



# Case Study of the Existence of Lowland Anoa and Mountain Anoa on Sulawesi Island in Terms of Type of Feed

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## Abstract

**Background:** Anoa is an endemic animal on Sulawesi Island that is threatened with extinction. Both lowland anoa (*Bubalus depressicornis*) and mountain anoa (*Bubalus quarlesi*) share the status of Endangered. The study aims to determine the condition of lowland anoa and mountain anoa on Sulawesi Island in terms of the type of feed. **Methods:** This research was carried out using literature review techniques based on an assessment from related sources. **Results:** The result of this study represented that lowland anoa in terms of feed type has an endangered status, as well as mountain anoa in terms of feed type, which is endangered. The position of the lowland and mountain Anoa existence, both of the kind of diet and IUCN data, is threatened. The similar condition and conservation status obtained from the result is because the two different anoas living in different habitats can adjust their own feed according to the animals' location. **Conclusions:** Although it has no bearing on anoa condition and conservation status, it is expected that anoa's national park and captivity on Sulawesi Island can better sort food for lowland anoa and mountain anoa to support their physiological functions for their existence.

**Keywords:** Anoa Existence Status; Anoa Feed; Anoa; Existence Condition of Anoa;



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## Introduction

Anoa is a ruminant animal often referred to as a small buffalo. Anoa lives as an endemic animal on the island of Sulawesi. Based on the habitat, anoa is divided into two types: lowland anoa and mountain anoa. Based on the status of existence, both have the status of being endangered, and the population is decreasing (Burton et al., 2016). The degradation of the anoa population is supposed to be because it is considered a totem animal by the Sulawesi people. So, the people of Sulawesi often use parts of their skulls and horns for medicinal ingredients (CNN, 2020).

Data from the Lore Lindu National Park in Sulawesi states that animals are vulnerable to extinction based on the Decree of the DG-KSDAE 2015 concerning the Prioritization of Endangered Animals (Direktorat Jenderal Konservasi Sumber Daya Alam dan Ekosistem, 2018; Susanto, 2020). Anoa belongs to a small buffalo, but they are not as tame as buffalo or other ruminants because of their aggressive nature and live solitary. (Badan Penelitian Pengembangan dan Inovasi, 2016). Anoa is challenging to find because they prefer to avoid human activities area. Anoa is more often found in primary forest types with rich topography and difficult access for humans to reach. Although it has difficult access, this is precisely what makes it an easy target for hunting due to the difficulty of monitoring by protection agencies such as National Parks. The level of public awareness of anoa conservation is still low because people still use anoa as a source of high protein feed. Its

skull and horns are used as medicinal ingredients. However, people only take it without preserving the anoa survival (Pujaningsih, 2012).

It is hard to observe the feeding behavior of lowland anoa and mountain anoa in primary forests. Difficult access is the main obstacle to monitoring their feeding behavior. Anoa is also intolerant of outside species and its herd because it avoids competition for food. Given the endangered status of existence, the captive carries out efforts so the anoa can continue to breed outside of their original habitat. Feeding in captivity must also be considered in terms of nutritional content. So, it can still meet the physiological needs of anoa. Based on the result of the research at the Anoa Breeding Center in Manado, anoa is only given field grass as the feed every day (Irawati et al., 2017). The nutritional content of grass feed cannot fully meet the physiological needs of anoa due to the lack of mineral content. Lack of nutrition or insufficient amount of feed for anoa can cause serious problems. It is chronic diarrhea (Miyamoto et al., 2005).

Information about animal feed, how animals get the feast, and what was eaten by an animal is the base thing needed to determine the animal's physiology. Animal physiology also affects the growth and development of animal survival. According to the data in 2009 referring to the Decree of the DG-KSDAE, anoa is one of the 25 priority endangered species, and the population is decreasing. The situation also occurs in one of the Rawa Apoa Watumohai National Parks based on the statement by the Head of the Section II National Park Management Section of the National Park Hall. There are about 11-15 species in the lowland anoa, while around 3-4 in the mountain anoa (CNN, 2020; Direktorat Jenderal Konservasi Sumber Daya Alam dan Ekosistem, 2018).

Therefore, the author wants to compare the condition of lowland anoa with mountain anoa on Sulawesi Island in terms of the type of feed. The information obtained is expected to be used as reference material to increase life expectancy and preserve anoa.

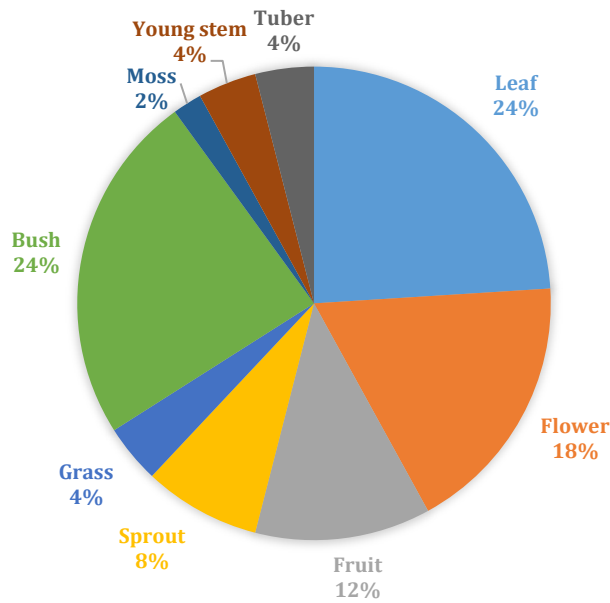
## Methods

This type of this research is descriptive research with a narrative analysis approach. The implementation of this research time is starting in December 2020. The data collection technique is classified as a literature study. The preparation step carried out in this literature study was by accessing the articles, national books, and international books through science direct, google scholar and others. The researcher used keywords related to the discussion. They are lowland anoa, highland anoa, the existing condition of anoa, and anoa feed. Based on the search results, relevant literature was obtained and then stored in Mendeley as an application to manage references. The relevant literature is then re-analyzed and developed in the writing of this article. The data obtained is secondary data regarding the diet of lowland anoa (*Bubalus depressicornis*) and mountain anoa (*Bubalus quarlesi*) on Sulawesi Island based on various previous studies. In the next step, the researchers analyzed the data and obtained comprehensive study results related to the existing lowland anoa and mountain anoa on Sulawesi Island regarding the type of feed.

## Results and Discussions

### Anoa Feed

Based on the research conducted by Pujaningsih (2009), anoa can choose the type of feed according to a certain proportion to meet the needs of his body. The relative proportion of anoa feed types is based on the dry matter of each plant species in anoa feces. The higher the value of the relative proportion of anoa feeds types, the higher the level of anoa's preference for that feed. Picture 1 shows that anoa prefers leaves and bushes (24%) to flowers (18%); fruits (12%); young plants (8%); grasses, tubers, and young stems (respectively 4% for each); and also mosses (2%).



**Picture 1.** Diagram of anoa feed preference based on field observations and feces analysis. (Source: Pujaningsih, 2012).

**Table 1.** Variety in plants of anoa's natural feed based on a combination of direct observation methods and feces analysis.

Local Name	Latin Name	Family	Edible Plant Part
Bakanggaroka	<i>Garcinia</i> sp.	Clusiaceae	leaves, fruits
Katatuma	<i>Elatostema</i> sp.	Urticaceae	leaves, flowers, young stems
Lambori	<i>Frecynetia insignis</i>	Pandanaceae	Leaves
Tamomo	<i>Trichosteleum</i> sp.	Hypnaceae	Leaves
Kadamuku	<i>Smilax leucophylla</i>	Smilacaceae	leaves, flowers, tubers
Walangkome	<i>Acer laurinum</i>	Aceraceae	Leaves
Rotan nook	<i>Calamus inops</i>	Arecaceae	leaves, plant buds
Kao Pangko	<i>Podocarpus imbricatus</i>	Podocarpaceae	leaves, young stems
Harao Pinang Hutan	<i>Areca vestiarea</i>	Arecaceae	Plant buds, fruits
Pakuwana	<i>Microlepia todayensis</i>	Denstaedtiaceae	Leaves
Bonitu	<i>Lasianthus clementis</i>	Rubiaceae	plant buds, leaves, fruits, flowers
Marantapi	<i>Calophyllum soulatri</i>	Clusiaceae	plant buds
Tatari	<i>Scleria</i> sp.	Cyperaceae	Leaves
Tomanete	<i>Dysoxylum</i> sp.	Meliaceae	leaves, tunas, flowers, fruits
Palili	<i>Lythocarpus celebicum</i>	Fagaceae	leaves, fruits

(Source: Pujaningsih, 2012).

Based on the table, it is recorded that various plants are eaten by anoa in inaccessible habitats, ranging from plant species, plant classifications, and plant parts eaten by anoa. According to Mackinnon & Mackinnon (1979) and Mustari (2005) in Pujaningsih (Pujaningsih, 2012) states that anoas consume leaves on bushes, grasses, ferns, mosses, and fruits. In line with this, it is supported by research conducted by Arini et al. (2014),

which provides various types of feed for anoa in captivity at the Manado Forestry Research Institute. The results show that anoa can eat multiple vegetables, fruits, and grasses. Concerning the statement of [Mackinnon & Mackinnon \(1979\)](#), it is proven that the ferns eaten by anoa in the table show the Hypnaceae family, which are mosses and palms from the Araceae family, field grass from the Cyperaceae family, pandanus from the Pandanaceae family, and bamboo from the Poaceae family. Along with similarities, there are other types of plants, such as flowering plants (Meliaceae, Rubiaceae, Smilacaceae, and Urticaceae).

Anoa's energy and nutrient needs are essential things that affect the quality and productivity of anoa's life. [Basri \(2008\)](#) shows the estimation of anoa's nutrient needs. He shows that the consumption of energy and nutrients will increase body weight. With an estimate of Total Digestible Nutrient (TDN), the need for life is 22,000 g/kg BB<sup>0.75</sup>, and the growing requirement is 1,333,640 g/kg PBB. Therefore, this condition provides an opportunity to measure energy, protein, Ca, and P needs. In this study, there are calculations carried out using a regression model, including the following; 1) TDN consumption was 61%, 2) protein consumption was 35%, 3) calcium consumption was 62%, and 4) phosphorus consumption was 58%.

Based on the research conducted by [Pujaningsih \(2012\)](#), anoa feed rations can be prepared with protein (8.5%) and crude fiber (28%). This percentage can be a reference approach for the nutritional needs of anoa feed. The average nutrient content and consumption of anoa feed showed that the crude protein (PK) and crude fiber (SK) nutrient range of alternative feed sources in ex-situ locations had better quality than natural feed ingredients in their habitat. The crude protein (PK) percentage at the in-situ was 7.30% and at the ex-situ location was 15.19%. The crude fiber (SK) percentage at the in-situ is 25.70% and at the ex-situ location is 14.62%.

Considering the eating preferences studied by [Mustari \(2015\)](#), These eight anoa samples were collected from three different places; Jakarta Ragunan Wildlife Park (3 anoas), near the Tanjung Peropa Wildlife Reserve (3 anoas), and the Southeast Sulawesi Natural Resources Conservation Agency (BKSDA) office (2 anoas). Four types of green plants are given simultaneously in equal portions. They include; roots (*Mikania cordata*), elephant grass (*Pennisetum purpureum*), papaitan grass (*Cyrtococcum patens*), and pacingan leaves (*Costus speciosus*). The anoa showed eating the roots and *pacingan* leaves first, then followed by eating elephant grass and *papaitan* leaves. The four plants are fed to the anoa because they belong to natural food available in conservation areas.

### **Ethology of Lowland Anoa and Highland Anoa**

The food chosen by lowland and mountain anoa in their natural habitat is shrubs, trees, ferns, palms, bamboo, tubers, and even mosses. ([Pujaningsih, 2012](#)). Based on the studies of feed preference research, some anoas prefer to eat herbaceous and low taxa plants. ([Mustari, 2019](#); [Tanggoro et al., 2018](#)). Anoa chooses to consume these foods because these animals can be classified as intermediate feeders/grazers ([Miyamoto et al., 2005](#)). Anoa can be considered an animal that needs water regularly to survive or is called a water-dependent species ([Mustari, 2019](#)). The parts of plants preferred by anoa are leaves, bushes, flowers, fruits, young plants, young stems, grasses, tubers, and mosses ([Pujaningsih, 2012](#)). Some anoas informed that they consume various types of aquatic plants (example: moss), indicating that anoa can survive in conditions where water resources are limited by adapting their rations ([Pujaningsih, 2012](#); [Susilo & Suciati, 2018](#)). Based on this case, it can be interpreted that the food chosen by anoa is in line with anoa conditions; for example, mountain anoas that live in the highlands with primary forest, dense forest vegetation, rich topography, and difficult access for human.

Based on their habitat, anoas prefer places where the vegetation is not too dense. Besides, anoas prefer areas with a flat topography with low tree density and filled with shrubs, lianas, and trees ([Arini, 2012](#)). Based on the observations, it shows that the behavior of anoa is attempting to find shelter when the sun starts to get hot. This behavior may indicate that anoa is categorized as an animal unable to bear the sun ([Rusiyantono et al., 2019](#)). Meanwhile, there is also data that the anoa is a solitary creature because anoa is

an intermediate feeder/grazer animal which means that its eating habits are either browsers (top eaters) or grazers (grass eaters) (Arini & Wahyuni, 2016). In addition to being classified as solitary animals due to their eating habits, there are other indicators. They are the anoa's habitat at an altitude range of 766-1391 masl, where the higher the habitat, the less anoa encounters other living creatures. (Broto, 2015). These animals prefer to live in a place with dense vegetation and live in primary forests with difficult access. These animals do not like to be approached by other species or their herds to avoid competition. Anoa has high mobility and a sharp sense of smell to hide from the presence of other species (Pujaningsih, 2012). In addition to avoiding other species, the anoa's sense of smell works for its selectivity in choosing food (Arini & Wahyuni, 2016).

Primarily, anoas depend on forest conditions, but continuous forest fragmentation can reduce the natural movement of anoas among forest paths. (Burton et al., 2005). This condition potentially causes a loss of genetic diversity and an increase in the extinction of anoa. Based on the previous study, it was concluded that there were different conditions in the anoa's habitat. It means that the state of the living habitat described according to Arini's research is anoa in the lowlands (Arini, 2012). While according to Pujaningsih's research (Pujaningsih, 2012), the result showed that the condition of the habitat where they live is anoa in the highlands or mountains.

### Comparison of Anoa's Feeds in National Parks, Captivity, and Habitat

The results of anoa feces analysis based on research conducted by Pujaningsih (2012) found no anoa eating fruits and tubers but mosses plants. On the other hand, according to research conducted by Arini (2012), anoa was found in the forest of Mount Poniki, Bogani Nangi Wartabone National Park, North Sulawesi, which eats fruits such as banyan tree fruit, broadleaf Gora, creeping Gora, catfish, and pakoba. According to Pujaningsih's research (Pujaningsih 2012), the feed differences mean that anoa belongs to mountain anoa because of the discovery of mosses (aquatic plants) eaten by anoa to meet water needs. The habitat is far from water sources, especially moss, a marker of the highlands' vegetation. In addition, the condition of highlands has moist soil, made enormous mosses are discovered (Wardah et al., 2012).

The nutritional needs of anoa are recognized based on the content composed of anoa feed rations. There is a protein content of 8.5% and a crude fiber of 28%. The percentage of protein and crude fiber content is found in plants consumed for the nutritional needs of anoa. Based on the data in Pujaningsih's research (Pujaningsih, 2012), she compared the nutritional requirements obtained by anoa in their natural habitat (in situ) with those obtained at the Ragunan Wildlife Park, South Jakarta (ex-situ). The result showed that the nutritional requirements of crude protein and crude fiber in ex situ locations are better than natural food in their habitat. This is because anoa can quickly adapt to new types of feed, making it easier to fulfill their needs in captivity. Anoa is a tolerant animal for various kinds of feed and can survive with this capability (Basri, 2009). Besides, it is also supported by the fact that anoa is a herbivorous animal with browser and grazer characteristics. It indicated that anoa prefers feed from a combination of food rather than only one type (Ranuntu & Mallombasang, 2015).

### Anoa Type Polemic

Anoa lived in the highlands and lowlands in obtaining nutritional needs from feed ingredients is not limited to the geographical conditions of the different plains. Mountain anoa can still eat plants in the lowlands area and vice versa. According to Groves (1969), Kasim (2002), and (Whitten et al, 1987; Arini, 2012), supported by Okarda (2010); Broto (2015) stated that, now, these species no longer have unique habitat characteristics. Sometimes lowland anoa can be found in the highlands, and mountain anoa can also be found in lowland areas. In addition, this is supported by a statement on the *asianwildcattle.org* page (Burton, 2020). Some experts stated that the taxonomy of anoa is still a matter of debate. They are thought to be the same species but only separated because of geographically different populations. Based on this statement, this happens because

anoa has the nature of adaptation to the type of feed, so it does not cause problems for anoa to obtain feed ingredients on different terrains from their natural one.

## Conclusions

Anoa is an endemic animal on Sulawesi Island that is threatened with extinction, both lowland anoa (*Bubalus depressicornis*) and mountain anoa (*Bubalus quarlesi*) which share the status of Endangered.) and their population is decreasing. Considering anoa with the condition of its existence, we need to pay attention to its nutrition of anoa. Anoa has special nutritional needs to support its physiological functions related to where it lives. There are food differences between the mountain anoa and the lowland anoa. However, mountains can still eat plants in lowlands and vice versa because anoa no longer has special habitat characteristics. Although these animals should have special nutrition, they are adaptive. Therefore, the type of anoa feed has no bearing on the condition and status of anoa's existence. So, lowland anoa in terms of feed type has an endangered status, as well as mountain anoa in terms of feed type, which is endangered. Practically, the contribution of this research help in explaining that the lowland and mountain anoa is still a matter of debate in the taxonomy issue. The anoa feed has no bearing on the existing conditions, so this can contribute to assisting further research in distinguishing the two anoas in the realm of genetic and molecular studies. Thus, the researcher suggests that further research should be conducted not only related to the specific data of the plants eaten by each anoa in the lowlands and mountains but also additional information about the total population on Sulawesi Island as a whole based on the two anoas. So, the national park and captivity of anoa on Sulawesi Island can better sort food for lowland anoa and mountain anoa to support their physiological functions their existence.

## Declaration Statement

The authors reported no potential conflict of interest.

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