

Conference Paper

MORFOMETRY STUDY OF HEMIPENIS BIAWAK AIR *Varanus salvator* ON LENGTH MEASUREMENT OF Snouth Vent Length (SVL) and BODY WEIGHT

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Abstract

Varanus salvator is a water reptile that has various kinds depends on the habitat. *Varanus salvator* has been hunted by people for hundreds or even thousands of years, therefore the populations decreased. People used *Varanus salvator* as a source of protein and as medicine for particular parts of the body. Informations about *Varanus salvator* reproductive anatomy was highly needed as the base of conservation. The objective of this research was to know the corelation of snouth vent length and body weight to the size of hemipenes. Forty male *Varanus salvator* in random sizes was measured in snouth vent length and body weight, then the measurement's result was analized and correlated with the size of hemipenes. The size of hemipenes was the length of hemipenes, the diameter of radix hemipenes, the diameter of corpus hemipenes and the diameter of glands hemipenes. The datas was processed using Anova test, Linear regression test, correlation test, and double correlation test. The result showed that body weight and snouth vent length correlated to the size of hemipenes because the value of correlation test showed $\rho > 0,5$. Based on double correlation test, the result showed that snouth vent lengt was more correlated to the size of hemipenes. The value of double correlation test showed $z < 1,96$.

Keywords: *Snouth vent length*, Hemipenis, *Varanus salvator*.

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1. INTRODUCTION

Biawak isa water reptile that has various kinds depends of their habitat. Biawak has been hunted by people for hundreds and even thousands of years. The trading of

Biawak has supported thousands of lives. One million pieces of Biawak's skins were collected from every part of the world each year (Shine *et al.*, 1998)

European Union, specifically Germany ranked first on exotic reptile consumption in the world. Biawak is one of the species of monitor lizards in Indonesia. Biawak is the second biggest monitor lizard in the world with the length of snout vent length more than one meter. *Snouth Vent Length* is the length that is measured from the snout to cloaca (Koch *et al.*, 2007). The total length of the body is 2,5 meters with bodyweight 20 kg (Shine *et al.*, 1996).

The abundant kind of Biawak in Java island was *Varanus salvator bivittatus*. People used body parts of Biawak such as the gall blader and hemipenis because they are believed to have particular effects on people. People used biawak's skin as jewellery and biawak's meat as traditional medicine (Putra *et al.*, 2008).

Biawak's meat was stated to be the medicine of common skin's disease to extreme skins disease and there was a statemen that said Biawak's meat is a source of protein. (Uyeda *et al.*, 2014) stated that biawak's meat is rarely used in Indonesia, and biawak's meat is used for three major ethnic group (Batak in Sumatera, Dayak in Kalimantan, and Minahasa in Sulawesi) as the people who consumed Biawak. *Varanus salvator* is rarely consumed in a region with the majority of moslem residents because it is haram (Nijman, 2015).

In the development of reproductive organs, there would be a functional development and addition in the size of primary reproductive organs or secondary reproductive organs. Started with testis which is a primary reproductive organ to hemipenis which is a secondary reproductive organ. *Varanus salvator* reached mature stage reproductively eventhough the length of the body is still short, with the SVL length of 40 centimeters, that is characterized with bigger testis and the deposit of sperm in ductus defferens (Shine *et al.*, 1996).

Hemipenis of *Varanus salvator* is located in the caudal part of cloaca which is in the tail to be precise. The number of hemipenis in *Varanus salvator* is two that comes out from the two holes in cloaca that is located at the beginning of the tail. Because of that male Biawak and female Biawak looks different when they are compared. Hemipenis is a sexual organ in *Varanus salvator*, it is also present in other squamata such as snakes and lizards. Every hemipenis is curved to accomodate the transportation of sperm (Kardong, 2008). The component of sexual organs in Biawak is not majorly different with the other reptiles, male reproductive system is composed of a pair of testis, reproductive tracts, and accessory glands (Eroschenko, 2008).

The status of *Varanus salvator* in Indonesia is mentioned in Keputusan Menteri Kehutanan dan Perkebunan Nomor: 461/Kpts-II/1999 about the arrangement of hunting season of hunting commodities and hunting area, *Varanus salvator* was not listed in the list of protected species. International Union for Conservation of Nature (IUCN) listed *Varanus salvator* in the category of least concerned (LC) which means it has low risk of extinction (Bennet *et al.*, 2010). Convention of International Trade in Endangered Species (CITES) of Wild Fauna and Flora, *Varanus salvator* is listed in Appendix II, that has low risk of extinction but if it wasn't given enough attention, this species is concerned to be extinct especially if it is being uncontrollably hunted and traded (CITES, 2016).

Researches in Biawak, especially in its male reproductive anatomical aspect is rare. There were a lot of researches regarding Biawak, but it is concentrated in ecology only (De Lisle, 2007).

Based on the backgrounds stated above, this research is aimed to study the correlation between snout vent length and body weight to the length of hemipenis in *Varanus salvator*.

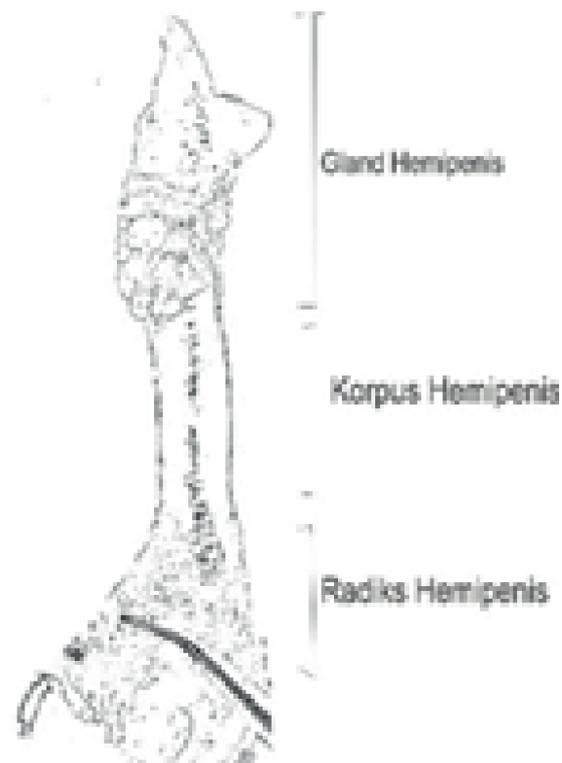
The result of this result is hoped to be the additional knowledge about reproductive anatomy of *Varanus salvator*, that can be served as reference to update the reproductive technology of exotic reptiles, especially *Varanus salvator* reproduction. This research is hoped to serve as the base of further research and reference for local government to arrange the pacts and constitution about the exploitation.

2. MATERIALS AND METHODS

This research used 40 biawak that is obtained from local biawak's slaughter house in the village of Pagerwojo, Sidoarjo. The biawak is a wild-caught biawak in the area of Sidoarjo.

The measurement of Snout vent length, bodyweight, and number tagging on the biawak took place before the slaughter. After the slaughter, the male reproductive organs is extracted. The extraction started with tectis to hemipenis and the accessory organs. After the extraction, the hemipenis was being measured. After the measurement the testes and hemipenes is stored in atube of preservement solution for future research.

The measurement of hemipenis is done after hemipenis was extracted from the biawak's body. The measurement of the length and the diameter of hemipenis began from the beginning of hemipenis (the end of the beginning of hemipenis and retractor muscle is characterized by tghe alteration of colors) to the tip of hemipenis using



Picture 1: Parts of Hemipenis.

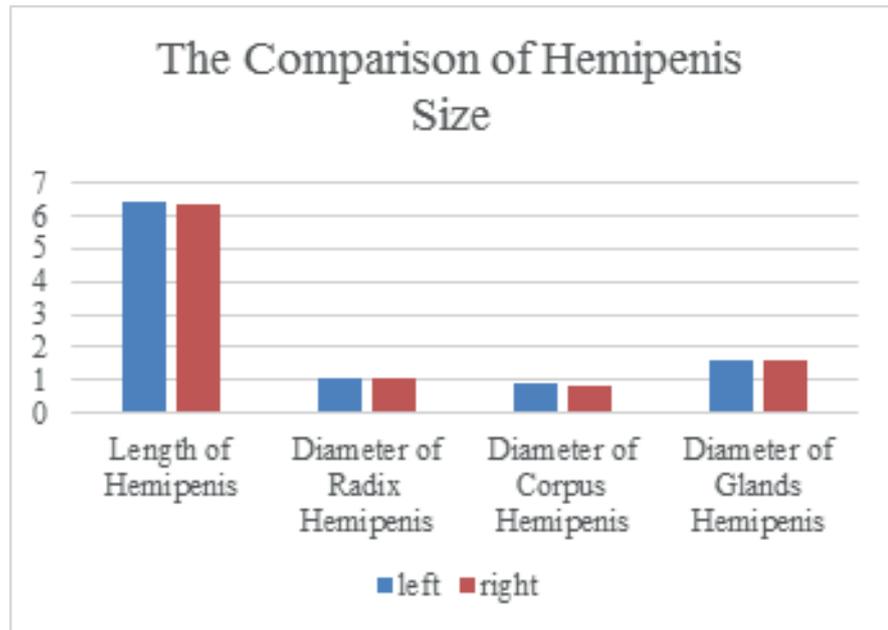
sliding caliper. The measurement of diameter was done in three points which is radiz penis, corpus penis, and glands penis. The measurement is done on both hemipenes of biawak that has a pair of hemipenis (Kardong, 2008). The data obtained from this research was analyzed descriptively using T test to determine wether there is a difference between the size of left and right hemipenis. The data was processed with SPSS which is then tested by Linear Regression Test and Correlation Test. If the result ($p > 0.5$) then it means the data was correlated.

3. RESULT

Based on the result of T test, it is known that the size of hemipenis in *Varanus salvator* is the same in left and right side.

The left and right hemipenis have no significant difference in the length of hemipenis, diameter of radix penis, corpus penis, and glands penis., dan Gland hemipenis.

The data obtained was analayzed nest with correlation tesr to know the correlation between SVL length and bodyweight to the size of hemipenis. The correlation test result showed that bodyweight and SVL length correlated to the size of hemipenis.



Picture 2: Comparison Graphic of Right and Left Hemipenis Size.

TABLE 1: Mean and Standard deviation of Weight.

		Mean (\bar{x})	Std.Deviation (SD)
Bodyweight(kg)		2,3509	1,16949
SVL (cm)		49,2625	7,32399
Length of hemipenis (cm)	Right	6,3332	1,83915
	Left	6,3994	1,88530
Diameter corpus hemipenis (cm)	Right	0,8546	0,28647
	Left	0,8914	0,32472
Diamater gland hemipenis (cm)	Right	1,6354	0,53813
	Left	1,5738	0,49492
Diameter radix hemipenis (cm)	Right	1,0995	0,32422
	Left	1,1000	0,30764

The value of correlation test was $>0,5$. If the value of correlation test was close to zero or $p < 0,5$, it can be concluded as the two variables has no correlation.

If the value of correlation test was closer to one or $>0,5$, it can be concluded that the two variables was correlated, the closer to one, the stronger the correlation between the two variables. Bodyweight correlated as much as 0,687 to the length of right hemipenis and as much as 0,652 to the left hemipenis. SVL correlated to the right hemipenis as much as 0,75 and 0,768 to the left hemipenis. Bodyweight correlated to the diamerer of Biawak’s hemipenis. Bodyweight and the diameter of right radix

hemipenis correlated as much as 0,614 and 0,631 with the left radix hemipenis. Body weight correlated to the right corpus hemipenis as much as 0,757 and 0,636 in the left corpus hemipenis. Body weight correlated to the diameter of glands hemipenis as much as 0,593 in the right corpus hemipenis and 0,540 to the left glands hemipenis.

Varanus salvator SVL correlated to the diameter of hemipenis. The average correlation test value of SVL to the diameter of hemipenis showed is >0,5. Hence, it can be concluded that SVL correlated to the size of hemipenis. SVL correlated to the diameter of right radix hemipenis for as much as 0,757 and the left radix hemipenis for as much as 0,729. SVL correlated to the right corpus hemipenis for as much as 0,757 and the left corpus hemipenis for as much as 0,671. SVL correlated to the right gland hemipenis for as much as 0,671 and the left gland hemipenis for as much as 0,629. The correlation test result between body weight and the size of hemipenis showed a significant result that body weight and SVL have a strong correlation to the size of hemipenis on Biawak air *Varanus salvator*. The length of hemipenis, the diameter of radix hemipenis, corpus hemipenis, and glands hemipenis are correlated.

Body weight and SVL according to the result of correlation test showed that both have correlation to the size of hemipenis, To determine which variable that has greater effect on hemipenis, a double correlation test was done. If the result was >1,96 then r_1 have greater effect to the size of hemipenis, this can be formulated as a double correlation formula as follows:

$$z = \frac{r_1' - r_2'}{\sqrt{\frac{1}{n_1-3} + \frac{1}{n_2-3}}}$$

Variables:

z : The value of double correlation test

r_1' : The value of correlation test to SVL

r_2' : The value of correlation test to body weight

n_1 : The number of sample

n_2 : The number of sample

Based on the result of double correlation test, the value z was <1,96 which means SVL have greater effect on the size of hemipenis. T test showed that the right and left hemipenis have no significant difference. Therefore, the linear regression test was done by regressing the average of right and left hemipenis size with body weight and/or SVL.

The data obtained from the measurement was later processed by a linear regression test which can be formulated as follows :

TABLE 2: The value of double correlation test between SVL and body weight.

	P_HP_	R_HP_	K_HP_	G_HP_	P_HP_	R_HP_	K_HP_	G_HP_
	right	right	right	right	left	left	left	left
Body weight	0,687	0,614	0,757	0,593	0,652	0,631	0,636	0,54
SVL	0,75	0,685	0,757	0,631	0,768	0,729	0,671	0,629
Z	0,00241	0,00271	0	0,00145	0,00443	0,00375	0,00134	0,0034

Index: P_HP: Length of hemipenis, R_P : Radix Hemipenis, K_HP: Corpus Hemipenis, G_HP: Gland Hemipenis (Radix hemipenis, corpus hemipenis and gland hemipenis was measured on the diameter), z: The value of double correlation test.

TABLE 3: Linear regression equation.

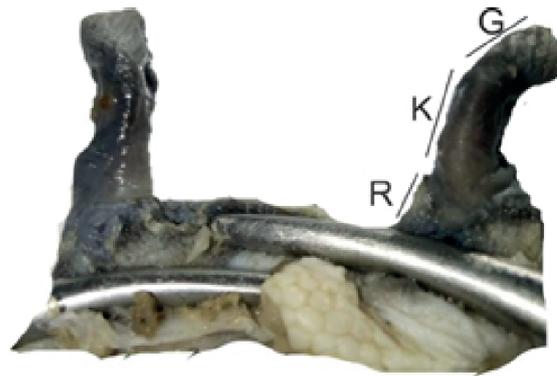
Linear Regression	Equation
Body weight to the Length of Hemipenis	$3,860 + 1,066(\text{body weight})$
SVL to the Length of Hemipenis	$-3,141 + 0,193(\text{SVL})$
Body weight to the diameter of Radix Hemipenis	$0,705 + 0,168(\text{body weight})$
SVL to the Diameter of Radix Hemipenis	$-0,401 + 0,030(\text{SVL})$
Body weight to the diameter of Corpus Hemipenis	$0,461 + 0,175(\text{body weight})$
SVL to the diameter of Corpus Hemipenis	$-0,543 + 0,029(\text{SVL})$
Body weight to the diameter of Gland Hemipenis	$1,015 + 0,251(\text{body weight})$
SVL to the Diameter Glands Hemipenis	$= -0,585 + 0,044(\text{SVL})$

Based on the data of equation above, the size of hemipenis *Varanus salvator* can be known by entering body weight and/or SVL to the equation in table no. 3.

4. DISCUSSION

Based on the research result, it was known that the size of hemipenis always grows in size following the growth of SVL and body weight. The morphology of gland penis also develops following the body development. Based on the research result it is known that the size of right and left hemipenis was the same. In general, hemipenis of *V. salvator* was almost the same as the hemipenis of other squamatas, on each hemipenis there is an erection hole on the tip of hemipenis that have a cortical protrusion that has a tongue shape and retractor muscle on each hemipenis (Mahfud at al., 2014).

According to Mahfud (2014) the size of testis of *V. salvator* will get bigger following the size of the body. The addition of body weight in *V. salvator* will always be followed by the addition of body length, specifically SVL. The size of *V. salvator* body that affect the testis as a primary reproductive organ i male *V. salvator* would also affect the size



Picture 3: Hemipenis of *V. salvator* with SVL 36 cm and body weight 0,66 kg. Index : G: Gland hemipenis, K: Corpus hemipenis, R: Radix hemipenis.

of the secondary reproductive organ. On hemipenis, the accessory glands and ducts will also develop following the size of the body. The size of hemipenis on *V. salvator* that developed following the development of the body is predicted to be the effect of testosterone hormone on male *V. Salvator* that also developed. Testosterone has several roles including the regulation and development of secondary sexual characteristics, the urge to copulate, and maintaining the genital tracts and accessory glands (Kardong, 2008).

The morphological structure of glands hemipenis in *Varanus salvator* is a flower-like jagged part that functions as a hook in the vagina in a copulation process. Hemipenis is covered by a stratified squamous epithelial tissue that has protruding parts in the cranial tip. In some snakes, the tip of hemipenis has a rough jagged or thorny structure in order to prolong the mating process for fertilization (Kardong, 2008; MNH, 2009; Porto, 2013).

Hemipenis on biawak that has SVL of 36 cm showed a structure in glands hemipenis that is still a line structure hence the number of jagged structures can not be known. The distance between one jagged structure to another was still extremely close making it near impossible to be measured. The cartilage structure on the tip of hemipenis also had not developed.

Hemipenis on biawak that had SVL 39 cm showed the structure of jagged parts on glands hemipenis/ The jagged structure had already started to form and can be counted. There were 6 rows of jagged structure. On the countable jagged structure it had a clear distance that can be easily counted. While the jagged structure that had not completely formed, the distance was still extremely close making it impossible to count. The cartilage structure on the tip of hemipenis had already started to form.

Hemipenis on biawak that has SVL of 58 cm showed a fully developed structure of gland hemipenis. The jagged structure on glands hemipenis had been developed



Picture 4: Hemipenis on *V. salvator* with SVL 39 cm and body weight 0,92 kg. Index : G: Gland hemipenis, K: Corpus hemipenis, R: Radix hemipenis.



Picture 5: Hemipenis on *V. salvator* with SVL 58 cm and body weight 3,6 kg. Index : G: Gland hemipenis, K: Corpus hemipenis, R: Radix hemipenis.

perfectly, there were 12 rows of jagged structures. The distance between each jagged structures was clear and there were no more lines at the end of hemipenis, every line had developed into a complete jagged structure. The cartilage structure had developed perfectly and measured as big as the nail of human's pinky finger.

The jagged structures at the tip of hemipenis alterates following the development of the body. Male *Varanus salvator* that had not reached sexual mature stage with SVL of 36 cm and 39 cm according to the result of this research showed an incomplete development of jagged structures. The jagged structures was still in the form of lines that had no real forms yet. The male *Varanus alvator* that had reached sexual

mature stage with SVL of 40 cm the jagged structures had started to form though still incomplete. The hemipenis sample of male *Varanus salvator* that had SVL of 58 cm showed a fully developed jagged structure and it was predicted to function well in copulation.

At the tip of *Varanus salvator* hemipenis, there was a structure that was almost the same as the structure in snake's hemipenis. At the tip of the hemipenis there was a protruding structure that resembled a thorn and had a cartilage structure (cartilaginous). The structure had a cone form and it was sited around a fibrous connective tissue (Karim, 1998). The cartilage structure at the tip of hemipenis developed following the development of male *Varanus salvator* body. The protrusion of cartilage was started to be seen on a sexually matured biawak and continue to develop following the size of the body.

5. CONCLUSION

based on the result and the discussion of this research, the conclusion that can be obtained was SVL and body weight correlated to the size of hemipenis *Varanus salvator*, specifically it correlated to the length of hemipenis, the diameter of radix hemipenis, the diameter of corpus hemipenis, and the diameter of gland hemipenis. Based on the T test result, hemipenis had a same size on the right and left side. SVL and body weight based on the result of double correlation test showed that SVL stronger correlation to the size of hemipenis.

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