BIODIVERSITY OF SERICIGENOUS SATURNIIDAE OF MANIPUR IN INDIA

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[Luikham, R., Keisa, T. J., Bidyapati, L., Sinha, A. K. & Oeigler, R. S. 2017. Biodiversity of sericigenous Saturniidae of Manipur in India. Munis Entomology & Zoology, 12 (2): 500-507**]**

ABSTRACT: The biodiversity of sericigenous Saturniidae producing silks was surveyed, and thirteen different species were collected from the Northeast region of India, particularly Manipur. The collected wild silk moths belong to six genera, *Antheraea, Actias, Attacus, Samia,Cricula* and *Rhodinia*. Of these, seven species belong to *Antheraea*, two to *Samia* and one each to *Actias*, *Attacus*, *Criculaand Rhodinia*. *Antheraeaproylei, A. pernyi, A. assamensis*, and *Samia ricini* are commercially exploited for seed and silk production, while *Antheraea roylei*, *Antheraea compta, Samia canningi*, *Attacus atlas*, *Antheraea frithi* and *Antheraea helferi* yield silk products but are yet to be exploited. Seasonal incidence pattern of wild silkworm species revealed that *S. canningi* and *A. atlas* occurred throughout the year except December and January. The population densities of a few species like *R. newara, A. helferi, A. roylei* and *A. compta* were low and scattered. However, *A. frithi* population reached more than one lakh in wild condition indicating the best adaptability to build up the population in the prevailing ecological conditions of the region. Economic parameters among the sericigenous species indicate highest 642±33.10m filament length in *A. frithi*, which is comparable to the commercially exploited species, *A. proylei* (635±48.05m). Hence sericigenous saturniids have economic parameters and so need multiplication for silk production. Therefore, the need of the hour is conservation of sericigenous species in the region, thereby improving the livelihood of the tribal inhabitants and maintaining the ecological balance.

KEY WORDS: Biodiversity, sericigenous Saturniidae, silk moths, silk yarn, conservation

Northeast India constitutes a part of the Indo-Burma biodiversity hotspot and is the centre of wild silkworm culture which includes muga, eri, tropical tasar, temperate tasar and fagara silks (Peigler & Naumann, 2003) and only the first four are commercially exploited for production of silk (Jolly et al., 1976).The family Saturniidae comprises of 1800 or more species all over the world of which the Indian sub-continent, extending from Himalayas to Sri Lanka possesses over 50species (Nässig et al., 1996). About 80 species of silk producing insects of economic valueoccurred in Asia and Africa (Jolly et al., 1975).Out of those, 24 species are enlisted from North-east India alone (Singh & Chakravorty, 2006). Some wild sericigenous insects not only yield valuable silk, but also play an important role in the ecosystem (Thangavelu, 1991) for conservation and utilisation of biodiversity (Frankel, 1982; Peigler, 1993). Among insects, *Antheraea* species are an important and significant component of faunal genetic diversity used in the assessment, conservation and utilization of biodiversity. The conservation protects diverse gene pool, habitat or ecosystem and makes a link for genetic diversity utilization (Metzler & Zebold, 1995). At present many important

genetic resources of wild silkmoths are facing major threats due to large area of forest under shifting cultivation. It is necessary to tap the other important genetic resources of wild silkmoths to boost the silk production, thereby helping in conservation and utilisation of biodiversity.

Considering the economic importance of the sericigenous saturniids, an attempt has been made to survey and collect the sericigenous insects along with their hostplant found in different districts of Manipur.Conservation of naturally grown food plants along with regional biodiversity of wild silk moths will contribute substantial economic gain to tribal people. Hence, many important genetic resources, diversity and natural distribution pattern and conservation of wild silk moth are generally lacking which can be commercially exploited for their valuable silk and boost up the economy of the tribal populace.

MATERIALS AND METHODS

Surveys and collection of wild sericigenous Saturniidae along with their food plants were conducted at various places in nine districts of Manipur viz., Bishnupur, Chandel, Churachandpur, Imphal East, Imphal West, Tamenglong, Thoubal, Senapati and Ukhrul. During the survey, tribal inhabitants, farmers and private rearers were interviewed for information on presence/absence of wild sericigenous insects in their locality. The incidence pattern of all the wild silk moth species was recorded throughout the year.The economic parameters of the collected wild species cocoons were analysed by measuring the length, breadth, cocoon weight, shell weight, shell ratio and productivity of silk yarn.

RESULTS

Sericigenous Saturniidae were collected from different parts of the state, of which 13 species were identified along with its 22 different food plants in Table 1. More than 22 different host plants were exploited by diverse sericigenous insects and maximum numbers of species were found on the host plants of *Lithocarpus dealbata, Litsea polyantha* and *Ricinus communis*. The wild eri silk, *S. canningi* feeds on more than eight host plant species. The collected wild silk moths belong to six genera, *Antheraea, Actias, Attacus, Samia, Cricula* and *Rhodinia*. Of these, seven species belong to *Antheraea*, two to *Samia* and one each to *Actias*, *Attacus*, *Cricula* and *Rhodinia* (Fig. 1).

The distribution patterns of the species in nine districts of hill regions were Chandel, Churachandpur, Senapati, Tamenglong and Ukhrul and valley were Bishnupur, Imphal East, Imphal West and Thoubal regions are presentedin Table 2. The total incidence population of different species was more 30,875 numbers in the hill than 5,824 numbers in the valley. *A. proylei, A. pernyi, A. assamensis* and *S. ricini* was exploited commercially by rearing, hence during population studies of the wild silk moths, commercial wild silk moth was not included. Seven numbers of different species were collected from Senapati district (1000-1800m ASL), three number of species from Chandel, Churachandpur, Tamenglong and Ukhrul. Only two species were recorded from valley regions of Bishnupur, Imphal East, Imphal West and Thoubal (Fig. 2).

Maximum individuals of 5, 520 and 230 numbers of *S. canningi* and *A. atlas* are found in the valley than 620 and 78 numbers in the hill, whereas more than 30,000 numbers of *A. frithi* cocoons were collected from the hill and only 46 numbers in the valley. The distribution pattern and number of wild silk moth species were more in the hill than in the valley. Seasonal incidence pattern of wild

silkworm species observed during 2011-15 revealed that *S. canningi* and *A. atlas* occurred almost throughout the year except December and January (Fig. 3). In Manipur, the maximum incidence of *S. canningi* was recorded from Imphal East district and minimum from Tamenlong district and occurred continuously and present throughout the year compared to the rest of the species.Similarly, the maximum incidence of *A. atlas* was recorded from Imphal East district and minimum in Senapati district. Incidences of other species were low and scattered. However, *A. frithi* occurred in large numbers more than a lakh in wild condition indicating the best adapted to build up the population in the prevailing ecological conditions of the Phaibung village (1000-1800m ASL) of Senapati district. The following species *viz*., *R. newara, A. helferi, A.roylei* and *A. compta* were found in scattered and in low numbers in Senapati district.

The cocoon analysis of different wild silk moth species indicates that male cocoon weight ranges from 2.30g in *S. canningi* to 8.82g in *Attacus atlas* and the female cocoon weight ranges from 3.50g in *S. canningi* to 11.80g in *Attacus atlas.* Among the *Antheraea* species, the highest 6.31g and 9.19g cocoon weight was recorded in male and female of *A. helferi* and minimum 3.82g and 6.20g weight shown in male and female of *A. assamensis*. However, male shell percentage is higher (8.77-15.21%) than (7.85-12.49%) in female of sericigenous saturniid. The main objective of sampling the serigenous Saturniidae was to determine the potential species that can produce utilizable silk from wild cocoons for fabric preparation. The viable cocoons were used for possible single filament length. The pierced (emerged) cocoons were used for ghicha yarn production. The single filament length of a wild sericigenous cocoon was analysed and recorded ranging from 223-642m (Fig. 5). The maximum 642m length was recorded in *A. frithi* and minimum 223m length in *A. roylei.*

DISCUSSION

Northeast India is the natural abode of many wild sericigenous species that feeds on naturally grown plants. Saturniidae or wild silk moths of the world was recorded (Regier et al., 2008), approximately of 1861 species in 162 genera and nine subfamilies. In the present observations, 13 species belonging to six genera *viz*., *Antheraea, Actias, Attacus, Samia, Cricula,* and *Rhodinia* were recorded from Manipur (Table 1). Earlier, (Thangavelu, 1991) reported nine species belonging to three genera *viz*., *Antheraea, Samia* and *Attacus* in the sub-Himalayan region and Northeast India. Kakati & Chutia, 2009 reported 14 species of eight genera, such as *Antheraea, Attacus, Archaeoattacus, Actias, Cricula, Loepa, Samia* and *Sonthonnaxia* from the Nagaland. The natural population of a few species *viz*., *R. newara, A. helferi, A. roylei* and *A. compta* were low and scattered. Sericigenous insects were not given much attention due to their unrecognised character as a result their population level declined, calls for the initiation of immediate steps towards conservation and population multiplication.

More than 22 different host plants were exploited by diverse sericigenous insects and maximum numbers of species were found on the host plants of *Lithocarpus dealbata, Litsea polyantha* and *Ricinus communis*. The wild eri silk, *S. canningi* feeds on more than eight host plant species (Table 1). Positive relationship observed between food plant and animal species richness revealed that most plant species could provide more niches for the coexistence of animal species (Hutchinson, 1959). The saturniid species exhibit genetic diversity and natural variations in the wild population indicative of specialized adaptations to specific niches (Thangavelu, 1991). The total incidence population of different

species was more 30,875 numbers in the hill than 5,824 numbers in the valley (Table 2). *S. canningi* was the most abundant species both in the hill and valley region, remains an important genetic resource for its cultivated strains *S. ricini*, which only ranks after mulberry silk (*Bombyx mori*) and tussah silk (*A. pernyi*) in world production and consumption of silk (Peigler, 2012). Among the varied species, several showed their capacity to adjust with different ecological conditions revealing their potential and genetic adaptability to struggle and sustain in varying ecological niches (Kakati & Chutia, 2009).

Economic parameters of wild cocoons revealed the highest shell percentage (13.85%) with *A. frithi* (Reeta et al., 2016*)*. The wild silk moths offer a promising future for novel silk with unique features and high economic value. In terms of filament length, *A. frithi* performed the best and deserves higher value than the commercially exploited oak tasar, *A. proylei* (Fig. 5). The present observations indicate that *A. frithi* can come up to the status of commercial exploitation and open up additional avenue in tasar silk production. Many sericigenous insects having important genetic resources may become extinct due to deforestation and adverse climatic change. Several workers have noted the importance of conserving the natural populations and habitats of these wild sericigenous insects (Singh & Suryanarayana, 2005; Devi et al., 2011; Peigler, 2012). Therefore, proper conservation and utilization of the sericigenous insects are essential for economic gain to tribal people and helps to conserve forests and regional biodiversity.

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Table 1. Distribution of wild sericigenous saturniids and its host plants in North East India.

Family	**Genus**	**Scientific name**	**Host plants**	**Distribution**
Family: Saturniidae Subfamily: Saturniinae Tribe: Saturniini	1.*Actias* Leach	*A. selene* (Hübner)	*Rhus javanica, Prunus cerasoides, Syzygium praecox, S. cumini, Ricinus communis*	Sikkim, Assam, Nagaland, Manipur
	2.*Rhodinia* Staudinger	*R. newara* (Moore)	*Syzygium cumini*	Sikkim, Meghalaya, Manipur
	3.*Antheraea* Hübner	*1.A. assamensis* (Helfer)	*Persea bombycina, Litsea polyantha, L. citrata,*	Sikkim, Assam, Nagaland, Meghalaya, Manipur
		2.*A. pernyi* (Guérin-Méneville)	*Quercusserrata, Q. griffithii, Lithocarpus dealbata*	Manipur
		3.A. frithi Moore	*L. dealbata, Q. serrata*	Sikkim, Manipur, Meghalaya
		4. A. compta Rothschild	*L. polyantha, L. citrata, P. bombycina*	Sikkim, Assam, Nagaland, Meghalaya, Manipur
		5. A. roylei Moore	*L. dealbata, Q. serrata*	Arunachal Pradesh, Manipur, Nagaland, Jammu & Kashmir
		6. A. helferi Moore	*L. dealbata, Q. serrata*	Sikkim, Manipur
		7. A. proylei Jolly	*Quercusserrata, Q. griffithii, Lithocarpus dealbata*	North eastern and north western states of India
	4.*Cricula* Walker	*C. trifenestrata* (Helfer)	*P. bombycina*	Assam, Manipur, Meghalaya, Nagaland
Tribe: Attacini	1. *Attacus* Linnaeus	*A. atlas* (Linnaeus)	*Maesa indica, Psidium guajava, Delonix regia*	Arunachal Pradesh, Assam, Manipur, Meghalaya, Nagaland, Sikkim
	2.*Samia* Hübner	1.*S. canningi* (Hutton)	*R. communis, H. fragrans, Manihot utilissima, Zanthoxylu marmatum, Zizyphus jujuba, polyantha, P.*	Assam, Manipur

			guajava, Plumeria acutifolia	
		2.S. ricini (Wm Jones)	*R. communis, Manihot esculenta, Heteropanax fragrans*	North Eastern states

Table 2. Total number of species traced in the hill and valley regions.

Sl. No.	Species	Valley region (750 – 950m ASL)	Hill region (1000-1800m ASL)
1	*Samia canningi*	5520	620
2	*Attacus atlas*	230	78
3	*Antheraea roylei*	0	26
4	*Antheraea frithi*	46	30,000
5	*Actias selene*	28	52
6	*Rhodinia newara*	0	16
7	*Antheraea compta*	0	32
8	*Antheraea helferi*	0	43
9	*Criculatri fenestrata*	0	8
Total		5,824	30,875

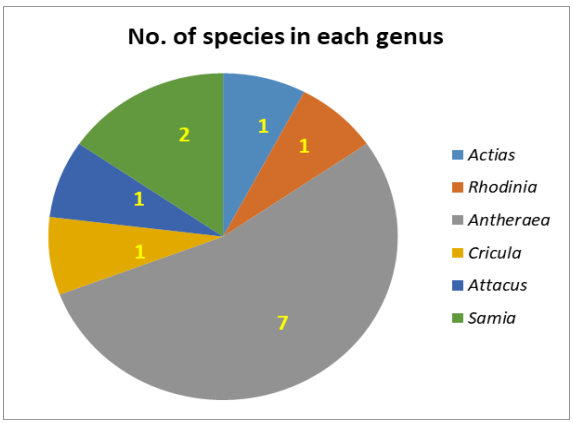


Figure 1. Distribution of species in each genus.

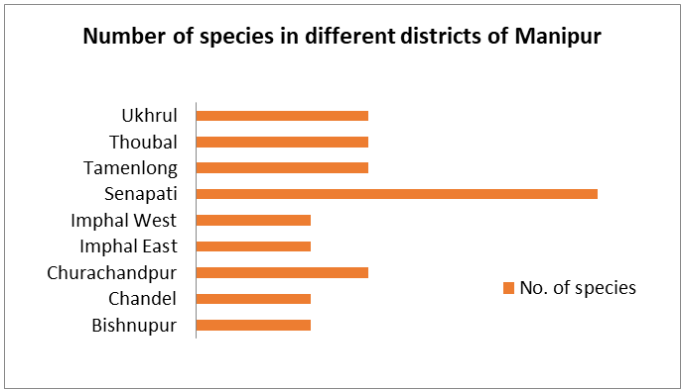


Figure 2. Incidence of species in different districts of Manipur.

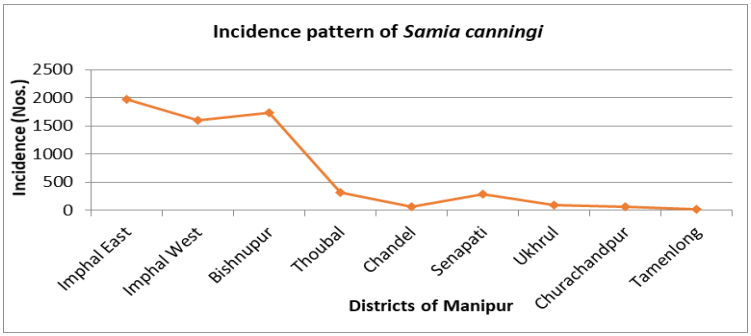


Figure 3. Incidence of *Samia canningi* in different districts of Manipur.

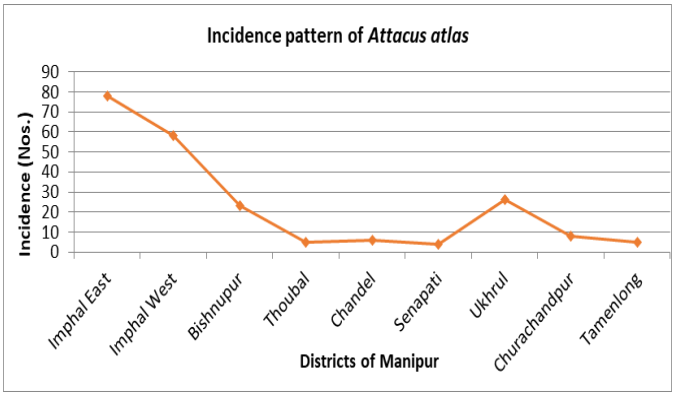
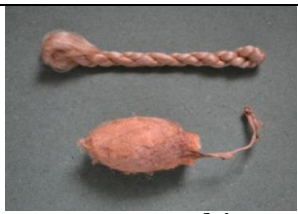


Figure 4. Incidence of *Attacus atlas* in different districts of Manipur.



A. proylei
Filament length: 635±48.05m

A. frithi
Filament length: 642±33.10m

A. assamensis
Filament length: 296±43.12m

A. roylei
Filament length: 223±36.09m

S. canningi
Filament length: 357±71.81m

R. newara
Ghicha length: 672 ±48.45m

A. selene
Filament length: 273±52.15m

A. atlas
Filament length: 286±59.46m

A. helferi
Filament length: 639±49.14m

A. compta
Filament length: 288±37.12m

Figure 5. Single filament length of wild sericigenous cocoon yarn.