Tạp chí Khoa học và Công nghệ ***54*** *(3) (2016) 332-339*

DOI: 10.15625/0866-708X/54/3/7253

AN ESTIMATION OF BAMBOO BORER BIOMASS IN SON LA PROVINCE, NORTHWESTERN VIETNAM AND REMARKS ON ITS PARASITIC CHARACTERISTICS

Pham Quynh Mai

Institute of Ecology and Biological Resources, VAST, 18 Hoang Quoc Viet, Cau Giay, Hanoi

Email: *pqmai70@gmail.com*

Received: 9 October 2015; Accepted for publication: 29 March 2016

ABSTRACT

The population of Vietnam has been rapidly increased and would reach 100 million people in the near future. It is very likely that the sources of traditional food are insufficient to the whole population. Therefore, a study for sustainable usage of insects as a supplemental food for human in the future is clearly required. In fact, larvae of bamboo borer, *Omphisa fuscidentalis*, has been used as a kind of foods by local people in mountainous provinces in northern Vietnam. It also appears as a trade product in local markets. This paper presents the results of recent studies on the infested rates of bamboo borer larvae from different bamboo species. An assessment of its parasitic characteristics and an estimation of biomass in Son La province are also given in this paper.

Keywords: estimation, biomass, food, insect, *Omphisa fuscidentalis*, Vietnam.

1. INTRODUCTION

Scientific research to use insects as a kind of food for human is essentially important [1, 2]. *Omphisa fuscidentalis* is a tropical species [3, 4], which distributes in the Southeast Asian region including Vietnam [5, 6, 7]. The species has been exploited for food by local people in northern Vietnam for many years. It inhabits shoots of bamboo and other plant species. In Son La province, bamboo shoots annually growth in early summer, between April and May. Adult borer lays an egg cluster on a bamboo shoot in June. The newly hatched larvae bore a hole through the internodal wall so that all larvae from the egg cluster move into the internode and feed on the inner pulp. Within the tree body, larvae bore a hole through the septum and move upward from an internode to another internode in order to obtain fresh inner pulp. The larvae inhabit internode between nine and ten months. In April, they find the original internode or the internode just above the original one to pupate in the middle of the following April. Eclosion takes place inside the internode then the newborn moths come out of the internode at the entrance hole [8]. The larval period thus lasts from mid-June until early April of the following year [9]. Nutritional value of *Omphisa fuscidentalis* bamboo borer has also been identified. Of which, every 100mg of dry bamboo borer contains 26.29 % protein and 50.54 % fat [6, 10]. Bamboo borer is one of

the insect species supplying local people with food and other products. The species would play important role in development of social economics in mountainous regions of Vietnam.

2. STUDY SITES AND METHODS

2.1. Study sites

Field surveys were implemented in six communes and one town of Son La province: Chieng Sinh, Ta Xua, Gia Phu, Phu Yen town (Phu Yen), Muong Sai, Muong Lum, Chieng Son (Fig. 1).

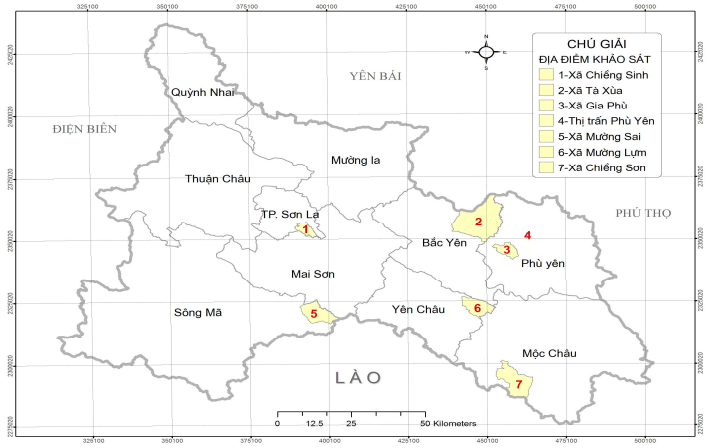

Figure 1. The study sites in Son La province, northern Vietnam.

2.2. Methods

RRA (Rapid Rural Approach) was employed to understand the natural and socioeconomic features in the study areas. Questionnaires were produced for interviews during the field surveys. Information from the interviews was analyzed using the PRA (Participatory Rural Approach) method for obtaining proper results.

Distributional data of bamboo species and their biomass were obtained from published literatures and local institutions: Son La Statistics office 2013 [11]; A list of all plant species in Vietnam [12]; Separate Forest Inventory and Planning Institute North West [13].

Bamboo species were identified following Anantachot [14], Dransfield and Widjaja [5]; Watcharapuk [15]; A list of all plant species in Vietnam [11]; Leksawasdi [8]; Separate Forest Inventory and Planning Institute Northwest [12]; Garden et al. [7];

To determine the infection rate of borer within each bamboo species, at each study site, the author conducted surveys of 25 random bamboo clusters. Based on observational data, The age of bamboo clusters and the rate of bamboo trees infected by borer were estimated using observational data. Number of borers were averaged were collected from at least 30 bamboo trees then calculated for an average.

3. RESULTS AND DISCUSSION

3.1. Distribution of bamboo species and infection of *O. fuscidentalis*

At least 20 bamboo species belonging to the subfamily Bambusoideae were found in the seven study areas in the Son La province. The author conducted research on ca. 60,260 trees of each species. Borer was found from ten bamboo species. The parasite rates of borer are given in Table 1.

Table 1. List of bamboo species distributing in Son La province and parasite rates of borer.

No.	Scientific names	Rate of infected borer (%)	No.	Scientific names	Rate of infected borer (%)
1	*Ampelocalamus patellaris* (Gamble) Stapleton	0	2	*Bambusa agrestis* (Lour.) Poir.	0
3	*B. bambos* (L.) Voss.	2.7	4	*B. blumeana* Schult. & Schult.f.	3.5
5	*B. multiplex* (Lour.) Raeusch.	0	6	*B. nutans* Wall.ex Munro	2.1
7	*B. tuldoides* Munro	0	8	*B. vulgaris* Schrad. in Wendl.	3.2
9	*Dendrocalamus asper* (Schult.f.) Back. ex Heyne	5.3	10	*D. brandisii* (Munro) Kurz	1.5
11	*D. giganteus* Munro	3.8	12	*D. hamilltonii* Nees ex Arn. ex Munro	4.9
13	*D. sericeus* (Roxb.) Nees	5.5	14	*Indosasa amabilis* McClure	0
15	*I. crassifolia* McClure	0	16	*Gigantochloa levis* (Blanco) Merr.	5.1
17	*Neohouzeaua dullooa* (Gamble) A. Camus	0	18	*Phyllostachys pubescens* Mazel ex H. de Lehaie	0
19	*Schizostachyum aciculare* Gamble	0	20	*Sinobambusa sat* (Bal.) T.Q. Nguyen	0

Ten bamboo species were infested by borers comprising *Bambusa bambos, B. blumeana, B. nutans, B. vulgaris, Dendrocalamus asper, D. brandisii, D. giganteus, D. hamilltonii, D. sericeus, Gigantochloa levis.* Considerably, three species exhibited high infested rates: *D. sericeus*, *D. asper* and *G. levis*; four species exhibited an average infested rate of over 3 %: *B. vulgaris, B. blumeana, D. giganteus* and *D. hamilltonii*; three species exhibited an average infested rate of under 3 %: *B. bambos, B. nutans* and *D. brandisii*.

The study results also indicated that borers are only found in 10 of the 20 known bamboo species in Son La province. The rates infected borer in 10 bamboo species are given in the Figure 2.

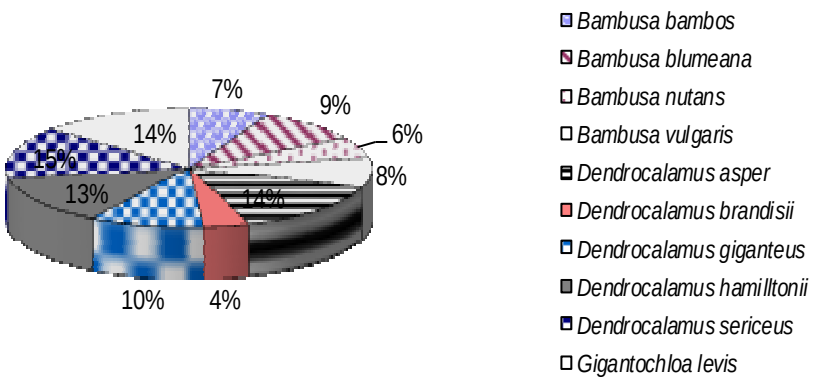

Figure 2. The rates infected borer in 10 bamboo species in Sơn La.

Borers were only found in large bamboo trees of 5.0 - 7.0 meters in height with a root trunk of at least 10 cm in diameter. They were not found in small bamboo with body wall thinner than 0.5 cm. Remarkably, borers were only discovered in young bamboo, which is less than 12 months of age. The findings are equal to the developmental stages of the borer larvae, which is more or less 10 months.

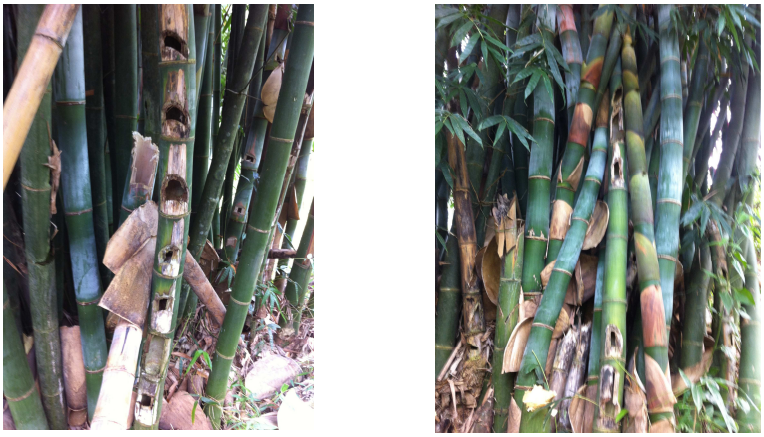

Figure 3. Bamboo trees were infested by *O. fuscidentalis.*

The bamboo trees infested by borers would be easily recognized. They develop abnormally. Their bodies are stunted, often curved and crooked with short internode. The young bamboo trees normally growth up without the top (Fig. 3).

3.2. Parasitic characteristics and development of borer in bamboo trees

Bamboo shoots in Son La annually grow up in early summer, between April and May. Afterwards, adult female moths lay a mass of 80 - 130 white eggs on the bamboo sheaths, mostly at the base of bamboo shoot. Upon hatching, the first stage of young larvae was pale brown. After an arrangement into long rows, they found a suitable internode for infestation. The larvae got inside the bamboo internode for a new development stage. Their food is bamboo powder inside the internodes. During the developmental processes, larvae moved upward within the shoots for food (Fig. 4).

Figure 4. Bamboo borer in a bamboo internode.

The larval stages in the internodes lasted for more or less 10 months. Bamboo borer is found in young bamboo at any time. However, local people annually harvest them from September to November. Within these months, larvae reach the largest body size with the best quality for human food. Numbers of larvae from each studied bamboo species are presented in Table 2.

Table 2. The average number of individuals of *O. fuscidentalis* from each studied bamboo species.

No	Bamboo species	Number of borer (individual /bamboo)	No.	Bamboo species	Number of borer (individual /bamboo)
1	*B. bambos*	68 ± 2.5	2	*B. blumeana*	110 ± 4.2
3	*B. nutans*	45 ± 2.7	4	*B. vulgaris*	75 ± 1.2
5	*D. asper*	81 ± 3.6	6	*D. brandisii*	35 ± 2.4
7	*D. giganteus*	95 ± 2.8	8	*D. hamilltonii*	125 ± 3.5
9	*D. sericeus*	105 ± 3.3	10	*G. levis*	130 ± 3.7

Based on the number of borers from the studied bamboo trees, which can be divided into 3 groups of bamboo. Group 1: Bamboo hosts many borers (over 100 individuals/bamboo tree). There were four bamboo species in this group: *D. sericeus, B. blumeana, D. hamilltonii* and *G. levis*; Group 2: Number of borers in a range of 68 to 95 individuals per one bamboo. There were four bamboo species in this group: *B. bambos, B. vulgaris* và *D. asper and D. giganteus;* Group 3: Number of borer less than 50 individuals per one bamboo. There were two bamboo species in this group: *B. nutans, D. brandisii*.

3.3. Estimated biomass of bamboo borer

To cater for the determination of bamboo borer biomass, the author determined an average weight of 10 borer. The study results showed that an average weight of 10 bamboo borers is 4.5 g Therefore, the average weight of 1 bamboo borer is 0.45 g. (Tab. 3).

Table 3. Biomass of bamboo borer in Son La.

No	Bamboo species	Total of bamboos (tree)	Total of infested bamboo (tree)	Total of bamboo borer (individual)	Total weight of borer bamboo (kg)
1	*B. bambos*	60,260	1,627	110,636	49.8
2	*B. blumeana*	60,260	2,109	231,990	104.4
3	*B. nutans*	60,260	1,265	56,925	25.6
4	*B. vulgaris*	60,260	1,928	144,600	65.1
5	*D. asper*	60,260	3,194	258,714	116.4
6	*D. brandisii*	60,260	904	31,640	14.2
7	*D. giganteus*	60,260	2,290	217,550	97.9
8	*D. hamilltonii*	60,260	2,953	369,125	166.1
9	*D. sericeus*	60,260	3,314	347,970	156.6
10	*G. levis*	60,260	3,073	399,490	179.8
Total		**602,600**	**22,657**	**2,168,640**	**975.9**

The results in the Table 1 show that, the total of bamboo infested by bamboo borer (of 10 species of bamboo in Son La) are 33745 trees; The total of bamboo borers in 10 species of bamboos in Son La are 2,168,640 individuals with total weight of approximately 975.9 kg. The biomass of natural bamboo borer in Son La province could reach around 1,000 kg/year. The cost of larvae in local market is more or less 200,000 VND/kg. Therefore, the total costs for 975.9 kg of bamboo borer larvae would be 1 billion 952 million VND per year. This amount is clearly valuable to local people communities.

In fact, weight of bamboo borers traded at markets was smaller than the estimated weight in the wild. Local people has just collected bamboo borers from bamboo trees around their houses or villages. Many bamboo species have naturally grown in protected areas of Son La province. Currently, Son La contains five nature reserves including: Copia, Sop Cop, Ta Xua, Xuan Nha and Muong La. The total area of the reserves is 79,000 ha. Local people are not allowed to exploit bamboo borers in the nature reserves. As consequence, the traded biomass of bamboo borers sold Son La province is still limited.

4. CONCLUSION

Among 20 bamboo species distributing in Son La province, 10 species were infested by bamboo borer: *Bambusa bambos, B. blumeana, B. nutans, B. vulgaris, Dendrocalamus asper, D. brandisii, D. giganteus, D. hamilltonii, D. sericeus, Gigantochloa levis*.

In a clump of bamboos, borers were found only in the body of the bamboo trees younger than 12 months of age whose height ranges from 1 m to 3 m.

The bamboo borers annually appear between April and May then live inside a bamboo shoot until following February or March.

The amount of larvae in each infested culm ranged from 35 individuals (*D. brandisii*) to 130 individuals (*G. levis*) with an average weight of 4.5 g/10 larvae.

An estimated weight of about 2,168,640 larva individuals collected from infested bamboos was 975.9 kg. This would be an important food source for local people in the future.

Acknowledgments. This research was financially supported by the Science Foundation of Vietnam Academy of Science and Technology for the project "*Survey on insect resource diversity in the northwestern region, propose solutions for the development, exploitation and sustainable use*"; Code VAST04.02/2014-2015.

REFERENCES

1. Ashiru M. O. - Ecology of Food and Nutrion, Taylor and Francis Online, 1988, pp. 1-25.
2. Bodenheimer F. S. - Insects as food, U. junk, the Hugue, published by Ellsevier Ltd., 1951, pp. 352-361.
3. Fu- Qiang Chen, Chun- Sheng Wu - Taxonomic review of the subfamily Schoenobiinae (Lepidoptera: Pyraloidea: Crambidae) from China, Zoological Systematics **39** (2) (2014) 163-208.
4. Monastyrskii A. L., Devyatkin A. L. - Butterflies of Vietnam (an Illustrated checklist), Thong Nhat Printing House, Hanoi, 2003, 56pp.
5. Dransfield S. and Widjaja E. A. - Bamboo, Plant resources of South- East Asia, No. 7. Bogor Indonesia, 1995, 189 pp.
6. Kayikananta L. - Biological and ecological study on bamboo caterpillar, *Omphisa* sp. Proceedings of the forestry conference 1994 "Reforestation for Environmental Development", 1994, pp. 159-171.
7. Garden S., Robinson K., Tuck R. and Shaffes M. - A field guide to the smaller moths of South- East Asia, The Natural History Museum and Malaysian Nature Society, 1994, pp. 181-308.
8. Leksawasdi P. - Life history and natural enemy of a bamboo borer (*Omphisa* sp., Pyralidae: Lepidoptera) the second Plant Protection Conference **1** (1993) 96-102.
9. Tippawan Singtripop, Somsak Wanichacheewa, Seiji Tsuzuki and Sho Sakurai - Larval Growth and Diapause in a Tropical Moth, *Omphisa fuscidentalis* Hampson, Zoological Science **16** (1999) 725-733.
10. Kayikananta L. - Mass rearing of bamboo caterpillar, *Omphisa* sp., a new profitable job for extra incoms (with right collecting technique could get caterpillars, comprising food value from natural protein, and also get bamboo wood for utilizations). No. R. 477, Royal Forest Department, 1996,14 pp.
11. Sonla statistics office, 2014, Sonla statistical yearbook: 348 pp.
12. Hanoi National University and the Institute of Ecology and Biological Resources, 2005, A list of all plant species in Vietnam, Volume 3, Agriculture Publisher.
13. Separate Forest Inventory and Planning Institute North West - Report on the survey results, assess the situation and investment opportunities developing Northwest forestry sector, 2009.

14. Anantachot A. - Bamboo in Thailand, Faculty of Forestry, Kasetsart University, 1991, 74 pp.
15. Watcharapuk C. - Bamboo, 1985, 113 pp.

TÓM TẮT

ƯỚC TÍNH TRỮ LƯỢNG LOÀI SÂU TRE VÀ MỘT SỐ ĐẶC ĐIỂM KÍ SINH CỦA CHÚNG TRÊN CÂY TRE Ở TỈNH SƠN LA, VÙNG TÂY BẮC VIỆT NAM

Phạm Quỳnh Mai

Viện Sinh thái và Tài nguyên sinh vật, Viện HLKHCNVN, 18 Hoàng Quốc Việt, Cầu Giấy, Hà Nội

Email: *pqmai70@gmail.com*

Dân số Việt Nam đã và đang tăng nhanh, có thể đạt tới 100 triệu dân trong tương lai không xa. Khi dân số tăng cao, lượng thực và thực phẩm từ các nguồn truyền thống không thể đáp ứng đủ. Do vậy, việc nghiên cứu côn trùng làm thực phẩm bổ sung là rất cần thiết và có ý nghĩa chiến lược. Từ lâu, ấu trùng loài Sâu tre *Omphisa fuscidentalis* được người dân các tỉnh miền núi phía Bắc Việt Nam sử dụng làm thực phẩm. Hơn nữa, ấu trùng đó đã trở thành một loại thương phẩm và sử dụng nhiều trên thị trường trong nước hiện nay. Kết quả nghiên cứu về tỉ lệ nhiễm sâu tre của các loài tre ở Sơn La đạt cao nhất là loài *Dendrocalamus sericeus* 5,5 %. Ước tính trữ lượng của loài côn trùng này tại Sơn La khoảng 975,9 kg, tương ứng với giá trị kinh tế khoảng 1 tỉ 952 triệu đồng. Ấu trùng sâu tre *Omphisa fuscidentalis* là nguồn tài nguyên sinh vật có thể được khai thác để bổ sung vào nguồn thực phẩm và có thể trở thành hàng hoá có giá trị góp phần tăng thêm thu nhập cho người dân ở Sơn La.

Từ khóa: ước tính, sinh khối, thực phẩm, côn trùng, sâu tre *Omphisa fuscidentalis*, cây tre.