the vegetation. After approximately 1 min of this rejection dance by the female, the male flew. Five males in succession were rejected by one female. Males that landed near a mated pair flew off after several seconds of wing fluttering by all three.

Estimates of the density of adult butterflies in the wet meadow in August 1988 ranged from 1 to 25/10 m^2 (1000 to 2500 adults/ha) in areas with large *P. natans* patches. The population explosion of *L. hyllus* may have resulted from the effects of the extreme drought conditions throughout central Minnesota during the spring and summer of 1988, which exposed shoreline that was colonized by *P. natans* and *P. coccineum*. These *Polygonum* have both terrestrial and aquatic forms (Gleason, H. A. & A. Cronquist, 1963, Manual of vascular plants of northeastern United States and adjacent Canada, D. Van Nostrand Co., Princeton, NJ, 810 pp.) enabling them to invade rapidly and dominate. We did not observe large numbers of bronze coppers in 23 previous years of normal and above normal precipitation. The presence of several female bronze coppers visiting flowers approximately 1 km from the meadow suggests that dispersal may be an important means by which this butterfly exploits temporary wetland habitats.

After twelve additional months of below average precipitation, the lake level had dropped several more feet by 20 August 1989, exposing additional shoreline. Areas that had been newly exposed in 1988 were extremely dry. Plant diversity had increased at the expense of the *Polygonum* species. The dense stands of *P. coccineum* observed in 1988 were greatly reduced except for newly exposed areas of the slough and shoreline. Searching the area on 20, 21, 22, and 26 August 1989 revealed only 10 adult male *L. hyllus*. Explanations of the population crash may include parasitism and a reduction of suitable larval foodplants.

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DAVID B. MACLEAN, *Department of Biological Sciences, Youngstown State University, Youngstown, Ohio 44555* AND BONNIE K. MACLEAN, *Department of Biology, Thiel College, Greenville, Pennsylvania 16125.*

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SEASONAL VARIATION OF OCCURRENCE OF DEFORMED COCOONS OF THE TASAR SILK MOTHS *ANTHERAEA MYLITTA* (DRURY) AND *ANTHERAEA PAPHIA* (L.) (SATURNIIDAE) IN INDIA

Additional key words: bipupate, bishellate, flimsy cocoons.

The tasar silk moth, *Antheraea mylitta* (Drury), is trivoltine in India and is reared in the Rainy season (July–August), Autumn (September–October), and Winter (November–December). By contrast, *Antheraea paphia* (L.) is reared only during the Autumn season; although it multiples in nature during the Rainy and Winter seasons, its economic performance at these times is poor. Tasar culture is an age-old practice in Orissa and good cocoons are more highly valued in tasar commerce than deformed cocoons because of the former's better reelability (ability to be spun onto a reel with a continuous filament for production of fine fabrics). Although the occurrence of deformed cocoons in the tasar crop is a common phenomenon, the seasonal variation of their occurrence has not been

TABLE 1. Seasonal variation in percentage occurrence of deformed cocoons of *A. mylitta*[1] and *A. paphia*.[1]

Season	Tasar species with commercial names of the seasonal crops	Deformed cocoons (%)			
		Bipupate	Bishellate	Flimsy	Total
Rainy	*A. mylitta* (Ampatia)	0.047	0.698	6.130	6.875
	A. paphia (Godamodal)	0.008	0.154	0.125	0.287
Autumn	*A. mylitta* (Daba)	0.060	1.073	25.912	27.045
	A. paphia (Bogei)	0.021	1.868	10.412	12.301
Winter	*A. mylitta* (Jadei)	0.131	1.479	47.559	49.169
	A. paphia (Patrajhada)	0.005	0.132	0.122	0.259

[1] N = 10,000

documented, which creates confusion in commercial sectors during grading and trading. This study documents the relative abundance of deformed cocoons produced in different rearing seasons of the year.

Because of the availability of both *A. mylitta* and *A. paphia*, the important tasar zones of Singda, Kendujuani,Thakurmunda, Sarat, and Kaptipada in the Mayurbhanj district of Orissa were chosen for this study. Ten thousand cocoons of both *A. mylitta* and *A. paphia* were collected at random in five equal groups from the above five localities during each of the three rearing seasons in 1987. The Rainy season and Winter cocoons of *A. paphia* were collected from natural populations in the forests of the study sites. All other samples were taken from commercial cultures. Deformed cocoons were sorted from good cocoons in each sample group.

Deformed cocoons were classified as either bipupate (a single cocoon having two pupae), bishellate (two cocoons joined by their shells, which interrupts the continuity of the silk filament), or flimsy (cocoons having thin and unsubstantial shells without strength or solidarity) (Nayak, B. K., M. L. Gupta, B. C. Guru & B. N. Satpathy, 1987, Towards classification of cocoons in tasar silk insect *Antheraea mylitta* Drury (Lepidoptera: Saturniidae), Sericologia 27:505–512). The mean percentages of each class of deformed cocoons during each season were calculated and the data were analyzed by season and by species (Table 1).

In *A. paphia*, the percentage of deformed cocoons was highest (12.30%) during the Autumn Season, followed by Rainy Season (0.29%) and Winter Season (0.26%) (Table 1). In *A. mylitta*, the highest percentage (49.17%) of deformed cocoons appeared during the Winter season, followed by Autumn season (27.05%) and Rainy season (6.88%). Trends in the occurrence of deformed cocoons of both *A. paphia* and *A. mylitta* were found to be similar with respect to each type of cocoon deformity.

The percentage of flimsy cocoons in *A. mylitta* increased dramatically from the Rainy season (6.13%) to Winter Season (47.60%), whereas the number of flimsy cocoons was negligible (0.12%) in natural populations of *A. paphia* during the Rainy and Winter seasons.The maximum number of deformed cocoons of *A. paphia* occurred during Autumn Season and was probably due to its rearing in semidomesticated conditions. Such rearing is against its natural tendency, as it usually grows only during the Rainy and Winter seasons. In the case of *A. mylitta*, the percentage of deformed cocoons was much greater and might result from the frequent handling of the silkworm during the semidomesticated rearing.

The higher frequency of deformed cocoons in the Winter Season might result from physioclimatic stress at the onset of Winter in the places of study. Nayak et al. (Nayak, B. K., A. K. Dash, P. K. Das, A. K. Sasmal & B. N. Satpathy, 1986, Sex association in doubled cocoons of tasar silk insect *Antheraea mylitta* Drury (Lepidoptera: Saturniidae), Sericologia 26:285–290) assumed that physiological, physical, or environmental stress causes formation of bipupate (double) cocoons. However, studies should be carried out

to determine the effects of varying climatic conditions and of handling of silkworms during rearing and spinning on the frequency of deformed cocoons.

A. K. DASH* AND B. K. NAYAK, *State Sericultural Research Station, Baripada-757001, Orissa, India.*

* Present address: Dept. of Zoology, Dr. J. N. College, Salt Road, Balasore-75601, India.

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