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Incidence of Wood Boring Bostrychid Beetles in Different Wood Yards at Mettupalayam

Asokan G [1*], Aruna R[2], Senthil Kumar M[3] and Balasubramanian A[1]

[1] Department of Silviculture and NRM, Forest College and Research Institute, TNAU, Mettupalayam - 641 301

[2] Department of Sericulture, Forest College and Research Institute, TNAU, Mettupalayam - 641 301

[3]Horticultural Research Station, TNAU, Yercaud - 636602

[*]Corresponding Author e-mail: asokan.g@tnau.ac.in

Abstract

An experiment was conducted to document the population dynamics of wood-boring bostrychid beetles collected from different wood yards at Mettupalayam, Tamil Nadu. The abundance of wood boring beetles showed that out of 455 individual beetles collected from different wood pieces, 319 beetles belonged to the family bostrychidae. *Sinoxylon sp.* (Coleoptera: Bostrychidae) was the dominant species accounting 76.70 percent. Diversity indices were calculated for the wood-boring beetles recorded as Shannon Diversity Index (H) (1.34), Species richness (Margalef) (0.43), Species Diversity (D) (3.67) and Pielou's Species Eveness (0.97). The number of exit holes were evaluated, which showed that the wood samples from sites 3, 4 and 5 had significantly higher number of exit holes than those recorded at sites 1 and 2. The size of exit holes bored by beetles showed that the wood samples of teak, silver oak, neem and eucalyptus have the maximum number of exit holes with 1.1-2.0 mm

Keywords: *Bostrychids; Wood boring beetles; Abundance*

Introduction

Bostrychid beetles have worldwide distribution but are mainly found in tropical and arid regions. New geographical records continue to be added from all over the world (Liu 2010). One of the most characteristic signs of infestation is the exit holes created by the adults at emergence, which are perfectly circular with varying diameters depending on the wood-boring species (Herald *et al.,* 2009). The boring activity of larvae typically caused damages and adult beetles in the stems, branches and twigs of dead, and damaged or stressed hosts (Halperin and Geis 1999; Liu *et al.,* 2008). Tunnelling through the host tissues lead to extensive frass-filled galleries (El Obied 1998; Beaver *et al.,* 2011). It was because of the ability of the larvae and some adults to reduce the wood into powdery frass that the beetles are of considerable economic importance to forestry and the timber industries, especially in countries within the tropics (Liu *et al.*, 2008; Beaver *et al.*, 2011). Wood-damaging Bostrychidae of the genus *Sinoxylon* is commonly found in tropical areas, especially in arid regions, where they damage a wide range of soft and hardwoods (Bushara, 1981). They had also been reported on fruits and food crops. *Sinoxylon conigerum* Gerstäcker (Coleoptera: Bostrychidae) has been reported to attack pigeon pea *Cajanus cajan* (L.), mango trees, *Mangifera indica* L., cassava stems, *Manihot esculenta* Crantz, cotton dry roots, *Gossypium hirsutum* L. and branches of guava, *Psidium guajava* L. (Balasubramanya *et al.*, 1990; Tomimura, 1993). *Sinoxylon senegalense* Karsch is the most notorious pest of the whitethorn acacia, *Acacia seyal* (Fabaceae Mimosoideae) native to Kenya (Orwa *et al.*, 2009). *Acacia tortilis* is also infested by *Sinoxylon crassum*, while, *Sinoxylon anale* and *Sinoxylon unidentatum* are the most destructive beetles of rubber-sawn wood in southern Thailand (Halperin and Geis 1999; Liu *et al.*, 2008). *Sinoxylon anale* was also a serious pest of agricultural, forest, and forest product industries, especially very harmful to trees, bamboo and wood (Liu *et al.*, 2008).

Materials and Methods

The study was conducted at Forest College and Research Institute, Mettupalayam, to assess the seasonal incidence of wood-boring bostrychid beetles on different wood. Five wood depots located at Mettupalayam were selected, and infested samples of economically important woods *viz.*, silver oak, teak, neem, eucalyptus and rose wood were collected. The wood samples were cut into pieces, each measuring 20 cm, and placed in clear plastic containers. They were kept in the laboratory for 3 months at 26 ± 1°C temperature and 60 ± 10 % relative humidity (RH) for the emergence of positively phototropic beetles as described by Sittichaya and Beaver (2009). The wood samples were weighed at the beginning and end of the experiment to determine the mean percent damage caused by wood-boring beetles. The number and size of the exit holes found on the wood samples were measured using a calliper and recorded. The sizes were classified into five groups, namely less than 1 mm, between 1.1- 2.0, 2.1 - 3.0, 3.1 - 4.0 and greater than 4 mm. The emerging adult beetles were handpicked using soft forceps and camel hair brush, and placed in killing jar with ethyl acetate for morphological identification. Sampling was done periodically twice a week for three months.

The abundance of wood boring beetle species was calculated as percentage of the total number of individual beetles collected. The composition of wood-boring beetles were subjected to the Shannon index ($H^1 = \Sigma P_i \log P_i$ where P_i is the relative abundance of the i^{th} species) and evenness ($E^1 = H^1 / \log S$, where S is the number of species) to determine species diversity and species evenness as described by Magurran (1988). Mean intensity, abundance and prevalence of associated natural enemies were quantified as described by Rozsa *et al.* (2000)

Data on the distribution of associated natural enemies, levels of infestation by bostrychid beetles, and size of exit holes were subjected to a one-way analysis of variance. Damage by wood-boring beetles was expressed as a percentage (Initial weight - Final weight)/100. Significance means were separated using the Student- Newman–Keuls Test at a<0.05. Shannon diversity index (H^1) (Shannon and Weaver, 1949; Brower and Zar, 1984), richness (R) Margalef (1958), and evenness (E) (Pielou, 1969) were calculated to evaluate species diversity of the wood boring and predatory beetles using Pc-ord 4.0 (Mc Cune and Mefford, 1999)

Diversity indices was collected by applying the following equation

$H^1 = \Sigma P_i \log P_i$

$E = H^1 / H^1 \max$

$= H_o \max$

$R = (n_i - 1) / Ln(N)$

$i = 1;2;3;S$

P_i = proportion of the individual in the i^{th} species

N_i = number of the individual in the i^{th} species

N = total number of individuals

Results and Discussion

Abundance and distribution of beetles

A total of 455 individual beetles belonging to five genera (anobiids, bostrychids and weevils) were recorded during the study. Among these, 319 were identified as wood-boring beetles, mainly four genera from the families of bostrychidae (Table1). The wood boring beetles recovered from wood depots were dominated by the family bostrychidae ranging from 65.00 to 74.66% of the total abundance.

Evaluation of species diversity of the wood-boring beetles

Diversity indices were calculated for the total number of 455 individual beetles recovered. Shannon Diversity Index (H) (1.34), Species richness (Margalef) (0.43), Species Diversity (D) (3.67) and Pielou's Species Evenness (0.97) were recorded. *Sinoxylon* sp was observed as the major wood boring beetle and registered throughout the sampling period lasting 31 weeks during the study period. The highest population of beetles *viz.,* 25 numbers *Sinoxylon* in weeks 8 and 10, 6 numbers of *Lyctus* sp in week10 and 6 numbers of *Dinoderus* sp in week 10 were recorded from bamboo. The Shannon diversity index of rubber wood-boring beetles in the eastern coastal area was significantly ($p < 0.01$) greater than that in the western coastal area in Southern Thailand (Kangkamanee *et al.*, 2011)

Evaluation of the number of exit holes of the wood-boring beetles

There was a significant difference in the number of exit holes made by the wood-boring beetles on the pieces of silver oak. It was observed that samples from sites 3, 4, and 5 had a significantly higher number of exit holes than those recorded at sites 1 and 2 (Table 4). The mean number of exit holes was comparable in all three sites at 3, 4, and 5. In teak, the lowest mean number of exit holes was made by the wood-boring beetles. Site 1 had the highest exit holes of 3.86, while site 5 had the lowest number of 1.21. In neem, the lowest exit holes (19.09) were recorded at site 1 and site 5 had the highest exit holes of 20.50. In rosewood, the lowest exit holes of 2.66 was recorded at site 3 and mean exit holes was recorded to be the highest of 3.14 and 3.21 in sites 1 and 2, respectively.

Size of exit holes and damage on economically important woods

Different size of exit holes was calibrated on the bark of the wood samples collected (Table 5). There was a significant difference in the size of exit holes in silver oak. A higher number of the exit holes measured between 1.1 - 2.0 mm followed by ≤1.0mm with a mean of 33.6 ±2.36 and 16.4 ±3.68, respectively. Exit holes larger than 4 mm had the lowest mean of 0.3 ±0.67. In teak, the lowest number of exit holes was observed and a higher number of exit holes measured between 1.1 - 2.0 mm followed by ≤1.0mm with mean of 1.4±1.07 and 0.3 ±0.67, respectively. Exit holes larger than 4 mm in teak had the lowest mean of 0.1±0.31. In neem, higher number of exit holes measured between 1.1-2.0 mm followed by ≤1.0 mm with mean of 17.4±2.98 and 7.6±2.50, respectively. Exit holes larger than 4 mm in neem had the lowest mean 0.4 ±0.51. In eucalyptus, a higher number of exit holes measured between 1.1-2.0 mm followed by ≤1.0 mm with mean of 25.11±1.61 and 3.33±1.73, respectively. Exit holes larger than 4 mm had the lowest mean of 0.44±0.72. In rosewood, a higher number of exit holes measured between 1.1 - 2.0 mm followed by ≤1.0 mm with a mean of 1.33± 1.11 and 0.66 ± 0.70, respectively. Exit holes with the lowest mean of 0.44 ±0.72 were observed in the exit hole size larger than 4 mm and ≤1.0 mm, respectively. In all the wood species, a maximum number of exit holes measured between 1.1-2.0 mm followed by ≤1.0 mm. Jackman (2006) reported that the exit hole size of bostrychidae is 1/8 to 3/8 inch (3.175 mm to 9.525 mm)

Wood-damaging Bostrychidae of the genus *Sinoxylon* is commonly found in tropical areas, especially in arid regions, where they damage a wide range of soft and hardwoods (Bushara, 1981).

Table 1. Percent contribution of the family bostrychidae recovered from wood depots at Mettupalayam

Study site	Beetles collected (Numbers)	Bostrychidae (Numbers)	Percent contribution
M/s. Sajeena Timber, Kothakiri road, Mettupalayam	120	78	65.00
M/s. Sudharsan Timber, Annur road, Mettupalayam	90	65	72.20
M/s. Gayathiri Timber, Odonthurai, Mettupalayam	110	78	70.90
M/S. Alim Timber, Ooty Road, Mettupalayam	60	42	70.00
M/s. Vijay sawmill, Kothagiri	75	56	74.66

Road, Mettupalayam			

Table 2. Wood boring beetles recovered from wood depot between September, 2019 to February, 2020

Insect species	No. of beetles	Percent (%)
Sinoxylon sp	349	76.70
Lyctus sp	90	19.78
Dinoderus sp	10	2.19
Scolytus sp	06	1.31

Table 3. Evaluation of species diversity of the wood boring beetles

Shannon Diversity Index (H)	1.34
Species richness (Margalef)	0.43
Species Diversity (D)	3.67
Pielou's Species Eveness	0.97

Table 4. Mean number of exit holes of wood boring beetles on economic important woods

Wood species	Site	N	Number of exit hole
Silver oak	1	14	27.76 ± 3.53^{a}
	2	12	28.58 ± 1.31^{a}
	3	14	31.20 ± 1.81^{b}
	4	12	32.00 ± 2.31^{b}
	5	12	32.10 ± 2.24^{b}
	1	15	3.86 ± 2.09^{e}
	2	14	2.85 ± 1.79^{c}

Teak	3	12	1.66 ± 1.07^{b}
	4	13	3.15 ± 1.90^{d}
	5	12	1.21 ± 1.12^{a}
Neem	1	11	19.09 ± 2.07^{c}
	2	13	19.61 ± 2.14^{ab}
	3	12	20.08 ± 1.62^{bc}
	4	16	19.62 ± 1. 82^{a}
	5	14	20.05 ± 1.50^{b}
Eucalyptus	1	12	24.58 ± 1.44^{d}
	2	13	23.46 ± 2.22^{c}
	3	14	24.85 ± 1.95^{e}
	4	12	22.91 ± 2.10^{b}
	5	12	22.50 ± 2.15^{a}
Rose wood	1	13	3.15 ± 1.46^{ab}
	2	14	3.21 ± 1.80^{a}
	3	15	2.66 ± 1.54^{d}
	4	16	2.93 ± 2.20^{b}
	5	12	2.83 ± 1.94^{c}

Mean followed by the same letter in the column are not significantly different at P≤0.05

Table 5. Mean size of exit holes made by the wood boring beetles on different woods

Mean ± SE					
Size of the exit hole (mm)	**Silver oak**	**Teak**	**Neem**	**Eucalyptus**	**Rose wood**
≤ 1.0	16.4 ± 3.68^{b}	0.3 ± 0.67^{b}	7.6 ± 2.56^{b}	3.33 ± 1.73^{b}	0.44 ± 0.72^{c}

1.1 – 2.0	33.6 ± 2.36[a]	1.4 ± 1.07[a]	17.4 ± 2.98[a]	25.11 ± 1.61[a]	1.33 ± 1.11[a]
2.1 – 3.0	2.6 ± 1.42[c]	0.3 ± 0.48[c]	1.4 ± 1.17[c]	1.88 ± 1.96[c]	0.66 ± 0.70[b]
3.1 – 4.0	1.0 ± 1.24[d]	0.2 ± 0.42[d]	0.6 ± 0.69[d]	0.55 ± 0.72[d]	0.44 ± 0.72[c]
> 4	0.3 ± 0.67[e]	0.1 ± 0.31[e]	0.4 ± 0.51[e]	0.44 ± 0.72[e]	0.22 ± 0.44[d]
CD (0.05)	0.34	0.01	0.17	0.236	0.014
SE.d	0.16	0.006	0.085	0.113	0.007
CV (%)	2.46	2.38	2.46	2.86	1.81

SE- Standard Error

* Mean ± in the same column followed by the same letter do not differ significantly at $P \leq 0.05$ (Newman–Keuls Test)

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Ethics statement

No specific permits were required for the described field studies because no human or animal subjects were involved in this research.

Originality and plagiarism

The entire research work was originally carried out at Forest College and Research Institute, Mettupalayam during 2019-2022 and based on the research outcome the article is written and published

Consent for publication

All the authors agreed to publish the content.

Competing interests

There was no conflict of interest in the publication of this content

Data availability

All the data of this manuscript are included in the MS. No separate external data source is required. If anything is required from the MS, certainly, this will be extended by communicating with the corresponding author through corresponding official mail; asokan.g@tnau.ac.in

Authors contributions

Research – Tamil Nadu Agricultural University, Idea conceptualization-Asokan, Senthilkumar, Experiments-Asokan, Senthilkumar, Aruna, Guidance – Balasubramaniam , Writing original draft – Asokan Writing-reviewing &editing – Asokan , Aruna

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