Population Census of Indian Flying Fox, *Pteropus giganteus* (Brünnich, 1782) With Relation to Climatic Conditions in Thazi, Mandalay Region, Central Myanmar

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Abstract - Population census of *Pteropus giganteus* (Brünnich, 1782) with relation to climatic conditions in Thazi, Mandalay Region in Central Myanmar was executed from July, 2015 to June, 2018. The initial population size of *P. ginanteus* was recorded as 545.69 ± 55.63 individuals during first study period (July, 2015 - June, 2016) and 638.16 ± 35.81 individuals in second study period (July, 2016 - June, 2017). The population size was gradually increased to 655.53 ± 29.65 individuals in third study period (June, 2017 - July, 2018). Positive correlation was established between population size of *P. giganteus* and climatic conditions such as ambient temperature, relative humidity and rainfall. Relation between ambient temperature and monthly mean population size was positive (R^2 = 0.042, R^2 = 0.1015, R^2 = 0.236) in three study periods. Positive correlation between relative humidity and monthly mean population size revealed to (R^2 = 0.0029, R^2 = 0.0261, R^2 = 0.0481). The result of correlation between rainfall and monthly mean population size was occurred (R^2 = 0.1506, R^2 = 0.2629, R^2 = 0.1457) respectively during three years study.

Index Terms- population size, *Pteropus giganteus*, climatic conditions, positive correlation

I. INTRODUCTION

Of the rich diversity of vertebrate fauna, bats are unique in being the only group of mammals, like aves, have sustained flight (Kumar and Kanaujia, 2015). More than 20% all known mammal species of the world are bats. At present, there are about more than 1,300 extant species of bats distributed throughout the world (Voigt and Kingston, 2016).

Southeast Asia is a critical area for biodiversity conservation; level of species richness and endemism are the highest in the world, but rapid land – use changes endanger much of the region's fauna. Bats are critical component of this biodiversity, comprising nearly a third of Southeast Asia's mammal species and providing vital ecological and economic services. However, nearly half the species are of conservation concern as many as 40% of bats species are predicted to be extinct by the end of this century if current deforestation rates persist (Kingston, 2008). The Indian flying fox, *P. giganteus* is scared while IUCN (2013) assessed the status least concern due to the decreasing its population.

Barlow (1999) pointed out that population estimation is an important initial step in determining what management programs and protective resources are required for a species Hunting and habitat loss were identified as major threats to nearly all flying fox species (Biotani *et al*., 2006). Another important factor is changes in climate. It is significant for natural system as climate changes can affect population abundance shift, in species invasions and extinctions and also climatic conditions play an important role in the dynamics of flying-fox roosts (Root *et al.*, 2003).

Bat conservation depends on research; especially is Population census is extremely important in evaluating conservation priorities for a species. Therefore, current population status of the *Pteropus giganteus* in the region is one of the critical factors to assess population dynamics of the studied species.The study area, Thazi Township is located in the Dry Zone Belt of central Myanmar, it suffers a

hot dry season annually. According to the local people, a colony of *Pteropus giganteus* took residence in this study site for more than 40 years. There is no formal data why *P. giganteus* can reside for many years and their population status in the study area with relation to environmental parameters.

Population census plays an important role in understanding the status of any species in a particular area. Therefore the estimation of population concerned with monthly occurrence must be considered as an important initial step in determining management priorities, protection and conservation of the Indian flying fox, *P. giganteus* in the central Myanmar. Therefore the study was conducted to assess the population status of *P. giganteus* with respect to climatic conditions.

II. MATERIALS AND METHODS

Study Area and Study Site

The study was conducted in Thazi, Mandalay Region. Thazi is located in the Dry Zone Belt of Central Myanmar and lies between North Latitudes of 20° 30' and 21° 05' and East Longitudes of 95° 28' and 96° 32'. Thazi is situated at 213.41m above sea level The study site,Yele monastery is situated at the southern border of Thazi and its western and southern borders are lined with an irrigated channel(Fig .1).

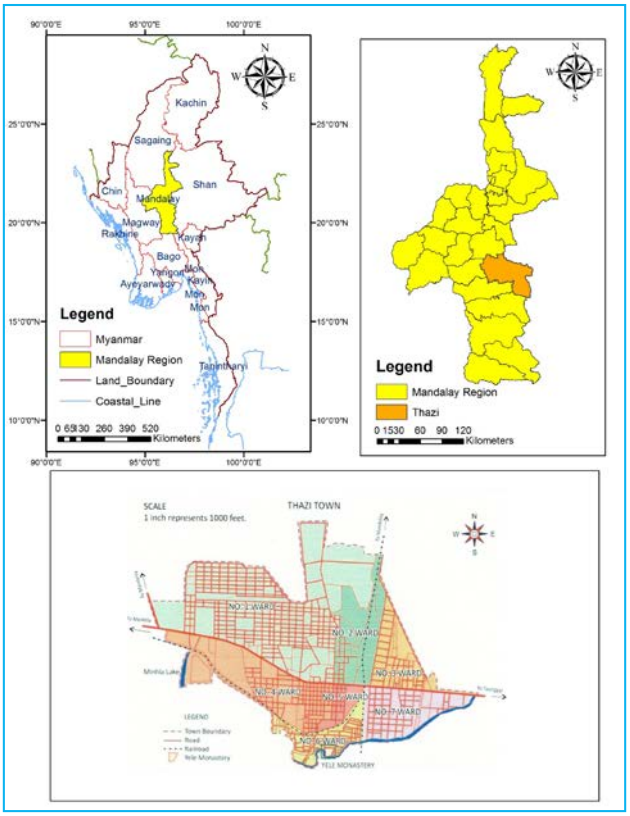

Fig.1.Map of the study area (above) and close-up view of study site (below)

Source: Land Records Department, Thazi Township

Study Period

The study was carried out from July, 2015 to June, 2018.

Estimation of Population size

Estimation of population size was conducted by direct visual count under the root trees followed by (Kunz, 2003). The roosting bats were counted between 9:00 am to 11:30 am. Counting was conducted two consecutive days per every weekend in every month regularly. The number of bats on each roost tree was visually counted with the help of binocular and recorded by hand tally counters. Two observers took the suitable distance of about 7.5 m to 10 m on either side of the roost tree and counted the bats and the result pooled.

Climatic Conditions

Monthly climatic conditions such as ambient temperature, humidity and rainfall were recorded. Ambient temperature and humidity were recorded by using thermohygrometer (Tm: −30°C~60°C, RH: 0%~100%, TH603, China) during day roost counts. Rainfall data were obtained from the Department of Meteorology and Hydrology, Thazi.

Statistical Analysis

Coefficient of determination was conducted to assess the relationship between ambient mean temperature, relative humidity and rainfall monthly mean number of individuals.

III. RESULTS

Population Size of *Pteropus giganteus*

During three years study, the total population size was occurred as slightly fluctuated. Total mean population size of *P. giganteus* in first study was nearly 545.69 ± 55.63 individuals and the maximum monthly population size was recorded in June. In the second study period, the total mean population size was 638.16 ± 35.81 individuals and the maximum monthly population was occurred in July. In third study, it was recorded that a total mean population as 655.33 ± 29.65 individuals and monthly peak population was counted in May (Table 1).

Table 1 Population status of *Pteropus giganteus* in study area (2015-2018)

Month	**First study period 2015-2016**	**Second study period 2016-2017**	**Third study period 2017-2018**
July	512.8 ± 5.88	706.7 ± 23.74	623.3 ± 7.5
August	512.29 ± 9.22	626.3 ± 42.02	656. ± 4.47
September	525.14 ± 8.74	667.7 ± 11.84	645.1 ± 27.65
October	494.67 ± 22.22	668.5 ± 16.13	642.8 ± 11.63
November	529.5 ± 48.01	625.3 ± 11.9	641.0 ± 6
December	541.75 ± 58.91	642.9 ± 48.96	643.1 ± 8.6
January	520.7 ±5.5	598.8 ± 31.94	634.8 ± 16.76
February	521.88 ± 8.19	605.3 ± 11.09	629 ± 1.92
March	496.33 ± 22.98	602.3 ± 9.92	639.6 ± 14.23
April	583.38 ± 57.06	638.1 ± 20.17	649.3 ± 41.35
May	638.7 ± 18.28	655.7 ± 64.41	734.7 ±12.67
June	667.3 ± 25.7	637.17 ± 35.8	723.5 ± 10.85
Total mean individuals	**545.69 ± 55.63**	**638.16 ± 35.81**	**655.33 ± 29.65**

Statistical Analysis of Population Size and Environmental Parameter

The coefficient of determination between monthly mean population size and monthly mean environmental parameters such as ambient temperature, relative humidity and rain fall.

Coefficient of determination between ambient mean temperature and monthly mean population in first, second and third study periods revealed as positive (R^2 = 0. 0442), (R^2 = 0. 1015) and (R^2 = 0. 236). Monthly mean humidity and monthly mean population size revealed positive correlation during the three study periods (R^2 = 0. 0029), (R^2 = 0. 0261) and (R^2 = 0. 0481) respectively. Similarly between rainfall factor and monthly mean population size and the coefficient of determination was positive (R^2 = 0. 5106), (R^2 = 0. 2629) and R^2 = 0. 1457) (Fig. 2, 3, 4, 5,6,7,8,9 and10).

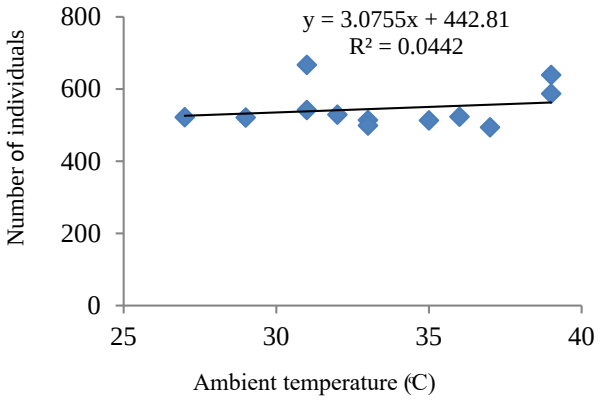

Fig 2. Relationship between ambient temperature and monthly mean population size in first study period

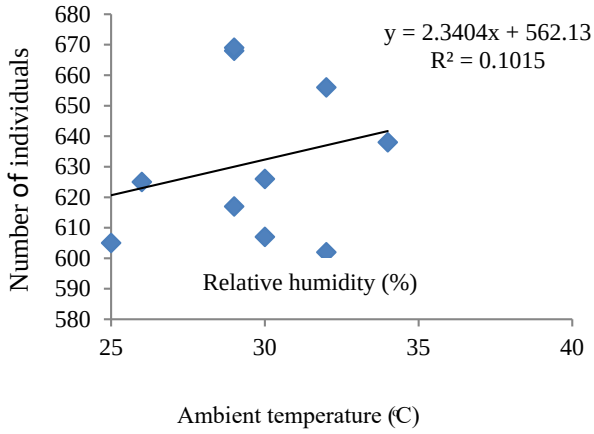

Fig 3. Relationship between ambient temperature and monthly mean population size in second study period

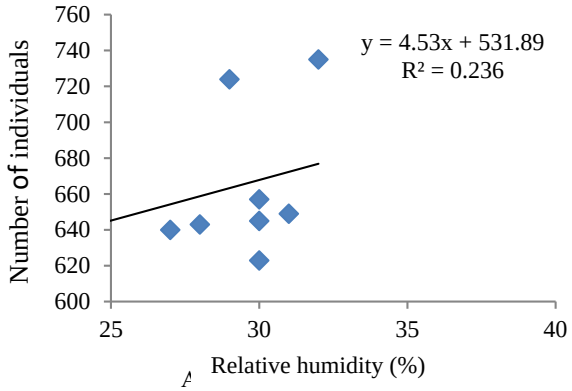

Fig 4. Relationship between ambient temperature and monthly mean population size in third study period

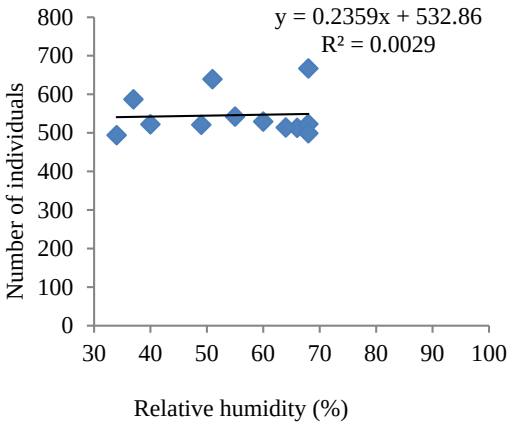

Fig 5. Relationship between relative humidity and monthly mean population size in first study period

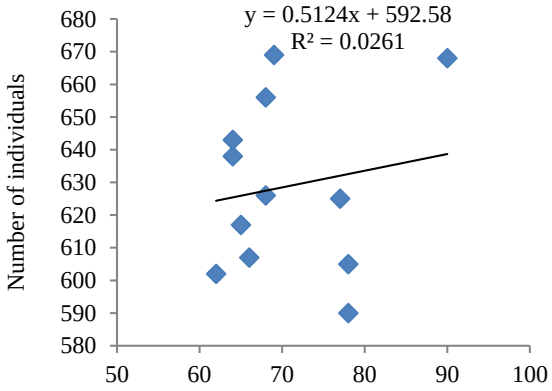

Fig 6. Relationship between relative humidity and monthly mean population size in second study period

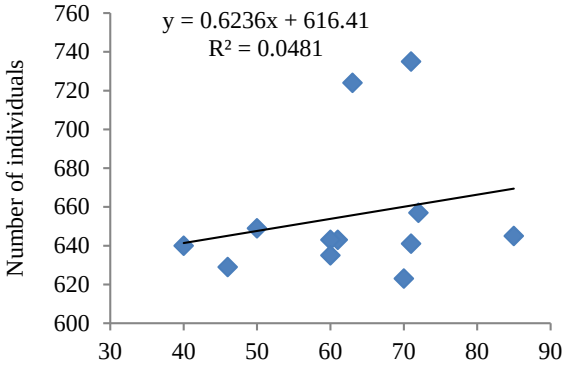

Fig 7. Relationship between relative humidity and monthly mean population size in second study period

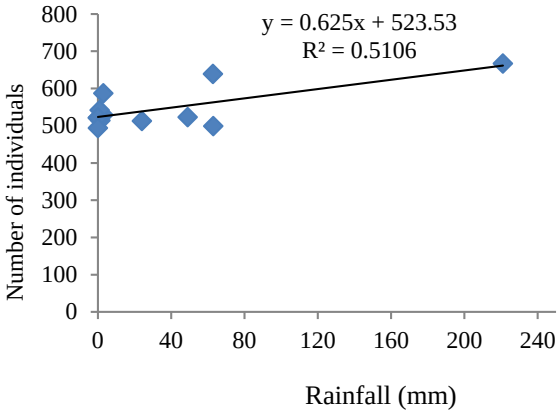

Fig 8. Relationship between rainfall and monthly mean population size in first study period

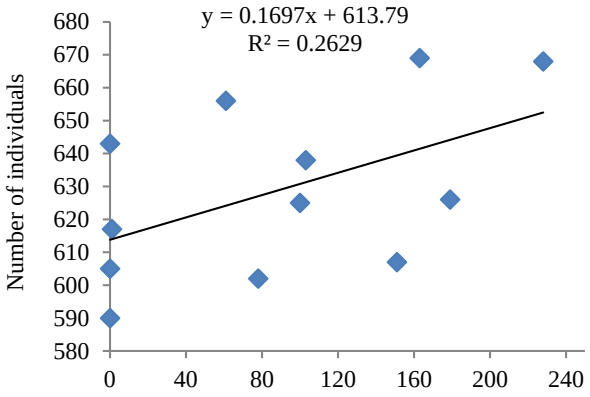

Fig 9. Relationship between rainfall and monthly mean population size in second study period

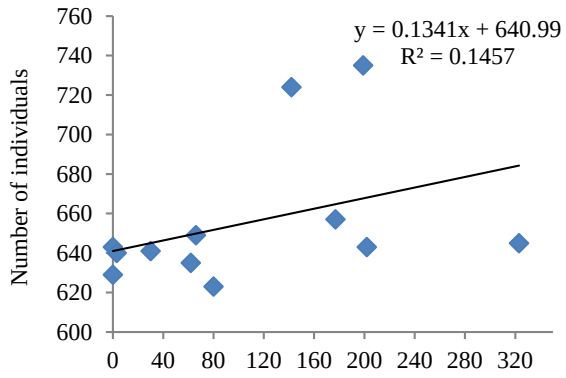

Fig 10. Relationship between rainfall and monthly mean population size in third study period

IV. DISCUSSION

During the present study, (July, 2015 to June, 2018) mean population size of *Pteropus giganteus* recorded ranged from 545.69 ± 55.63 to 655.33 ± 29.65 individuals. The largest population of nearly 660 individuals was recorded during third year study and followed nearly 630 individuals recorded during second study. Approximately 550 individuals were recorded during first study period. And then the colony size increased gradually year to year.

Roost occupancy and maintenance by *P. giganteus* requires a variety of geographic, physical and ecological characteristics which control their behavior and population dynamics (Pierson and Rainey, 1992). Flying fox conservation and management of population status depend on the reliable estimation and indices of population size (Kumar and Kanaujia, 2015).

Throughout three years study, the maximum mean numbers were observed from May to July in each year. It is assumed that increasing the population size was due to the time of parturition period, and the newly pup appeared as recruitment in their c Rainfall (mm) ı population size occurred in October, January, February and March during first, second and third study periods due to human disturbance, when people gathered in the precinct of the monastery and prepared food for the religious ceremony. But there was no abrupt change in monthly mean population size in each year.

During the present study, the result of correlation between monthly mean temperature, relative humidity and rainfall was positively during three study periods. The maximum mean temperature in three study periods was 39 ºC, 34 ºC and 32 ºC, whereas the minimum temperature was 27 ºC, 22 ºC and 21 ºC respectively. Therefore the temperature between 21 ºC and 39 ºC were favorable condition for *Ptero* Rainfall (mm) y area.

It was observed that during three study periods, both ambient roost humidity and rain fall showed positive correlations with the monthly mean numbers of individuals. Khin Than Oo (2009) also stated that population size was positively correlated with both of humidity and rainfall. Sein Sein Win (2006) reported that there was no correlation between the ambient humidity and population size of fruit bat. It is assumed that these differences appeared because of spatial and temporal disparity. Physical characteristics of roost sites are important for the bats and roost selection of the bats. The most criteria for roost microclimate selection appear to be temperature and humidity for both temperate and tropical species (Churchill, 1991).

Habitat destruction, degradation and alteration have serious implications for bats, as these anthropogenic factors

can seriously reduce the availability of suitable roosting sites, which in turn affect population size and ultimately, species survival (Tan *et al*., 1999). Estimation population and colony size for bats presents particularly challenges but is an essential element in effective assessments of conservation status and in providing a baseline from which to identify any future population decline (Kunz and Fenton, 2003)

Although the colony of *P. giganteus* had been residing more than 40 years in the study site, the fluctuation of colony occurred since five years ago. It is assumed that the appropriate roost facilities, lack of over hunting and availability of food resources are critical factor for roost fidelity of *P. giganteus* in the study site. In the present study, the climatic conditions especially ambient temperature, relative humidity and rainfall were somewhat related to population fluctuation of *P. giganteus*. Yele is a religious area so that hunting of *P. gigateus* is strictly prohibited. Other important factor is the roost trees which also provide for their food supply partially for long time survival for *P. giganteus* in study area.

Therefore, the study will provide as the information for effective conservation and management of Indian flying fox, *P. giganteus*. Moreover, this study may be elucidated for ecological and biological aspects of *P. giganteus* for long-term survival for the future.

V. CONCLUSION

From the result of the study , total population size of *Pteropus giganteus* in the study site ranged from 550 to 650 individuals. It was observed approximately 100 individuals increased during three years study period, moreover the climatic conditions, especially ambient temperature, relative humidity and rainfall were somewhat related to population fluctuation of *P. giganteus*. Yele monastery is a religious precinct, lush green in vegetation ad large trees provided as a safe haven not only for flying foxes but also other living assets. Moreover, *de-facto* protection afforded ensured the long term preservation of *P. giganteus* in the study area.

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