CHAPTER VI

SUMMARY

The Northeast region of India is unique for its diverse floral and faunal composition. This region is the natural abode and homeland for a large number of insects. Butterflies belong to the order Lepidoptera that are the most familiar and easily recognizable of all other insects.

Among the various groups of butterfly families, family Pieridae is an important group characterized by flashing white and yellow colour. Of more than 1000 species of Pieridae butterflies identified all over the world (Carter, 1992), the distribution of these butterflies shows maximum diversity in this part of the country. The butterflies included under this group are economically important because the larvae of some species (Pieris brassicae, Pieris rapae, Pieris canidia) are pests of various cultivated crops and medicinal plants. Pierid butterflies have aesthetic value and are used as ornamental insects in some parts of the world.

In the present study, the field studies (survey, population density and pest status) of Pierid butterflies were carried out in South Kamrup area of Assam and the laboratory works (Biology) were performed in the Department of Zoology, Gauhati University. A thorough survey was conducted to estimate the diversity of Pierid butterfly along with their larval and adult food-plants in the entire South Kamrup area. The survey was carried out from March 2004 to January 2006, in an area of 2,130 sq. km., using the line-transect method of Pollard et al. (1975) and Pollard (1977) with minor modifications. Rearing of three selected species (L. nina nina, C. pyranthe and D. hyperate indica) was conducted in laboratory conditions following the method of Singh and Singh (1993) and Sheikh and Kalita (1996). Food preference of L. nina nina, C. pyranthe and P. brassicae nepalensis...
were carried out in the laboratory from July 2005 to January 2006 following the method of Bogawat and Pandey (1967). Larval survivability study of *P. brassicae nepalensis* on different host plants was carried out under laboratory conditions following Watanabe (1979). The population density study of *L. nina nina, C. pyranthe, A. libythea olferna* and *P. brassicae nepalensis* were carried out in the five selected zones of South Kamrup area in different seasons. For population study "line-transect methods" of Pollard *et al.* (1975) and Pollard (1977) were followed. The pest infestation status of Pieridae butterfly on cabbage crops was studied in five selected commercial fields in Basistha, Rani, Boko, Maliata and Jalukari areas under South Kamrup area of Assam. Pest status experiments were carried out following Beck and Cameron (1990).

The South Kamrup area is located within the geographic limits of longitudes 91°0'E to 92°0'E and latitudes 25°75'N to 26°25'N with an elevation of 40-744 m MSL. It covers an area of approximately 2,130 sq km with lush green vegetation. Majority of the study area is composed of hills and hillocks, giving a unique physiographic appearance. The presence of numerous marshy lands, wetlands, ponds, lakes and beels gives the area a great ecological value. For carrying out all the experiments the whole South Kamrup area was divided into five zones on the basis of presence of reserve forests. The selected zones are Rani Reserve forest, Basistha Reserve forest, Jalukbari Reserve forest, Maliata Reserve forest and Boko Reserve forest.

The survey reveals that altogether 26 species of Pierid butterflies are distributed throughout the area, found both in agricultural fields and forest areas. The species are included under twelve different genera. Almost all these 26 species are remarkably different from each other by colour, size and wing venation pattern with a few exceptions. The largest Pieridae species observed during the survey was the Great orange tip (*Hebomoia glaucippe glaucippe*), of 70-100 mm wing span and the smallest one was the
Spotless grass yellow (*Eurema laeta laeta*) with 30-45 mm wing span. Out of the 26 recorded Pieridae butterflies, 9 are commonly available, 7 species are less common and 10 species were rarely observed.

During the survey, 31 species of larval food plants and 10 species of adult food plants were recorded and identified. The larval food plants comprise of nine different families, namely capparaceae, cruciferae and leguminosae family were randomly distributed in all parts of South Kamrup area, but the other families were found to be restricted in some specific pockets only.

Five species were selected for biological and ecological study considering their availability and importance within the study area. These species are *Leptosia nina nina*, *Catopsilia pyranthe*, *Delias hyperate indica*, *Appias libythea olferna* and *Pieris brassicae nepalensis*.

During rearing of three selected species (*L. nina nina*, *C. pyranthe* and *D. hyperate indica*), it was observed that gravid females selected egg-laying sites after repeatedly testing the leaves of their food-plants. The newly hatched larvae devour a portion of the eggshell as food. The first instar larva of *L. nina nina*, *C. pyranthe* and *D. hyperate indica* measure 3.26 mm to 3.50 mm, 4.56 mm to 5.02 mm and 5.01 mm to 5.53 mm respectively according to different seasons. The maximum lengths recorded for these larvae during the fifth instar were 19.06 mm to 20.50 mm, 26.11 mm to 30.11 mm and 30.67 mm to 35.33 mm respectively. Larval sizes of all these three species were found to increase rapidly depending on the adequacy of quality food supply and their maturity stages. The 2-4 day old fifth instar larva stopped feeding and eliminated all the undigested food. After removing the excreta, the larva moved about restlessly for more than half an hour and then selected a suitable pupation site. It was observed that the larvae preferred stem or midrib on the upper side of the leaf, coating the leaf where they lie with a bed of
silk. The larvae of *L. nina nina*, *C. pyranthe* and *D. hyperate indica* took the longest time (18.83±3.13 days) for development during Winter season and the shortest (11.66±0.82 days) during Monsoon season. All the above three species completed 22 generations each in a year. The first generation started from Pre-Monsoon season (Early March) and last generation was completed by the end of Winter season (Last part of February). During Pre-Monsoon, Monsoon and Winter season there were 6 generations each, but in the Retreating Monsoon season there were only 4 generations.

It was observed from the investigations on food preference that the larvae of *L. nina nina* and *C. pyranthe* preferred to feed on *C. rutidosperma* followed by *C. viscosa* whereas *P. brassicae nepalensis* preferred *B. oleracea Var. capitata* host plant, which was followed by *B. oleracea Var. botrytis*. The *C. rutidosperma* fed 2\(^{nd}\), 3\(^{rd}\), 4\(^{th}\) and 5\(^{th}\) instar larvae of *L. nina nina* consumed as much as 190.00 sq.mm, 370.20 sq.mm, 597.20 sq.mm and 701.00 sq.mm of leaf area in 24 hours, that were significantly more than those recorded on other food plants. Similarly, in case of *C. pyranthe* also, the consumed leaf areas were 240.00 sq.mm, 410.30 sq.mm, 630.50 sq.mm and 790.00 sq.mm. The *B. oleracea Var. capitata* fed 2\(^{nd}\), 3\(^{rd}\), 4\(^{th}\) and 5\(^{th}\) instar larvae of *P. brassicae nepalensis* consumed as much as 241.20 sq.mm, 411.20 sq.mm, 631.36 sq.mm and 791.24 sq.mm of leaf area in 24 hours, which were significantly more than those recorded on other food plants. In the present study *B. oleracea Var. capitata* was found to be the least preferred food plant for both *L. nina nina* and *C. pyranthe* while, in case of *Pieris brassicae nepalensis*, *Tropaeolum majus* was the least preferred host plant.

Feeding behaviours of *L. nina nina*, *C. pyranthe* and *P. brassicae nepalensis* were similar. The larval feeding varies according to maturity stages of the leaf. First and second instar larvae consumed only the tender leaves but from the third instar onwards were found to consume all kinds of leaf of the host plant.
The larval growth and pupal size of *P. brassicae nepalensis* on different host plants were investigated. The larval growth was observed to be the highest when larval rearing was conducted on *B. oleracea Var. capitata* plants. In case of pupal size also, *B. oleracea Var. capitata* fed larvae attained the highest body length followed by *B. oleracea Var. botrytis*, *Cleome viscosa*, *C. rutidosperma*, *B. campestris* and *Tropaeolum majus*.

The larval survivability of *P. brassicae nepalensis* on different host plants was carried out under laboratory conditions. Larval survivability was observed to be higher when rearing was conducted on *Brassica oleracea Var. capitata* and *Brassica oleracea Var. botrytis* as compared to other food plants. *C. rutidosperma*, *C. viscosa*, and *Tropaeolum majus*, which ranked low in contributing to larval growth and were also responsible for higher larval mortality especially during the early instars.

*Brassica oleracea Var. capitata* leaves were the most preferred oviposition substrates for the female *P. brassicae nepalensis*. Although *Tropaeolum majus* was not preferred as a food plant by the larvae, adult females also showed positive response to *Tropaeolum majus* and *Brassica oleracea Var. botrytis* for oviposition. This may be due to similar colour pattern and glabrous leaf surface of *Tropaeolum majus* with the preferred food plants.

The population density study of *L. nina nina*, *C. pyranthe*, *A. libythea olferna* and *P. brassicae* were carried out in the five selected zones of South Kamrup area in different seasons. The population density of these four species was found to be highly variable and significant (p<0.01) in all the study areas irrespective of the seasons. On the other hand, seasonal observations also revealed that the climate plays an important role in the building up of population. In Monsoon season, due to favourable climatic conditions and availability of food plants, the population density of *L. nina nina*, *C. pyranthe* and *A.
Libythea olferna was observed to be the highest in each study zone. In contrast to this, during the Winter season when the brassicae and cruciferae plants which are the primary food plants of *P. brassicae nepalensis* becomes naturally available, the population density of *P. brassicae* also increased during this season. The population of *L. nina nina* (17.24% & 17.62%), *C. pyranthe* (17.66% & 17.77%), *A. libythea olferna* (11.24% & 11.22%) and *P. brassicae* (14.12% & 15.08%) were observed to be the highest in Rani and Basistha reserve forest during Monsoon and Winter season respectively due to availability of their preferred food plants. The lowest population density of all the four species (12.56%, 11.07%, 7.37% and 10.46% respectively) was found in the Jalukbari reserve forest where the larval food plants for the butterflies were very limited due to largescale deforestation and urbanization.

The pest infestation status of Pieridae butterfly on cabbage crop was studied in the five selected commercial fields in Basistha, Rani, Boko, Maliata and Jalukari under South Kamrup area of Assam. The harvested crops were categorised into premium, acceptable and not acceptable category depending on the mode of infestation. In Maliata, Jalukbari and Boko the infestation was observed to be low compared to Basistha and Rani where the infestation was medium.