CLIMETO-CYLIC IMMIGRATIONS WITH DECLINING POPULATION OF WILD HONEYBEE, APIS DORSATA F. IN CHITWAN VALLEY, NEPAL

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ABSTRACT

A general survey was conducted to investigate the phenomena of seasonal immigration, aggregation and staying of Apis dorsata Fab. colonies in Chitwan valley, Nepal in 2003/04. The primary immigration of small colonies occurred during November-December in Southern areas and secondary type mainly from site shifting of the large colonies towards north of Chitwan valley in January-February and smaller colonies through swarming in March-April respectively. Maximum colonies aggregated in March with maximum staying of eight months. Colonies aggregation declined by 54%, 50% and 100% in May, June and July and the period of colony staying declined by 25% as compared to previous years. The causes of population decline were: bad weather, predators and parasites, honey hunting, increasing pesticide use, declining bee pasture and inter species competition with exotic A. mellifera L. Policy declaration with suitable programs for the conservation of native wild honeybee, A. dorsata in its indigenous habitat for the maintenance of biodiversity and raising the crop productivity is necessary.

Key words: Aggregation, bee pasture, biodiversity, colony staying, honey hunting, immigration, nesting site, swarming.

INTRODUCTION

Honeybee diversity in Hindu Kush Himalayan (HKH) region consists of Apis cerana F., *A. dorsata* F., *A. florea* F. and *A. laboriosa* Smith and exotic *A. mellifera* L. Among these honeybees *A. dorsata* is a wild, open nesting and single comb building honeybee and is a natural pollinator of several cultivated and wild plants in Asia (Atwal, 1970; Maun and Gurdip, 1983; Singh, 2000). They are distributed throughout the foothills, Terai and inner Terai of Nepal. Their nesting sites are tall trees, buildings, and water towers with available food resources (Lindauer, 1956: Morse and Benton, 1967; Reddy, 1980, Hadorn, 1984; Pokhrel, 2005). However, the biology, aggregation, migration and immigration of this species are poorly understood (Roepke, 1930; Lindauer, 1956; Morse and Benton, 1967; Koeniger and Koeniger, 1980; Seeley et al,. 1982; Hadorn, 1984; Sihag, 1998;). The members of this species are furious and attack in mass for defense (Maschwitz, 1963; Frish, 1967; Morse et al., 1967; Koeniger et al., 1979). They are good honey collectors (Thakar and Tonapi, 1961; Singh, 1980), and therefore, important source of honey in Nepal (Shrestha, 2001). The role of these bees as crop pollinators to augment national income through increased bio-diversity and crop production has been forgotten. In addition, honey hunting, destruction of the nesting sites and the natural pasture (forest), increasing trend of pesticide use for crop protection, reduction of cultivated bee flora and the rapid multiplication of *A. mellifera* colonies in its natural habitat in Chitwan valley Nepal, in nineties, pushed this species on the verge of extinction (Shrestha, 2001; Pokhrel, 2005; Pokhrel, 2006; Pokhrel, 2008; Pokhrel, 2009). Thus, study on the natural biology and cause of decline of *A. dorsata* population in its natural habitat in Chitwan valley was necessary. The objective of the study was to investigate the phenomena of seasonal immigration, aggregation and staying of *A. dorsata* colonies in Chitwan valley, Nepal.

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MATERIALS AND METHODS

The study was carried out in Chitwan district (inner Terai) in central Nepal. Sites selected for the study were the man-made structures and Bombax trees, which had the previous history of having this bee colonies nesting onto them in aggregate of 3-30 colonies on a single structure/tree at Sukranagar, Mangalpur, Yagapuri, Narayanghat, Aaptari and Bharatpur. All the sites were at 350 metres above sea level. Study was carried out throughout the year, starting from May 2003 to July 2004.

Survey of the nesting sites was carried out at monthly interval to find out the seasonal immigration of *A. dorsata* colonies in Chitwan. Observations were recorded every month on the dates of immigration and number of colonies nesting at particular sites (Sukranagar, Mangalpur, Yagapuri, Narayanghat, Aaptari and Bharatpur) and absconding. Weather data (temperature, humidity and rainfall) were collected from National Maize Research Program, Rampur.

EXCEL software was used to tabulate collected data, to prepare necessary tables, graphs and figures and to calculate means, variance and standard errors.

RESULTS

IMMIGRATION SEASON

November was the beginning month of immigration of *A. dorsata* colonies in Chitwan. The first immigration site noticed was Sukranagar (near by Chitwan National Park) followed by Yagyapuri (Horticulture Farm). Out of five sites observed in Chitwan, the immigration was continued during winter, spring and ended by early summer. In November, there were all together 12 colonies, 9 in Sukranagar and 3 in Yagyapuri. The number increased by 66.7% in December, which decreased in the winter by 60.0% and increased again in spring by 225.0%. Of the total colonies immigrated in Sukranagar, 92.8% occurred in November-December (N=26) and the rest in March-April (N=2). Yangapuri was only a site of continuously immigrating colonies for five months from November to March. Immigration of the colonies in Mangalpur occurred only in January and in Bharatpur (Narayani Safari and Hotel Island) in February-March (Fig.1).

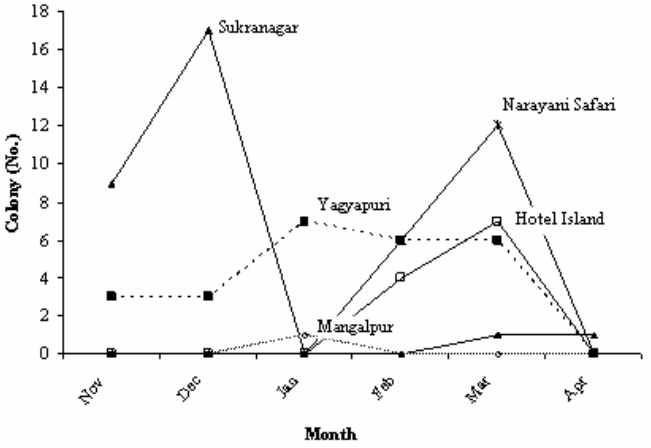

Fig. 1: Immigration of *A. dorsata* colonies in different locations, Chitwan, 2003/04

The immigration was mainly of two types: primary and secondary immigration.

The colonies from a long distance flight arrived to the southern area of the Chitwan, near the Chitwan National Park where the early mustard, Brassica spp. and buckwheat, Fagopyrum esculentum Moench bloomed earlier in November-December. Of the total colonies (N=83), 38.6% (N=32) were the primary immigrant colonies. Over 80.0% of the primary observed immigrant (early in-coming) colonies from long distance nested at a

private building at Bishalchock, Sukranagar and the rest nested on the water tower, Yagyapuri (Fig.1).

Secondary immigration was of two types: site shifting and swarming.

Out of the total colonies (N=32) immigrated during November-December in Chitwan, 52.0% (N=17) shifted their nesting sites in January-February. In a total of five locations, incoming colonies (N=83), the secondary immigrants through temporary site shifting were 44.6% (N=37).

Secondly, about one-forth of the colonies immigrated in November-December produced 4-7 queen cells per colony and swarmed in late February. Nearly 17% (N=14) colonies immigrated from swarming in February-March (Fig.1). Both the secondary type of immigrants spread to water tower at Yagyapuri, Bombax tree at Hotel Narayani Safari and Hotel Island at Bharatpur, and private building at Mangalpur.

NESTING SITE

Colonies of *A. dorsata* preferred non-disturbed previous nesting sites. They denied using white washed building at Narayanghat and the standing dead Bombax tree at Aaptari. The private building at Bishalchok, Sukranagar was most preferred due to the least disturbance and being near by the Chitwan National Park where mustard, Brassica spp. and buckwheat, F. esculentum bloomed earlier in November. They nested on tall water towers (Fig.2 and 3), Bombax trees and taller buildings at different locations. The private building at Bishalchok, Sukranagar was most preferred due to the least disturbance and being near by the Chitwan National Park where mustard, Brassica spp. and buckwheat, F. esculentum bloomed earlier in November. They nested on water towers, Bombax trees and taller buildings at different locations.

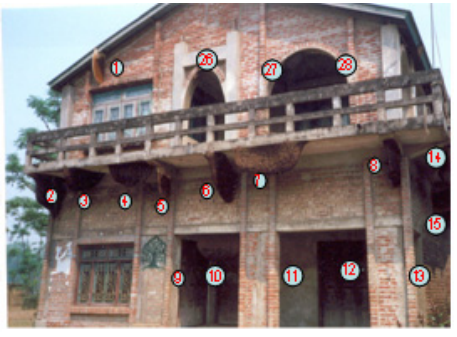

Fig. 2: Colonies nesting on a non-disturbed building at Sukranagar, Chitwan, 2003/04

Fig. 3: Colonies nesting on a non-disturbed water tower at Yagyapuri, Chitwan, 2003/04

DECLINING RATE OF COLONY IMMIGRATION AND AGGREGATION

The highest number of *A. dorsata* colonies (N=67) aggregated during March at all locations except at Sukranagar where the nesting colonies were the highest (N=26) in December. The colony number severely decreased after March ending in October in 2003 and in July in 2004. The bee colonies at Sukranagar, Yagyapuri and Hotel Island left in July; however, in Narayani Safari they left two months earlier i.e. in May 2004. In disturbed locations (Aaptari and Pradhan Stationary) in Narayanghat, the maximum number of the colonies was observed in March (N=7) in 2003 and all the colonies left by September, and did not return in 2004 (Fig.4).

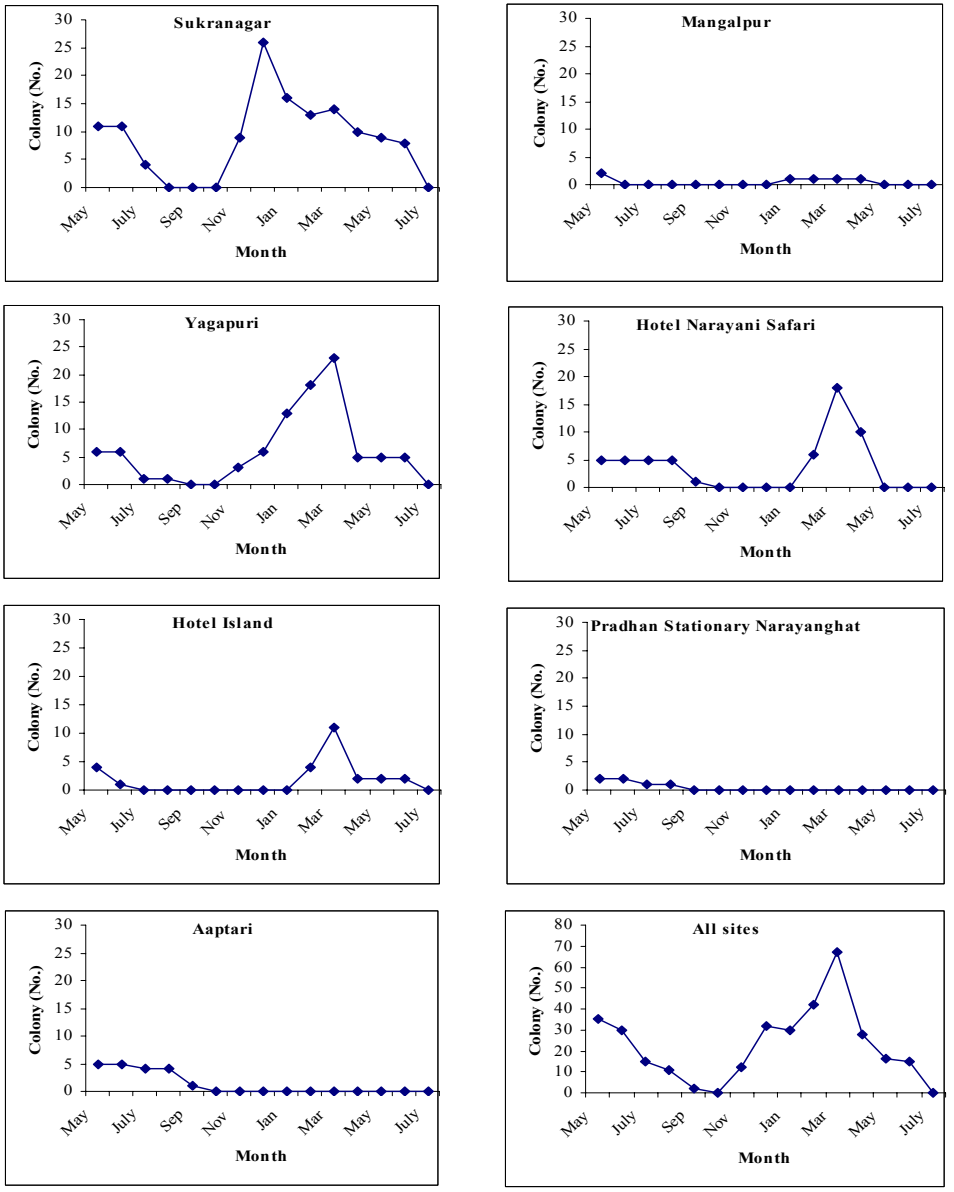

Fig. 4: Aggregation of *A. dorsata* colonies at different sites, Chitwan, 2003/04

DECLINING RATE OF COLONY AGGREGATION AND PERIOD OF STAYING

The number of *A. dorsata* colonies aggregated at different locations of Chitwan declined by 54.0%, 50.0% and 100% in May, June and July in 2004 compared to 2003. All the colonies left three month earlier (July) in 2004 as compared to 2003 (Fig.5). It was declined at Sukranagar by 18.2%, 27.3%, and 100% in May, June and July, respectively, in 2004. Bee

colonies leaving their occupied sites differed 1-5 months at different locations, i.e. one month earlier at Mangalpur, two months at Yagyapuri and five months at Narayani Safari. The reason behind this might be environmental and climatic, and increased farming of the exotic honeybee, *A. mellifera* in Chitwan valley.

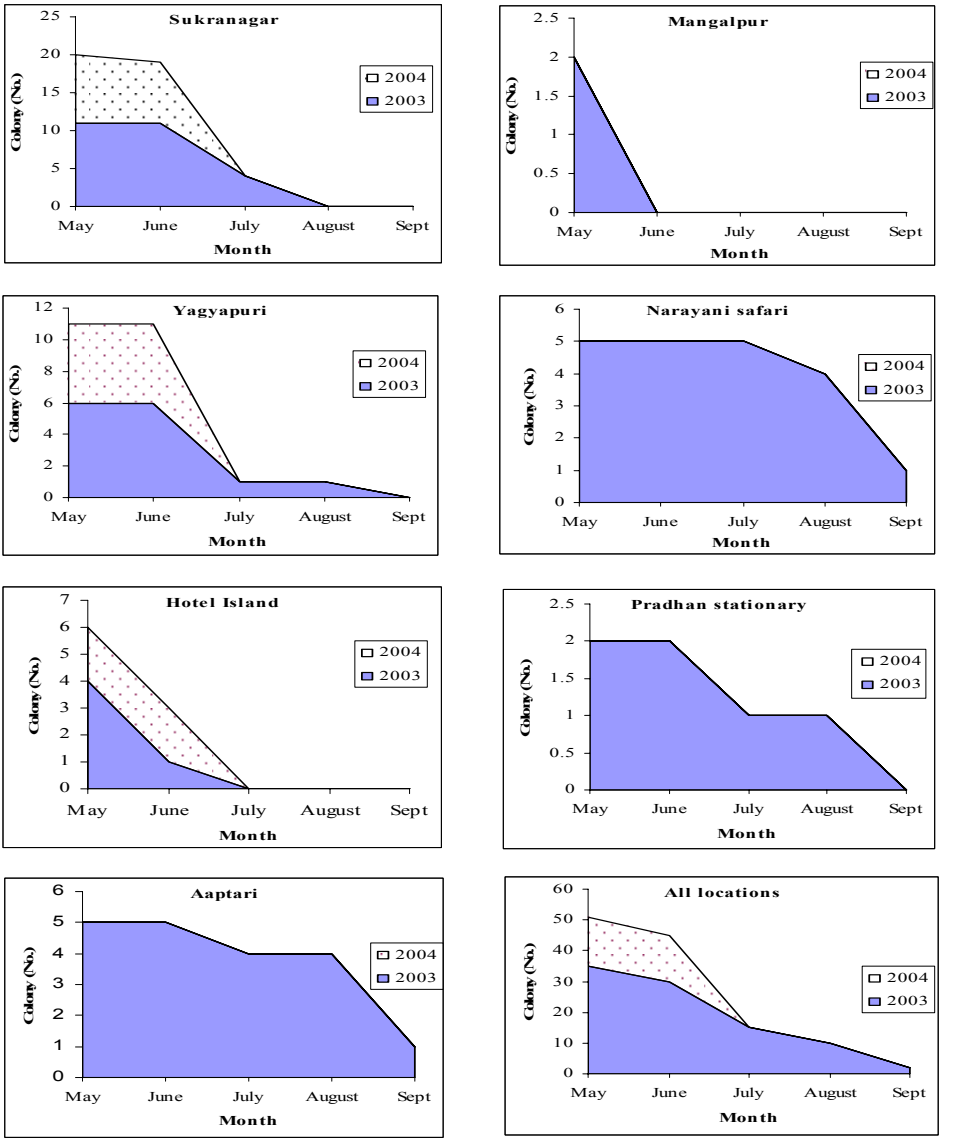

Fig. 5: *Apis dorsata* colonies staying during May-September in Chitwan, 2003/04

CORRELATION BETWEEN THE PARAMETERS

All parameters except initial colony size (r=-0.211) with colony immigration were positively correlated with each other (Table 1). Aggregation of *A. dorsata* colonies positively

correlated with immigration (r=0.473), initial colony size (r=0.307), and colony migration (r=0.263). Similarly, colony migration was positively correlated with colony immigration (r=0.258), colony aggregation (r=0.263), colony growth rate (r=0.070), and initial colony size (r=0.141).

Table 1: Correlation between the parameters of A.dorsata colony migration in Chitwan, 2005.

Parameter	Colony immigration (No.)	Colony aggregation (No.)	Initial colony size (cm2)	Migration (No.)
Colony immigration	1.000	0.473	-0.211	0.258
Colony aggregation	0.473	1.000	0.307	0.263
Initial colony size	-0.211	0.307	1.000	0.141
Migration	0.258	0.412	0.141	1.000

DISCUSSION

Three cyclic immigrations of the *A. dorsata* colonies occurred in November-December, January-February, and February-March in Chitwan, Nepal. The primary immigration of 38.6% very small colonies (591.8 cm2 and 549.8 cm2) occurred in November-December from the long distance flight. In January-February, the secondary immigration (44.6%, N=37) of the larger colonies (2302.8 cm2 and 1188.6 cm2) was through temporary site shifting and nearly 17.0% (N=14) much smaller (225-713 cm2) colonies spread from swarming in March-April. Shrestha (2001) reported that most of them immigrated in Chitwan in November. The returning time of this bee in the upland of Srilanka and in Banglore, India was little earlier i.e. at the starting of dry period (October-December) (Koeniger and Koeniger, 1980) but it was late at the end of February in Mae Tung Ting and Mae Hong Son, Thailand. Hadorn (1984) observed only two cyclic immigrations of 2-3 months in Sumatra and Thapa (1998) observed two peaks of reoccupation and abandonment of nest sites in Chiang Mai, Thailand, first in November and second in January-February. The first two immigrations were similar with as explained by Thapa (1998) and Shrestha (2001). In Chitwan, additional third immigration was observed in March-April, which was from queen rearing during favorable season in February and swarming during March-April, when maximum number of bee flora were available (N=96).

The honeybee colonies nested on tall water towers, Bombax trees, and taller buildings at different locations in Chitwan. The first site of immigration was in south, near Chitwan National Park and around a horticulture farm in South-west of Chitwan. They preferred non-disturbed previous nesting sites near fields having early crop of mustard, *Brassica spp*. and buckwheat, Fagopyrum esculentum Moench blooming in November-December. They denied using white washed buildings and standing dead Bombax trees. Lindauer (1956), Morse and Benton (1967), Reddy (1980) and Seeley et al. (1982) also found the similar, non disturbed nesting sites of *A. dorsata* throughout South and South-east Asia. Mardan (1989) and Crane (1990) explained the nest site chosen by *A. dorsata* swarms for nesting was usually not directly exposed to wind currents and partially sheltered. Swarms closer to the old nest sites got first opportunity to occupy the protective nest sites and also exploited natural and cultivated flora for their survival, growth and development.

Colony aggregation was up to 28 at a private building near Chitwan National Park, 25 on a water tower at Horticulture Farm, and 18 on a Bombax tree at Hotel Narayani Safari. Aggregation of these colonies started from November, reached the highest in March (N=67). Aggregation of 69 colonies on a single tree and 72 on a water tower was reported in Thailand and Nepal, respectively (Wongsiri et al., 1996; Thapa, 1998). Shrestha (2001) reported 31 colonies nesting (as close as 46 cm apart) on a water tower at the Institute of Agriculture and Animal Science at Rampur in 2000. The aggregation of these colonies on a tree/structure has been reported from 30 to 150 (Roepke 1930; Lindauer 1956; Morse and

Benton 1967; Koeniger and Koeniger 1980; Seeley et al., 1982; Hadorn 1984). Such aggregations of colonies was for the availability of the drones for mating (Singh, 1962; Koeniger and Koeniger, 1980; Seeley et al., 1982; Mardan, 1989; Koeniger et al., 1994; Oldroyd et al., 1996; Wongsiri et al., 1996;), for reducing predation risk and accelerating out-breeding (Moritz, 1985). Presumably, aggregation of numerous colonies might be for enhancing mutual defense (Brock and Riffenburg, ; 1960 Shrestha, 2001).

The trend of *A. dorsata* colony immigrating and aggregating in Chitwan was declined by 54%, 50% and 100% in May, June, and July 2004 respectively compared to 2003. The reason behind can be environmental, agricultural and the biological. Rapid multiplication of exotic honeybee, *A. mellifera* L. reduction on the area of bee crops, i.e. mustard, deforestation, pesticide poisoning and predation of the colonies might be the causes. Pokhrel 2005, 2006, 2008 and 2009) agreed on these causes of *A. dorsata* population decline. Shrestha (2001) and Pokhrel (2006, 2008 and 2009) recommended conservation and protection from factors or activities bringing about their devastation or pushing them towards the course of extinction from their habitat. Hadorn (1984) and Schmidt et al. (1985) also explained extensive predation of *A. dorsata*, however, the impact on the species was smaller than the destruction of the primary forests with its tall trees in its habitat.

Seasonal immigration of *A. dorsata* colonies coincided with lower rainfall, availability of bee flora and low pest prevalence in Chitwan. Thus, it was mainly due to climato-cyclics and food availability and vice versa for their absconding/long distance migration. Thapa (1998) in Thailand also found positive correlation of *A. dorsata* migration with predators, parasites, temperature, rainfall, wind speed and physical disturbances and negative correlation to the relative humidity. Wongsiri et al. (1996) also found seasonal and cyclic migration of *A. dorsata* colonies in Thailand to exploit new resources. Oldroyd et aI. (1996) described the reason of seasonal and cyclic migration and it was for to increase colony fitness by improved food availability, enhanced out-breeding and reduced brood-parasite pressures. Terai of Chitwan valley enriched with bee flora only in winter and spring, where food and nesting sites also are available. Such sites are feasible for *A. dorsata* migration as reported by Hadorn (1984).

CONCLUSION AND RECOMMENDATION

Earlier immigration of the primary immigrants' colonies in Sukranagar and Yangapuri was mainly on the non-disturbed nesting sites and earlier availability of the food sources. Secondary immigration in all the sites was from temporary site shifting and through swarming. The trend of colonies immigration and the period of colony staying declined year after year due to climate change, bad weather, increasing pesticide use for crop production, honey hunting, declining pasture both in forest and agro-ecosystem and inter species competition with exotic honeybee, *A. mellifera* L. in Chitwan. Conservation of *A. dorsata* in its traditional habitat for the maintenance of biodiversity and raising the crop productivity, for which promotion of bee pasture both in forest and agro ecosystem, prevention of pesticide poisoning, reduction of house bee colonies and prevention of honey hunting is necessary.

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