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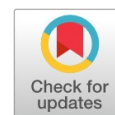
Increasing Growth and Survival Rate of Land Hermit Crabs (*Coenobita* sp.) in Artificial Habitat through Feeding Habit

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INCREASING GROWTH AND SURVIVAL RATE OF LAND HERMIT CRABS (*COENOBITA* SP.) IN ARTIFICIAL HABITAT THROUGH FEEDING HABIT

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Abstract. Land hermit crabs (*Coenobita* sp.) have the potential to be traded as pets, especially due to their uniqueness. Indeed, this animal does not have complete exoskeletons and uses gastropod shells to protect itself. However, the animal may not survive in captivity because of the feeding problem. This study aimed to increase the growth and survival rate of *Coenobita* sp. in captivity through the feeding approach. The research was begun by developing a standard curve allowing the body weight estimation through total weight. Fresh, non refreshed, and mixed feed and feeding patterns were tested by measuring the consumption rate and hermit crabs' growth and survival rate. The regression between total and body weight for *C. rugosus* was $Y = 0.276X - 0.049$ and for *C. perlatus* was $Y = 0.101X^{1.33}$. The feed composition between the two species was not significantly different. Both species needed varied, fresh, and low protein content feed. If one of these criteria were not available, the feed consumption rate would decrease, leading to lower growth and survival rate. Non-varied but fresh feed did not affect the survival rate. However, the negative effect of non-varied feed was observed on the growth rate. The best feed for hermit crabs was found to be apples, followed by jicama and corn.

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INTRODUCTION

Land hermit crabs (*Coenobita* sp.) meet all the criteria to become pets. They manage to evolve from the marine life to the terrestrial life, which makes the maintenance of this animal in captivity simple. The relatively small size of this animal (maximum 8 cm) is also a trait that contributes to the ease of its maintenance in the home as pets [1]. In terms of color, the species belonging to the *Coenobita* have a broad color spectrum and one of them is *Coenobita perlatus* whose colors are red, orange or red and white stripes [2]. The main attraction of this animal as a pet lies in its uniqueness in which the animal does not have the original shell and instead uses the shells of other animals as its home [3].

Although the land hermit crabs have the potential to be traded as pets, the volume of trade of the species is relatively small compared to other similar commodities. Land hermit crabs have been found to be very sensitive [4] and they often experience massive sudden death during captivity. That is, the death of several individual crabs will quickly provoke the death of others and finally the massive death of the animals [5]. One of the main causes of the death is feeding (especially food types and feeding patterns). Despite having a broad spectrum of food and belonging to the omnivorous type of animal [4], the feeding habit of the crabs is quite unique. Land hermit crabs are

known to avoid the feed that has previously been consumed [6] and instead prefer fresh feed [7]. The crabs do this to reduce the amount of toxins entering their bodies and to regulate the balance of nutrients [8], [9].

Until now, the research literature of food and feeding habit of hermit crabs is very limited. In their natural surroundings, hermit crabs eat fruits, seeds, plants, insects, fungi, and feces [10]. However, there is little research into food and feeding habits of these crabs when they are in captivity. Therefore, research into the food and feeding habit of land hermit crabs living in the artificial habitat needs to be developed in order to improve their growth and survival rate.

The aim of this research is to improve the growth and survival rate of land hermit crabs (*Coenobita perlatus* and *Coenobita rugosus*) through feeding habits.

MATERIALS AND METHODS

The main material used in this research was strawberry hermit crabs (*C. perlatus*) and *C. rugosus* which originated from Nias Island, Indonesia. The study was divided into five main phases. The first experiment was to analyze the effect of non-renewable and non-variable feed on feed consumption rate. A simple factorial design with 2 treatments was applied.

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The first treatment was applied on the hermit crab species (*C. perlatus* and *C. rugosus*) and the second treatment was the food type, i.e. corn, apple, carrot, jicama, cucumber, and fish. The experiment was repeated for 5 times. All the experiments were conducted by giving 200 g/cage containing 50 individuals of each species for 7 days without renewing. The remaining feed was weighed daily to determine the rate of consumption of feed per day.

The second experiment was to test the fresh but non-varied feed. A simple factorial design with similar treatments was also applied, but the feed was renewed (fresh) every day. The remaining feed was weighed daily to determine the rate of consumption of feed per day. The third experiment was to test the fresh and varied feed. A design similar to previous ones was applied, but the feed was renewed and refreshed. The variable measured was the same, i.e. the feed consumption per day. The fourth experiment was to test the varied feed simultaneously. That is, all 6 types of feed were offered simultaneously and the remaining food of the 6 types of feed was measured to determine the consumption rate of each feed per day.

The results of the 4 first experiments were considered for the last experiment. In this last experiment, three types of feed consisting of apple, corn, and jicama were chosen to test the growth and survival rate of *C. perlatus*. A simple randomized design was applied and the treatment was the food combination. The first factor was a sequence of apple, corn, jicama, and so forth. The second one was a sequence of apple, corn and so forth. The third factor was a sequence of jicama, corn, and so forth. Finally, the last factor was the 3 types of feed offered together. The variable measured was the growth rate and the survival rate of the *C. perlatus*.

RESULTS

For the non-renewed and non-varied feed, the consumption decreased from day to day (see figure 1). The reduction reached 75% for the favorite feed (apple and jicama) on the second day. There were no significant differences ($p > 0.05$) in consumption rate between *C. perlatus* and *C. rugosus*. The significant differences ($p = 0.000$) were observed on the time (days). After 2 days, the feed was practically not consumed.

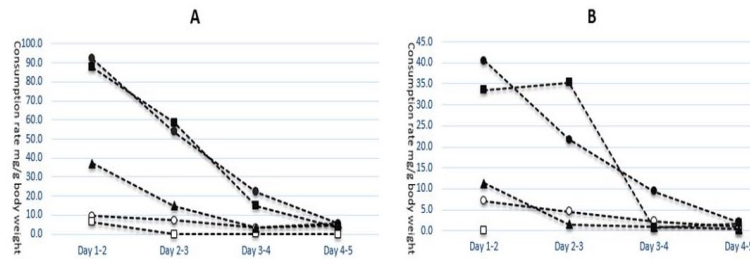


Fig. 1 . Consumption rate of non-renewed and non-varied feed by *C. rugosus* (A) and *C. perlatus* (B) (...●... apple...■...jicama ...▲... corn ...○...cucumber ...□... carrot

When the feed was renewed, the consumption rate was relatively the same from day to day even though the feed was not varied (see figure 2). The only significant differences in

consumption ($p > 0.05$) which were observed were the food type. That is, both species mostly consumed apple and jicama, followed by cucumber and corn.

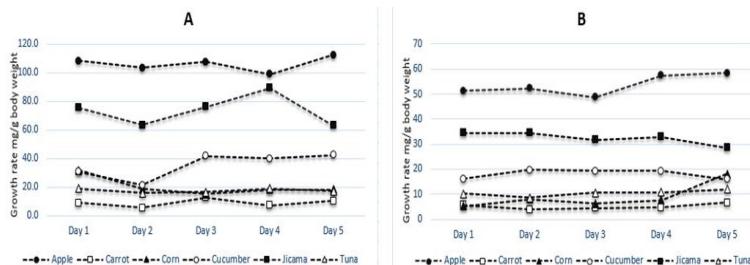


Fig. 2 . Consumption rate of renewed but non-varied feed by *C. rugosus* (A) and *C. perlatus* (B) (...●... apple...■...jicama ...▲... corn ...○...cucumber ...□... carrot

When the feed was renewed and varied (given in sequence), there were no significant differences ($p > 0.05$) in consumption between non-sequenced feed and sequenced (varied) feed except for jicama, apple and cucumber (see figure 3).

For these three types of food, the consumption of sequenced feed was significantly ($p < 0.05$) higher than the non-sequenced one.

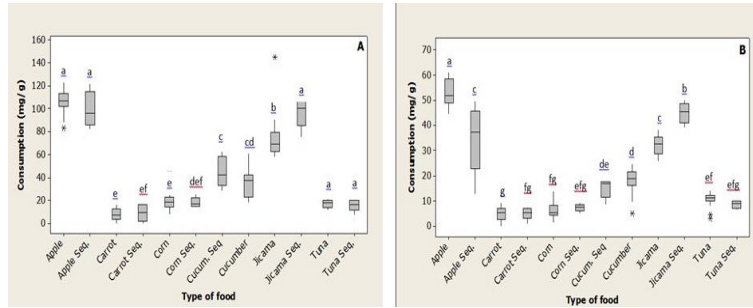


Fig. 3 . Consumption rate of non-sequenced feed and sequenced feed by *C. rugosus* (A) and *C. perlatius* (B)

The preference of the 2 species was tested by providing the 6 types of feed simultaneously. There were no significant differences between the two species. The differences which

were observed were the feed preferences. Both species significantly consumed ($p > 0.05$) more apple, jicama, and corn (see figure 4).

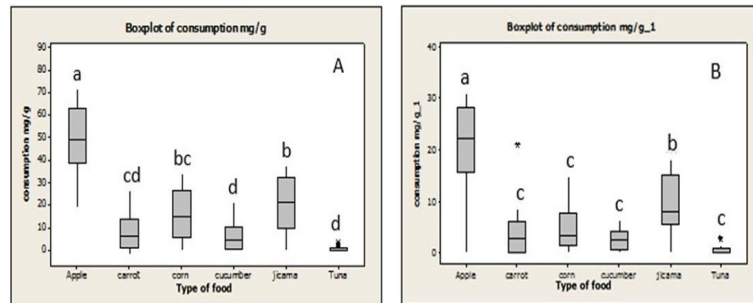


Fig. 4 . Consumption rate of non-sequenced feed and sequenced feed by *C. rugosus* (A) and *C. perlatius* (B)

From the four previous results, it was observed that the preferred feed was apple, corn, and jicama. These 3 types of feed were then used to evaluate the growth and survival rate of hermit crabs. The sequence of apple, jicama, and corn (AJC) resulted in the best growth rate until the 3rd week (see figure

5). The highest survival rate was also observed at that treatment (see table 1). For the treatment “All” (i.e., 3 types of feed were offered every day), the growth rate was high until the second week, but it decreased sharply on the 3rd week and the survival rate was also low.

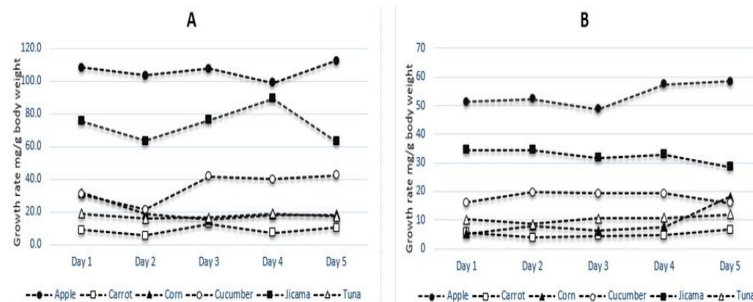


Fig. 5 . Growth rate of small *C. perlatius* according to feeding combination (... ● ... sequenced feed apple-corn, ... □ ... sequenced feed apple-jicama-corn, ... ▲ ... sequenced feed corn-jicama, ... ■ ... all feed)

TABLE 1
C. PERLATUS SURVIVAL RATE ACCORDING TO SEQUENCED FEED (AC: APPLE-CORN. ACJ: APPLE-CORN-JICAMA CJ:
 CORN-JICAMA, ALL: ALL FEED

AC	JC	ACJ	All
37.6% ± 1.7%	37.2% ± 3.7%	45.6% ± 3.5%	32.8% ± 1.8%

DISCUSSION

The consumption rate decreased from day to day when the feed was not refreshed and not varied. This result confirmed previous research which found that land hermit crabs are known to avoid the feed that has been previously consumed [6] and prefer fresh feed instead [7]. It also showed that although the rate of feed intake was reduced, the feed would still be consumed by hermit crabs until the 2nd day but when the feed was not renewed the hermit crabs would not eat the feed after the 2nd day.

When the feed was renewed, the consumption rate was relatively the same from day to day even though the feed was not varied. The only significant differences in consumption which were observed were the food type. Both species mostly consumed apple and jicama, followed by cucumber and corn. This fact showed that hermit crabs tend to consume feed containing high carbohydrate such as apples and jicama, but avoid high protein feed such as fish. This may be related to the results of previous research which revealed that hermit crabs have the enzymes N-acetyl- β -D-glucosaminidase, cellulase, endo- β -1,4-glucanase, hemicellulase, lichenase and laminarinase to digest carbohydrate from plants [11]. The carbohydrate content of apples is much higher (13.81 g/100 g and fiber 2.4 g/100 g) compared to tuna fish whose carbohydrate and fiber content is less than 1% [12]. Thus, the feeding habit of hermit crabs is similar to their relative, namely coconut crabs (*Birgus latro*), which do not like food with high protein content [13].

When the feed was renewed and varied (given in sequences), the consumption difference was only observed on jicama, apple and cucumber. This might have something to do with the water content. The three types of food (jicama, apple

and cucumber) contain more water compared to other types of food such as carrot, corn, etc. When the food preference was tested by giving the crabs 6 types of food simultaneously, both species consumed more apple, jicama, and corn. The consumption rate of these 3 types of food was high and the survival rate was high as well. However, the negative impact of non-varied feed was observed on the growth rate. The hermit crabs need to be forced to consume sequenced feed rather than letting them choosing their own favorite feed. When they choosing their feed freely, it seems that they do not obtain sufficient nutrients, which makes the growth rate decrease. Thus, the best feed for hermit crabs was a sequence consisting of apple, followed by jicama and corn.

CONCLUSION

The feeding habit and feed composition of *C. rugosus* and *C. perlatus* were not significantly different. Both species needed varied and fresh feed with low protein content. If one of these criteria was not available, the feed consumption rate would decrease, leading to lower growth and survival rate. For the favorite feed (apple and jicama), the decrease could reach 75% after two days when the feed was not renewed. The non-varied but fresh feed did not affect the survival rate. However, the negative impact of non-varied feed was observed on the growth rate. The best feed for hermit crabs was a sequence consisting of apple, followed by jicama and corn.

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REFERENCES

- [1] W. W. Burrgrren and B. R. McMahon, *Biology of the Land Crab*. New York, NY: Cambridge University Press, 1988.
- [2] A. Pavia, *Hermit Crab: Your Happy Healthy Pet*. Hoboken, NJ: Wiley-Blackwell, 2006.
- [3] D. R. Hahn, "Hermit crab shell use patterns: Response to previous shell experience and to water flow," *Journal of Experimental Marine Biology and Ecology*, vol. 228, no. 1, pp. 35-51, 1998.
- [4] P. Greenaway, "Terrestrial adaptations in the anomura (Crustacea: Decapoda)," *Memoirs of Museum Victoria*, vol. 60, no. 1, pp. 13-26, 2003.
- [5] R. A. Hutagalung, Josef and S. Mastrotillo, "Improving the survival rate of land hermit crabs through shell ecology," *Journal of Engineering and Applied Science*, 2016.

- [6] R. W. Thacker, "Avoidance of recently eaten foods by land hermit crabs, *Coenobita compressus*," *Animal Behaviour*, vol. 55, no. 2, pp. 485-496, 1998.
- [7] M. Debanks, *The Pet Owners Guide to Hermit Crabs: The Complete Guide to a Happy and Healthy Hermit Crab*. New York, NY: Matthew Debanks, 2012.
- [8] S. Fox, *Hermit Crabs: Everything about Anatomy, Ecology, Purchasing, Feeding, Housing, Behavior, and Illness*. New York, NY: Barron, 2010.
- [9] B. T. Lumeran, "Spatial Distribution of marine planktons off the Coast of Sitra, Kingdom of Bahrain," *International Journal of Applied and Physical Sciences*, vol. 2, no. 3, pp. 71-78, 2016.
- [10] S. M. Linton and P. Greenaway, "A review of feeding and nutrition of herbivorous land crabs: Adaptations to low quality plant diets," *Journal of Comparative Physiology B*, vol. 177, no. 3, pp. 269-286, 2007.
- [11] S. M. Linton, R. Saborowski, A. J. Shirley and J. A. Penny, "Digestive enzymes of two brachyuran and two anomuran land crabs from Christmas Island, Indian Ocean," *Journal of Comparative Physiology B*, vol. 184, no. 4, pp. 449-468, 2014.
- [12] United States Department of Agriculture (USDA). (2013). *Agricultural research service national nutrient database for standard reference release 28* [Online]. Available: <http://ndb.nal.usda.gov/ndb/foods>
- [13] J. E. Wilde, S. M. Linton and P. Greenaway, "Dietary assimilation and the digestive strategy of the omnivorous anomuran land crab *Birgus latro* (Coenobitidae)," *Journal of Comparative Physiology B*, vol. 174, no. 4, pp. 299-308, 2004.

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