THE DECLINE OF BUTTERFLY (LEPIDOPTERA, RHOPALOCERA) ABUNDANCE DUE TO HABITAT DESTRUCTION: RESULT OF BUTTERFLY MONITORING IN TWO YEARS IN TAM DAO NATIONAL PARK

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I. INTRODUCTION

Long-term ecological monitoring has the potential to provide timely information on changes in the biota, and when properly designed, it can identify adequate responses to reverse undesired trends and should be used by natural recourse managers to evaluate the success of their policies in meeting conservation objectives [2].

Insects are important in environmental assessments because of their dominance in terrestrial ecosystems, their short generation times that can result in rapid population responses to disturbance, and their wide range of life styles that make them sensitive to changes in the biotic and abiotic environments. Butterflies are extremely susceptible to unusual climatic conditions and certain species them can be used to indicate certain environmental regimes. Butterflies are widely recognized as potentially valuable ecological indicators [4, 5, 8]. Their presence can prove that habitats are suitable and indicate that certain conditions have been met. Those species can be used to define environmental health simply by the presence of particular species. In contrast, their absence may reflect declining health.

In this research, butterflies were chosen for monitoring because they have become a popular group for study. They are day flying and in relative abundance; they are the most conspicuous and relatively easily identifiable and frequently serve as "flagship taxa" in biodiversity inventory. Butterflies are often colorful and sensitive to rather subtle habitat and environmental changes. Any change in the forest can lead to changes in butterfly communities. For example, they are highly sensitive to changes in temperature, humidity and light levels that are caused by habitat change [1, 2, 7, 9]. Changes in butterfly composition and abundance can point to subtle changes in forested habitat because the larvae have specialized host-plant requirements and adults are important in pollinating some flowering plants. Using selected groups of local butterflies for long-term monitoring can reveal the stabilization or decline of butterfly species populations due to habitat destruction or loss of forest ecosystems.

This paper is the first effort to use transect method to monitor butterfly species populations at local site of Tam Dao National Park and to detect changes of their abundance in short and long term. This also outlines a simple guide to set up butterfly monitoring in the park.

II. OBJECTIVE AND METHODS

2.1. Site study

The research site was located at an area near Tam Dao village at the elevation of 900 meters a.s.l. of Tam Dao National Park ($21^0$21'-$21^0$42' North and $105^0$23'-$105^0$44' East), with the area of 36,883 ha of natural forest and 15,515 ha of buffer zone. The research area is located in a region of seasonally wet climate where the rainy season occurs from April through the middle of October.

Butterfly monitoring was conducted along four 700-m transects. The transects were restricted to a local road and a forest path from the Tam Dao village toward Rung Rinh Mountain and represented different habitats according to environmental types as follow:

Transect 1: closed forest, located on the forest ridge with some small gaps and disturbed areas, consisting of small to medium trees and bamboo. Compared with other transects in the forest, this transect is closest to a natural forest.

Transect 2: human-disturbed forest, containing shrub and small to medium trees and bamboo.

Transect 3: an area along the local road with disturbed and forest edge, consisting of grass, shrub and small to medium trees.

Transect 4: open and agriculture habitat, consisting of grass and shrub and agriculture plant.

The vegetation (mostly some trees, shrub and grass) along all transects was cut down at different times from July to September 2003, especially vegetation along the local road was much disturbed due to widening of the road. The vegetation destruction created more gaps and opens in transects.

2.2. Sampling method

Before starting any monitoring activities, reconnaissance should be conducted at the study area where the line count transects are located. This will ensure that the transects are representative of different habitat types of the area, and enables the study team members to become familiar with the area. We began by surveying butterflies in the Tam Dao National Park, thus establishing which species were currently in our study area in previous years [10]. This included an effort to make a comprehensive list of those butterflies that were in the park.

We then quantified butterflies (species and individuals) along the four transects. Pollard's transect walking method [6] was modified to quantify butterflies and has been applied in Vietnam [10]. The method is meant to monitor for changes in species populations of butterflies over time, as well as to study differences in butterfly communities of different habitats.

Transect counts were carried out once or twice daily from 8:30 to 12:00 am and from 1:00 to 6:00 pm (except rainy days) for eight days each month for six months from July through September 2002 and 2003. The counting teams walked at a uniform pace and recorded all butterflies seen within prescribed limits in an imaginary 10 m x 10 m x 10 m box, and the time needed for checking each transect was approximately 40 to 50 minutes. The counting times were altered so that the effect of different times during the day on butterfly's activities was reduced. Individual butterflies may fly ahead of the recorder after being counted and risk being double counted. To avoid this, only one entry was made, and only when there was no doubt that the same individual

was counted. To record butterflies, one person took notes while others observed, caught and identified. Some butterflies were seen, others were caught to identify and then released. Data on butterfly composition and abundance of one count daily are used to compare between two years. Data on butterfly abundance of two counts daily (morning and afternoon) are used to assess the effect of different times of day on butterfly activities.

The identification and nomenclature of butterflies follow [3].

On the data sheet the following detail information is filled:

Date and transect number;

Time to start and end recording for each transect;

Recorder (the person who takes notes in record sheets);

The weather conditions of each transect including temperature, relative humidity, wind, mist, cloud and sun.

For each butterfly sighted the following was recorded:

Butterfly family, species name;

Number of individuals and species.

Plants along transects and any vegetation change were also recorded.

III. RESULTS AND DISCUSSION

A total 48 days of counting butter -flies with 143 species were recorded during survey periods in 2002 and 2003. The total species number of families recorded along transects in two years are presented in Figure 1. The family Nymphalidae has the highest species numbering 37 species, which constitutes 25.9% of total species. Other families Papilionidae, Satyridae, Pieridae, Hesperiidae and Lycaenidae have almost the same species number. Meanwhile, the family Riodinidae has the lowest species numbering 2 species, which constitutes 1.14%.

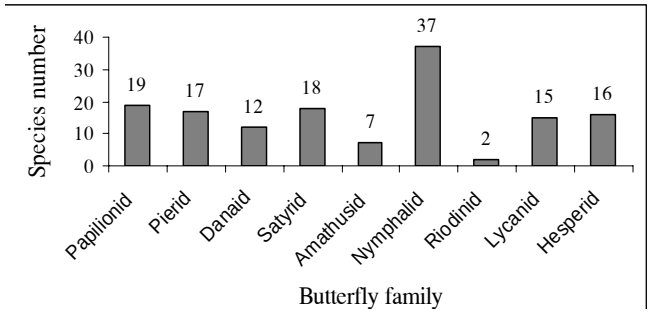

Figure 1. Species of butterfly families recorded in two years along transects

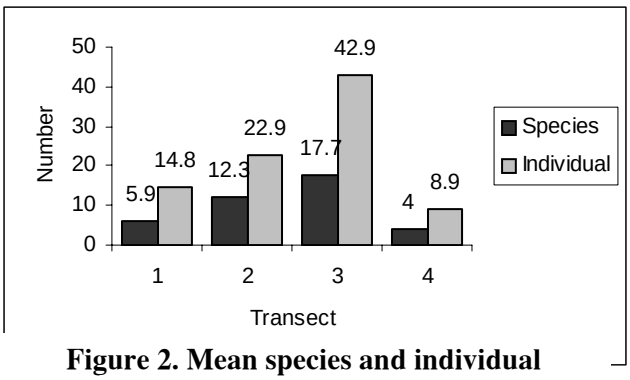

Figure 2. Mean species and individual number per count by transect

Species and individual number per count (a day) of four transects in all studied months were presented in Figure 2. There were 45 species found in transect 1; 50 species in transect 2; 75 species in transect 3 and 67 species in transect 4. Transect 3 has the highest number (75 species). The closed forest (transect 1) has the least number (45 species). The distribution of butterfly species by families varies depending upon habitat types. The families Papilionidae, Pieridae, Danaidae, Nymphalidae and Hesperiidae have more species seen in transects 3 and 4. Some species of those families are also found flying in forest gaps. The families Satyridae and Amathusiidae have more species seen in transects 1 and 2. It is common that most species of Satyridae

and Amathusiidae distribute in the forest area. They prefer flying in the forest. Species of other families prefer flying in open areas and distribute in large areas.

Three species *Euploea mulciber, Ideopsis similis* and *Tirumala septentrionis* (Danaidae) are the most common and compose 54.3 % individuals recorded in transect 3 and 4. Four species *Ragadia crisilda, Mycalesis misenus, Melanitis leda* (Satyridae) and *Stichophthalma howqua* (Amathusidae) are the most common and compose 76.6 % of the individuals recorded in the forest (transects 1 and 2). Many species with more individuals were seen; otherwise there were rare species with only a single or a few representatives (such was the case for the species of Lycaenidae, Amathusiidae, Satyridaeae and Riodinidae, species found specially in the forest).

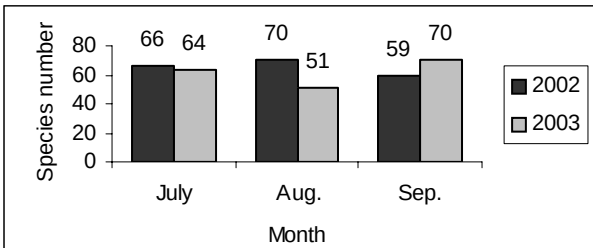

Figure 3. Total number of butterfly species by month in 2002 and 2003

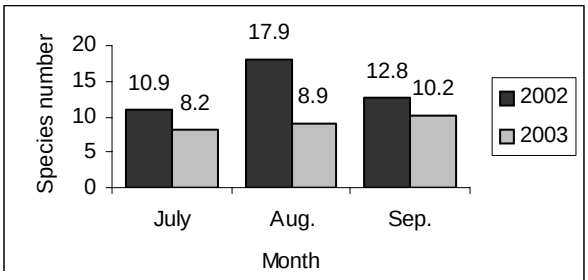

Figure 4. Mean species number per count by month in 2002 and 2003

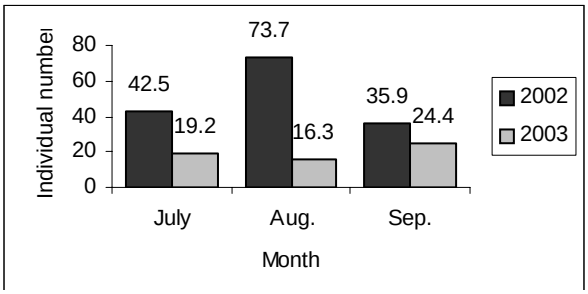

Figure 5. Mean individual number per count by months in 2002 and 2003

Total species recorded by month in two years are shown in Figure 3. The Figure indicates that there is the same species number in July between two years but it is rather different in August and September. The differences of butterfly species numbers between two years were mostly in the families Nymphalidae, Lycaenidae and Hesperidae. Species numbers of the families Danaidae and Riodinidae are the same between two years.

Mean species and individual number per count (a day) are presented in Figure 4 and 5. Two Figures show that both numbers of species and individuals per count in 2003 was much lower than those in 2002. The most difference was in August. Both the lowest mean species and individual numbers were in July and August respectively.

The results of the research indicated that in 2003 both species richness and abundance of butterflies are less than in 2002. The decline of butterflies is due to several reasons, of which one of the main reasons can be destruction of vegetation along transects especially the road transect. The vegetation was cut down, larvae food plants were also destroyed that then affected larvae and butterflies. Another reason that can cause butterfly declineis weather condition such as rainfall, wind, etc. However, the weather was almost the same between two years even though was weather better in September 2003, the numbers of butterfly species richness and abundance were lower than in the previous year. The other reason is butterfly phenonolgy. Butterfly populations can fluctuate from year to year so that there may be abundance in one year and less abundance in the next Predators, parasites and other factors also can affect butterfly populations. However in this research the

decline in species richness and abundance of butterflies in the later year can be due to vegetation destruction.

The weather of Tam Dao in study period changed daily even though during a day that much affected butterfly activities. The climate factors that can affect their flying are temperature, wind, cloud and sun. We observed that less butterflies were seen in windy days as well as cloudy days, and weather affected butterfly activities in open habitat, but less in forest. Different times of the day also impacted butterfly activity. We observed more butterflies in the morning than in the afternoon ($t = 2.3$; $df = 12$; $p < 0.01$).

To monitor butterflies in tropical forest, one needs to choose a proper representative site for the area, the advance information on biological aspects of the butterfly populations being studied, delineation of the surveying site and description of the area by shape, size and types of habitats. The site should consist of several habitats within the monitoring areas and should be chosen for the potential to repeat counts year after year. Flying activities of butterfly are affected by the weather and different times of the day. However, the count may be held earlier or later than the period of the previous year if this is advantageous for counting butterflies in the area. Not all species encountered in the area should be monitored because there are too many. Butterflies are very rich in species composition. In the tropical forest, if one chooses all species, it will be more work than necessary. Which species should be chosen for monitoring? Consider choosing local common butterflies restricted to certain specific habitats that are relatively easy to identify and to record. When possible, rare species that reveal valuable conservation information should be monitored. A monitoring team must include at least one trained person who is able to identify specimens.

IV. CONCLUSION

Habitat destruction in Tam Dao National Park could be the main reason that impacted butterfly species richness and abundance and resulted in decline in abundance from 2002 to 2003.

Monitoring butterflies, better a subset of butterflies on fixed sites temporally can assess and forecast the impact of habitat disturbance and negative change of environment on butterflies. They also can be used as early warning indicators of degradation of forest and environment that will be very helpful to bolster conservation measures, meet conservation objectives and reverse undesired trends in protected areas.

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TÓM TẮT

SỰ GIẢM SÚT ĐỘ PHONG PHÚ BƯỚM (LEPIDOPTERA, RHOPALOCERA) DO ẢNH HƯỞNG TÀN PHÁ NƠI Ở: KẾT QUẢ BAN ĐẦU QUAN TRẮC BƯỚM TRONG HAI NĂM Ở VƯỜN QUỐC GIA TAM ĐẢO

VŨ VĂN LIÊN

Nghiên cứu và quan trắc quần thể các loài bướm (Lepidoptera, Rhopalocera) được tiến hành mỗi tháng tám ngày trong sáu tháng từ tháng 6 đến tháng 9 năm 2002 và 2003 ở độ cao 900 mét của vườn quốc gia Tam Đảo, Vĩnh Phúc. Bốn tuyến điều tra cố định đại diện cho bốn loại sinh cảnh khác nhau, mỗi tuyến có chiều dài 700 được thiết lập tại nơi rừng ít bị tác động, rừng bị tác động nhiều, dọc đường có độ che phủ thảm thực vật thấp, và trảng cỏ và canh tác nông nghiệp. Phương pháp tuyến điều tra được sử dụng để quan trắc bướm.

Chỉ số về độ giàu có loài và phong phú cá thể (số loài và cá thể trung bình) của các tháng của năm 2003 được sử dụng để so sánh với năm trước. Năm 2003 thảm thực vật của các tuyến điều tra trên bị tác động do việc chặt phá cây để mở và nâng cấp đường xung quanh thị trấn Tam Đảo cũng như từ thị trấn vào chân đỉnh Rùng Rình, đặc biệt là thảm thực vật hai bên đường quanh thị trấn bị tàn phá mạnh.

Qua hai năm quan trắc thấy độ giàu có loài và đặc biệt sự phong phú cá thể năm sau giảm rõ rệt so với năm trước, sự giảm sút này có thể là do nơi ở của bướm bị tàn phá. Nghiên cứu cũng cho thấy thời gian trong ngày có ảnh hưởng đến các hoạt động bay của bướm như buổi sáng thấy nhiều cá thể bướm hơn buổi chiều, thời tiết cũng ảnh hưởng nhiều đến các hoạt động của chúng. Để nắm bắt được ảnh hưởng tác động nơi ở mà cụ thể là rừng cũng như thay đổi của môi trường đến bướm, quan trắc quần thể các loài bướm nhất là các loài phân bố hẹp tại các tuyến điều tra cố định vào các thời điểm nhất định (thời gian trong ngày và tháng) qua các năm sẽ cung cấp thông tin về xu hướng biến động và tình trạng các loài theo thời gian; có thể quần thể một số loài bị giảm sút do rừng bị tàn phá hay môi trường sống bị xuống cấp. Bướm có thể được sử dụng như là chỉ thị cảnh báo sớm về sự xuống cấp của rừng hay môi trường sống.