

# Spread And Environmental Impact To Presence Of Sulawesi's Endemic Butterfly *Graphium Androcles Boisduval* (Lepidoptera : Papilionidae) In Bantimurung-Bulusaraung National Park

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**Abstract:** Swallow Tail butterfly (*Graphium androcles Boisduval*) is the one of endemic butterfly from Bantimurung-Bulusaraung National Park, South Sulawesi. Currently, *G. androcles* very difficult to find in their natural habitat. The purpose of research is to study spread and environmental impact to presence of *G. androcles*. The research was conducted in April 2014 to March 2015 on two areas : Bantimurung and Pattunuang. Our observation was used Cruise Methods and data analysis with descriptive methods. The result was showed total number of butterfly about 57 individuals divided into: Bantimurung (12 individuals) and Pattunuang (45 individuals). Based on Pearson's analysis, temperature ( $r = 0.716$   $p=0.009$ ) and rainfall periods ( $r=0.676$ ,  $p=0.016$ ) has strong correlation with presence of *G. androcles*. On the other hand, no correlation with humidity ( $r=-0.888$ ,  $p=0.786$ ) and light intensity ( $r=0.172$ ,  $p=0.593$ ) in the presence of butterfly. We find more *G. androcles* in the beginning of dry season (end of Juni until November 2014) on the river area and open field. Commonly the activity of butterfly was started 11.00 until 14.00 am. The range of temperature, light intensity and humidity is 29 – 31°C, 45 -1.735 and 55 – 70%, respectively. Our conclusion is *G. androcles* activity as the behavioral response to adapted in their environment.

**Keywords:** *G. androcles*, butterfly, endemic, environment, Sulawesi, temperature, humidity

## 1 INTRODUCTION

Sulawesi is the one of islands in Indonesia has a high diversity of endemic butterflies. About 557 butterflies species have been discovered surrounding the island of Sulawesi, then 353 species were found in South Sulawesi (Vane-Wright and de Jong, 2003) [34]. *Graphium androcles Boisduval* is one of Sulawesi endemic butterflies can be found around the Bantimurung-Bulusaraung National Park (BBNP) South Sulawesi Province (Durden, 2010) [11]. The English naturalist, Alfred Russell Wallace, have been done his research in the area around BBNP in the periods 1856 to 1857. He find thousand of colorful butterflies illustrated form clouds. Also Alfred Russel Wallace find *G. androcles* and various types of butterflies, whose wings measuring 7-8 inches (17-20 cm). In 1882, *G. androcles* no longer to be found in their habitat. He were suspected the presence of butterflies influence of the season, because 45 years later *G. androcles* could be recovered (Whitten et al., 1987) [33]. The current status of *G. androcles* an endangered species and rarely found in other areas (Mastricht and Rosariyanto, 2005) [19]. *G. androcles* as the members of Papilionids with characteristic white long tail.

The wings colour dominated black and white (Whitten et al., 1987 and Gillot, 2005) [33, 14]. The beautiful wings colour of Papilionids make few people taking butterflies from the wild. Butterfly trades enhancing wild hunting by people as a dry collection (Coote, 2000) [8]. This activities can be particularly damaging to island endemics, as uncontrolled collecting can lead to their extinction (Primack et al., 1998) [24]. The morphology of *G. androcles* was shown in Figure 1.



**Figure 1.** Swallow Tail Butterfly (*Graphium androcles Boisduval*)

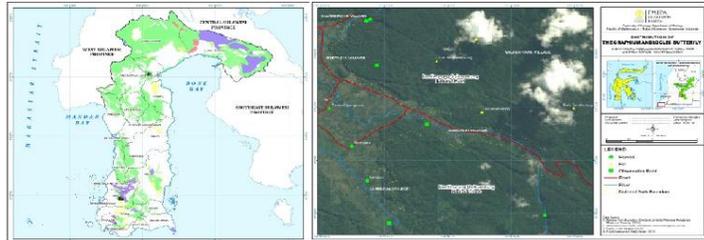
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Based on the number of butterflies identification in Sulawesi, many unidentified species for biocology and their habit. In Indonesia, especially in South Sulawesi has never done research on the distribution and environmental condition that support of *G. androcles* survival. We hope the result of research is expected to provide information and contribute preservation effort of *G. androcles* in South Sulawesi.

## 2 METHODOLOGY

### 2.1 Preparing Research Areas

The study was conducted in the area around BBNP. The research areas divided into two : Bantimurung, as tourism areas and Pattunuang. Location of research and spread of *G. androcles* in research areas was shown in Figure 2.



**Figure 2.** Research areas and spread of *G. androcles* in Bantimurung-Bulusaraung National Park (BBNP) South Sulawesi

### 2.2 Butterfly observation

The study was conducted in April 2014 to March 2015. Observation of *G. androcles* was done twice a week in each area of research using Cruise's methods. The determine location of observed butterflies by purposive sampling (Palys, 2008) using GPS (Global Positioning System). The area was selected based on habitat of *G. androcles*. In the first place, we put some baits such as urine, soapy water, rotten shrimp and dead butterflies to attract *G. androcles* (Boonvanno et al., 2000). Observation time starts at 09.00 to 12.00 am and continue at 13.00 to 15.00 pm. Our observation depend to climate or local weather conditions. The observation we done when sunny day and delay when rainy day. The catching of butterfly using insect net. To avoid double catching of butterfly, we have been marked butterfly wings using nail polish, then released back to the nature. In the same time, we measure of temperature, humidity and light intensity. The monthly data of rainfall periods, we have got from Meteorological and Geophysics Office Maros District, South Sulawesi. Data analysis using individual descriptive.

### 2.3 Data Analysis

The number of *G. androcles* and their relation to environmental were analyzed using Pearson correlation and significance value with SPSS version 16.0.

### 2.5. Data Analysis

Data analysis of pest insects population, we were used SPSS at Analysis of Variance (ANOVA) with DMRT level 95% ( $\alpha = 0,05$ ).

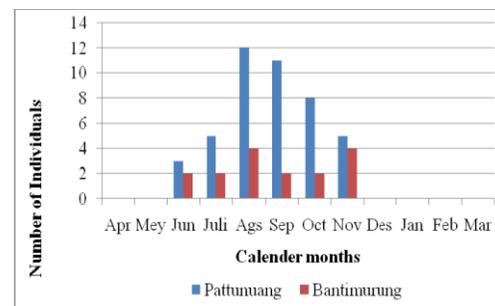
## 3 RESULT AND DISCUSSION

BBNP region is the one of habitat butterflies in South Sulawesi. The another studies was reported, spread of *G. androcles* very limited. *G. androcles* very selective and spread only in opening field, rocky rivers and wet sandy soil. The habitat condition *G. androcles* in research areas was showed in Figure 3.



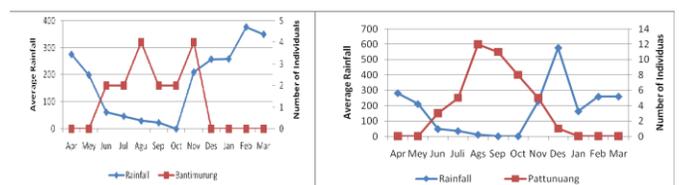
**Figure 3.** The habitat condition *G. androcles* in research areas

The number of *G. androcles* has a variety based on months in two research areas. Based on data, the high number of *G. androcles* was found in Pattunuang than Bantimurung. Only six months in every year we can find *G. androcles* in Bantimurung and Pattunuang. The number of butterfly in two research area was showed in Figure 4.



**Figure 4.** The number of *G. androcles* in two research areas

Based on Pearson's correlation analysis was showed rainfall ( $r = -0.676$ ;  $p = 0.016$ ) and temperature ( $r = 0.716$ ,  $p = 0.009$ ) significant to presence of *G. androcles*. On the other hand, no correlation between light intensity ( $r = 0.172$ ,  $p = 0.593$ ) and humidity ( $r = -0.088$ ,  $p = 0.786$ ) for butterfly presence in field. The relationship between rainfall periods to presence of *G. androcles* in Bantimurung and Pattunuang was showed in Figure 5.



**Figure 5.** The impact of rainfall on presence of *G. androcles* in two research areas

The comparison of light intensity, temperature, humidity and rainfall periods in Pattunuang and Bantimurung was showed in Table 1.

**Table 1.** Light intensity, temperature, humidity and rainfall periods in research areas (min and max)

Research areas	Light intensity (cd/m <sup>2</sup> )	Temperature (°C)	Humidity (%)	Rainfall periods (mm)
Pattunang	122.43-1.464.5	25 – 33	56-76	0 – 567
Bantimurung	419.76-2.021.7	24-35	54-70	0 – 259

BBNP region is a habitat for endemic butterflies such as *G. androcles* (Tsukada, Nishiyama and Kaneko, 1982; and D' Abrera, 1971) [32, 9]. Spreading of *G. androcles* in Bantimurung and Pattunang as tourism areas and resorts strong related with natural landscape including karst hills, shrubs, trees and the rivers. Various types of shrubs can be alternative food for larvae and adult of *G. androcles*. According to Achmad (2011) [1] the area of Bantimurung and Pattunang has landscape generally flat including few hills as a suitable habitat of many butterflies species. All species of butterfly has ability to adapt and living in a particular habitat (Vane-Wright and de Jong, 2003) [34]. We assumed, vegetation as a major factor in determining presence of *G. androcles* in each observation area. Grzimek (1975) [15] state the function of vegetation as a source of food and shelter for butterfly. Plants as the source of food *G. androcles* larvae is *Uvaria rufa* Blume (Annonaceae). We find *U. rufa* plants around Pattunang and not in Bantimurung. *G. androcles* moving from Bantimurung to Pattunang or another areas because presence of food and suitable habitat. Michael (1995) [20] state as the insects, butterflies have ability to fly avoid changes in temperature, humidity, chemicals or other abiotic factors. Whitten et al., (1987) [33] state insects are animals that are easily spread, carried away by the wind. Insect eggs can be carried along with the leaves as a result of wind blow. The distribution channels tend to assimilate the characteristics of insects of two adjacent islands. The distribution is : (i) through direct and mutual exchange of species, and (ii) through the continuous immigration of individuals who are commonly found on other islands. Changes that occurs in insects due to the distribution channels can be seen among the various species of butterflies. The number of individual *G. androcles* more found in open habitat compared to the closed habitat. Similar behaviour find in *G. doson* (Kumar and Singh, 2014) [26], but different with *G. agamemnon* are often found in habitat with dense canopy (Ramana et al., 2003 and Sharma et al., 2012) [27, 30]. This is related to the amount of light intensity required by each type of butterfly. To perform activities mating and copulation, butterfly required sunlight in higher intensity (Davies and Butler, 2008) [10]. In compared, open habitats has sunlight to be higher than in a closed habitat (Severns et al., 2006) [29]. *G. androcles* often found in rock, rivers and wet sandy soil. A similar behaviour find in *G. nomius* and different habit with *G. sarpedon*. *G. sarpedon* or Common Bluebottle is more often found in roadside Himalayas at higher altitude up to 2.100 m (Smetacek, 2011) [31] and *G. doson* often found in human settlements, parks and urban and the lowland forests up to an altitude of 1.400 meters above sea level (Kumar and Singh, 2014) [26]. It is a similar to male butterflies *Papilio blumei* in mating strategy. Sometimes they wait of adult females in certain places such as rocks (Alias and Soesilohadi, 2015) [2]. Butterflies visiting the wet areas for water and energy needs (Corner, 2009) [7]. Commonly

presence of *G. androcles* in river areas. Water resources giving effect to the presence of *G. androcles*, however, not all water sources in each habitat has any relationship or positive effect on the existence of *G. androcles*. Actually *G. androcles* prefer water with more sandy soil. The conditions around sandy soil caused ability of *G. androcles* to absorb it. Sandy soil is fine absorb of soapy water and urine that are used as baits to invite *G. androcles* visiting research areas. Freerk et al. (2005) [13] state that butterfly sucking nectar and water with their proboscis. Butterflies have got sodium and other minerals in the salt and sometimes get from human sweat. Something similar to the presence species of butterflies *G. sarpedon*, *G. doson*, *G. evemon* and *G. delesserti* on the riverbanks. The condition of the riverbanks suitable for butterflies to suck water turns sandy. In contrast to regional conditions with water sources in other habitats that not contain sandy (Indriyani et al., 2010 and Ramesh et al., 2012) [18, 28]. Total number of *G. androcles* more common in Pattunang compared to Bantimurung as a tourism area. This is related to the condition of the area and the availability of plant food for larvae. The condition of Pattunang covered by rainfall forest than Bantimurung supported suitable habitat for *G. androcles*. Many visitors it can generate noise and the probability loss of habitat, causing butterflies to migrate in another areas. New (2009) [21] stated that the destruction of habitat will affect the number of individuals in a population of Lepidopteran. Impact of noise or sound has a strong correlation with presence of *G. androcles*. As a illustrated, the number of *G. androcles* in riverbanks more higher than in waterfall areas. Butterflies reproduce during certain months with optimum environmental conditions (Vu and Quang, 2011) [35]. Commonly *G. androcles* can be found at the beginning of the dry season, the time of observation coincides June to November 2014. It is associated with mud-puddling behavior of butterflies during the dry season. *G. androcles* female lay their eggs on the leaf *U. rufa*. Based on the results of field survey, *U. rufa* plants will flowering at the beginning of dry season. Beck, Eva and Konrad (1999) [4] reported that some locations such as in California, mud-puddling behavior in some species of butterfly only occurs during the dry season, as well as in some species of Steppe biome in Turkey. Similar behaviour in *Papilio blumei*, where mud-puddling behavior occurs during the dry season (Alias and Soesilohadi, 2015) [2]. Flying butterfly season responsive to temperature and can change due to climate change (Hill et al., 2003; Kerr, 2001; Andrew and Hughes, 2005) [17, 25, 3]. Based on the results of Pearson's correlation, temperature and rainfall significantly affect the number of individual *G. androcles*. According Boonvanno et al., (2000) [5] there are several types of butterflies prefer habitat with higher temperatures, such as *Eurema nicevillei* (Pieridae), while another type of butterfly prefer warm habitat such as *Euplea mulciber* and *E. radamanthus*. *Prothoe frank boornensis* and *Lexias panther* has color patterns wings dark is one form and means adaptation to habitat conditions in high levels of low temperature and sunlight slightly, contrary to species of butterflies that live in habitats with high temperature conditions often found in open forest section, has a light-colored wings (Indriyani et al., 2010) [18]. *G. androcles* classified types of butterflies prefer warm temperatures and bright color. The wings color of *G. androcles* dominated by a line of white and yellowish. *G. androcles* activities depend on the weather. In sunny day, the butterflies can be found and more active on the weather season. Some kind of butterfly

wings wide to be able to fly if the body temperature should be around 28-30°C, therefore, often seen butterflies are in place that is open to absorb sunlight in order to increase its body temperature (Davies and Butler, 2008) [10]. The temperature suitable for the development of adult *G. androcles* ranged between 29-31°C. Temperature also affects the growth of forage plants as food plant for adult butterflies that relate to the number of individual butterflies (Boonvanno et al., 2000) [5]. The air temperature is closely related to rainfall and humidity affect the research location. Indirectly humidity affect the quality of food plants and therefore contributes to the spread of the butterfly as well as the survival of adult butterflies and larvae (Hamer et al., 2003) [16]. Butterflies can not living at very high humidity (Braby, 2004) [6]. Humidity is measured during the observation, no significant effect on the number of individuals. However, the range of values of moisture in the location ranging from 55- 70%. According to Orr and Kitching (2010) [22] adult butterflies are difficult to find in the regions with humidity above 90%. Humidity very strong related for development of adult *G. androcles* which ranges from 55 -65%. According Fetwel (1986)[12] butterfly activity best in the humidity around 60% because reduces the risk lack of water or dehydration. Humidity in the research location associated with the light intensity. *G. androcles* presence in each area of observation was found at 11:00 am to 14:00 pm, which intensity of light in the tourism area Bantimurung average ranges 1.087 cd / m<sup>2</sup> and in Pattunuang average range of 703 cd / m<sup>2</sup>. According Fetwel (1986) [12] butterfly generally activity in light with range of 230 cd / m<sup>2</sup>. Light is required to dry the wings of a butterfly on exit from the cocoon. The light will provide heat energy to the body, increasing body temperature and metabolism faster. Increasing body temperature will accelerate the development of butterfly larvae (Braby, 2004) [6]. The light intensity measured during the observation, no significant effect on the number of individual *G. androcles*. Severns et al., (2006)[29] state that the light intensity is affected by the canopy cover on butterfly habitat.

#### 4 CONCLUSION

The presence of *G. androcles* found at the beginning of the dry season with low rainfall. *G. androcles* encountered particular in places, including in the area of open expanse of rocks, riverbanks and wet sandy soil. The presence of *G. androcles* related to ecological characteristics and their habitat. *G. androcles* prefer habitat containing many water and sandy soil. Temperature and humidity as the factors that can affect the existence of *G. androcles* in research areas location. The activity of *G. androcles* a response behavior to adapt to the environmental conditions.

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