

GPS Essential for Mapping Species Distribution

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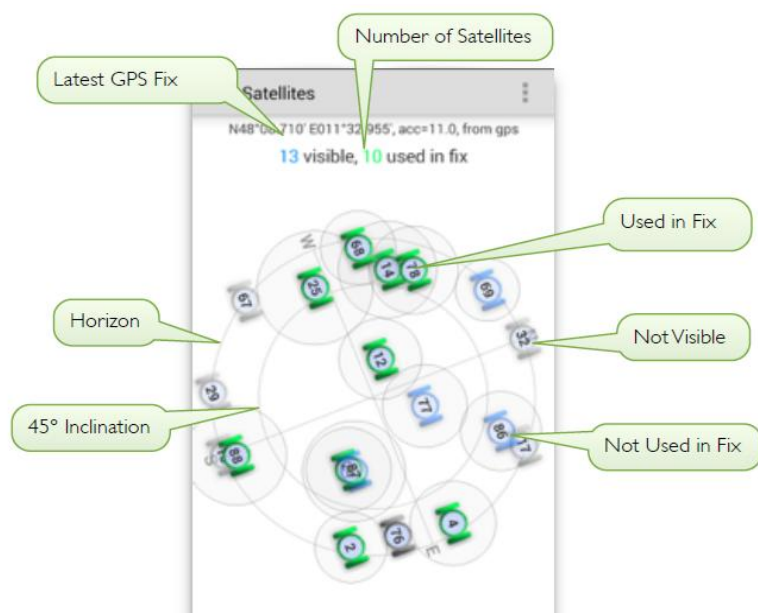
1. Introduction

Conservation of our environment is the important phenomenon which includes integration of government, scientist and local community to understand the fauna or flora present in a particular region. This is where the role citizen science comes to play. In addition to the community technological collaboration will results in scientific conclusion for any decision One such role is played by geographical mapping for understanding species distribution Integrated GIS and GPS are being successfully used to map several plants and animal species. Advanced mapping software's allow us to model the distribution of particular species by analysing the environmental characteristics of its known localities. GIS and GPS are now extensively used to predict or generate species distribution maps using ecological niche and environment of the region as a base. GPS is generally used to collect the geographical coordinated of species occurrences and satellite data in the GIS environment is useful to identify the habitat

condition and generate the environmental predictors. SDMs thus generated using species occurrence data are correlated with environmental predictors using geo-statistics methods and tools.

2. Tools for Species Distribution Models

GPS essential is an android application for SDMs. Waypoints can be easily located in the field and tracking can also be made which can be located in Google maps. In addition to this information can be gathered when geographical coordinated are visualized. Some of the important ecological tools include DIVA-GIS, ENFA, GARP and importantly Q-GIS is used for mapping and analysing all data set. An important part of Q-GIS is that Google map can be added as plugins to work out with it. Georeferencing of maps are not done in Q-GIS because the google maps are already geo-referenced data sets.



3. Methodology

The study was conducted in three different sites of Wayanad district of Kerala. In order to achieve the listed objectives of the present research work, intensive and extensive collection-cum-survey tours were conducted during July 2017 to September 2017. Sampling of Sphingidae was carried out in each of the collection sites using battery operated light traps, specially fitted with switching device are used to facilitate automatic operation at specified hours (Mathew and Rahamathulla, 1995). Some specimens were

collected at night to an illuminated vertical white sheet (Shamsudeen *et al.*, 2005). In addition, to trap catches, collections were also made during day time using insect nets as a part of all out search.

GPS essential was use for getting way points from the coordinates. Other bioclimatic variables are also drawn. The distribution pattern of Hawk Moths was analysed with respect to altitude, slope, vegetation types and anthropogenic disturbance. Altitude and slope values for each survey point were extracted from the Digital Elevation Model (DEM) using

ArcGIS tools. Anthropogenic disturbance was measured as distance between the survey point and nearest human settlement using MapInfo tools. The vegetation type in a point was evaluated using Point-Centred Quarter method (Muller-Dombois and Ellenberg, 1974).

Based on the relative abundance (no. of Hawk Moths per survey point) of owls in the survey points, the population status of owls was assessed.

Sampling over difficult terrain and cryptic animal often makes the researcher a tough target to assess the spatial distribution pattern with limited quality of data (lack of true absence and presence). In addition, it is time consuming and labour expensive to survey extensively over large landscapes for a nocturnal species. So, the Ecological Niche Modelling (ENM) approach have been attempted to derive distribution pattern by relating the presence sites to a set of environmental variable (Phillips *et al.*, 2006). Maxent is one of the ENM approach to predict the geographic distribution of a species based on the presence only data. It is, a machine learning programme, developed to make prediction of species distribution from incomplete information. It estimates the most uniform distribution (maximum entropy) across the study area given the constraint that the expected value of each environmental predictor variable under this estimated distribution matches its empirical average (average values for the set of presence-only occurrence data) (Phillips *et al.* 2006). The constraints are expressed in terms of simple functions of the environmental variable called features.

Maxent selects constraints that have maximum entropy (most spread out) for predicting the probability distribution of species, hence it is prone to over fitting, resulting in predicted distribution that are clustered around sampled points. Therefore, a relaxation component called regularization is included in the algorithm. The variable importance in the model was determined by two approaches namely relative contribution of variable to the model and Jack-knife method. The relative contribution values are determined by the increase in gain in the model provided by the variable. Jack-knife approach (leave-one-out) excludes one variable at a time when running the model. In doing so, it provides information on the performance of each variable in the model in terms of how important each variable is at explaining the species distribution and how much unique information each variable provides (Baldwin, 2009). With the help of developed model, quantitative information on the potential habitats for Hawk Moths was estimated using Q-GIS tools

4. Results and Discussions

Abundance of Hawk moths

Most species of Sphingidae were captured between 19:30 h and 20:30 hr. Towards midnight there was a steady decline in individuals captured, with the minimum number between 20:30 h and 21:30 h. Basically abundance of moths' increases as darkness persists. Also it is observed that the Abundance of hawk moths during capturing hours have some relation with lunar phase and the seasonality.

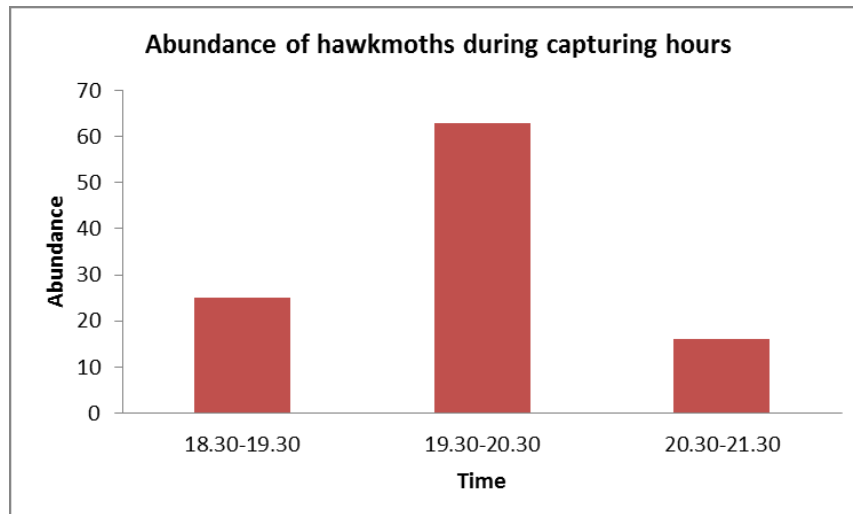


Figure 3. Abundance of hawk moths during capturing hours

Species accumulation curve

Species accumulation curve plots the cumulative number of species recorded as a function of sampling effort. The species accumulation curve rise as a lot of species new to the sample are discovered, but it's rate of increase will slow down after all the common species are found. Ultimately the curve tends to stabilize for longer and longer periods, i.e it takes more and more effort to find the next new unrecorded species. Here, the species accumulation curve shows a final inclination which indicates that there are more species of Sphingidae yet to be discovered.

Ecological parameters

How the diversity of Sphingidae changes with parameters like temperature and rainfall was shown in Figure 4. The number individuals collected were high in the month of July (51), followed by September (40) and the least number was obtained in August. The average temperature of all the three months remained somewhat similar, but the average rainfall shows significant difference. Highest rainfall occurred during August, followed by September.

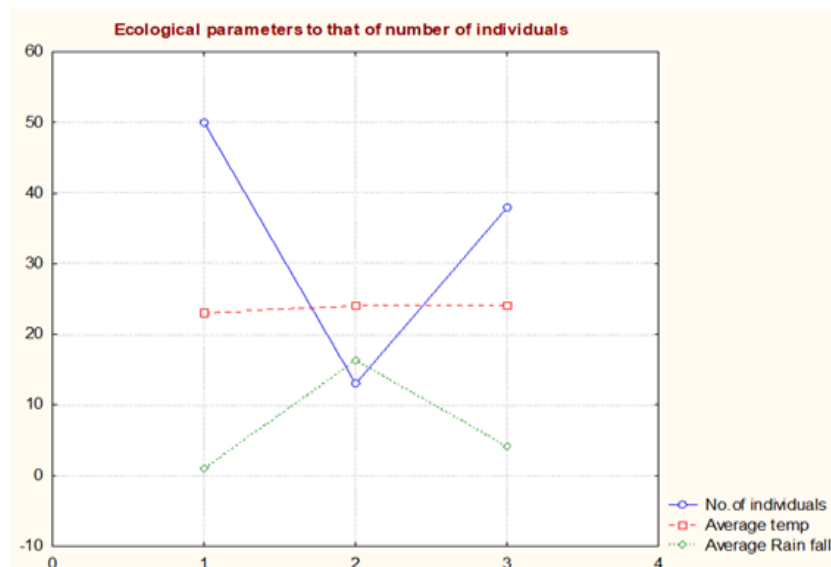
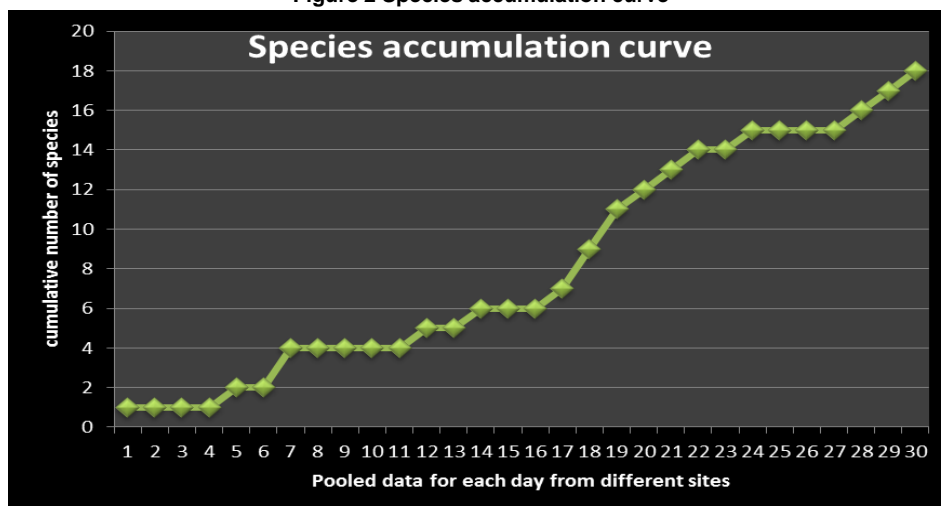


Figure 4 Ecological parameters to the number of individuals

Figure 2 Species accumulation curve



George Mathew and V. K. Rahamathulla, 1995 studied the Insect species diversity with reference to moths in representative forest habitats in the Silent Valley National Park. Altogether 318 species of moths belonging to 19 families were recorded in this study, out of which 11 species belonging to Sphingidae. George Mathew *et al.*, (2004) documented a total of 32 species of insects from the Shendurny Sanctuary, of which 301 species could be identified. These included 129 species of moths, in which 4 species are coming under Sphingidae and also conducted a study on the insect fauna of

Peppara Wildlife Sanctuary, Only 4 species of Sphingidae were reported in this study. Another study was conducted in the Peechi-Vazhani Wildlife Sanctuary by George Mathew *et al.*, (2005). A total of 374 species of insects were recorded, of which 6 species belongs to Sphingidae. Usha A.U and Dr. Vimala K John (2015) studied the insect diversity of a selected area in Wadakkanchery, Thrissur, Kerala. A total of 58 species and 529 individual insects belonging to nine orders and 38 families were sighted, which include only one species of Sphingidae.

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