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Preliminary Survey On Insects And Spiders From Papumpare And East Kameng District, Arunachal Pradesh With Commercial And Economic Value

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Abstract: Arunachal Pradesh is situated in the eastern region of greater Himalaya ranging from Karakoram to Patkai Hills. Present investigation was aimed to document the wild sericigenous insects, beautiful and colourful insects with potential for utilization in cosmetic industry, insects with nutritional importance and golden silk producing spiders from Papumpare and East Kameng district of Arunachal Pradesh. The data were collected through extensive field survey in certain localities and interaction with local people. A total of 17 species of insects belonging to 11 genera and 1 species of spider having prospect for commercial importance have been recorded during this study. These include the sericigenous lepidopterans *Attacus atlas, Actias maenas, Actias selene, Actias parasinensis, Antheraea frithi, Loepa katinka, Cricula trifenestrata, Samia canningii*; the beautiful and colourful orthopterans *Sanaa intermedia, Sanaa regalis, Schistocerca shoshone*; nutritionally important hemipterans *Coridius nepalensis, Phromnia marginella*; nutritionally and medicinally important hymenopterans *Apis dorsata, Apis indica, Apis florea* and golden silk producing spider *Nephila maculata.*

Key words: Silk, Nutrition, Colour, Cosmetics

Introduction

Insects are the most abundant and most diverse group of animals on earth. The estimates range from 5 to 30 million species (Espirito-Santo and Fernandes, 2007). In north-east ecoregion of India around 3,624 species of insects has been recorded while, a large number of insects are hitherto unexplored from the region (Tripathi and Barik, 2003). Out of recorded species, only a few sericigenous insects, honey bee and lac insect, *Laccifer lacca* has been exploited for commercial purposes. Iron gall ink is the most important ink in the history of Western civilization. It is made of vitriol, gum, water and most notably, tannin extracted from aleppo galls. Oaks produce aleppo galls in response to a chemical secreted by *Cynips gallae tinctoria*. Historically, adult females of Mediterranean scales, *Kermes iticies* and *K. vermilio*; oriental lac insect, *Kerria lacca*; Central European scales, *Porphyrophora polonica* and new world cochineal scales, *Dactylopius coccus* were used in preparation of red dye by a number of indigenous people. Now, cochineal dye is the most important one and is chiefly used as biological stain. Even, 3,600 years ago, insects, their parts and toxins were used to alleviate a number of human ills. Chinese researchers have discovered that beetles such as *Mylabris phalerata*, *M. chichori* have antitumor properties (Irwin and Kempmeier, 2002).

However, there is lots of scope for the use of insects in cosmetics and wild silk industry. Therefore, present investigation was aimed to document the wild sericigenous insects, beautiful and colourful insects with potential for utilization in cosmetic industry and spiders with potential to

possess economic value from Papumpare and East Kameng district of Arunachal Pradesh, the easternmost state of Eastern Himalaya. The studied area falls within the Himalaya biodiversity hotspot of the world which has a remaining vegetation of 185,427 km^2 compared to original extent of 741,706 km^2 (Conservation International, 2014).

Materials and methods

An extensive field survey in certain localities of Papumpare and East Kameng district of Arunachal Pradesh was conducted during the year 2013. Villagers were also interacted as guidance for this purpose where necessary. Papumpare district is located between latitude 26°55′ – 28°40′ N and longitude 92°40′ - 94°21′ E with altitudinal variation ranging from 170-800 m MSL (NIC - Papumpare, 2015). Another study area, East Kameng district is located between latitude 26°56′ – 27°59′ N and longitude 92°36′ - 93°24′ E with altitudinal variation ranging from 363-1906 m MSL (NIC - East Kameng, 2015). These areas receive an average rainfall of 08 mm (December) - 493 mm (June) and vegetation cover includes – Tropical evergreen forest, tropical mixed evergreen forest and secondary forest. Temperature ranges from 12 to 34°C and monsoon period extends from April to October (IMD, 2013).

The insects and spiders were sampled with insect sampling net, identified using standard keys, photographed and released again (Hampson, 1892; Pocock, 1900; Song, 2009; Eades *et al.,* 2014). Collection was avoided due to the guidelines of restricted access to threatened, likely threatened, endemic and rare species in 'Arunachal Pradesh (biological diversity) rules 2011' to ensure conservation (Department of Environment and Forest, Govt. of Arunachal Pradesh, 2011).

Results

A total of 17 species of insects belonging to 11 genera viz. *Attacus* Linn, 1766; *Samia* Hubner, 1819; *Actias* Leach, 1815; *Antheraea* Hubner, 1818; *Loepa* Moore, 1858; *Cricula* Walker, 1858; *Sanaa* Walker, 1870; *Schistocerca* Stall, 1873; *Coridius* Illiger, 1807; *Phromnia* Stall, 1858; *Apis* Linn, 1767 and one species of spider from the genus *Nephila* Leach, 1815 having prospects for commercial importance were recorded during the study. These include the sericigenous lepidopterans viz., *Attacus atlas* Linn, 1758; *Samia canningii* Hutton, 1860; *Actias selene* Hübner, 1807; *Actias maenas* Doubleday, 1847; *Actias parasinensis* Brechlin, 2009; *Antheraea frithi* Moore, 1859; *Loepa katinka* Westwood, 1848; *Cricula trifenestrata* Helfer, 1837 (Fig. 1 a) which are well known for silk thread production. The beautiful and colourful orthopterans viz., *Sanaa intermedia* Beier 1944 (Fig.1 b); *Sanaa regalis* (Brunner von Wattenwyl, 1895) (Fig. 1 c); *Schistocerca shoshone* (Thomas, 1873) (Fig.1 d) are significant for production of dye and cosmetics. Hemipterans like *Phromnia marginella* (Olivier, 1791) (Fig.1 e, f); *Coridius nepalensis* (Westwood, 1837) (= *Aspongopus nepalensis* Westwood, 1837) (Fig.1 g) which are known for their nutritional value have been recorded during the study. Nymphs of *P. marginella* are streamed on boiled water or grilled on charcoal wrapping with banana leaves and

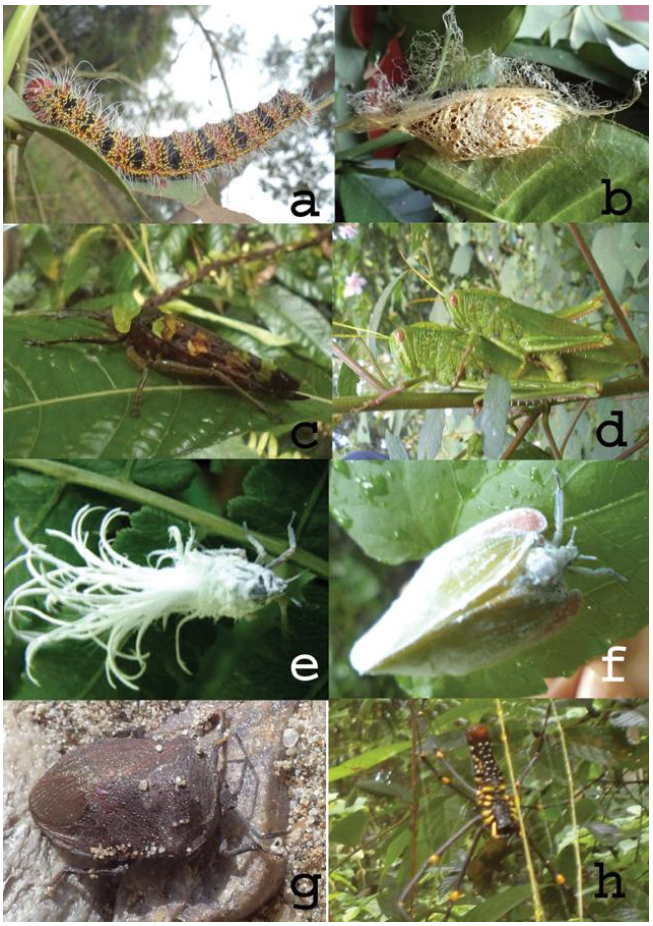

Fig. 1. a. Caterpillar of *Cricula trifenestrata*, b. Cocoon of *Cricula trifenestrata*, c. *Sanaa intermedia,* d. *Schistocerca shoshone,* e. *Phromnia marginella* (Nymph), f. *Phromnia marginella* (Adult bug), g. *Coridius nepalensis*, h. *Nephila maculata* with golden silk thread.

served. Nutritionally and medicinally important hymenopterans that have been recorded during the present study were *Apis dorsata* Fabricious, 1793; *Apis indica* Fabricious, 1793; *Apis florea* Fabricious, 1787. A single species of arachnid, *Nephila maculata* Fabricious, 1793 (Fig. 1 h) which is well known for production of golden silk is available in this region. The list of collected data of the present study on insects and spiders is presented in Table 1.

During the interaction with the villagers, it has been understood that consumption of certain related species of *Coridius nepalensis* induces undesired effects like mental disorder and paralysis immediately (about half an hour) following the meal.

Discussion

Sericigenous insects

We recorded the presence of 8 species of wild silk moths viz. *Attacus atlas*, *Samia canningii, Actias parasinensis*, *Actias*

Table 1. Industrially important Insects and spider recorded from Papumpare and East Kameng district of Arunachal Pradesh.

Sl. No.	Name of the species	District	Months of documentation
Order: Lepidoptera			
Family: Saturniidae			
1	*Attacus atlas*	PP	September
2	*Samia canningii*	PP	May, September
3	*Actias maenas*	EK, PP	September, December
4	*Actias selene*	PP	August
5	*Actias parasinensis*	PP	August, December
6	*Antheraea frithi*	EK, PP	April, September, December
7	*Loepa katinka*	PP	November
8	*Cricula trifenestrata*	EK	January
Order: Orthoptera			
Family: Phasgonuridae			
9	*Sanaa intermedia*	EK	September
10	*Sanaa regalis*	EK	September
Family: Acridiidae			
11	*Schistocerca shoshone*	EK, PP	Annual
Order: Hemiptera			
Family: Fulgoridae			
12	*Phromnia marginella*	EK	May (Nymph), September (Adult)
Family: Dinidoridae			
13	*Coridius nepalensis*	EK, PP	May-August (Cucurbitaceae plant),November-February (Dry river bed)
Order: Hymenoptera			
Family: Apidae			
14	*Apis dorsata*	EK	Annual
15	*Apis indica*	EK, PP	Annual
16	*Apis florea*	EK, PP	Annual
Order: Araneae			
Family: Nephilidae			
17	*Nephila maculata*	EK	Annual

*(PP = Papumpare; EK= East Kameng)

maenas, *Actias selene*, *Actias parasinensis*, *Antheraea frithi*, *Cricula trifenestrata* in studied area of Arunachal Pradesh. Entire Eastern Himalaya region is characterized by different climatic environment due to altitudinal variation and forest pattern. Due to these factors, other species of sericigenous moths are reported in north eastern region of India. Earlier, Seitz (1933) recorded 19 wild sericigenous insects from the entire north eastern India including Sikkim. Kakati and Chutia (2009) recorded 14 species of wild silkmoths from Nagaland which is one of the frontier states of north east India sharing its border with Arunachal Pradesh and famous for its Patkai Hill range. Recently, Gogoi *et al.* (2014) documented 12 species of Saturniid moths from West Siang district of Arunachal Pradesh.

Cosmetics and colour yielding insects

The insects recorded during the present investigation like *Sanaa intermedia*, *Sanaa regalis* and *Phromnia marginella* could be potential sources of colour and dye to be used for cosmetics, textile and other areas of industries. Many species of insects like *Porphyrophora polonica*, *P. hameli*, *Kermes vermilio*, *Kerria lacca* have been known to be used for production of dyes (Bozena and Golan, 2008). In the present study, the speculation has been made that the insects could be source of colours and cosmectis looking at the colour pattern of the insects while, a systematic biochemical study shall be required to get an ultimate product. Preparation of colour and dye from natural resource (e.g. insects) is associated with limiting factors e.g. instability, long time consumption during dying, need of mordant, tedious collection and extraction procedure relative to colour value (Visalakshi and Jawaharlal, 2013). Around the turn of the 20th century, scientists began formulating synthetic colors, derived from coal tar, to replace the natural ones. Unfortunately, these synthetic alternatives have proven to have their own slew of problems. The safety of products containing artificial colors has been a point of debate for decades. The adversaries claiming that they are toxic, carcinogens and contributors of "attention deficit hyperactivity disorder" (ADHD) (Kobylewski and Jacobson, 2010; Pereira and Alves, 2012). Due to the toxic effects of certain available cosmetic and demand of natural mimics, it may be presumed that dyes and colour with less toxicity and high market demand can be extracted from certain insects.

Food, nutrition and medicine

There are a number of records of edible insects consumed by a certain ethnic groups of people in Arunachal Pradesh (Kato and Gopi, 2009; Chakravorty *et al.*, 2011). Among these edible insects the *Coridius nepalensis*, known as "tari", in local dialect of by "Galo" tribe is very often sold in market for purpose of consumption (Kato and Gopi, 2009). It has been observed that the insect is collected by the local people mainly from the dry river bed during the winter session (November to February) in Arunachal Pradesh. This choice as a source of food in north east India has been recorded as early as beginning of 20th Century (Distant, 1906). The present study revealed that local people in Arunachal Pradesh eat this insect either in roasted form or making paste of uncooked adult and mix with the rice. The legs, head and antennae are discarded at the time of preparation. It has been noted from the local people that very often person gets intoxicated after consumption of "tari". However, it is not clearly known if the intoxication is due to volatile compound secreted by metathoracic gland of *C. nepalensis* or consumption of related species of the insect due to misidentification at the time of collection. *C. nepalensis* has many other related species morphologically indistinguishable for a layman. There are 10 other related species of *C. nepalensis* that has been recorded earlier in India (Distant, 1906).

Phromnia marginella is known to produce a white watery secretion having a narcotic effect. In the present investigation *Phromnia marginella* was documented in the forest of surveyed areas of Arunachal Pradesh. There is no information on this insect product being consumed by any group of local people of the region. However, it has been reported earlier that the white secretory product of the insect is edible and used to consume by people of certain parts of India (Distant, 1906).

Honey bee is well known among the people of north east India including Arunachal Pradesh. People are very much

aware of the availability and habitat of these insects in wild condition which is considered as significant for its nutritional and medicinal value. The local people gather honey from wild honey bee nest lighting fire which could be a threat for honey bee population in the region. During the study period, we recorded only 3 species of wild honey bee, the giant *Apis dorsata,* the Indian *Apis indica* and the dwarf *Apis florea*. Earlier, Kundu *et al.* (2007) recorded another two species of honey bee viz. *Trigona laeviceps*, *Trigona ventralis* from Arunachal Pradesh. It is believed that gathering of honey from the wild nest following a means without disturbing the local environment could be beneficial for conservation of honey bee population and the microhabitats of the ecosystem.

Sericigenous spider

The golden silk spider, *Nephila maculata* famous for its golden silk produced from its silk gland has been recorded during the present study in Arunachal Pradesh. Earlier, Biswas and Biswas (2006) recorded 2 species of *Nephila*, (*N. maculata* and *N. dirangensis*) from Arunachal Pradesh. The male and female *Nephila* are distinctively different in their morphology. The females *Nephila* is known for its largest size of orb webs (up to 1.5 m in diameter) among the web making spiders. The web is characterized by distinctive golden silk spreading from trees to herbs in wild condition. It has been speculated that the fibers in the web made by the spider possess high tensile strength as because, the web remain undamaged and capable of trapping water droplets following hail storms in studied area of Eastern Himalayan region. In addition, this web is used as trap for others organism which is used as food of the spider. It has been reported earlier that the tensile strength of the web fiber is similar to nylon, kelvar and steel of high tensile strength (Hsia *et al.,* 2011). Dragline silk of the spiders are known to be stronger than steel and tougher than kelvar, a synthetic fibre used in body armour. Earlier studies showed that by controlling the reeling speed through the spinneret, the spider can modulate the beta sheet crystallite size and tensile strength of the silk (Du *et al.,* 2006). Studies investigating the effects of reeling speed demonstrate 3 nanometer nanocrystals that have exceptionally high tensile strength (Nova *et al.,* 2010). Besides, the silk of spiders are known to exhibit stability over a wide range of temperature (Ando *et al.,* 1980). *Nephila* males are relatively diminutive in comparison to their conspecific females, providing an example of extreme sexual dimorphism (Coddington *et al.,* 1997; Vollrath, 1998; Hormiga *et al.,* 2000). Unlike the silkmoths, which produce diverse silk due to diversity of species, these spiders are known to possess a number of silk glands that produce silk of specific colour and functions (Sarvanan, 2006; Nagaraju, 2011).

Spider silk fibres are also known to increase cell adhesion and proliferation. They also mediate normal growth of nerve cells acting as base. For this reason, the spider silk are being used for nerve regeneration by the researchers (Allmeling *et al.,* 2006; Yang, 2007, 2008).

This study indicated the tremendous prospects in Arunachal Pradesh for the strengthening the rural economy utilizing the potentials in the sericulture, apiculture, colour and dye yielding insects and spiders producing golden silk. The region is considered as the natural home for a number of silk moths and golden-silk spiders, honey bee species and beautiful insects. These natural resources are spreading over a wide range virgin land and forest areas of Arunachal Pradesh, many of which are hitherto believed to be unknown. A systematic bioecological study will unfold the natural history of the species and ecosystem. It will provide the technique for mass rearing of the targeted species for their sustainable use. Considering its potentiality, utilization of all the available natural resources for the development of the insect based industry is the call of time for the region. Mass rearing of the insects following region based indigenous technology could provide new areas of bioprospecting from these valuable insect fauna of Himalayan biodiversity region.

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