The ability to adapt for ex situ conservation of anoa (Bubalus sp) through regulation of feeding pattern

Y Rusiyantono, M I Mumu and Y Duma

Animal Science and Fisheries Faculty, Tadulako University, Soekarno-Hatta Street, Km. 9 Palu 94118, Central Sulawesi, Indonesia

Email: yohan.rusiyanto@gmail.com

Abstract. Anoa was an endemic animal in Central Sulawesi that has to be conserved. The aim of this research is to know an ability of adaptation anoa in ex situ conservation. This research used anoa come from natural habitats. Anoa has been domesticated with regulation of feeding. The first pattern, anoa gave feeding legume and grass. The second pattern, anoa gave feeding concentrate, legume and grass. The result showed anoa has ability to adapt with new environment. Based of observation on general behaviours, feeding behavior and normal frequency of respiration. The numbers of leucocyt (6500 cells) showed that there was no under pressure of environment to this creature. On the other hand, anoa showed no indication of stress with no disturbing for its environment. Daily average weight gain of male anoa was greater than female (0.055/kg/day and .045 kg/day, respectively). The addition of concentrate as a feeding gave positive result to get daily weight gain that were 0.061 kg and 0.055 kg, for male and female, respectively. In conclusion, anoa has ability for adaptation on conservation ex situ area.

1. Introduction
The current population of anoa has been greatly reduced. This can be proved by the difficulty of finding randomized anoa in their habitat areas. The main factors causing the decline of the anoa population in Central Sulawesi, especially in Lore Lindu National Park are habitat destruction and poaching. Anoa animals have been included in the Red Data Book published by IUCN (International Union for Natural Resources) categorized as wildlife species that are almost extinct [1].

Although anoa preservation efforts have long been done with indigenous habitat protection methods (in situ), their success rates have not yet been determined. This can be proved by the level of cutting and hunting of anoa in the conservation area was increasing [2]. The pattern of ex situ protection by regulating the feed pattern by providing feed ingredients based on protein and energy balance can be an alternative problem solving, so that it can be obtained a pattern of maintenance of anoa outside the habitat and at the same time it can get picture of growth pattern of anoa. The other ex-situ conservation with cryopreservation technique was through in-vitro fertilization (IVF) but the results showed under expectation [3, 4].

The growth pattern can be determined by measuring the daily weight gain. Good feeding is expected to improve reproductive ability. Anoa living in its habitat has a poor reproductive profiles. The results showed that the number of sperm obtained from the testes and epididymis which can be determined through the concentration is very low. Besides that in female anoa animals, the signs of
estrus are difficult to detect [5]. This situation occurs because anoa is a solitary animal, so the pattern of reproduction is not running as usual. Previous research was done through gonatrophin introduction to stimulate oestrous cycle. This can also be done by the other animals with significant results [6, 7].

With the maintenance pattern in the enclosure, it can be stated based on the observation that anoa has an ability to adapt in a new environment outside its natural habitat.

2. Research methods
The targets to be achieved in this study is to know the pattern of anoa adaptation in the cage maintenance and see a pattern of anoa on each feed treatment.

2.1. Feeding management
Anoa obtained from their habitats are then kept in cages that have been equipped with shade, puddles and feeding places. Feed given in the form of forages and concentrates In order to meet the needs of minerals, the drinking water that has been provided were added minerals and vitamins.

In the first four months, the anoa is fed only forage and field grass in an ad libitum state. The next four months anoa was given an additional meal of concentrate. Concentrate was administered before anoa was fed forage and field grass.

2.2. Anoa Growth Pattern
To know the growth pattern of Anoa, then weighing the body weight and measurement of body size at every end of week, at each feed treatment given.

2.3. Anoa Adaptation Pattern
Anoa adaptation rates are observed based on diet and drinking, anoa calm on changes in environment and breathing frequency. On the other hand, it was also performed white blood cell analysis.

2.4. Blood Sampling ad Analysis
Blood is taken from the jugular vein with a syringe which has been given anti-coagulant and collected in the test tube by rocking so that the blood is well blended with anti-coagulant, where there is no clumping. The blood sample is then left under 5°C to separate serum with plasma. Samples of blood that has been separated the serum and plasma, subsequently performed a leukocyte analysis to see whether the anoa is experiencing stress or not.

3. Results and discussion

3.1. The ability of anoa adaptation
The ability to adapt anoa can be seen based on eating and drinking behaviors, and the frequency of breath and individual calm in a new environment. At the beginning of the anoa is moved from the original habitat to the place of maintenance, the symptoms are the anoa tend to consume a lot of water and the visible frequency of breathing faster. This situation did not last long, the next day the symptoms have started to disappear, and the behavior of anoa looked like usual. After 2 weeks of being in a new breeding area, anoa in this study, both male and female have shown normal eating and drinking behaviors. Anoa did not choose the type of grass and forage provided. The feed given at the beginning of the study was adapted to some of the original feeding species. Based on the results of the observation obtained data that there are two feed groups are usually eaten anoa. The main feed consists of: Agathis sp; Arenga pinnata (Wurmb) Merr; Asplenium sp; Athyrium dilatatum BI; Axonopus compressus (Sw) Beauv; Calamus sp; Christella dentala (Forsk); Coleus sp; Cyperus sp; Diploma of BI asperum; Elaeocarpus morbindus; Elmerrilia ovalis (Mig); Ervatamia sphaerocarpa Burkill; Ficus vasculosa Rumph; Gnetum sp; Homalomena sp; Ipomoea aquatica Fordik; Ipomoea batatas Poir; Manihot Utilissima Pohl; Moses paradomisiaca L; Musci sp; Neprolepis sp; Oplismenus compositus L; Oroxylum indicum Vent; Osmunda Javanica BI; Paspalum conjugatum Bergius; Piper
sp; Rubus molucanus L; Xylocarpus granatum Koen; Zingiber officinale Rose. Secondary Feed consists of Artocarpus elastica; Dracontomelon mangiferum BI; Eugenia sp; Palaquium macrophyllum (de Vriese); Pangium edule Reinw; Pa. Anoa animals have been categorised as animals that like water. This can be seen from the habit of anoa who is always looking for water after doing the activity. Anoa including animals that are not heat resistant. Based on observations that have been done, anoa tend to seek shelter when the sun began to heat. Although it does not show difficulty in adapting to food, but the behavior of anoa still shows its wild nature. Anoa is still sensitive to the sounds and movements that approach him/her. The desire to defend against the opponent is indicated by the attacking phenomenon when there is a movement approaching it. Anoa, both male and female accept all the forages given to him. In order to easily maintenance, the selected and given forages are always available, namely water spinach (Ipomoea aquatic) and grass field. Like other ruminant animals, anoa do all day eating activities. This eating and drinking activity is not disturbed by the circumstances surrounding it. This shows that anoa has begun to adapt to its environment. One indication that animals have been able to adapt to the environment can be determined based on the status of leucocytes in the blood. All types of leucocytes have distinctive shapes, nuclei, cytoplasm and organelles, are capable of moving in certain circumstances. Erythrocytes are passive and perform their function in the blood vessels, while leucocytes are able to escape from the blood vessels to the tissues in performing their functions.

The total number of leucocytes is far below erythrocytes, and varies depending on the type of animal. Fluctuations in the number of leucocytes in each individual is quite large under certain conditions, such as stress, physiological activity, nutrition, age, and others. Based on observations that have been done show that the number of leucocytes in the blood anoa still shows a normal amount (± 6600). This situation illustrates that the anoa in a maintenance cage is not in stress, either environmental or stress-induced stress originating from within itself [8].

3.2. Pattern of increase body weight anoa without foods strengthening

Anoa weight gain in studies with the provision of forage and field grass without feeding the reinforcement can be seen in figure 1.

![Figure 1 Anoa Daily Body Weight Gain (kg) without additional concentrate feeding](image)

Based on the data obtained during the observation showed that the average body weight gain for male anoa was higher (0.055 kg/day) compared with the increase of female anoa body weight (0.045 kg/day). The difference of daily weight gain of male and female anoa is caused by the ability of consuming feed (grass and forage) of male anoa larger than the female anoa. Male anoa showed more frequent eating and drinking activity than female anoa. But there was no hierarchy in eating and
drinking behavior. Although anoa animals are categorized as wildlife, feeding booster (concentrate) in anoa increased the daily weight gain. Although anoa is a ruminant animal, protein and energy requirements can be met only from forage and grass feeds, but concentrate feeding greatly supports the nutritional needs of anoa. Reinforcing feed is essential for growing animals. The content of non-essential amino acids in the reinforcing feed is an indispensable material for the growth of cells in the animal’s body in the activities of eating drinking does not occur quarrels.

3.3. Pattern of anoa weighting gain with additional concentrate feeding

Additional feeding (concentrate) in anoa increases the daily weight gain. Although anoa is a ruminant animal, protein and energy requirements can be met only from forage and grass feeds, but concentrate feeding greatly supports the nutritional needs of anoa. Reinforcing feed is essential for growing animals. The content of non-essential amino acids in the reinforcing feed is an indispensable material for the growth of cells in the animal's body. The increasing of the averages of anoa body weight showed a relatively stable amount in each month, with little difference between male and female anoa.

![Figure 2. Anoa Daily Body Weight Gain (kg) with additional concentrate feeding](image)

4. Conclusion

Anoa has ability for adaptation on conservation ex situ area. Firstly, anoa is able to adapt in a cage outside its natural habitat. Secondly, both male and female of anoa showed good weight gain. Lastly, anoa weight can be increased by concentrate supplementation.

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