DIET COMPOSITION OF ANOA (*Buballus sp.*) STUDIED USING DIRECT OBSERVATION AND DUNG ANALYSIS METHOD IN THEIR HABITAT

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ABSTRACT

Anoa are fully protected under Indonesian Law since 1931 (Law of Protection of Wild Animals 1931, no 134). Increasing law enforcement regarding hunting as well as promoting awareness of the Anoas unique threatened the existence of conservation measures. The modern concept of conservation based on the sustainability utilization, and therefore the knowledge of the Anoa preference in feeding to support the sustainability conservation should be studied. In the present study, the combination of direct observation methods which was done in the Lore Lindu National Park in Toro village at District Kulawi, Central Sulawesi and the epidermal analysis method which was carried out to Anoa's dung were aimed to identify the vegetations preferred by Anoa in their habitat. The result showed 28 species of vegetations was used as feed by Anoa on *in situ* area. According to its percentage, the first ten were *Freycinetia insignis* Blume (17%), *Microlepia todayensis* Christ (8.9%), *Disoxylum sp* (8.6%), *Lasianthus clementis* Merr (7.7%), *Clusia sp* (7.5%), *Schleria sp* (6%), *Podocarpus imbricatus* (5.4%), *Smilax leucophylla* (5.1%), *Elastostema sp* (4.2%), and *Garcinia sp* (3.8%), respectively. Furthermore, it can be concluded that Anoa was eat more leafs and shrubs/bushes (each 24%, respectively) compared to flowers (18%), fruits (12%), shoots (8%), grasses, tubers, young grooves (each 4%, respectively) and moss (2%). Nutritionally, Anoa consumed 8.8% protein and 25.6% crude fiber.

Keywords: Diet Composition, Dung Analysis, Anoa

INTRODUCTION

Study on Anoa was relatively limited compared to another protected animals (Orang Utan, Rhinoceros, Sumatran Elephant, Tiger). Up to now, the research that carried out was small and in a limited scoped, such as on population and taxonomic distribution of these endemic species. Learning on what was eaten by an animal, why they use to consume certain type of feed and how the animal get the feed represent the base information which is needed to know the influence of the feed concerning with the animal physiology (Kamukuru and Mgaya, 2004). This basic information will assist the effort of animal cultivation in conservation frame and its exploitation. Modern concepts of conservation do not interpret as 'may not use', but 'may utilize on sustainability bases'.

One of method used to identify the feed is direct observation method (Hügi *et al*., 1999) that is cheaper than other method and has a similar accuracy to telemetric method (Franco *et al*., 2004). Feed identification method through dung epidermis analysis often been used together with direct observation method. Refer to Storr (1960), dung analysis may know herbivore feeding type by identifying microscopic epidermis fraction in the feces. Type of vegetation consumed was known by comparing identified epidermis fraction in the dung with the

references of vegetation epidermis. Dietary composition was known by using quantitative analysis of the sum and size of epidermis fragmentation. Quantitative analysis was done by modifying the vegetation analysis technique resulting in an important value index for each vegetation type (Bhadresa, 1986 cited by De Boer *et al*., 2000).

Information on Anoa's feed identified at Sulawesi island concluded that Anoa is adaptable to feed and places. In order to support the cultivation based on sustainability, the knowledge of nutrient requirement, as well as Anoa's meat quality, is needed.

Kasim (2002) informed that Anoa has muscle group index better than cattle, buffaloes and bull. Moreover, Anoa's horn and skull were traditionally used for medicine. Therefore, the effort on Anoa exploitation requires the balance between the animal and human needs to ensure the sustainability. Information of feed vegetation preferred by Anoa that continually provided in a good quality and quantity may support Anoa performance.

This research was generally aimed to support the *ex situ* conservation of Anoa (*Bubalus sp*.), by exploring the data of feed vegetation type and its part of vegetation consumed by Anoa as well as protein and crude fiber composition of the feed which is needed to formulate Anoa's diet that could be applied in the conservation area for the first step of domesticating Anoa.

MATERIALS AND METHOD

Experimental location

The Research was conducted from May 2007 to January 2008 at Toro village in the area of National Lore Lindu Park (NLLP), Central Sulawesi. Anoa's feed identification at that *in situ* conservation area was done by following the foot-step of the animal.

The NLLP situated on 200 – 2,500 m above sea level with most area lies on 1,000 m. Topographically Toro presented as land (36.64%) and mountain (65.36%), which refers to the classification by Schmitt and Fergusson climatically were categorized as A type. Daily temperature was ranged at 18-30°C. The average of the rainfall was ranged at 1,700 – 2,400 mm/year.

Samples collection

Observation was carried out in field and laboratory. Field observation to gain samples and fecal was conducted as follow.

- Eighteen plots of 10 x 10 m were set up purposively on the location where Anoa's used to eat by following Anoa's footprint and the information from local people. Observation was done on the type and part of vegetation eaten by Anoa (leaf, shoot, young grooves, tuber, flower and fruit). Each predicted vegetation consumed by Anoa was sampled as well as Anoa's dung around the plots location.
- Observation conducted on 6 months periods of transition season from dry to wet season. Anoa's preferable vegetation was then compared to density vegetation in the location by combination method of Viljoen (1989), Snedecor and Cochran (1967) and Hansen *et al.*(1984). The composite samples followed the method of Cavender and Hansen (1970).

Laboratory observation was carried out to identify the epidermis of vegetation and Anoa's dung as well as the protein and crude fiber content of these samples. Protein and crude fiber were analyzed with proximate analysis procedures. Parameter observed were vegetation type in the *in situ* area, feed proportion, protein and crude fiber content on the Anoa's feces and Anoa's vegetation feed.

Data analysis

Feed proportion analysis in dry matter content

The data observed from quantitative analysis were used to calculate the proportion of feed after converted to dry matter basis following the formulas:

k = W : A; where the W is the weight of herbarium sample on dry matter basic (gram); A is surface area of each feed sample (mm^2), and:

x = P. k; where x is feed proportion on dry matter basis (gram) the k is index surface area of each feed type/species ($gram/mm^2$); P is multiplication of index surface area to feed type coverage value. Therefore, feed proportion relative (xr) which presents the percentage proportion of feed type on the fecal sample can be calculated by following formula:

$$xr = \frac{\text{x of a feed type x 100\%}}{\text{sum of x in total feed types}}$$

Feed identification by using dung analysis

To identify the vegetation type in dung, it was needed to have the data base of Anoa's feed vegetation that was made by determining epidermis of Anoa's leaf samples. The Anoa's feed was then determined by matching the epidermis fragment of vegetation in feces with the data base. The Epidermis identification was referred to the method by Sparks and Malecheck (1968) and also Foppe (1984) continued by the calculation of dung and vegetation epidermis percentage according to the method of Hansen *et al.*(1984).

RESULTS AND DISCUSSION

Identification of Anoa's feed vegetation

Measurement made from 18 plots resulted 342 vegetation samples predicted as Anoa's feed by field direct observation method. It was come from 36 *familia*, 58 species and 6 *familia* including 37 species of unidentified vegetation. This condition was caused by one type of *familia* has more than 1 local name, and vice versa. The identification using combination methods of direct observation and dung analysis found that Anoa's feed vegetation consist of 24 *familia* and 28 species; which only one of them was unidentified (Table 1).

Table 1. Anoa's Feed After Combination Method of Observation in National Lore Lindu Park

No	Familia	Scientific Name	Local Name	Part consumed
1.	*Graminae*	*Bambusa sp.*	Bambu	leaf, young growth, young grooves
2.	*Poaceae*	*Dinochloa barbata*	Rumput	leaf, flower
3.	*Cyperaceae*	*Schleria sp.*	Rumput	leaf, flower
4.	*Arecaceae*	*Calamus inops;* *Areca vestiara Giseke*	Rotan noko Harao Pinang Hutan	young growth, young grooves
5.	*Pandanaceae*	*Freycinetia insignis Blume*	Lambori, Pandan	leaf, tuber, stem
6.	*Hypnaceae*	*Trichosteleum sp.*	Tamomo	leaf (moss)
7.	*Podocarpaceae*	*Podocarpus imbricatus*	Pangkao	bushes, leaf, flower
8.	*Polypodiaceae*	*Hymenopteris sp.;* *Histiopteris sp.;* *Blechnum sp.;* *Drynaria rigidula (s.w) bedd*	Paku-pakuan	bushes, leaf, young grooves
9.	*Cyatheaceae*	*Cyathea sp.*	Pakis	bushes, leaf, young grooves
10.	*Selaginellaceae*	*Selaginella caudata*	Paku	leaf, flower
11.	*Urticaceae*	*Elastostema sp.*	Katatuma	bushes
12.	*Piperaceae*	*Piper sp.*	Sirih Hutan	leaf, tuber
13.	*Moraceae*	*Ficus sp.*	Beringin	leaf, fruit
14.	*Myrtaceae*	*Syzigium accuminatissima*	Palohawana	bushes, leaf, flower, fruit
15.	*Clusiaceae*	*Calophyllum soulatri*	Marantapi	leaf, flower
16.	*Rubiaceae*	*Lasianthus clementis Merr*	Binutu/Bonitu	bushes, leaf, flower, fruit
17.	*Melastomataceae*	*Medinilla myrtiformis Triana*	unidentified	leaf, flower
18.	*Meliaceae*	*Dysoxylum sp.*	Walangkome	leaf, flower, young growth, fruit
19.	*Smilaceae*	*Smilax leucophylla*	unidentified	leaf, flower, tuber root
20.	*Apocynaceae*	*Clusia sp*	Bakanggaroka	leaf
21.	*Cluciaceae*	*Garcinia sp*	Binutu	leaf, fruit
22.	*Denstaedtiaceae*	*Microlepia todayensis* Christ	Pakuwana (A)	leaf
23.	*Caprifoliaceae*	Tak teridentifikasi	Tomanete (B)	bushes, leaf
24.	*Fagaceae*	*Lythocarpus celebicum*	Palili (C)	leaf, fruit, flower

The result of present study was in agree with the previous study by Pujaningsih *et al*. (2005) who recommended that Anoa in their own habitat consumed leaf of the bushes, shoots, ferns, palms, tubers, fruits and even moss. This study also confirmed similar results in the previous studies (Mackinon and Mackinon, 1979; Bostid, 1983; Balgooy and Tantra, 1986 cited by Whitten *et al*., 1987, Labiro, 2001 and Mustari, 2003) that used direct observation method only Some type of feed found in this study was found similarities to the previous studies. Similarities in ferns was in Polypodiaceae familia, namely: *Hymenopteris sp., Histiopteris sp., Blechnum sp., Drynaria rigidula (s.w) bedd,* Sellaginellaceae (*Sellaginella caudate*), Cyatheaceae (*Cyathea sp*.}. Another similarities were found in moss type of Hypnaceae (*Trichosteleum sp.*), palms of Arecaceae (*Calamus inops and Areca vestiara),* type of field grasses of Cyperaceae (*Schleria sp*), pandan of Pandanaceae (*Frecynetia insignis*), type of Bamboo of Poaceae (*Bambusa sp*. and *Dinochloa barbata*), type of Gymnospermae of Podocarpaceae (*Podocarpus imbricatus*). Other type of vegetation observed were: *Elastostema sp., Piper sp., Ficus sp., Syzigium accuminatissima, Callophylum soulatri, Lasianthus clementis Merr, Medinilla myrtiformis Triana, Disoxylum sp., and Smilax leucophylla.* However, the feeds come from fruits and tubers could not be proved by dung analysis method. There were some possibilities to explain that phenomena, one of them was the animal only use the water content in fruits or tubers, or another possibility is the epidermis which was ingested into his stomach was completely digested, so that was not found in feces. However, from the present study it can be concluded that the type of Anoa's feed from year to year is not changed.

Proportion of Anoa's feed based on dung analysis

Anoa are able to select the type of feed in a certain proportion to meet the needs of her body as shown in the difference proportion of each type of feed. Based on the dung analysis, the first ten types of vegetation identified was: *Freycinetia insignis* Blume (17%), *Microlepia todayensis* Christ (8.9%), *Disoxylum sp* (8.6%), *Lasianthus clementis* Merr (7.7%), *Clusia sp* (7.5%), *Schleria sp* (6%), *Podocarpus imbricatus* (5.4%), *Smilax leucophylla* (5.1%), *Elastostema sp* (4.2%), *Garcinia sp* (3.8%).

Storr (1960) indicated that large proportion of the feed was affected by leaf age, which was increasing leaf age will give a higher value of feed. Relative proportion of feed value also showed the level of Anoa preference on certain types of vegetation. The higher relative proportion of feed type value will increase the level of Anoa's preference. Figure 1 presented Anoa preference to consume leaves and bushes (24%), flower (18%), fruit (12%), young growth (8%), grasses, tuber, young grooves (each 4%, respectively) and moss (2%) as well.

Flower was ranked in the third place because it was consumed along with leaf, leaf buds or the flowering bushes, not merely eaten the flower. In contrast with fruit, this was consumed on purpose. This was in agree with Parakkasi (1995) who stated

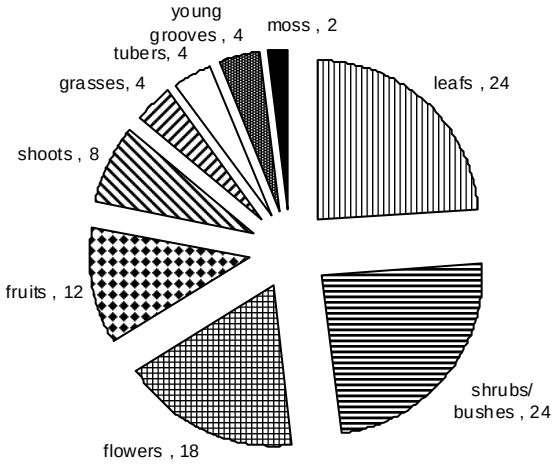

Figure 1. Anoa's feed proportion (%) based on dung analysis

that generally animal and especially ~~for~~ in ruminant that have naturally feed selection.

Anoa on the study area fulfilled their water requirement by consuming *pokae* fruit coming from *Ficus sp*., by stabbing the stem of the tree to get the falling fruits. Mustari (2003) found that Anoa in Tanjung Peropa, at Southeast Sulawesi Conservation area also consumed *dongi* fruit (*Wormia ochreata*), *toho* fruit (*Artocarpus sp.*), *konduri* fruit (*Parkia timoriana*) and *huhubi* fruit (*Artocarpus dasyphyllus*). Moreover, Basri (2008) recommended that Anoa able to consume 10 kg of *pokae* fruit within 2 – 3 hours on the *ex situ* condition.

Bloembergen in Whitten *et al.* (1987) stated that in Nokilalaki Mountain (one of the highest mountain close to Roroka Timbu Mountain in NLLP on the height of 2100 m above sea level was found many types of climbing pandanus (Freycinetia sp.) If it was correlated to the discovery of Anoa's feces on the area at 1500 m above sea level, it means that Anoa need to climb 600 m more to find the plant species most identified in Anoa's feces. This condition may lead to the conclusion that Anoa has a high moving ability or living adaptability in order to fulfill the feed requirement.

Protein and crude fiber content of Anoa's feed

Nutritional values of forest plants that consumed by Anoa was widely ranged, for protein at 0.6 – 18.86% averaged of 8.8% (sd = 4.4), crude fiber at 8.4 – 37.26% averaged of 25.6% (sd = 7.8), as well as moisture content ranged at 65.21 – 94.38% averaged of 80% (sd= 11.7), respectively. It showed the selected plant species as feed by Anoa was widely varied. Therefore, the complete nutritional analysis of the feed plants was needed to support the nutrient requirement of Anoa prior to the conservation and development as well.

CONCLUSION

Dietary composition of Anoa which discovered from its habitat consisted vegetation on the part of leaf, leaf bud, young growth, young grooves, tuber, fruit and flower. Based on the combination method between direct observation and Anoa's dung epidermis analysis, it was observed that Anoa consumed more leaves and bushes (each 24%, respectively) compare to flower (18%), fruit (12%), shoots (8%), grasses, tuber, young grooves (each 4%, respectively) and also moss (2%). The ten types of vegetation from the highest percentage were *Freycinetia insignis* Blume (17%), *Microlepia todayensis* Christ (8.9%), *Disoxylum sp* (8.6%), *Lasianthus clementis* Merr (7.7%), *Clusia sp* (7.5%), *Schleria sp* (6%), *Podocarpus imbricatus* (5,4%), *Smilax leucophylla* (5.1%), *Elastostema sp* (4.2%), and *Garcinia sp* (3.8%), respectively. Moreover, the range value of protein was at 0.6 – 18.86%, crude fiber was at 8.4 – 37.26%, and moisture was at 65.21 – 94.38%, respectively.

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