Growth rates of Maleo birds (*Macrocephalon maleo*) fed by different levels of protein in the captivity

Hafsah,* Tri Yuwanta,† and Kustono†

*Department of Animal Science, Agricultural Faculty, Tadulako University, Jl. Sukarno Hatta Km 8 Kampus Bumi Tadulako Tondo Palu, Central Sulawesi, Indonesia; and †Animal Science Faculty, Gadjah Mada University, Yogyakarta, Indonesia

ABSTRACT: The objective of the research was to study the growth rate of Maleo birds fed with graded levels of protein in the captivity. The experiment was designed using Randomized Block Design, block based on *in-situ* and *ex-situ* habitat and five treatments within three replications. The study used 15 Maleos with one week old from semi-natural hatchery reared in captive housing in *in-situ* habitat at Lore Lindu National Park, and also 15 Maleos from incubator hatchery reared in captive housing in *ex-situ* habitat at Experimental Farm of Animal Science Department Agricultural Faculty Tadulako University Palu, Central Sulawesi. The Maleo birds were fed by commercial diets *ad libitum*. Each Maleo chick was placed in different pen and fed five levels of protein:13.54% (P_1); 15.43% (P_2); 17.42% (P_3); 19.45% (P_4); and 21.42% (P_5) with isocaloric diets. Data were analysed using variance analysis of SPSS Program version 16. The results indicated that level of protein significantly improved live weight gain and feed conversion ratio in *in-situ* habitat, but this trend did not significant in *ex-situ* condition. Protein level of 17.42% produced a better bird growth. There were no different growth rates of Maleo birds that captive between *in-situ* and *ex-situ* has been recorded during the study.

Key words: captivity, *ex-situ*, growth, habitat, *in-situ*, maleo

INTRODUCTION

Maleo bird (*Macrocephalon maleo*) is one of Sulawesi endemic bird species and they live in the wild in a particular region. The habitat can be found only in primary forest with geothermal sources or in the coastal region with fine sand and direct sunlight during the day. The birds include Megapodes groups (*family Megapodiidae*) with genus *Macrocephalon* (Sukmantoro et al., 2007). Birds are protected by the Indonesian government and the International (IUCN) as endangered species and putting in appendix I (IUCN, 2006). The bird is severely threatened by over-exploitation of its eggs and destruction of its habitat. It is listed in the Red Data Book and has been the subject of conservation projects supervised by the International Council for Birds Preservation (ICBP), World Wide Fund for nature (WWF). In Indonesia this animal was conserved based on decree: Minister of Agriculture RI No. 421/KPTS/UM/8/1970, and no. 90/KPTS/UM/2/1997, UU No.5 1990: Natural Resources Conservation and Ecosystem, Decree Minister of Forestry No.301/KPTS/II/1991, and No.882/KPTS/II/1992, PP No.7.1999, January 27 1999 on plants and animal conservation.

Exploitation of natural resources by human constitutes a worldwide problem not only threatens individual birds, but ecosystems as whole. Human need to be controlled by the authorities of the countries involved, if necessary with international support. However, before anything will be achieved on worldwide scale or before the habitat of those birds is safe, the threatened birds can be helped in a simple or through temporary ways. From a conservation point of views, the birds has a major advantage over many other endangered birds: captive breeding is relatively easy and effective, and success can be guaranteed at low cost and with little man power. Since the chicks are self supporting from the first day, they can be released immediately after hatching (Dekker, 1989).

Unlike most birds, Maleo has the size almost the same as chicken with a white breast and black of plumages on the body, wings and tail, has also capsety on the top of the head (Hafsah *et al*. 2004). Another unique characteristic of Maleo birds is the way on laying eggs, the eggs are laid in burrows which the adult birds excavate using their powerful feet's and legs in geothermal heated soils in forest, or in-solar heated sandy beaches. The adults provide no care of the eggs and do not get parental

care after hatching, but the eggs are incubated by environmental sources of the heat. After hatching the chicks dig their way to the surface and are able to fly on the day of hatching (Jones e*t al*., 1995). Furthermore, Maleo eggs are four to five times heavier than domestic chicken eggs and high percentage of yolk content (Dekker and Brom, 1990).

Diet is one factor affecting the survival of birds in their natural habitat. As the successful growth depend on good nutrition, it is extremely important to provide the correct diets. Wiriosoepartho (1979) reported that diets of Maleo birds under natural habitat consumed mostly fruits and grain lays on the ground and rarely on the three, also consumed forest insect like grasshoppers, butterflies, ants, crickets, dragonflies, small crabs and snails caught from the river side that crossing of the nesting ground. Nutrient deficiency can affect the development and function of reproductive organs. Directly, it causes abnormal cellular metabolism in reproductive organs and indirectly, it affects the endocrine system related to reproduction. Under nutrition delays the onset of puberty and leads to impaired fertility in mature animals (Etches, 1996).

One way to prevent the Maleo birds from the extinction is through conservation *in-situ* and *ex-situ*. *In-situ* conservation is done by the habitat security restoration and protection of habitat by the government. As the realization of the program is running slowly and outcome is also low, other possibility effort need to be considered. *Ex-situ* conservation is one of an effort that can support the *in-situ* conservation, is done outside the nature habitat in the form of captivity, aimed to maintain continuity and enhance the population. On the captivity, feed is one of the important factors that need to be done. Nowadays, there are no clear guidelines on feeding Maleo birds in captivity.

Maleo birds feed in captivity of *ex-situ* habitat, for instance in Ragunan Zoo was given different types of feed such as the unhulled rice, mung bean, peanut, bean sprouts, papaya and flyblow worm (Nasution, 1997); in National Park in the Bogani Nani Warta Bone North Sulawesi given corn, red beans , snail, insects, and papaya (Sumangando, 2002), while in Taman Mini Indonesia Indah the Maleo was given diets like voer 511 and 521, millet, black sticky rice, *jewawut*, corn, rice, green beans, un-hulled rice, *kangkung*, bean sprouts and worm (Mardiana, 2002). The ability of each individual animal on different diets are depend on conditions of the place, genetics, also which caused by certain food indirectly influence the nature of the genes related to the physiological status.

Maleo bird conservation has been attempted in *ex-situ* habitat, but has not yet successfully survives in a long time. Research on aspects of Maleo bird wildlife habitat has not been explored, especially on the scientific feeding. Based on these facts, the present study aims to look at post hatching growth performance of Maleo birds through control feeding in the captivity in *in-situ* and *ex-situ* habitat.

MATERIALS AND METHODS

Research was conducted in captivity in the Lore Lindu National Park as *in-situ* habitat and experimental Farm of Tadulako University as *ex-situ* habitat. 15 Maleo chicks used in in-*situ* captivity were taken from semi natural incubation in nature habitat and 15 Maleo chicks were placed in *ex-situ* captivity were taken from incubation hatchery in the laboratory. Research was designed using Completely Randomized Design with five treatments and three replications. The five treatments were 13.54% (P_1); 15.43% (P_2); 17.42% (P_3); 19.45% (P_4), and 21.42% (P_5) with iso-caloric diets. It was applied in *in-situ* and *ex-situ* captivity. The Maleo's were captive individual with the plot size 1x1x1m. The feed tray and water were put inside the plot and prepared ad libitum. The observation was held for 8 weeks with the variables observed were body weight, gain, feed consumption, and feed conversion ratio. The appropriate feed composition and nutrient content was summarized in Table 1.

Data were analyzed using variance analysis of General Linier Model (GLM) Multivariate in SPSS program and Least Significant Different (LSD) was used to identify the different among the treatments effect (Santoso, 2003).

RESULTS AND DISCUSSION

Results of the study showed that there was no significantly different between the live weight of the birds in *in-situ* and *ex-situ* habitat (Figure 1). The same trend resulted also from the effects of protein level on live weigh in *in-situ* habitat. However, the effect of the treatments in *ex-situ* habitat was

found highly significant (P<0.01) on live weigh. The highest live weight was achieved at 21.42% (P_5) and 17.42% (P_3) for *in-situ* and ex-*situ* condition, respectively. The difference occurred dealt to environment change of captive area. The growth rate of the birds in *in-situ* followed the common growth pattern for which increased as protein level increased. However, this trend did not occur in *ex-situ* due to stress of the bird. Decuypere and Buyse (2005) reported that, feed quality, macronutrients, physiological status and metabolism status influenced the growth of the birds. Additionally, environmental condition and feed availability also have a contribution on the growth (Brzek and Konarzewski, 2007).

Graded level of protein significantly improved (P <0.01) live weight gain and feed conversion of Maleo birds in *in-situ* habitat, however treatment did not produce a significant effect on live weight and feed conversion in *ex-situ*. Live weight gain of birds did not produce any different on *in-situ* and *ex-situ*. The birds at *ex-situ* habit have eaten more feed, but it doesn't create a better live weight gain. This phenomenon could be related to temperature which higher than 30^0C as reported by Pilliang (1992). The highest live weigh gain was produced by protein level of 17.42% (P_3).

Table 1. Diets composition and nutrient content of formulation feed used in the experiment

	Treatments				
Composition, %	P_1	P_2	P_3	P_4	P_5
Feed composition:					
1. Candlenut grain	9.00	9.00	9.00	9.00	9.00
2.Corn grain	59.00	55.00	47.00	43.00	36.00
3. Concentrate BR1	6.00	10.00	14.00	15.00	19.00
4. Mung bean grain	9.00	9.00	9.00	9.00	9.00
5. Rice bran	11.00	8.00	9.00	8.00	8.00
6. Fish meals	5.00	8.00	11.00	15.00	18.00
7. Top mix	1.00	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00	100.00
Nutrients*:					
1. Protein (%)	13.54	15.43	17.42	19.45	21.42
2.ME (kcal)	3118	3097	3089	3083	3038
3. Fat (%)	7.86	7.94	8.14	8.15	8.32
4. Crude fiber (%)	5.33	5.48	5.74	5.78	6.19
5. Ca (%)	0.55	0.65	0.74	0.80	0.90
6. P (%)	0.38	0.42	0.45	0.49	0.54

* Counted based on nutrient content of the feed that analyzed in the Laboratory Nutrition of Agricultural Faculty Tadulako University, Palu (2007).

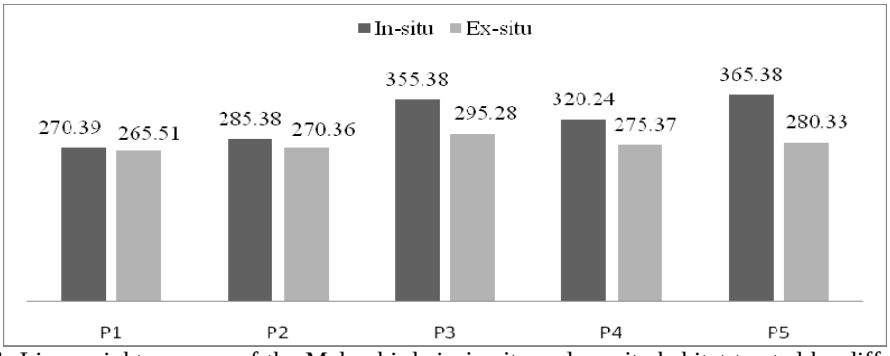

Figure 1. Live weight average of the Maleo birds in *in-situ* and ex-*situ* habitat treated by different protein level: 13.45% (P_1); 15.43% (P_2); 17.42% (P_3); 19.54% (P_4); 21.42% (P_5)

Treatments and habitat types did not produce effect on feed consumption. The cumulative feed consumption commonly influenced by energy metabolism of the diets (Anita et.al., 2007), nutrient

contents (Akiba *et.al*., 1982), and physical form of the feed (Amerah et.al., 2008). Although based on statistical analysis did not shown the differences among the treatments, however Maleo that captive in *ex-situ* habitat tend to consumed more feed than in *in-situ* habitat. Daily activity of the birds that captive in *ex-situ* was seen to be active, so it required more energy to move inside the captive housing.

Table 2. Growth performance in *in-situ* and *ex-situ* habitat with different protein level

Habitat	Performance	Treatments					Prob.
		P_1	P_2	P_3	P_4	P_5	
In-situ	Live Weight Gain, g	140.05[a]	174.82[ab]	240.09[b]	189.91[ab]	240.06[b]	**
	Feed consumption, g	1767.27	1732.61	1661.43	1652.03	1647.75	ns
	Feed conversion	12.62[a]	9.94[ab]	6.91[b]	8.70[ab]	6.87[b]	**
Ex-situ	Live Weight Gain, g	130.32	147.64	164.96	150.19	167.55	ns
	Feed consumption, g	1799.64	1776.63	1790.76	1712.27	1707.47	ns
	Feed conversion	13.91	12.04	10.87	11.48	10.35	ns

Prob. (Probability); * * Highly significant different (P< 0. 01) of the treatments; ns = *non significant*

Megapodes is categorized as a slow growth animal which is characterized by a complete feather after hatching, well developed eyes, aggression in movement, it self feeding, and flying after hatching. The growth pattern of the Maleo from this study was similar to animal growth in general and following the sigmoid trend. Animal is grows from day old up to mature stage (O'Connor, 1985). Furthermore, megapodes growth closely related to galliforms, such as the domestic chicken (Wong, 1999).

CONCLUSIONS

There were no different in growth rates of Maleo birds that captive between *in-situ* and *ex-situ* has been recorded during the study. However, protein level of 17.42% produced a better bird performance in *ex-situ* habitat and 21.42% in *in-situ* habitat.

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