Sericulture is an art of rearing silkworm for the production of cocoon which is the raw material for the production of silk. Since ages, silk and silk fabrics have attracted mankind and have found their place among the most valued and elegant human fabrics. Silk has played an important role in the economic life of man ever since its discovery more than 4000 years ago.

The world of silk has been divided into two distinct sectors – the mulberry and the non-mulberry/wild silk (Vanya silk). Mulberry silks are produced by Bombyx mori L. belonging to the family Bombycidae which feeds on mulberry leaves (Morus sp.). Non-mulberry silks are mostly produced by sericigenous insects belonging to the family Saturniidae. Most of the species in this family are wild and oligophagous to polyphagous in nature. Non-mulberry sericulture consists of varieties of silks, viz., muga, eri, tasar, etc. Muga silk is produced by Antheraea assamensis (Helfer) which is commonly distributed in North-Eastern India, particularly in the Brahmaputra basin of Assam. Eri silk is produced mainly by the domesticated silk moth, Samia ricini (Donovan). Tasar silk is of two types, namely tropical tasar and temperate tasar or oak tasar. Tropical tasar is produced by Antheraea mylitta Drury and temperate tasar is produced by Antheraea proylei Jolly, A. roylei (Moore), A. frithi Moore and A. pernyi Guérin-Méneville. Oak tasar silkmoths are wild in habitat and feed on different species of oak (Quercus sp.). The commercially exploited oak tasar silkmoths are Antheraea pernyi of China, Antheraea proylei, Antheraea roylei, Antheraea frithi of India and Antheraea yamamai of Japan.

In India, oak tasar culture is practiced in the sub-Himalayan belt of India extending from Jammu and Kashmir, Himachal Pradesh and Uttaranchal in the North-West to Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram and Nagaland in the North-East. In Manipur, its cultivation is practiced in all the districts namely, Imphal East, Imphal West, Tamenglong, Bishnupur, Churachandpur, Senapati, Chandel, Thoubal and Ukhrul. A. proylei is the only oak tasar silkworm which is commercially

CHAPTER I:
INTRODUCTION
reared for the production of oak tasar silk in India. It is a hybrid produced by crossing the native Himalayan *A. roylei* (chromosome no. *n* = 30) with the Chinese counterpart *A. pernyi* Guérin-Méneville (chromosome no. *n* = 49).

*Antheraea proylei* (Lepidoptera: Saturniidae) is a true hybrid species evolved by crossing an indigenous *Antheraea roylei* Moore and its Chinese counterpart *Antheraea pernyi* Guérin-Méneville as the component races. Tutt (1902) has reported the cross breeds and reciprocal cross breeds between *A. pernyi* and *A. roylei*, but they were unable to find out whether the crossbreeds were fertile or not. Tutt (1902) named *pernyi* ♀ × *roylei* ♂ as hybrid *moorei*, and *roylei* ♀ × *pernyi* ♂ as hybrid *kirbyi*. However, the concept of priority is irrelevant in this case since the names proposed for hybrids are not treated in the International Code of Zoological Nomenclature. These have never been used either in any scientific or even in any sericultural document for more than 50 years—hence, they were considered as *nomen oblitum* (Jolly, 1976). Instead, Jolly (1973) had independently established the name *A. proylei*. Arora and Rao (1976) reviewed against recognizing species of this widely variable entity as hybrids are not viable species and the nomenclature does not strictly fall under the International Code of Zoological Nomenclature. Jolly (1976) has given the justification for giving a new name of the hybrid individual that the reciprocal hybrid produces successive generations of characteristic individuals which has become established as a "population" of its own (Arora and Rao, 1976) and was no longer regarded as a mere hybrid individual.

In 1973, Jolly make a successful rearing of the hybrid up to 12 generations and independently described the name "*Antheraea proylei*" explaining that the "p" stands for the female parent *A. pernyi*; and "roylei" of the male parent *A. roylei*. He, however, furnished neither the description nor any figure of the hybrid, except some notes on improvement in the quality of reelable silk (double the reelability) contents from either of the parents. The aforesaid work on interspecific hybrid has also been acclaimed by Tazima (Jolly, 1971) as the first example of interspecific hybrid in insects which can so far be obtained were sterile. However, second generation cannot be obtained from crossing of first generation parents.
The oak tasar silkworm is a semi-domesticated insect exhibiting weak bivoltinism. Generally, the first crop rearing starts from the first/second week of March when the natural sprouting of oak plants takes place (i.e., in the spring season, hence termed spring crop). An additional subsidiary crop, second crop can also be taken up during autumn by breaking the pupal diapause through the exposure of seed cocoons to photoperiodic treatment for about 30 days at 17 hrs light a day and by following light pruning of oak bushes well in advance (autumn crop rearing). The spring crop is the main seed as well as commercial crop. The silkworms usually take 35 - 45 days to complete their larval development. Larval development occurs in the field, while the egg, pupal and adult stages in the laboratory.

The oak tasar silkworm is oligophagous in nature. The main food plants of oak tasar silkworms belonged to *Quercus* species of the family Fagaceae and order Fagales. The available species of the oak belt includes *Q. accutissima* Carruthers, *Q. griffithii* Hook and Thoms., *Q. semecarpifolia*, *Q. incana*, *Q. himalayana* and *Lithocarpus dealbata*. Some species of *Castanopsis* (Fagaceae) and *Salix* (Salicaceae) are occasionally visited by this silkworm viz., *Castanopsis hystrix* Hook and Thoms., *Salix viminalis* Linn (Seth, 2000). The different varieties of oaks and their ranges in India are presented in Table 1.1.

In 1962, trials were made to introduce oak tasar silkworm in the Ramsu area at Batote under Central Tasar Research & Training Institute (CTR&TI) (Central Silk Board), Ranchi. But it was not acquired a commercial status so far. Then in 1969, this hybrid has been introduced for the first time in Manipur under CTR&TI so as to exploit the abundant oak plantations of the state. Then, Regional Tasar Research Station was established in 1974 at Imphal for the cause of the oak tasar industry in NE region.

The valuable works on introduction of oak tasar culture in India has laid the very foundation for development of oak tasar culture which was a new avenue in the silk industry. Manipur has the unique privilege of taking up this pioneering work in North East India since 1969 - 70. This is a landmark in the history of Indian Sericulture. At present, the entire state of Manipur is hovering with sericulture activities as the largest producer of oak tasar in India.
Table 1.1: Exploitable area of oak rangelands in India.

<table>
<thead>
<tr>
<th>State</th>
<th>Species available</th>
<th>Exploitable area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Manipur</td>
<td>Q. acutissima, Q. griffithii</td>
<td>20,000</td>
</tr>
<tr>
<td>2. Nagaland</td>
<td>Q. acutissima, Q. griffithii</td>
<td>10,000</td>
</tr>
<tr>
<td>3. Mizoram</td>
<td>Q. acutissima, Q. griffithii</td>
<td>2,000</td>
</tr>
<tr>
<td>4. Arunachal Pradesh</td>
<td>Q. acutissima, Q. griffithii, Q. lanuginose, Q. semecarpifolia, Q. semiserrata</td>
<td>2,000</td>
</tr>
<tr>
<td>5. Assam</td>
<td>Q. acutissima, Q. griffithii</td>
<td>1,000</td>
</tr>
<tr>
<td>6. Himachal Pradesh</td>
<td>Q. lanuginose, Q. semecarpifolia</td>
<td>3,000</td>
</tr>
<tr>
<td>7. Uttarakhand</td>
<td>Q. lanuginose, Q. semecarpifolia</td>
<td>5,000</td>
</tr>
<tr>
<td>8. Jammu &amp; Kashmir</td>
<td>Q. lanuginose, Q. semecarpifolia</td>
<td>1,000</td>
</tr>
<tr>
<td>Total:</td>
<td></td>
<td>44,000</td>
</tr>
</tbody>
</table>

(Source: Regional Tasar Research Station, Central Silk Board, Imphal)
Fig. 1.1: Map of Manipur showing different districts
Manipur, a state in the North-Eastern part of India, lies between 23°50’ N and 25°41’ N Latitude and 93°2’ and 94°47’ E Longitude (Fig 1.1). It is situated in the far-flung North-Eastern corner of India. The confines of the state touch Nagaland in the North, the Chin Hills and Myanmar in the East, Mizoram in the South and in the West it borders Cachar and the North Cachar hill district of Assam. It covers an area of 22,347 sq. km. The altitude of the state is extremely variable, ranging between 200 to 2,994 m above Mean Sea Level. The average annual rainfall, maximum and minimum temperatures likewise, vary in different parts of the state. However, in a generalized way it may be stated that the average annual rainfall is approximately 175 cm; whereas the average minimum and maximum temperatures ranges between 0.5°C and 32.5°C respectively. Generally, three distinct seasons, viz., winter, spring and monsoon with a less distinct season of autumn or retreating monsoon are recognizable, and sub-tropical to temperate types of climate prevail in the state depending upon elevations.
Fig. 1.2: Map of Manipur illustrating district-wise distribution of oak tasar rearing localities.
For the sustainable development of oak tasar culture continuous efforts have been made to evolve new breeds by the scientists of the RTRS, Imphal relentlessly for more improvement in yield contributing characters. Thus, silkworm breeders contributed to the production of oak tasar with the evolution of new silkworm breeds viz., PRP\(_2\), PRP\(_3\), PRP\(_5\), PRP\(_{12}\), RPP\(_4\) and Blue through hybridization and selection (Singh et al., 2000, 2008). They were isolated from the segregating progenies of the backcross involving the parents \textit{A. roylei} \((n = 30)\) and \textit{A. proylei} \((n = 49)\). It was reported that breeds PRP\(_2\), PRP\(_3\), PRP\(_5\), PRP\(_{12}\), RPP\(_4\) exhibited better performances in eight economic characters namely fecundity, hatching (%), larval weight, cocoon yield/dfl, ERR (%), cocoon weight, shell weight and filament length and the breed Blue in six economic characters viz., fecundity, average cocoon yield, ERR, cocoon weight, shell weight and filament length over that of \textit{A. proylei}. Regional Tasar Research Station, Central Silk Board, Imphal is being maintained and conserved \textit{A. proylei} and the evolved breeds. They play an important role in the production of oak tasar in Manipur and other NE and NW states of India. Different places of Manipur in all the districts are involved in oak tasar rearing (Fig. 1.2).

In India, \textit{A. proylei} is the only oak tasar silkworm which is commercially exploiting for oak tasar silk. Oak tasar silk is a rough, coarse and nubby silk usually with natural shades of beige. The oak tasar silk fibres are comparable to that of mulberry and muga with respect to lustre and grace. The tasar silk exceeds mulberry silk in strength and durability, but does not dye as well (Singh et al., 2012).

For sustainable development of oak tasar industry, study of \textit{A. proylei} and other breeds is very important. Scanty works has been done on this aspect and there is a wide gap in the characterization of \textit{A. proylei} and breeds at morphological, cytogenetical and molecular level. To bridge the gap proper characterization is required. Understanding of the basic genetic mechanism of these genotypes is essential to give rise to high yielding and disease resistant varieties with distinct quantitative and qualitative traits and for their conservation and further breeding programmes. The information generated from this investigation will help in the commercial exploitation of the abundantly available oak flora of Manipur and other sub-Himalayan states which will enhance the economy.
of the poor hill tribes as well as the economically backward communities residing in the foot hills of the states.

Keeping these views in mind, the present study has been undertaken with the following objectives:

1. Morphological characterization of *Antheraea proylei* and the breeds *viz.*, PRP\(_2\), PRP\(_3\), PRP\(_5\), PRP\(_{12}\), RPP\(_4\) and Blue.
2. Study of rearing performances of *A. proylei* and the breeds.
3. Cytogenetical characterization of *A. proylei* and the breeds.
4. Estimation of genetic diversity among them through molecular analysis.