Number 5 of 1990 concerning the Conservation of Living Natural Resources and their Ecosystems.

Although its status is protected by law, the hunting of blue-eyed cuscus is still being carried out for the purpose of consumption and trade. The population of *P. matabiru* is estimated to continue to decline due to deforestation and land use conversion to settlements and plantations, as well as the increasing population (Rahim 2018). This has the effect of shrinking the habitat of these animals.

In Indonesia, *Phalanger matabiru* is protected under Regulation of the Minister of Environment and Forestry Number P.106/MENLHK/SETJEN/KUM.1/8/2018 concerning Protected Types of Plants and Animals. The blue-eyed cuscus is classified as a species of vulnerable on the IUCN's Red List of Threatened Species.

Fig. 2.8. *Phalanger matabiru* and Geographical distribution *(Source : Hairil Abdul Rahim/Beritagar.id)*

2.3.6 Mountain Cuscus
Phalanger carmelitae (Thomas, 1898)

Mountain cuncus (*Phalanger carmelitae*) is limited distribution in West Papua and outside Indonesia in Papua New New Guinea (Leary *et al.* 2008). *P. carmelitae* is similar to the silky cuscus (*P. sericeus*), its fur is brown, only differs from the length of the coarse tubercle at the base of its tail, *P. carmelitae* is longer than *P. sericeus* (Flannery 1995a).

The habitat of this animal is in primary forest at an altitude above 2000 masl. (Dwyer 1983) and is also found in high open forest at an altitude of about 3000 masl (Flannery 1995a). These arboreal and nocturnal animals, usually rest during the day in the coils of epipitic plants or in pandanus leaves or in tree holes. In its habitat, *P. carmelitae* eats fruit (folivores) (Hume *et al.* 1993), young shoots and pandanus and epipitic orchids (Bulmer & Menzies 1972), and even eats lorikeet (George 1982).

Behavioral data suggest a facultative polygynous mating system in mountain cuscus (Salas 2002). However, so little is known of this species that it merits presenting the data of only one animal.

In Indonesia, Phalanger carmelitae is protected under Regulation of the Minister of Environment and Forestry Number P.106/MENLHK/SETJEN/KUM.1/8/2018 concerning Protected Types of Plants and Animals. The mountain cuscus is classified as a species of least concern on the IUCN's Red List of Threatened Species.

Fig. 2.9. *Phalanger carmalitae* and Geographical distribution (Source : Heath Warwick, Museums Victoria)

2.3.7 Ground Cuscus
Phalanger gymnotis (Peters & Doria, 1875)

The distribution of Ground cuscus (*Phalanger gymnotis*) includes Papua mainland, Yapen Island, Misool, Salawati, and Aru Island (Helgen & Flannery 2004; Wilson & Reeder 2005). Habitat of Ground cuscus in tropical forests from lowlands to an altitude of 2700 masl. Primarily terrestrial, *P. gymnotis* seeks refuge in dens, which are constructed in caves, under trees, and along stream beds. It may also be found in cultivated gardens, despite close proximity to humans. (George 1987; Leary *et al*. 2010; Majnep & Bulmer 2007; Ramono & Nash 1992).

Fig. 2.10. *Phalanger gymnotis* and Geographical distribution (Photo source: PT. Wijaya Sentosa)

Its body hair is short and thick, dark gray and whitish on the belly. The tail is coarse, easy to move for grip. Although it is terrestrial, Ground Cuscus can also climb trees and while eating sits on his hind legs. During the day, these animals usually sleep in holes under the roots of trees or in caves or in earthen holes near rivers (Majnep & Bulmer 1990). According to Menzies & Pernetta (1986), with the exception of *P. gymnotis* all species are entirely arboreal, resting in tree crowns or holes or amongst masses of epiphytic vegetation during the day, and feeding in the forest canopy at night. *P. gymnotis* is in contrast more terrestrial than the other species, being found sleeping in lairs in rock screes or at the base of large rainforest trees, or in abandoned mine tunnels and caves.

In its habitat, *P. gymnotis* is a fruit eater (folivore) (Hume *et al.* 1993), but also consumes eggs, seeds, and leaves. Fruits that are often consumed are Elaeocarpus, Ficus, Pipturus, Pandanus, and also Oenathe and Rungia (Bulmer & Menzies 1972). Fruit is collected from trees and from the ground. Female ground cuscuses have been observed filling their pouches with fruit and then returning to their home dens where it is stored (Flannery 1995a; Ganslosser & Etter-Ganslosser 1990; Mack & Wright 2005; Wilson & Reeder 2005).

In Indonesia, Ground cuscus is protected under Regulation of the Minister of Environment and Forestry Number P.106/MENLHK/SETJEN/KUM.1/8/2018 concerning Protected Types of Plants and Animals. *P. gymnotis* is classified as a species of Least Concern on the IUCN's Red List of Threatened Species.

2.3.8 Gebe Cuscus
Phalanger alexandrae (Flannery & Boeadi, 1995)

The Gebe Cuscus (*Phalanger alexandrae*) is one of the marsupials endemic to Gebe Island, Southeast Halmahera, North Maluku. The habitat of these animals is in tropical rainforests at an altitude of 300 masl. (Leary *et al*. 2008). *P. alexandrae* is larger than other North Maluku phalanger species. The body hair color on the front is bright reddish, posteriorly grayish, and the eyes are greenish (Flannery 1995b).

P. alexandrae is protected by Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.106/MENLHK/SETJEN/KUM.1/8/2018 concerning Protected Types of Plants and Animals, while the IUCN classifies The Gebe cuscus as a species of Endangered on the IUCN's Red List of Threatened Species. The spread of Gebe cuscus is restricted to single islands, is also worthy of conservation attention.

Fig. 2.11. Geographical distribution

2.3.9 Southern Common Cuscus
Phalanger mimicus (Thomas, 1895)

Southern Common Cuscus (*Phalanger mimicus*) also known as Gray Cuscus, Australian Cuscus, Gray phalanger, or To-ili is one of the marsupials endemic to South Papua, Aru island and outside of Indonesia in Cape York Peninsula (Australia) and Papua New Guinea . This animal occurs in both primary and secondary forest at lower elevations, sea level to - 800 masl. (Norris dan Musser 2001).

Until recently, it was considered conspecific with *P. intercastellanus*, and before that also with *P. orientalis* (Groves 2005). The top of the body is gray- brown with a black median stripe on the back, the underside is white. In some specimens, the belly is also gray-brown. The prehensile tail is the same color at the root as the top, the rest of the tail is bare and dark brown. The pink ears are short and round. The head-body length is (in the Australian subspecies) 330 to 400 mm, the tail length 280 to 350 mm and weight 1500 to 2200 g (Menkhorst & Knight 2001).

Phalanger mimicus is solitary, arboreal, nocturnal animal. During the day he stays in a tree hole. At night it moves long through the foliage in search of food. Its diet consists of leaves, fruits and flowers. *P. mimicus* is classified as a species of Least Concern on the IUCN's Red List of Threatened Species.

Fig. 2.12. *Phalanger mimicus* and Geographical distribution (Source: CNZdenek & AJBurnett)

2.3.10 Obi's Cuscus
Phalanger rothschildi (Thomas, 1898)

Obi's cuscus (*Phalanger rothschildi*) is one of the marsupials endemic to the islands of Obi, Bisa, Obi-Latoe in the North Central Moluccan Islands. *P. rothschildi* is probably most closely related to the *P. ornatus* complex. There are two colour morphs: orangebrown, and grey with dark underfur. The iris is pale sepia, body-size is small, and the white to yellow belly is sharply defined (Flannery 1995b), dark

dorsal stripe and white ear flashes present; ventral fur pure white, extensive; tail fur taper short, tail pale (Menzies & Pernetta 1986).

P. rothschildi is found in lowland forest, nest in tall trees and symbiose with *Asplenium nidus*. During the fruit season, cuscus is often found in the trees of *Pometia pinnata*, *Dracontomelon dao*, and *F. minahassae*, which is also a temporary nesting place (Farida, 2020). Nesting tree of 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. Obi's 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 (Farida *et al.* 1999a). Conform to its life habit: living on the trees (arboreal) and active in the night (nocturnal), in the day time cuscus hides and sleeps (George 1973).

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. The rapidly increasing rate of human settlement, particularly on the small island of Bisa, and the apparent vulnerability of this species to forest destruction, suggest that the Obi's Cuscus should be regarded as vulnerable (Flannery 1995b). Another cause is the habit of local people in hunting cuscus because it is believed to be able to cure various diseases (Tamalene *et al*. 2019).

Fig. 2.13. *Phalanger rothschildi* and Geographical distribution (Photo by W.R. Farida)

P. rothschildi has been protected since 1990 through the Regulation of the Wild Animal Hunting No. 226/1931, Law No. 5/1990 concerning Conservation of Biological Natural Resources and their Ecosystems, while *P. rothschildi* is classified as a species of Vulnerable on the IUCN's Red List of Threatened Species.

2.3.11 Common Spotted Cuscus
Spilocuscus maculatus (E. Geoffroy, 1803)

Common Spotted Cuscus (*Spilocuscus maculatus*) is a marsupial with colorful spotted hair. The distribution of spotted cuscus is the lowland area of Papua and surrounding islands such as Yapen, Misool, Salawati, and Aru (Flannery 1994). *S. maculatus* has been introduced to Selayar, Buru, Ambon, Seram, Banda, Kai, St. Matthias, New Ireland, New Britain adventive populations (Heinsohn 2006).

S. maculatus is found in secondary forests, and tropical lowland forests, which are located from 500 to 1000 masl. Within these forests, Com- mon Spotted Cuscus forage in the understory, subcanopy, and canopy lay- ers. Common spotted cuscus can also live in close proximity to human civilizations, where they inhabit agricultural matrices and coconut planta- tions (Heinsohn 2002; Richards & Gamui 2011; Strahan 1995).

The Common Spotted Cuscus is a medium sized marsupial mammal with a body mass of 3 to 6 kg. Males are typically larger than females. Tails are long, prehensile, and lack fur, but rough papillae are present on the ventral surface. This animal has thick, woolly fur of varying colours depending on age, sex, and location. Males are typically grey/white or brown/white with splotchy patterns on their back and a white underbelly. Only males have spots (*Grzimek 1990).* Females are usually white or grey

and unspotted. Unlike some other species of cuscuses or possums, the common spotted cuscus does not have a dorsal stripe on its fur (Ride 1970).

(A) **(B)**

Fig. 2.14. *Spilocuscus maculatus*, (A) Male, and (B) Female (Photo by W.R. Farida)

Fig. 2.15. Geographical distribution

S. maculatus is an arboreal species and mainly solitary. During the day the common spotted cuscus can be found sleeping in the forest canopy where they shield themselves with foliage to camouflage their bodies from predators. Cuscus does not use a den but sleeps on open branches (Winter 1983). The Common Spotted Cuscus is a foliovore, as its diet mainly consists of leaves, such as, leaves of epiphytic ferns, climbers, *Piper betle* and *Ficus* sp. This animal will often selectively consume young shoots and leaves. Even, they eat immature coconuts, fruits of *Pometia pometia*, insects, and small vertebrates (Chen *et al*. 2005; Latinis 1996; Saragih *et al*. 2010; Sinery *et al*. 2013).

S. maculatus is protected by Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.106/MENLHK/SETJEN/KUM.1/8/2018 concerning Protected Types of Plants and Animals, while the IUCN classifies The Common Spotted Cuscus as a species of Endangered on the IUCN's Red List of Threatened Species.

2.3.12 Black-Spotted Cuscus
Spilocuscus rufoniger (Zimara, 1937)

The Black-spotted Cuscus (*Spilocuscus rufoniger*) is the largest species of phalangerid. *S. rufoniger* is restricted to northern Papua (Indonesia) and PapuaNew Guinea. *S. rufoniger* inhabits tropical forests and thick scrub areas in northern New Guinea. It inhabits undisturbed forests below 1200 meters in elevation (Flannery 1995a; Nowak, 1999).

Female Black-spotted Cuscus are larger than males of the species. Although both male and female have striking black and red coloration, their pelage is sexually dimorphic. Females have a dark saddle on their backs, whereas males have only an area of mottling or spots. Young go through a sequence of color changes as they mature. The fur of black-spotted cuscus is dense and wooly.

The cuscus of the genus Spilocuscus has a vertical pupil (cat- like pupil). They are arboreal, probably nocturnal, and their diet consists of leaves and fruit, possibly feeding occasionally on small animals, and resting by day curled up exposed on a branch high in the canopy (Flannery, 1995a).

S. rufoniger is protected by Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.106/MENLHK/SETJEN/KUM.1/8/2018 concerning Protected Types of Plants and Animals, while the IUCN classifies The Black-spotted Cuscus as a species of Endangered on the IUCN's Red List of Threatened Species. The its limited range and colorful pelt have made it susceptible to overhunting. Habitat loss due to an expanding human population has caused the numbers of *S. rufoniger* to decline (Flannery 1995a; Nowak, 1999).

(A) **(B)**

Fig. 2.16. *Spilocuscus rufoniger* (A) Male and (B) Female (Photo source: PT. Wijaya Sentosa)

Fig. 2.17. Geographical distribution

2.3.13 Biak Spotted Cuscus
Spilocuscus wilsoni (Helgen & Flannery, 2004)

The Biak Spotted Cuscus (*Spilocuscus wilsoni*) is one of the marsupials endemic to the islands of Biak and Supiori in the Cenderawasih Bay, Papua Province (Aplin & Helgen 2008). While, Helgen & Flannery (2004) reported *phalangerid* genus *Spilocuscus* are endemic to tropical forest in the Australo-Papuan region. *S. wilsoni* might be the smallest of the spotted cuscuses and it is the only species of Spilocuscus with blue-green eyes. This animal has been recorded in lowland tropical moist forest. Very little is known of their ecology. Adult Biak spotted cuscus has a white coat on its back and belly. While the coat in juvenile is creamy brown and brownish gray with silvery fur. The hair on the neck and face is light brown. The tail is lighter in color with faint spots.

In their habitat, the parts of forest plants consumed by the Biak Spotted Cuscus are mostly fruit, leaves, flowers and tubers. The type of tree used by Biak Spotted Cuscus as a temporary nesting site is a leafy tree, overgrown with epiphytes with a strand of hanging roots (Dahruddin *et al*. 2005). Only scientifically described in 2004, it appears to be very rare, likely due to hunting and habitat loss, and has consequently been rated as Critically Endangered by the IUCN.

In detail, *Spilocuscus wilsoni* is not listed in Government Regulation No. 7/1999 which lists protected flora and fauna in Indonesia. However, the government regulation contains the phrase *Phalanger* spp. (all types of cuscus). So that the Blue-eyed cuscus from Biak is also one of the protected animals.

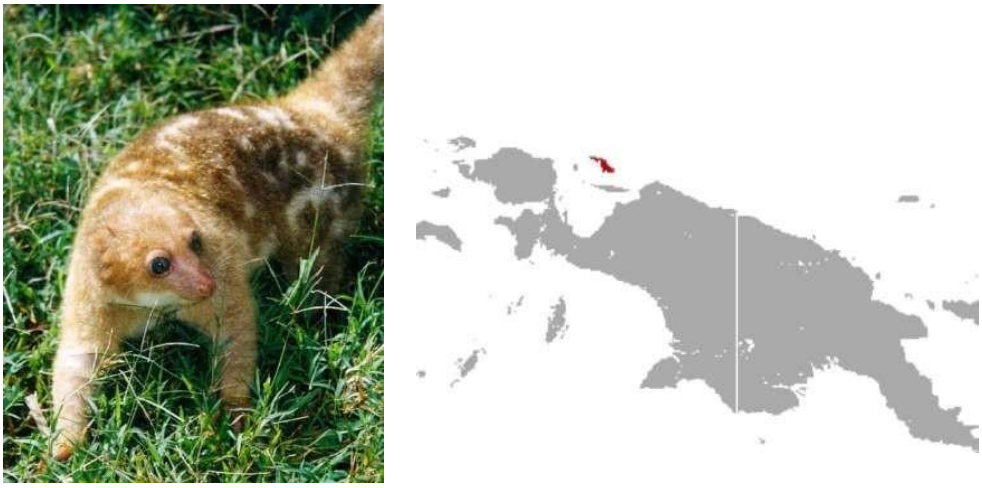

Fig. 2.18. *Spilocuscus wilsoni* and Geographical distribution (Photo by W.R. Farida)

2.3.14 Bear Cuscus
Ailurops ursinus (Temminck, 1824)

Two types of bear cuscuses that live in Sulawesi, namely the Sulawesi bear cuscus (*Ailurops ursinus*), which are distributed on the mainland of Sulawesi island, Peleng, Muna, Buton, Togian, and the Talaud bear cuscus (*Ailurops melanotis*) are endemic in Salibabu Island, Talaud Islands Regency, North Sulawesi (Flannery 1995b). *A. ursinus* is the largest cuscus of the Phalangeridae family that lives sympatric with Little Celebes Cuscus (*Strigocuscus celebensis*). Ruedes & Morales (2005) explained that the phylogenetic relationship of *Strigocuscus* and *Ailurops* has important biogeographic implications. Both genera are endemic to the Sulawesi and the surrounding islands. The distribution of bear cuscus to Salibabu Island is thought to be an introduction hundreds of years ago (Flannery 1994).

The bear cuscus is the most primitive of all phalangerids, retaining primitive dentition and cranial features (George 1987; Nowak 1997; Myers 1999). Its body length from head to tip of tail is more than one meter and is recorded as the largest mammal in the upper canopy of Sulawesi forest (Kinnaird 1995). Body weight can reach 8 kg, body hair is short and coarse blackish with yellow tips. The hairless part of the tail is covered with coarse tubercles. Its pupils are round, indicating this animal is active during the day. *A.ursinus* is an arboreal marsupial that lives in the upper canopy of lowland tropical rainforests and rarely found in primary forest with an altitude of more than 400 masl. (Dwiyahreni *et al.* 1999; Lee 2000).

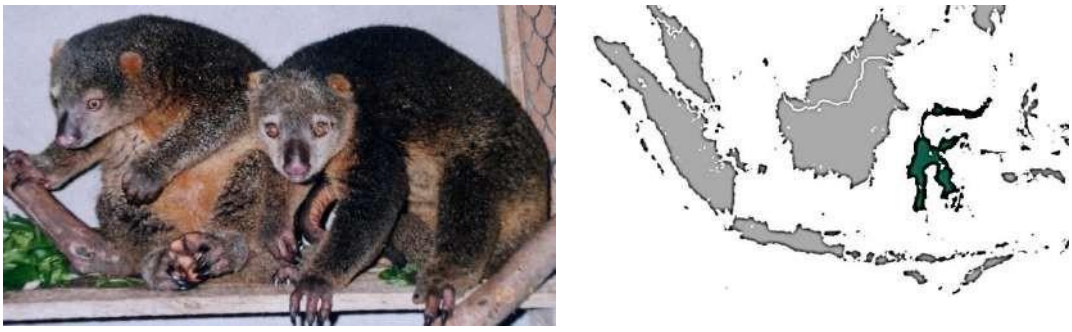

Fig. 2.19. *Ailurops ursinus* and Geographical distribution (Photo by W.R. Farida)

In nature, bear cuscus is diurnal and lives in pairs. It has been hypothesized that activity is spread throughout the day and night, with periods of rest between feeding or other activity (Tarmuji & McKinnon 1980; Flannery & Schouten 1994; Kinnaird 1995). Their life habits are different from other types of cuscus, which are generally solitary and nocturnal (Flannery 1995b). In their habitat, these animals consume more leaves (folivorous), while flowers and fruit are consumed in small amounts

(Dwiyahreni *et al.* 1999). Farida (2018) reported, the parts of forest plants eaten by bear cuscus are shoots, young leaves, flowers, and a little fruit, while other types of plants are shrubs, vines, and terrestrial.

Bear cuscus has protected status in Indonesia. Hunting greatly threatens this animal because of its low reproductive rate. *A. ursinus* is classified as a species of Vulnerable on the IUCN's Red List of Threatened Species.

2.3.15 Small Sulawesi Cuscus
Strigocuscus celebensis (Gray, 1858)

Small Sulawesi Cuscus (*Strigocuscus celebensis*) is one of the marsupials endemic to Sulawesi and its surrounding islands. Subspecies of *S. celebensis* occur throughout this range: *S. c. celebensis* is found in southern and central Sulawesi, *S. c. feileri* is found in north Sulawesi, and *S. c. sangirensis* is found on the Sangihe Islands north of Su- lawesi. (Grzimek's Animal Life Encyclopedia 2004; Flannery 1994; Groves 1987; Ruedas & Morales 2005). Farida & Dahruddin (2008) detected the species on Wowoni island, an important extension to the species' known range which has yet to be incorporated into distribution maps. *S. celebensis* occurs in rainforests and in secondary forests and gardens around human dwellings. Cuscuses are nocturnal and arboreal, and have been known to occur in male-female pairs. They are known to sleep in the crowns of coconut palms (Grzimek's Animal Life Encyclopedia 2004; Flannery 1994; Nowak 1999).

Small Sulawesi Cuscus has an overall pale buff coloration, lacking a dorsal stripe, and the tail is partially naked part. They are small pos- sums, weighing 1 kg or less (Flannery 1994; Nowak 1999), while Helgen & Jackson (2015) describe the species as being a uniform grey-brown colour dorsally, with a white underbelly. *S. celebensis* is a cryptic species given its nocturnal activity cycle and frugivorous, usually occurring in pairs and arboreal (Whitten *et al*. 2002).

In Indonesia, *Strigocuscus celebensis* is protected under Regulation of the Minister of Environment and Forestry Number P.106/MENLHK/SETJEN/KUM.1/8/2018 concerning Protected Types of Plants and Animals. The Little Celebes Cuscus is listed as vulnerable on the IUCN Red List of Threatened Species.

Fig. 2.20. Immature *Strigocuscus* and Geographical distribution (Photo by W.R. Farida)

2.3.16 Banggai Cuscus
Strigocuscus pelengensis (Tate, 1945)

The Banggai Cuscus (*Strigocuscus pelengensis*) is one of the marsupials endemic to Paleng Island, Central Sulawesi and Sula Islands, North Maluku (Wilson & Reeder 2005). *S. pelengensis* is currently only recorded from the Banggai and Sula islands, some 210 km to the north (Suyanto *et al*. 2002; Helgen & Jackson 2015; Leary *et al*. 2016).

In the Sula islands *S. pelengensis* is recorded from open dry forest, secondary habitats, farmland and scrub. The dorsal color is orange-brown and yellowish on the belly, the base of the tail is wider and does not have a distinctive dorsal stripe (Flannery 1995b; Helgen & Jackson 2015).

S. pelengensis is protected by Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.106/MENLHK/SETJEN/KUM.1/8/2018 concerning Protected Types of Plants and Animals. The Banggai cuscus is listed as Least Concern on the IUCN Red List of Threatened Species, but of very restricted geographic range (Leary *et al*. 2016).

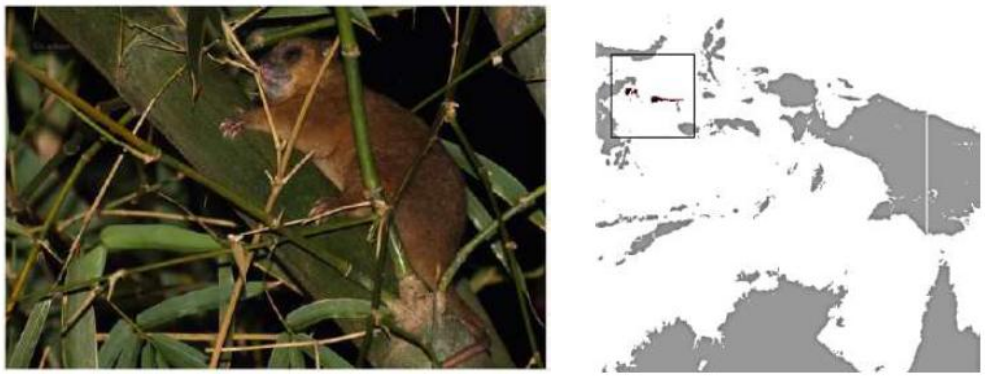

Fig. 2.21. *Strigocuscus pelengensis* and *Strigocuscus pelengensis* range (Source: © Christian Artuso, iNaturalist.ca)

2.4 CONCLUSION

The Phalangeridae are a family of mostly nocturnal marsupials native to Eastern Indonesia, Papua New Guinea, and Australia, including the cuscus, brushtail possum, and their close relatives. Most Cuscus species are categorized as an Endangered Species on the IUCN Red List; this means that it is threatened by extinction if no measures are taken to conserve its habitat and populations. The species is also included in Appendix II of CITES. The conservation status of cuscus in Indonesia has been protected since 1990 through the Wild Animal Hunting Regulation (PPBL) No. 226 /1931, Law No. 5/1990 concerning Conservation of Biological Natural Resources and Their Ecosystems, and Law No. 7/1999 concerning the Preservation of Plant and Animal Species. The Indonesian law and CITES mean that it may not be hunted, killed and traded, alive or dead, in whole or parts.

Currently the cuscus population is decreasing due to deforestation and land conversion, as well as increasing poaching. The factors that cause illegal hunting that continue to be carried out by local communities are consumption, cultural elements, the use of cuscus fur skins for accessories and souvenirs, and illegal trade. The main threat of cuscus today is habitat loss and destruction. Decreasing the rate of encroachment and other illegal activities which could decrease the quality and quantity of cuscus habitat. For this reason, the best way to protect cuscus from extinction is to maintain and protect their habitat. In an effort to conserve cuscus, it is necessary to establish the management of cuscus in its natural habitat, the management of cuscus in captivity, and conservation institutions (ex-situ), as well as population model of cuscus to estimate future populations with various scenarios.

Provide education to the public about the importance of preserving cuscus to survive in its habitat. Thus, the local community no longer disturbs the existence of the cuscus and keeps it alive in its natural habitat. Law enforcement and action against the practice of crimes against protected wildlife must be more emphasized. It is hoped that the prosecution of cases of trafficking in protected wildlife will be able to provide a deterrent effect as well as prevent this crime.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

Aplin, K. & Helgen, K. 2008. Spilocuscus wilsoni. In: IUCN 2008. IUCN Red List of Threatened Species.

Baillie, J & Groombridge, B. 1996. IUCN Red List of Threatened Animals. IUCN Gland. Switzerland.

Bulmer, R.N.H. & Menzies, J.L. 1972. Karam classification of marsupials and rodents. Journal of the Polynesian Society 81 (4): 472-499

Chen, X., Milne, N & O'Higgins, P. 2005. Morphological Variation of the Thoracolumbar Vertebrae in Macropodidae and Its Functional Relevance. Journal of Morphology 266: 167-181

Dahruddin, H., Farida, W.R. & Rohman, A.S. 2005. Types of Forage Plants and nesting sites for cuscuses (Family Phalangeridae) in the Biak Utara Nature Reserve, Papua. Biodiversitas 6 (4): 253-258.

Dwyer, P.D. 1983. Etolo hunting performance and energetics. Human Ecol 11: 145-174 Northern Biak Nature Reserve, Papua). Biodiversitas 6 (4): 253-258

Dwiyahreni, A. A., Kinnaird, M.F., O'Brien, T. G., Supriatna, J., & Andayani, N. 1999. Diet and activity of the bear cuscus (Ailurops ursinus), in North Sulawesi, Indonesia. Journal of Mammalogy 80 (3): 905 - 913.

Farida, W.R., Semiadi, G. & Dahruddin, H. 1999a. Plant selection patterns as nesting sites and feed sources of cuscus (family Phalangeridae) in Irian Jaya. Jurnal Biologi Indonesia II (5) : 235-243.

Farida, W.R., Semiadi, G. & Wirdateti. 1999b. Utilization of cuscus by the rural communities of Irian Jaya. Berita Biologi 4 (5) : 341-342.

Farida, W.R., Triono, T., Handayani, T.H. & Ismail. 2005. Selection of plant species as feed sources and nesting sites by cuscus (Phalanger sp.) in Gunung Mutis Nature Reserve, East Nusa Tenggara. Biodiversitas 6 (1): 50-54.

Farida, W.R. & Dahruddin, H. 2008. The Selection of Forest Plants As Feed Resources and Nesting Site of Dwarf Cuscus (Strigocuscus Celebensis) and Nutrient Analysis in Wawonii Island, South-East Sulawesi. Jurnal Biologi Indononesia 5 (2) : 201-210.

Farida, W.R. 2018. Selection of Forest Plants as Feed Source and Nesting Trees of Bear cuscus (Ailurops Ursinus) in Sulawesi. Prosiding Seminar Nasional Biologi XXIV PBI Manado. pp. 327-336. ISBN 978-602-51854-0-3.

Farida, W.R. 2020. Forest plants selection as feed sources and nesting tree of obi's cuscus (Phalanger rothschildi Thomas, 1898) in Obi islands, North Maluku. IOP Conf. Series: Earth and Environmental Science 486 (2020) 012104. https://doi.org/10.1088/1755-1315/486/1/011001

Flannery, T.F. 1994. Possums of the World: A Monograph of the Phalangeroidea. Sydney: Australian Museum/Geo Productions.

Flannery, T.F. 1995a. Mammals of New Guinea. Revised and updated edition. Sydney: Australian Museum/Reed Books.

Flannery, T.F. 1995b. Mammals of the South-West Pacific and Moluccan Islands. Sydney: Australian Museum/Reed Books.

Flannery, T. & Schouten, P. 2004. Astonishing Animals: Extraordinary Creatures and the Fantastic Worlds They Inhabit. New York: Atlantic Monthly Press. 58.

Flannery, T.F., Archer, M., & Maynes, J. 1987. The phylogenetic relationships of living phalangerids (Phalangeroidea: Marsupialia) with a suggested new taxonomy. In M. Archer (editor), Possums and opossums: studies in evolution: 477–506. Sydney: Surrey Beatty & Sons and the Royal Zoological Society of New South Wales.

Flannery, T.F. & White, J.P. 1991 Animal translocations: Zoogeography of New Ireland mammals. National Geographic Research and Exploration 7: 96-113. Ganslosser, U. & Etter-Ganslosser, R. 1990. Phalangers. Pp. 308-309 In S Parker, ed. Grizmek's Encyclopedia of Mammals, Vol. 1, 1990 Edition. Hastings-on-Hudson, NY: McGraw-Hill, Inc.

George, G.G. 1987. Characterisation of the living species of cuscus (Marsupialia: Pha- langeridae). Pp. 507-526 In M Archer, ed. Possums and Opossums: Studies in Evolution. Chipping Norton, N.S.W: Surrey Beatty & Sons Pty Limited in asso- ciation with The Royal Zoological Society of New South Wales.

George, G.G. 1982. Cuscus Phalanger spp.: their management in captivity. Pp. 67-72. In D.D. Evans (ed.) The Management of Australian Mammals in Captivity. Zoological Board of Victoria, Melbourne. Pp. 1-188.

George, G.G. 1973. Land mammal fauna. Aust. Nat. Hist 17**:** 420–26

Glover, I.C. 1971. Prehistoric Research in Timor. In D.J. Mulvaney and J. Golson (eds) Aboriginal Man and Environment in Australia, pp. 158-181. Canberra: Australian National University Press.

Glover, I.C, 1986. Archeology in Eastern Timor. Terra Australis 11. Canberra: Department of Prehistory, Research School of Pacific Studies.

Grzimek, B. 1990. Spotted Cuscus. Ensiklopedia Mamalia Grzimek. South Orange, NJ: McGraw-Hill.

Grzimek's Animal Life Encyclopedia. 2004. Pp. 57-64 In D. Kleiman, V. Geist, M. McDade, eds. Possums and Cuscuses, Vol. 13 / Mammals II, 2nd Edition. Farmington Hills, MI: Gale Group Inc.

Groves, C.P. 1987. On the cuscuses (Marsupialia: Phalangeridae) of the Phalanger orientalis group from Indonesian Territory. In M. Archer (editor), Possums and opossums: studies in evolution: 569–579. Sydney: Surrey Beatty & Sons and the Royal Zoological Society of New South Wales.

Groves, C.P. 2005. Order Diprotodontia. Pp. 43-70 In Wilson, DE & Reeder, DM (eds.). Mammal Species of the World: A taxonomic and geographic reference. 3rd ed. Baltimore: The Johns Hopkins University Press, Vol. 1: pp. i-xxxv + 1- 743; Vol. 2: pp. i-xvii + 745-2142. ISBN 0-8018-8221-4.

Handayani, S. K. & Kunda, R. M. 2019. Identification of Plant Types as Feed for Cuscus (Phalangeridae) from Maluku in the North of Manusela National Park, Central Maluku Regency**.** *Jurnal Matematika, Sains, dan Teknologi* 20 (1): 9–19.

Heinsohn, T. 2002. Observations of probable camouflaging behaviour in a semi-com- mensal common spotted cuscus Spilocuscus maculatus maculatus (Marsupi- alia: Phalangeridae) in New Ireland, Papua New Guinea. *Australian Mammalogy* 24: 243-245.

Heinsohn T.E. 2006. Secret life of the cuscus and the cassowary: The crypto- anthropogenic factor and zoogeographic interpretation in the Indo- Australian Archipelago and Oceania 1846-2006 (With a guide to introduced terrestrial vertebrates in the region). Canberra: Unpublished PhD thesis, Department of Archaeology and Natural History, Research School of Pacific and Asian Studies, Australian National University.

Heinsohn T.E. 2010. Marsupials as introduced species: Long-term anthropogenic expansion of the marsupial frontier and its implications for zoogeographic interpretation. In: Simon G. Haberle, Janelle Stevenson and Matthew Prebble (Eds), Altered Ecologies (Terra Australis 32): Fire, climate and human influence on terrestrial landscapes. DOI:10.22459/TA32.11.2010.09. http://www.jstor.com/stable/j.ctt24h8rj.11.

Helgen, K.M. & Flannery, T.F. 2004. Notes on The Phalangerid Marsupial Genus Spilocuscus, with Description of a New Species from Papua. *Journal of Mammalogy* 85(5). 825-833.

Helgen, K. & Jackson, S. 2015. Family Phalangeridae (Cuscuses, Brush-tailed Possums and Scaly-tailed Possum). In D. E. Wilson and R. A. Mittermeier (Eds.) Handbook of the Mammals of the World. Volume 5 Pp. 456–497 (Lynx Edicions: Barcelona).

Hume, I. D., Jazwinski, E. & Flannery, T.F. 1993. Morphology and function of the digestive tract in New Guinean possums. *Australian Journal of Zoology* 41: 85– 100.

Kinnaird, M.F. 1995. North Sulawesi: A Natural History Guide. Translation: Nicky Sutadi. Bogor: GEF-Biodiversity Collections Project, Pustlitbang Biologi-LIPI.

Latinis, K. 1996. Hunting The Cuscus in Western Seram: The Role of The Phalanger in Subsistence Economies in Central Maluku. *Cakalele* 7: 17–32.

Leary, T., Singadan, R., Menzies, J., Helgen, K., Wright, D., Allison, A., Salas, L. & Dickman, C. 2008. Phalanger carmelitae. IUCN Red List of Threatened Species. Version 2008. International Union for Conservation of Nature.

Leary, T., Singadan, R., Menzies, J., Helgen, K., Wright, D., Allison, A., Flannery, T.F., Salas, L. & Dickman, C. 2008. *Phalanger matabiru*. IUCN Red List of Threatened Species. 2008: eT T136200A4258928. DOI: 10.2305/IUCN.UK.2008.RLTS.T136200A4258928.

Leary, T., Singadan, R., Menzies, J., Helgen, K., Wright, D., Allison, A., Aplin, K., Salas, L. & Dickman, C. 2008. *Phalanger vestitus*. IUCN Red List of Threatened Species. Version 2008. International Union for Conservation of Nature.

Leary, T., Singadan,R., Menzies, J.I., Helgen, K., Wright, D., Allison, A., Salas, L. & Dickman, C. 2010. *Phalanger gymnotis*. The IUCN Red List of Threatened Species. Accessed February 26, 2011 at http://www.iucnredlist.org/apps/redlist/details/16856/0.

Leary, T., Singadan, R., Menzies, J.I., Helgen, K., Allison, A., James, R., Flannery, T.F., Aplin, K., Dickman, C.& Salas, L. 2016. Strigocuscus pelengensis. The IUCN Red List of Threatened Species 2016. Accessed August 02, 2017 at http://www.iucnredlist.org/details/20892/0.

Lee, R. 2000. Back Home for Kuse . *Wildlife Conservation* 103 (1): 52-55.

Leloltery, H. & Kunu, PJ. 2013. Kelimpahan Jenis Satwa di Kabupaten Seram Bagian Barat. *Ekosains* 2 (1): 10–20.

Mack, A. & Wright, D. 2005. The Frugivore Community and the Fruiting Plant Flora in a New Guinea Rainforest: Identifying Keyston Frugivores. Pp. 185-194 In A. Mack (ed.) Tropical Fruits and Frugivores: The Search for Strong Interactors. Heidelberg, Germany: Springer Netherlands.

Majnep, I.S. & Bulmer, R. 1990. Kalam Hunting Traditions. Part IV. Madaw, the Terrestrial Cuscus. Working Papers in Anthropology 88, Department of Anthropology, University of Auckland.

Majnep, I. & Bulmer, R. 2007. Animals the Ancestors Hunted. Belair SA, Australia: Crawford House.

McKay, G.M. & Winter, J.W. 1989. Phalangeridae. Pp. 636–651 in Walton, D.W. and Richardson, B.J. (eds) Fauna of Australia Vol. IB Mammalia. Australian Government Publishing Service : Canberra.

Menkhorst, P. & Knight, F. 2001. A Field Guide to the Mammals of Australia. South Melbourne: Oxford University Press, x + 269 pp. ISBN 0-19- 550870-X

Menzies J.I & Pernetta, J.C. 1986. A taxonomic revision of cuscuses allied to Phalanger orientalis (Marsupialia: Phalangeridae). *J. Zool., Lond.* 1:551-618. DOI:10.1111/J.1096-3642.1986.TB00647.X.

Myers, P. 1999. Family: Phalangeridae. Accessed September 26, 2001 at http://animaldiversity.ummz.umich.edu/chordata/mammalia/ diprotodontia/phalangeridae.html

Norris C.A. 1999. Mammals species: Phalanger lullulae. *Am. Soc. Mammal*. 620: 1- 4

Norris, C. A. & Musser, G.G. 2001. Systematic revision within the Phalanger orientalis complex (Diprotodontia, Phalangeridae): a third species of lowland gray cuscus from New Guinea and Australia. *Am.Mus. Novitates* 3356**:** 1-20.

Nowak, R.M. 1999. *Walker's Mammals of the World*. 6th. Ed. Volume 1. The Jhon Hopkins University Press.

Nowak, R.M. 1997. *Walker's Mammals of the World*. Accessed September 25, 2001 at http://www.press.jhu.edu/books/walker/marsupialia. phalangeridae.ailurops.html

Petocz, R.G. 1994. Mamalia Darat Irian Jaya. Jakarta: PT. Gramedia Pustaka Utama.

Rahim, H.A. 2018. The ternate blue eye cuscus is becoming increasingly rare. Diakses, 20 November 2019 pada https://media.beritagar.id/2018-07/f1337ae48d66ae760030cf5472ef8df85f43cbbd.jpg.

Ramono, W. & Nash, S. 1992. Conservation of Marsupials and Monotremes in Indonesia. Pp. 13-19 In M Kennedy, ed. Australian Marsupials and Monotremes. Gland, Switzerland: IUCN. Accessed April 06, 2011 at http://data.iucn.org/dbtw-wpd/edocs/1992-026.pdf.

Richards, S. & Gamui, B. 2011. Rapid Biological Assessments of the Nakanai Moun- tains and the upper Strickland Basin: surveying the biodiversity of the Papua New Guniea's sublime karst environments. Arlingtion, Virginia, USA: Conser- vation International.

Ride, W.D.L. 1970. A Guide to the Native Mammals of Australia. 1st. edition. Melbourne, Australia : Oxford University Press. p.72.

Ruedas, L.A. & Morales, J.C. 2005. Evolutionary Relationships among Genera of Phalangeridae (Metatheria: Diprotodontia) Inferred from Mitochondrial DNA. Journal of Mammalogy 86 (2): 353–365. DOI: 10.1644/BER-117.1

Salas L.A. 2002. Comparative Ecology and Behavior of The Mountain Cuscus (Phalanger carmelitae), Silky Cuscus (Phalanger sericeus) and Coppery Ringtail (Pseudochirops cupreus) At Mt. Stolle, Papua New Guinea. Dissertation. Graduate School of the University of Massachusetts Amherst

Saragih. E.V.I., Sadsoetoeitoeboen, M.J., & Pattisellano, F. 2010. The Diet of Kuskus (*Spilocucscus maculatus*) in Natural and Captivity Habitat. *Boscience* 2(2): 78-83.

Sinery, A.N., Chandradewana, B., & Farida, W.R. 2013. Population dynamics of cuscus in tourist island of Ahe, District of Nabire, Papua. *Biodiversitas* 14 (2): 95-100

Spriggs, M.J. 1997 *The Island Melanesians*. Oxford: Blackwell Publishers

Strahan, R. 1995. *Mammals of Australia*. Chatswood, New South Whales, Australia: Reed Books.

Summerhayes G.R. 2007. Island Melanesian Pasts: A View from Archaeology. In J.S. Friedlaender (ed) Genes, Language and Culture History in the Southwest Pacific, pp10-35. Oxford: Oxford University Press.

Suyanto, A., Yoneda, M., Maryanto, I., Maharadatunkamsi, & Sugardjito, J. (2002). Checklist of the Mammals of Indonesia. Bogor, Indonesia: LIPI-JICA- PHKA.

Tamalene M.N., Rahwani, B.L.P., & Hasan, S. 2019. Cuscus density of Genus Phalanger and Identification of Forage Plants on Obi Island. *Jurnal Penelitian Hutan dan Konservasi Alam* 16 (2): 159-171.

Tarmudji & Mackinnon, J. 1980. Tangkoko Duasudara Nature Reserve, North Sulawesi. Management plan 1981-1986. World Wildlife Fund, Bogor, Indonesia.

Usmany, M., Tuaputty, H., & Kakisina, P. 2015. Phenotype Study of cuscus (Family Phalangeridae) in Captivity, Lumoli Village, Piru District, Maluku. *Jurnal Sains Veteriner* 33 (2): 180–189.

Wallace, A. R. 1886. The Malay Archipelago. London: Macmillan.

Whitten, T., Mustafa, M., & Henderson, G.S. 2002. *The Ecology of Sulawesi*, 2nd. Edition. Yogyakarta: Gadjah Mada University Press.

Wickler S. 2001. The Prehistory of Buka: A Stepping Stone Island in the Northern Solomons. Terra Australis 16. Canberra: Department of Archaeology and Natural History, and Centre for Archaeological Research, Australian National University.

Wilson D.E & Reeder, D.M. (eds.). 2005. Mammal Species of the World: A Taxonomic and Geographic Reference. 3rd. Ed. Baltimore: Johns Hopkins University Press. 2142 pp. ISBN 0-8018-8221-4.

Winter, J.W. 1983. Spotted Cuscus Phalanger maculatus. Pp. 154–155 In Strahan, R. (ed.) The Australian Museum Complete Book of AustralianMammals. National Photographic Index of Australian Wildlife. Sydney: Angus & Robertson.