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Conservation Need of Tropical Tasar Silk Insect, *Antheraea Mylitta* Drury (Lepidoptera: Saturniidae)-Strategies and Impact

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Abstract: The commercially important tropical tasar silk insect, *Antheraea mylitta* Drury (Lepidoptera: Saturniidae) is having 44 ecoraces distributed along central India (12-31°N latitude and 72-96°E longitude) with varied phenotypic, physiological and behavioral characters. The sericigenous insect feeds primarily on *Shorea robusta* (Sal), *Terminalia arjuna* (Arjun), *Terminalia tomentosa* (Asan) besides variety of secondary and tertiary food plants available in tropical deciduous forests of West Bengal, Jharkhand, Bihar, Orissa, Chhattisgarh, Madhya Pradesh, Uttar Pradesh Maharashtra and Andhra Pradesh states of India. Some wild tasar ecoraces like, Raily (Chhattisgarh), Modal and Jata (Orissa), Sarihan and Laria (Jharkhand), Bhandara (Maharashtra) and Andhra (Andhra Pradesh), besides domesticated Daba and Sukinda are contributing for livelihood and alleviating the socio-economic status of around hundred and fifty thousand Indian tribal families. However, the extensive collection of nature grown cocoons, rapid deforestation and human encroachment to insect habitats has declined ecorace population. So, there is an imperative need to involve and educate local tribals on cocoon collection and insect conservation to save from extinction. The orderly involvement of forest, tribal welfare, sericulture departments and Non Government Organizations (NGOs) along with local aboriginals can up-keep the silk insect conservation for sustainable utility. This coordinated management of tasar insect population will also help in rejuvenation of their semi-domesticated relative seri-biodiversity and integrated bio-resource (flora and fauna) management of insect ecozones.

Key words: *Antheraea mylitta*, aboriginals, conservation, strategies, sustainable utilization

INTRODUCTION

Agro forestry and economic wild insect conservation are inter-disciplinary, multi-sector approaches of land use and its prime objective is to protect environment to maintain the natural integrity (Gill and Lal, 2002). The ecological education, water resource, energy, forest and wildlife managements are needed for an environmentally sustainable rural development in India (Raffi and Ramanujam, 2001). India has unique distinction of producing all varieties of silk i.e., mulberry, eri, tasar and muga, with special reference to tropical tasar silk, due to immense diversity in climatic conditions coupled with wide-ranging ecological habitats (Jolly *et al*., 1974; Reddy, 2009). Silk is a proteinaceous fibre derived from cocoon (pupal nest) spun by the caterpillars belongs to genus *Bombyx* feed on *Morus alba* and other wild silkworms, *Philosamia ricini* (eri), *Antheraea assama* (muga) and *Antheraea mylitta* (tasar), belongs to Saturniidae (Rao *et al*., 2004; Suryanarayana and Srivastava, 2005).

The tropical tasar silkworm, *Antheraea mylitta* feeds primarily on sal (*Shorea robusta*), asan (*Terminalia tomentosa*) and arjun (*Terminalia arjuna*) and few other food plants of secondary importance are *Zizyphus mauritiana*, *Terminalia paniculata*, *Anogeissus latifolia*, *Syzigium cumini*, *Careya arborea*, *Lagerstroemia parviflora* and *Hardwickia binata* (Mahapatra, 2009). The polyphagous nature of the tasar silkworm is a boon to its rural tribal rearers as their livelihood linked with the collection and sale of nature grown tasar wild cocoons (Nayak *et al*., 2000; Hansda *et al*., 2008; Ojha *et al*., 2009). The creation of employment, alleviation of poverty and elevation of socio-economic status of tribals are the unique features of tropical tasarculture (Suryanarayana and Srivastava, 2005; Manohar *et al*., 2009a, b). Hence, the conservation of naturally grown tropical tasar food plants along with silk insect will contributes for the bio-diversity maintenance besides their sustainable utilization by forest dwelling aboriginals.

PRESENT STATUS

The tasarculture is a cottage, agro-forestry and forestry based industry that provides sustainable livelihood to several rural communities and country to earn foreign exchange. The global production of raw silk is approximately 70,000 tones per year (Sohn, 2003) and the production of 16245, 1530, 428 and 117 MTs of mulberry, eri, tasar and muga raw silk respectively during 2007- 08 by India indicates the impact of silk industry on the county's economy (Reddy, 2009). The tasar silk industry generates cocoons through commercial rearings along with the collection from natural habitats by many Indian tribal families as tradition since immemorial. Though, the tropical tasar silkworm has 44 ecoraces, very few are domesticated and the larger commercial potential is yet to explore (Hansda *et al*., 2008; Ojha *et al*., 2009). Further, the varied voltinism, higher interference of environmental fluctuations on crop success and returns made the industry unreliable compared to other agro enterprise (Thangavelu, 2002; Nayak *et al*., 2000). The tasarculture provides livelihood and employment for 1.5 lakh tribals from Jharkhand, Chhattisgarh, Orissa, Madhya Pradesh, Uttar Pradesh, West Bengal, Bihar, Maharashtra and Andhra Pradesh states. The practice involves chain of activities like collection of cocoons from nature or rearing of silkworm on nature grown host plants or on economic plantations to rise cocoons, which are utilized by reelers and weavers to produce yarn and fabrics. The silk industry has lot of socio-cultural and traditional linkages in India and plays a vital role on rural economy and hence, the aboriginals are practicing tasarculture simultaneously with agriculture (Thangavelu, 2002; Reddy, 2009). Although, India's stands second largest silk producer in the World after China, it accounts for only 5% of silk market and the production potential of tasar silk can be enhanced, which is unique of the country and grow very little in rest of the wild.

CONSERVATION NEED

The ancient man lived in a hunter gather society which depends on biodiversity sustenance, but the advancement in agriculture, industries and urbanization has decreased emphasis on biodiversity. The understanding biodiversity and its preservation are the most important global challenges that biologists are facing today. The guiding principle must always be that no living species however insignificant or useless it may appear to be, should be allowed to go extinct. The destruction of natural habitats, over exploitation, induction of alien species, control of related pests and predators, pollution besides, deforestation are the main reasons for the diminution of tasar insect wild life. On realization, that the erosion of

biodiversity may threaten the very existence of life, has awakened man to take steps to safeguard it. The promotion of Indian tropical tasar (vanya) silk as green occupied a unique market status and a source of cash income for many rural tribal communities. Also, the wild tasar ecoraces are very important for evolution and breeding of new silkworm strains with desired economic characters. Hence, preserving tasar food plant and insect is inevitable for sustainable utilization, besides exploiting market avenues to progress rural India (Thangavelu, 2002).

The wild tasar-biodiversity of India is facing unparallel threat of extinction from their natural habitat due to environmental degradation and other related issues. The alarming decline in ecorace natural multiplication is attributed due to rampant collection, rapid deforestation and industrialization of their natural habitats (Sinha and Sinha, 1994; Nayak *et al*., 2000; Hansda *et al*., 2008). Further, the conservation focus and timely attention has not been given to smaller species like wild insects of high commercial importance (Wilson, 1987) which led to rapid dwindling of natural population even in their core habitats. The studies based on quantitative traits needs analysis to understand the genetic basis of their phenotypic variability (Rao and Shamitha, 2000; Rao *et al*., 2004) to generate substantial information on the genetic diversity of these populations so as to develop appropriate strategy for its conservation in their natural habitat. However, the said approach requires the conserved tasar seri-biodiversity initially, as the insect conservation; investigative studies and sustainable utilization are interlinked. In order to preserve the natural biodiversity present among these populations, the systematic attempts are required to conserve the wild seri biodiversity for ecological balance and for sustainable economic viability (Hansda *et al*., 2008; Reddy *et al*., 2009; Ojha *et al*., 2009).

CONSERVATION STRATEGIES

The widespread realization that biodiversity is strongly modified by changes in global environment has generated strategies to conserve it around the world. The assessment of the genetic diversity present within a species (Barrett *et al*., 2001; Manohar *et al*., 2009c) and the wider base of natural populations of tasar flora and insect (Srivastava *et al*., 1996) and tribal farmers who are interested in tasarculture are the prerequisites of conservation programme. The tasar wild insect needs conservation both under short and long term measures and on and off their habitat for the sustainable utility and socio-economic up-liftment of rural tribals (Srivastava *et al*., 2009). The economic values, employment potential and global demand in general and bio-diversity conservation in particular (Mahapatra, 2009) have motivated the conservation of tasar insect wildlife which found rapidly depleting and getting endangered with the following methods.

Core Zone Fortification

The interior forest patch (core-zone) in the tasar insect native habitat has to be selected and allowed the insect to reproduce *suo moto* and fortify its population. The restriction must be that nobody be allowed collecting any of tasar insects life form (egg, larva, cocoon and adult moth) from the demarcated core-zone, except for research purposes. This zone serves as a gene pool for defined tasar wild ecorace which is allowed to multiply amidst utter silence and serenity. The insect population of this zone, on proliferation, however, will move to adjacent buffer and peripheral zones on its own helping local tribal farmers for its sustainable utilization.

Host Plant Demarcation

A patch of tasar insect host trees in the forest has to be selected, pollard at 5-6 height, clear from pests and predators and optimum aseptic conditions to be maintained in and around areas. The garlands of cocoons relate to native tasar wild insect to be hanged on to the trees adopting free spacing in between the garlands. The host tree areas to be covered with net of the desired size based on selected and maintained canopy. The temporary shade of paddy straw or wild grass has to be fixed around the trees to avoid pupal mortality. The moths emerged from the cocoons will mate; lay eggs on the host plants and helps insect population to multiply rapidly under offered protection from diseases, pests and predators.

Cocoon Preservation in Pagoda Device

The cocoons collected from wild to be preserved in hanging position inside the umbrella shaped pagoda device erected under host trees. The device made of indigenous wooden poles, paddy straw and the sides to be covered with net to provide protection to the cocoons from pests and predators. The cocoons preserved in the device will have better environment and protection for better coupling and egg yielding. The gravid female moths and eggs are to be safely transferred to their habitats for better proliferation of insect. The cocoons so preserved in pagoda device can also be hanged on host trees of forests, just prior to their emergence.

Moth, Egg and Larva Release

The male and female moths emerged from the preserved cocoons to be released in the selected core forest area. The male and female moths on mating inside net, the gravid female moths are to be released every day in the evening on to the host plants of the forest. As also the eggs produced at base camp of peripheral zone, using cocoons of the same population and same area are to be placed in separate leaf cups of the host plant and tied vertically so that rain water does not enter in to the leaf cups allowing the hatched larvae crawl on to the plants. Alternatively, the young age (chawki) worms are to be reared in chawki garden up to 2nd or 3rd day and subsequently released in natural habitat for better multiplication of the insect.

Follow up and Exploration of Fresh Zones

After the release of cocoons, moths, eggs and larvae, the interference of insect core zone to be cordoned off and a time bound ban on collection of cocoons in the peripheral area also to be imposed to improve insect population and subsequent sustainable utilization. The management activities at times also contribute to habitat loss, which needs to be corrected in time to enhance the protection process (Wilhere, 2002). The conservation status to be assessed at regular intervals using suitable sampling methods, to provide follow up in containing diseases, pests and predators and to check the conservation impact. The survey to explore fresh zones should be conducted with time schedule to benefit the involved tribal farmers, whose livelihood is linked with income from the collection and sale of nature grown tasar cocoons.

Conservation of Insect along with Related Flora

Basically, the conservation plan should encompass whole spectrum of biota and activities ranging from eco systems at macro level (*in situ* conservation) and at micro level (*ex situ* conservation). The conservation (breeding) of endangered wild tasar silk insect species in India is a must activity. The intervention is needed from sericulture and forest

departments along with native tribal rearers from the habitats of tasar silk insect for *ex situ* conservation, as those areas are under their vicinity and control. The conduction of regular census on flora and fauna in collaboration with scientific institutions and non government organizations helps assessing the field conditions and silk insect species which need conservation. The *in situ* management study helps to address the cause of decline/extinction of wild insect population in its natural habitat, apart recommending inputs for improvement. The extensive cocoon collections, disease out-breaks, predators attack, besides the species suitability are to be enlightened to the native rearers for their effective participation in insect conservation.

Conservation through Eco-Park Creation

In traditional practice, the tasar larvae feed on irregularly distributed food plants leading to management problems and loss due to pests, diseases and natural hazards. The newly developed economic plantation method with close spacing can enhance foliage quality even under rain-fed and sub-marginal soils (Sinha and Sinha, 1994: Thangavelu, 2002; Rao *et al*., 2004). Till now the research has been stopped on exploration of species diversity as an individual population, but never talks about what its role in the total ecosystems. This agri-silvicultural and tasarculture potential can create sustainable returns, employment and rise in the living standards of forest-dwelling peoples, besides conserving the endangered tasar silk insect. The critically endangered species can be conserved through *ex situ* strategy by establishing eco-parks, a simulated ecological niche as like their native habitat. To bring in a holistic development of eco-parks and to achieve the main objective, we need to infuse more technical and scientific standards in operation of eco-parks and change the general perception of said parks from being mere picnic spots to more of a scientific institution.

Involving VSSs, TVSs, VFCs, JFCs and NGOs

The ecological education and wildlife management is needed for an environmentally sustainable rural development. The forest based host plants are providing livelihood for a vulnerable section of society, besides wildlife conservation. Here, the role of Vana Samrakshana Smithies (VSSs), Tasar Vikas Smithies (TVSs), Village Forest Committees (VFCs) and Joint Forest Management committees (JFMs) will play a vital role in conserving the forest flora and fauna (Balaji, 2001; Sethi and Singh, 2001; Berkes, 2004) and earn income as many of such society members being beneficiaries. The studies on people's participation in aforestation and conservation programmes indicate higher involvement of landless people over marginal and small farmers (Pande *et al*., 2002). The Non Government Organizations (NGOs) have understood the potential of tasarculture in tribal up-liftment and educating the importance of tasar insect wildlife along with food plants for their livelihood. They work on various elements of the tasar value chain to reduce uncertainty in returns, increase productivity, help poor people retain more of the added value and finally to motivate the members of societies for their active participation in conservation of tasar food plants and silk insect. The NGOs could locate the lacunae responsible for uncertainty in tasarculture and educated tasar rearers to set right their mistakes to make tasarculture a successful agro forestry venture.

CONSERVATION IMPACT

The tasarculture is an important co-discipline of applied forest biology that needs special attention to promote conservation and sustainable utilization of natural resources,

as they contribute to rural tribal socio-economic and cultural heritage. The forest conservation needs basic information on ecology, environmental factors, climatology, flora, fauna and their inter-relationship in the proposed site, while the life cycle, reproductive biology, voltinism and population dynamics of tasar insect of the ecozone reveal their critical requirements. The commercial attributes of the insect, viability in the offered eco-climatic condition suggests their biotic and economic potential. Insects have highly organized sensory and neuro-motor systems more comparable to those of vertebrates and the interactions between insects and plants in case of herbivorous insects, or hosts for parasitic insects are often called co-evolutionary (Carlsson and Berkes, 2005). They respond to altered conditions by genetic change and this heterogeneity or elasticity within insect species allows persistence to efficiently face the environmental change (Edward *et al.,* 2002; Kakati and Chutia, 2009). Thus, exploration of host plant-tasar insect interactions is critical to attain optimal wild silk insect conservation, their sustainable utilization and commercial exploitation. The single-species conservation is argued to preserve many other species by default which is known as umbrella effect (Novotny *et al*., 2002) and the conservation of silk insect wildlife indirectly conserves forest bio-diversity. The conservation management of any ecosystem should be an integrated endeavor concerning lower and higher flora along with invertebrate and vertebrate fauna. Hence, the co-ordination among agencies implementing conservation, irrespective of plant or animal, big or small in size, commercially important or not, together with beneficiaries can have better impact and success. Hence, the tasar silk iasect being viable forest wealth and source of income to forest based tribals, need focus for conservation so as to exploit the available huge tropical tasar food plant resource.

CONCLUSION

The India stands out as a treasure trove of natural tasar silk insect wealth, despite countless obstacles to their conservation and habitat restore. The tasarculture has been considered as an agro based industry of rural poor with potential of additional employment. The tasar activities are attended by local aboriginals and many of them are the members of VSS, TVS, VFC, JFC societies functioning for forest conservation. The problems though, manifold with conservation of tasar insect, the co-ordinate efforts from forest and sericulture departments with participation of forest based societies of native tasar aboriginals will facilitate conserving unique vanya seri-biodiversity as most viable resource. The conservation of tasar silk insect wildlife by feasible strategies, not only sustains its population and income of tasar rearers, but also augments the other endangered flora and fauna in the wild by default.

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