

A STUDY ON BABIRUSA (*Babyrousa babyrussa celebensis*) IN TROPICAL FOREST OF NORTHERN PART OF SULAWESI

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Abstract

Babirusa (Babyrousa babyrussa celebensis) is one of the endemic biodiversity of Sulawesi which is currently being very worrying population. The present study was designed to reveal habitat conditions, morphology and anatomy as well as complementary biological apparatus, feed resources, nutrition, as well as reproduction. Study was conducted in tropical rain forest of northern part of Sulawesi, where babirusa still extant. In general, species composition and community structure observed in the location illustrated that there was no particular plant species which is more dominant than others at each plant level. Babirusa is a non-ruminant foregut-fermenting frugivore (concentrate selector). Sexual maturity of either male or female babirusa is 5-10 months, with litter size 1-2 piglets. Birth weight of babirusa piglet is about 0.75 kg, suckling period of piglet is 1 month with mortality rate is 0.8%, and reproductive period after productive age is 7 years. Pangi fruit (Pangium edule) is a dominant feedstuff consumed by babirusa. It can be concluded that reproduction rate of babirusa is very low. Babirusa (Babyrousa babyrussa celebensis) habitat being a primary forest with a characteristic of Pangi fruit (Pangium edule) dominated the vegetation community in babirusa habitat.

Key words: *Babirusa (Babyrousa babyrussa celebensis), morphology, reproductive, digestive anatomy, feed.*

INTRODUCTION

Babirusa (*Babyrousa babyrussa celebensis*) is one of the endemic biodiversity of Sulawesi which is currently being very worrying population. Today, the animal is in the category of endangered species and is feared to become extinct due to habitat destruction, poaching, predators, and diseases. These animals are considered Vulnerable (VU A2cd) in the IUCN Red Data Book (IUCN, 2008). Although babirusa can be domesticated, but it is still not known whether these animals can be developed and handled in a large group. A constraint that must be addressed is the lack of scientific information on the net of babirusa life (biological). Scientific information for these constraints will be helpful in supporting conservation of babirusa in the native habitat. The present study was designed to unveil babirusa habitat conditions, morphology, and anatomy, as well as complementary biological apparatus, feed resources and nutrition, feeding behavior including reproduction and breeding that support babirusa adaptive life as one tro-

phic level in the food chain. Thus, this research can be used as the data base for wildlife conservation programs of babirusa, in relation to the welfare and safety of animals (animal welfare), either through management forests and wildlife in their natural habitat (*in situ*), or in particular habitat (artificial) for the nature conservation purposes.

MATERIALS AND METHODS

The present research was conducted in the tropical rainforest of North Sulawesi, where babirusa (*Babyrousa babyrussa celebensis*) still extant, among others Tangkoko Nature Reserve of Bitung North Sulawesi, Togid Forest of Bolaang Mongondow Regency, and Wildlife Nantu Gorontalo. The variables of observation were the general condition of babirusa habitat, identifying the source and type of feed and nutrient substances, morphology, physical character, digestive tracts, feeding behavior, and reproduction of babirusa. Nantu Wildlife Gorontalo was taken as a special location for observation of babirusa activity and behavior in

their habitat due to the babirusa population in this habitat still more (much common) compared with other forest locations. The diversity of vegetation and the data of fauna were collected from each location.

RESULTS AND DISCUSSIONS

General Conditions of Babirusa Habitat

Nantu Wildlife Reserve with an area of 31.215 ha designated for the protection of babirusa (*Babyrussa babyrussa celebensis*), anoa (*Bubalus depressicornis*), and monkey (*Macaca heckii*), also found some species of birds, including the hornbill bird (*Rhyticercus casidix*), small hornbill (*Penelopides exarhatus*) and Sulawesi parrots (*Prioniturus*, sp).

On the forest floor can be found partridges (*Gallus gallus*), birds Hirst (*Megapodius cumingii*) and some reptiles like python (*Python reticulata*) and monitor lizard or (*Varanus salvator*), and many other wildlife species.

In this area also found the Adudu forest with an area of approximately 800 ha with natural salt water as a gathering place for many kinds of wildlife. Saline water sources of Adudu as was observed being the biggest source of salt water that exist in the region, which consists of the muddy lagoon of about 20-30 cm deep, the rocky and sandy sections.

The mineral content of the saline water might be expected to fulfill mineral requirement for babirusa.

Vegetation Condition

Feed potential of vegetation composition was found in the original of babirusa habitat, as indicated by relative density, relative frequency, relative dominance, and of importance value index (IVI) data (Soerianegara and Indrawan, 1988). Two transect lines (A and B) were made for the data analysis. In each line was placed 7 plots consisting of the 20 x 20 m sample squares to analysis tree level plants, the 10 x 10 m sample squares for the analysis of pole level plants, the 5 x 5 m sample squares for the analysis of sampling (*young plants*) level plants and the 2 x 2 m for the analysis of seedling plants.

The types of plant communities in the flora constituent around observed area were approximately 66 species, which 6 of them were

strongly considered as feed sources of babirusa, namely pangi (*Pangium edule*), rao (*Draconolobum dao*), leu (*Dracontomelon mangiferum*), lamuta / Namo-namo (*Genetum sp*), palm sugar trees (seho=local name) (*Arenga sp*), and palango grass (*E. indica*). The other dominant plant species were *Dracontomelon mangiferum* (leu=local name), *Artocarpus elasticus* (tohupo=local name), *Eucalyptus deglupta* (wood, UK), *Cudrania sp* (forest langsung=local name), *Maelotus floribunda*, *Litsea sp* (dongi=local name), *Caryota mitis* (seho yaki=local name) and *Livistonia rotundifolia* (woka=local name).

The results of the abundance analysis of the community composer species to the tree level were identified about 35 plants species. Based on the calculated importance value index (IVI) there were 12 species of among plants (34.29%) as the main constituent of habitat vegetation community of babirusa. There were also 11 species of plants (31.43%) including feed plants for babirusa, namely pangi (*Pangium edule*), leu, roa, seho, tohupo, dongi, nantu, banyan, bohulo and gora forest and bugis wood (a local name given for each plants).

Species abundance of community composer pole level plants was identified 31 species of plants. Ten species (32.26%) as the plants feed of babirusa, rao, lamuta, leu, langsung, dongi, tohupo, gora, white nantu, red nantu and huhito/wood bugis.

Levels vegetation were obtained 24 species of plants as a constituent vegetation community, which rattan plants was the highest index value important (IVI=38.11%), and the lowest one was Boyuhu (2.58%). Of the 24 species of plants, 9 types (37.5%) were identified as the feed of babirusa, namely rattan, rao, lomuli, lamuta, forest seho, bohulo/olive woods, seho yaki; leu and bugis wood (huhito).

The analysis of seedlings types vegetation were 22 types of plants, where both biluanga (*O. sumatrana*) and laluta plants were the lowest of index value important (IVI =1.92%). There were 6 types of plants (28.57%) as primary communities, involved tongiito, palango, rattan, woka, ferns and tombito. There were 8 types (38.09%) of the 22 species plants considered as babirusa feed, vis palango (*E. indica*), rattan (*Calanus sp*), pandan forest.



Figure 1. Babirusa (*Babirusa babirusa celebensis*) are found only in undisturbed rain forest

(*Pandanus* sp), *molitoboi* (*Zingiber* sp), *bolulo* (*A. unifoliata*), *lamuta* (*Gnetum* sp), *seho yaki* (*C. mitis*) and *nantu* (*P. obtusifolium*).

In general, species composition and structure community, illustrated that there was no particular plant species which dominant at the level of plants. It can be said that the condition of the forest environment Wildlife Nantu suitable for the development of each plant species.

Morphology and Digestive Organ of Babirusa

Babirusa (*Babirusa babirusa celebensis*) has unique characteristics that can be seen from the morphology. Based on the observed data in the present study, and the previous study reported by Tulung, *et al* (2003), the typical morphology in adult males was to have both the maxillary canines, grow up through the nose and curved down toward the forehead without getting into the mouth. While the females babirusa have small tusks that grow up through the skin of the upper lip. Male babirusa has a relatively larger body size than that of female. The babirusa body is relatively long, with the front legs being shorter than that of hind legs. The fur color of the animal varies from gray, brownish gray or black.

Physical appearance and complementary organs of babirusa compared with wild pig (*Sus celebensis*) in the tropical forest habitat Tangkoko and Togid of North Sulawesi is presented in Table 1.

Babirusa classified as omnivorous animals like other pigs species, such as wild pig (*Sus celebensis*) and domestic pigs. Observations of the digestive tract showed that the structure of the adult babirusa digestive tract from

esophagus until the intestine is similar to the type of wild boar and domestic pigs others. However the front of the animal's stomach bigger than any domestic pigs. Microscopy observations were performed Leus (2000), reported the size of the stomach adults babirusa about 3000 cm², where the largest area (>70%) of the stomach internal surface contains mucus producing cardiac glands (mucosal), while in domestic pigs only about of 33%. This condition makes the gastric lumen pH babirusa ranged from 5.3 to 6.4, where there is a sizeable population of microorganisms.

Refers to some researchers studies, the microorganisms were bacterial that took roles on plant structural components fermentation by its enzymes, which are unable to produce on their own babirusa (Fischer, 2012). Leus *et al.* (1999) indicated that babirusa is non-ruminant foregut-fermenting frugivore concentrate selector.

Social and Reproductive Behavior

Social behavior of babirusa around the habitat more often done in the morning, everyday, while doing the activity of searching for sources of feed, scavenge, and wallowing in the mud. There was also a social interaction one and another in a small group. Number of babirusa in small groups varies between two and five heads.

Table 1. Physical performance and complementary organ of adult Babirusa (*Babirusa babirusa celebensis*) and wild pig (*Sus celebensis*)

Organ/physical measurement (gr/kg/cm)	n	Sex	
		Male	Female
Live weight (kg)	5	33.66	28.70
	1	(30.10)*	(20.40)*
Height (cm)	5	64.80	58.40
	1	(57.90)*	(51.50)*
Length (cm)	5	106.40	96.80
	1	(98.80)*	(90.00)*
Head length (cm)	5	32.60	30.30
	1	(31.40)*	(20.40)*
Fore leg length (cm)	5	58.20	51.80
	1	(47.70)*	(42.40)*
Hind leg length (cm)	5	60.88	54.50
	1	(50.30)*	(44.90)*
Waist length (cm)	5	78.70	73.50
	1	(73.20)*	(66.00)*
Liver (gram)	5	953.80	784.20
	1	(1287.50)	(1000.00)
Pancreas (gram)	5	28.66	25.26
	1	(45.15)*	(30.60)*

* numbers in the brackets are comparison measurements for adult wild pigs (*Sus celebensis*)

In addition, the interaction frequency every day was low enough. In small group interactions there were more females, while males more often observed only one animal in the group, or if there is, it was only a male children (male young). Usually the adult males which already have long tusks are doing their own activity to scrap its slender tusks against the tree trunk. Sometimes, when the two adults' males were among a group of females, there will be a fight for the females which ready to mate. Presumably, this is part of the male babirusa reproductive behavior.

Babirusa reproductive behavior that observed during the study were, respectively: the period to reach sexual maturity both females and males were approximately 5-10 months; the gestation period of babirusa is longer than domestic pigs, from 155-158 days; the litter size of babirusa is between 1-2 piglets; birth weight about 0.75 kg; period to wean is 1 month old, with a mortality rate of 0.8%; the numbers of birth per year is once. The reproductive period after production is 7 years of age, while the lifetime of babirusa is reached to about 23 years. According to Houston (1997) in Tisleric (2000) babirusa reach sexual maturity at age 1 to 2 years, while the gestation period between 150-157 days, in which pregnancy can occur 1-2 times per year.

Babirusa Feed Sources in Original Habitat

In the original habitat, there were many types of plants or fruits, including fungi and insects as well as other materials identified, and considered to be a source of feed for babirusa. There are 7 types of them most considered to be consumed by babirusa (*Babyrousa babyrussa celebensis*) in their natural habitat as shown in Table 2.

Observations showed that fruit of pangi (*Pangium edule*) is the most dominant type of feed plants consumed by babirusa. The analysis of plants feed types showed varying nutrient content. All kinds of feed were contained a relatively high crude fiber and can be a limiting factor for babirusa as non-ruminant animals. However, according to Langer (1988) in Clayton (1996) argued that the digestive system is more complex than other types of pigs. Presumably, with the system of digestive tracts, the animal can be able to have benefit from that

feed sources. Although the comparison of the babirusa stomach to a ruminant stomach is not justified yet, the microorganisms have been found in the mucus gel adhering to the stomach surface and within the stomach lumen (Leus, 1994). This is thought to be a beneficial factor for babirusa in dealing with coarser feed materials compared with other pig or non ruminant species.

Table 2. Nutrient composition of several feed sources of Babirusa (*Babyrousa babyrussa celebensis*) in their habitat (on a Dry-Matter Basis)

Feedstuffs	Nutrients, assayed						
	Protein (%)	Fat (%)	Fiber (%)	CH (%)	Energy (Cal)	Ca (%)	P (%)
Pangi :							
Pulp	17.70	52.08	31.50	12.33	165.84	0.40	3.15
Seed	18.05	43.86	30.02	13.06	520.98	0.20	6.43
Rao/Dao	6.24	3.34	28.12	28.34	168.38	0.74	1.06
Loyo/Leu	5.77	4.07	31.48	14.46	74.17	0.73	--
Seho hutan	14.81	3.06	22.55	18.85	162.18	0.85	1.44
Lamuta	6.54	4.75	46.14	25.85	172.31	0.20	0.34
Palango	14.82	3.86	23.16	14.44	151.78	0.57	2.78

DM = dry matter; CH = carbohydrate; Ca = calcium; P = phosphorus

Nutrients Sources of Babirusa

The feed analysis showed that pangi fruit (*Pangium edule*) has 26.2% of protein content (total seed protein and pulp), indicates that pangi fruit was a very good source of protein for babirusa. Besides, pangi fruit was also as a source of energy. In addition, seho fruit (*Arenga, sp*) has a pretty good protein content, as well as palango grass (*Eleusine indica*) and the types of grass field, although the frequencies level of babirusa in eating grass palango were relatively less as observed.

It was also identified that babirusa have a habit to scavenge for food around the rotten timbers of trees / plants. It was also proved that in the vicinity of rooting timber there were many insects' larvae, and other types of wood mushrooms. Allegedly, babirusa also eats insect larvae and wood fungi in order to satisfy the protein requirement for babirusa.

The most important energy source for babirusa was also come from pangi fruit. Table 2 shows pangi fruit has a fat content around 43%; followed by rao fruit (*Dractomelon dao*), seho fruit (*Arenga, sp.*) and lamuta fruit (*Gnetum sp.*)

The results were in agreement with other research information. Inquiry entrails and excrement babirusa in North Sulawesi by Clayton (1996) indicates that the diet of wild babirusa is mainly composed of fruits and/or seeds and some animal material, leaves, grass, soil and rock fragments. According to Leus (2000) and MacDonald (2005) as in most other species of suidae, babirusa seems as omnivorous animals. Observations made on both wild and captive individuals revealed that babirusa consume a variety of leaves, roots, fruits and other ingredients. The present study is still at the stage of identification and characterization of food resources and has not reached the stage of experimental measurement of the biological value of feed as the basis for setting up standards of nutrition and feed formulation needs for babirusa. However, Leus, *et al.* (1999) and Leus (2000) in an experiment that feed on babirusa in captivity at the zoo, using predictions equation of domestic pigs nutrient requirement, estimated that adult male babirusa needs for energy and protein 11.3 MJ or 2.7 Mcal and 88 g of protein per day, respectively. While the female babirusa needs for energy and protein 8.5 MJ or 2.03 Mcal and 59 g of protein per day, respectively.

Mineral Sources for babirusa

Field observations and laboratory analysis revealed that salt water of 'Adudu' is the main mineral source for babirusa besides minerals obtained from feedstuffs consumed. There was a tendency of a babirusa or a herd of babirusa to really engross in consuming salt water of 'Adudu'. Adudu saline water contains relatively high levels of macro minerals, as shown in Table 3.

Table 3. Macro mineral composition of Adudu saline water

Minerals	Content (ppm)
Calcium (Ca)	61.10
Magnesium (Mg)	0.92
Phosphorus (P)	46.00
Natrium (Na)	147.40
Kalium (K)	4.86

Data (Table 3) showed that sodium has the highest level amongst minerals in Adudu saline water, followed by Ca, P, K, and Mg.



Figure 2. Poachers are now being the most dangerous predators of babirusa

CONCLUSIONS

It can be concluded that reproduction rate of babirusa is very low. It is therefore important to control the population in the habitat by propagating females' babirusa and considering female : male ratio. Babirusa (*Babyrousa babyrussa celebensis*) habitat being a primary forest with a characteristic of Pangi fruit (*Pangium edule*) dominated the vegetation community in babirusa habitat.

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