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Effects of Altitude, Temperature, and Humidity on Abundance and Diversity of Insects Causing Skin Defect in Cattle in North Sulawesi

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Abstract: *This study aims to examine whether there are effects of altitude, humidity, and temperature on the diversity and abundance of some species of flies causing skin defect in cattle according to altitude, temperature, and humidity in North Sulawesi. This study was conducted in the centres of cattle in Minahasa Regency such as Kawangkoan, Tompaso (high altitude area), South Minahasa Regency such as Tengah, Poigar (lowland area). Identification of flies species was carried out according to the difference in temperature and humidity at three different locations according to altitude (suspected to be different in temperature and humidity). From the research results, it is concluded that the lowest abundance of insect causing defect in cattle is generated in the high humidity level (60.8-65.4). The lowest diversity of insect causing defects in cattle is generated in the low altitude (0-300 MASL) with the medium temperature (28.7-30.8 C).*
Keywords*: Insects causing defect in cattle, ANOVA, Abundance, Diversity, Temperature*

I. Introduction

In general, the cattle growing system in cattle areas in North Sulawesi, such as in South Minahasa Regency (Tengah and Sinonsayang) and Minahasa Regency (Kawangkoan, Tompaso and Langowan), is performed by grazing at about 7:00 AM to 05:00 PM in dry fields or under coconut trees, both during the wet season and dry season. Patterns of cattle grazing as practiced by farmers pay less attention to animal health, especially the health of body.

The health of grazed cattle have less attention and it frequently causes reaction in which the cattle scratch their body on hard objects, and at that time there is irritation in the skin of cattle. Overtime, this irritation causes wound so that it becomes a defect in the skin of cattle.

This skin defect can be also caused by several causes, among others; scratches on skin that occur due to the cattle activities which cause the cattle get injured, defects caused by blows, lashes, or any other mechanical causes occurring to cattle 's body in living conditions. Then the defects caused by insects (hypodermal flies) causing small perforated skin (antemortem).

Efforts against disturbance of flies that attack livestock (cattle) either directly by sucking their blood, or indirectly as transmitting various types of diseases or as a disturber by "attaching" on cattle so they disturb cattle physically and psychologically, have been implemented in various ways. Cattle environment and various facilities related to the lives of cattle, in fact, are widely utilized by flies as resting places habitat and looking for feed. Various types of flies live or exist at cattle environment, in which the presence can be a disturbance or even a danger to cattle as ectoparasites, from the order of *Diptera*, especially *Culicidae family* (fly) like a stable fly (*Stomoxys calcitrans*) and buffalo gnat (*Haematobia exigua*).

Flies as ectoparasites of cattle in Indonesia have become a priority response, although there is still a shortage of basic information such as the list of species that cause the existing skin defects in cattle, including the geographic, biology and ecology distribution. Koningsberger (1903), who first revealed the infestation of flies in cattle in Indonesia, reports the findings of *Tabanus Ruficantris, Chrysops dispar, Stomoxys calcitrans* and *Haematobis exigua sp* flies, although it is not explained the locations of each type of the fly. Partoutomo et al, (1981), report kinds of fly in cattle in North Sulawesi, they are *Haematobia irritans exigua, Sarcophagi sp., Musca conducens* and *Stomoxys calcitrans.*

The family of flies which infest cattle such as *Muscidae, Calliporidae, Tabanidae, and Hippoboscidae and Stomoxys calcitrans* stable fly (*Muscidae*), both males and females are blood-eaters, and they do it twice a day. *Haematobia irrtans exigua* (*Muscidae*) known as buffalo gnat exists in India, Malaysia, China, Indonesia, Philippine and United States (Soulsby, 1982). For blood-sucking female and male flies, the main host is buffalo, cattle and horses. The level of diversity and abundance of flies depend on the season, rainfall, humidity. The condition is much dependent on the altitude of cattle centre areas.

According Kettle (1977), it is estimated that cattle can tolerate buffalo gnat (cattle, horses) to 100-300 head, without any adverse effects. 500-1000 or even 5000 flies can be detected in single cattle and this provides impacts on both the weight loss of cattle and the quality of the skin, with injuries in the cattle. According to

Herms and James (1961), it is estimated that 100-300 flies in single cattle can still be tolerated without adverse effects, but 500 flies will significantly provide impacts on the health of cattle. The diversity and abundance of flies in cattle according to geography of area (altitude) of cattle centre can be identified after the arrests.

The diversity and abundance of flies which infest cattle according to geography of area (altitude) of cattle centre can be identified after the arrests. Based on the background of the problem, then the research objectives are formulated as follows: To determine the diversity and abundance of some species of flies causing the skin defect in cattle according to altitude, temperature, and humidity in North Sulawesi.

II. Literature Review

Skin is the largest organ of the body that covers the entire surface of the body and has several important functions; the magnitude is ± 10-12 % of the body.

Skin defect (defect) will affect the quality of skin that will be generated. There is a damage resulting in skin defect, so that it lowers the quality. This damage can be caused by other blood sucking insects.

The infestations of blood-sucking flies in large quantities can cause irritation and itchiness causing restless cattle, not enough time to rest, can damage the skin and body tissues, resulting in the loss of weight and cattle working power as well as the decline in the production of meat and milk (Sigit *et al*, 1983). Flies alight on cattle, especially on areas of shoulder and side of the body, but there is also the damage of skin in the area of neck and back. According Kettle (1977), it is estimated that single cattle can tolerate flies up to 100-300 heads, without any adverse effects.

Each skin of fresh slaughtered animal as the results of skinning has natural properties that differ from one another. The factors that cause these include: cutting age factor, heredity, environmental factors and growing or management factor.

Stable fly, *Stomoxys calcitrans* (Muscidae) both females and males are eating blood. Egg stage lasts for 23 days, 7 days of larval stage, 5 days of pupa stage and the life of adult flies is two days to three weeks (Kettle, 1977). The larvae prefer animal waste materials that have been mixed with straw, hay, grains and decaying leaves. The pupating occurs in the dried dung in the cage. This fly resembles house flies, but the ventral part of the abdomen is clearly illustrated by chessboard pattern becoming its distinctiveness. The female fly only requires one time copulation during her life. The copulation usually occurs when the females are two to three days. After that, the female flies still require several meals (blood) before laying the first egg. One female can produce more than 1000 eggs during her lifetime.

Haematobia irritans exigua (Muscidae) is known as buffalo gnat, located in the areas of India, Malaysia, China, Indonesia, the Philippine and USA, while *Haematobia irritans* is also known as horn fly. Both of the male and female flies are blood sucking. The main hosts are buffalo, cattle and horses. This fly is half the size of stable fly with a shorter proboscis. Female flies lay eggs on the fresh dung and hatch into larvae after 17-22 hours. Larval development takes two to three days to become pupae and to become mature takes five to seven days (Williams *et al*, 1985). Strong winds, humid air and low temperature conditions are not favoured and thus they lead to a reduction in population rapidly. This fly has a desire to fly in finding appropriate host than to wait the host comes by itself. When it is away from the host, this fly cannot live more than a day, as well as the flies recently from pupae will die within an hour if they do not find a host. The spread of the fly depends on the spread of cattle. The fly population depends on the season. Rainfall and humidity greatly affect it. This fly is easily recognizable, while eating or resting, it perch on cattle body, the glazed wings are directed upwards perpendicular to its body. The fly will always remain in the body of the host while it not disturbed.

Sorbens Musca (Muscidae) is often found around the trash can, cattle shed, animal or human waste. These fly is frequently called as market fly or eye fly. This fly likes to eat pus from wounds and ulcers. These flies can smell the pus from far away. First, this fly will scratch the skin surface of the animal till injured and produces blood serum and then the fly licks it. The larvae breed in dung of various animals and humans, as well as on other appropriate media. (Greenberg, 1971).

III. Research Methods

This study was conducted in the centres of cattle in Minahasa Regency, particularly in Kawangkoan, Tompaso (high altitude area), South Minahasa Regency, particularly in Tengah, Poigar (lowland area). Identification of fly species was conducted according to the difference in temperature and humidity at three different locations according to altitude (suspected to be different in temperature and humidity).

The research hypothesis to be tested was whether there were differences in the abundance and diversity of insects causing defect in cattle generated in each altitude, humidity and temperature.

The analytical instrument used was ANOVA along with Tukey test (Yitnosumarto, 1993). ANOVA or Analysis of Variance, and commonly known as the F-test was used to test a comparison of the value of the various groups (or treatment). ANOVA is equivalent to a completely randomized design (CRD) (Yitnosumarto, 1993).

The procedure used in the analysis of this variant was One Way ANOVA procedure or often referred to as a factor design, which was one of the instruments of statistical analysis of ANOVA that had one-way (one path) characteristic. This test instrument was to test whether two or more populations that were predictors had mean that was considered equal or not equal. ANOVA technique was to examine the variability of the observations of each group and the variability among group means.

IV. Results And Discussion

4.1. Testing of ANOVA Assumptions

Prior to the ANOVA testing, it was conducted testing on the fulfilment of assumptions, i.e. normality of data and homogeneity of variance. The assumption of normality used Kolmogorov-Smirnov Test, the data was said to be normal if the value of Sig KS was > 0.05. The assumption of homogeneity used Levene's test, the data was said to have a homogeneous diversity if the value of Sig Levene was > 0.05.

Table 1: Testing of Homogeneity and Normality Assumptions

Data	Normality Assumption	Homogeneity Assumption
Abundance	0.501	0.388
Diversity	0.068	0.412

Table 1 showed the value of Kolmogorov-Smirnov Test > 0.05, which indicated that the data used in this study were normally distributed. It was also showed that the value of Sig Levene 's Test was > 0:05, which indicated that the variance homogeneity assumption was fulfilled. Thus, homogeneity and normality assumptions underlying ANOVA were met.

4.2. Results of ANOVA analysis

The following results presented the testing of diversity and abundance differences of insects causing defect in cattle in various altitudes, humidity, and temperature. The analytical instrument used was Analysis of Variance (ANOVA). The effects of altitude and season were significant if the value of Sig F was > 0.05 (5 % error rate). From Table 2, it was showed the testing of altitude difference, indicating the significant differences in the diversity of insects causing defect in cattle, because the value of Sig F was < 0.05. In humidity testing, it could be seen that there was significant difference in the abundance of insects causing defect in cattle. In temperature testing, it was seen that there was difference in diversity of insects causing defect in cattle

Table 2: Results of ANOVA Analysis

Data	Value of Sig F		
	Altitude	Humidity	Temperature
Abundance	0.239	0.045*	0.126
Diversity	0.0019	0.052	0.038*

* Significant at 5 % error rate

4.2.1. Abundance of Insects Causing Skin Defect in Cattle

In the testing of altitude difference, it was obtained F value equal to 1.458, and Sig F equal to 0.239. Because the value of Sig F was > 0.05, it indicated that there was no difference in the Abundance of Insects causing defect in cattle that was significant in three types of altitude (low of 0-300 MASL, medium of 300-500 MASL, and high of 500-700 MASL). This suggested that the abundance of insects causing defect in cattle in three types of altitude was same.

In the testing of humidity difference, the value of F was equal to 3.208 with Sig F equal to 0.045 < 0.05. It could be concluded that there was difference of defect in cattle that was significant in three humidity (low of 51.3-56.0, medium of 56.1-60.7, and high of 60.8-65.4). To have deeper information, it was conducted advanced testing (post hoc) with Tukey analysis. The results of Tukey test results showed that high humidity had the smallest Abundance of Insects causing defect in cattle, that was 114.17 and was on subset 1 similar to low humidity, but it was different compared to medium humidity. On the other hand, the medium humidity had the biggest Abundance of Insects causing defect in cattle, that was 132.03, which was on the same subset with low humidity (subset 2). Cattle in high humidity level would result in the smallest Abundance of Insects causing defect in cattle compared to medium humidity.

In the testing of temperature difference, the value of F was equal to 2.126 with Sig F equal to 0126. The value of Sig F was > 0.05 indicated that there was no difference in Abundance of Insects causing defect in cattle that was significant in three temperature (low of 26.3-28.6 C, medium of 28.7-30.8 C and high of 30.9-

33.1 C). This suggested that the Abundance of Insects causing defect in cattle in three types of temperatures was same.

It could be concluded that the lowest abundance of insects causing defect in cattle was produced in high humidity levels (60.8-65.4).

4.2.2. Diversity of Insects Causing Skin Defect in Cattle

In the testing of altitude difference, it was obtained the value of F equal to 7.241, and Sig F equal to 0.001. Because the value of Sig F was > 0.05, it indicated that the difference in the Diversity of Insects causing defect in cattle was significant in three types of altitude (low of 0 -300 MASL, medium of 300-500 MASL, and high of 500-700 MASL). To find out more, it was conducted advanced testing (post hoc) with Tukey analysis. The results of Tukey test showed that low altitude had the smallest Diversity of Insects causing defect in cattle, that was 3.30 and was on the subset 1 similar with high altitude, but it was different compared to medium altitude. On the other hand, the medium altitude had the biggest Diversity of Insects causing defect in cattle, that was 3.83, which was in the same subset with medium altitude (subset 2). Cattle that were in low altitude level would result in the smallest Diversity of Insects causing defect in cattle compared to medium altitude.

In the testing of humidity difference, the F value was equal to 3.075 with the Sig F equal to 0.052 > 0.05. It could be concluded that there was no significant difference of defect in cattle in three humidity (low of 51.3-56.0, medium of 56.1-60.7, and high of 60.8-65.4,). This suggested that the Diversity of Insects causing defect in cattle in types of humidity was same.

In the testing of temperature difference, the value of F was equal to 3.407 with the Sig F equal to 0.038. The Sig F value < 0.05 stated that there was difference in the Diversity of Insects causing defect in cattle that was significant in three temperatures (low of 26.3-28.6 C, medium of 28.7-30.8 C and high of 30.9-33.1 C. To find out more, it was conducted advanced testing (post hoc) with Tukey analysis. The results of Tukey test showed that the medium temperature had the smallest Diversity of Insects causing defect in cattle, that was 3.43, and was in subset 1 that was similar with high temperatures but it was different compared to low temperature. On the other hand, the low temperature had the biggest Diversity of Insects causing defect in cattle, that was 3.70, which was in the same subset with high temperature (subset 2). Cattle that were in medium temperature levels would result in the smallest Diversity of Insects causing defect.

It could be concluded that the smallest Diversity of Insects causing defect in cattle was generated in low altitude (0-300 MASL) with medium temperature (28.7-30.8 C).

V. Conclusion

From the results of testing above, there are some conclusions as follows: the lowest Abundance of Insects causing defect in cattle is generated in high humidity levels (60.8-65.4). The lowest Diversity of Insects causing defect in cattle is generated in low altitude (0-300 MASL) with medium temperature (28.7-30.8 C).

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