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RESEARCH ARTICLE

ECOSYSTEM FUNCTIONING AND EFFECT OF CLIMATE CHANGE ON TERRESTRIAL ARTHROPOD OF DIFFERENT HABITATS OF METTUR RESERVOIR, TAMIL NADU, SOUTH INDIA

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ABSTRACT

Biodiversity is an important factor which is responsible for all the environmental changes and climatic conditions and Ecosystem functioning involves process of primary production, tropic transfer from plants to animals, nutrient cycling, water dynamics and heat transfer. The present study attempted to identify the role of ecosystem functioning and climatic effects on biodiversity of arthropods. When the species extinct or in critically endangered state the survival of these species are and hence reduced the eco-system function. The present study focuses on the Arthropod diversity in Mettur, from (November 2011 to April 2012). The insect collection was done by using Malaise Traps, Berlese Tullgren Funnel, Light Sheets, Pitfall Trap, Hand picking method, Sticky glove methods, and Yellow pan trapping methods etc., in four different habitats randomly selected from the sites. The study area was divided into four different sites based on the habitats, Agricultural area, undisturbed area, Thermal power station area and Mettur dam. Based on the survey we were observed nearly 32 species of insect belonging to 5 orders. The diversity was calculated by Shannon Wiener Index.

INTRODUCTION

Biodiversity is the basis for the existence and development of human beings. However, with the increasing exacerbation of human activities, biodiversity is losing at an unprecedented rate on the global scale, which has threatened human existence and development. Nowadays, the loss of biodiversity and its associated loss of ecosystem services have generated international contention. Several causes have been identified by scientists for the loss of biodiversity, e.g., land use change and global climate change. Biodiversity is a concept that has only recently attracted significant attention from ecologists and other researchers (Hamilton, 1991). The most significant components of ecosystem processes must be identified if we are to direct our best conservation efforts towards minimizing impacts on biodiversity in British Columbia. As Platnick (1991) states, "Speaking about biodiversity is essentially equivalent to speaking about arthropods". The effect of climate change on the geographic distributions of species is often assessed in terms of potential climate envelopes (or spatial niches) shifting in latitude, longitude or altitude (e.g. Thomas *et al.*, 2004; Harrison *et al.*, 2006). The IPCC report on the Regional Impacts of Climate Change (Watson *et al.*, 1997) states that 'for mid-latitude regions, an average warming of 1–3.5 8C over the next 100 years would be equivalent to apoleward shift of the present geographic bands of similar temperatures (or isotherms) of approximately 150–550 km, or an altitudinal shift of about 150–550 m'. Such climate changes are likely to act as an important driving force on natural systems (Parmesan and Yohe, 2003; Thomas *et al.*, 2004) and could threatened biodiversity and the conservation of species (Arau´ jo *et al.*, 2004).

The diversity of the arthropods highly depends on the soil of a particular region, since many arthropods were terrestrial. The present study attempts to analyze the soil and water parameter of the study area. Arthropods are useful for understanding general biological process (Gullan and Cranston 2005). The hydrology, soil characteristics, and flora of these habitats are well understood and are used in wetland classification schemes (Mitsch and Gosselink, 2007), but the distribution and abundance of invertebrate assemblages of mountain wetlands have received comparatively little attention (Wissinger *et al.*, 1999). Soils are natural resources of utmost importance for a number of ecosystem functions. Soil arthropods are increasingly recognized to impact plant performance, plant competition and thus plant community composition in grassland (Bardgett *et al.*, 2005). These impacts, however, are due to a variety of mechanisms such as below ground herbivore (Schädler *et al.*, 2004) and an acceleration of nutrient cycling via the action of arthropod detritivores (Masters, 2004). Invertebrates are responsible for a number of tasks such as facilitating in aerating and draining the soil, litter decomposition, pollination and seed dispersals as well as providing food for other vertebrate predators (Majer *et al.*, 2006). According to recent estimates, anthropogenic activities are doubling the amount of fixed N entering the terrestrial N cycle annually (Galloway and others 1994). Mettur is called 'Power City', Having Thermal Power Station (210MW x 4units =840 MW), Hydro Power Station is Dam and Tunnel (50MWx4 units = 200MW) and Several Barrage Power Stations located in thottilpatti areas. Thermal

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pollution, one of the major By-product of modern industries, especially of power plants forms a major ecological concern. Thermal discharges cause significant calefaction of water bodies (Kennish, 1992), affecting biological communities by inducing sub lethal damage, adversely impacting regeneration process in native biota (Thorhaug *et al.*, 1973), and often altering primary and secondary production (Kennish, 1998).

Many empirical and theoretical studies have revealed a positive relationship between biodiversity and ecosystem functioning, spanning a wide variety of ecosystems and functions (Balvanera and others 2006; among many others). Current research needs to focus on linking this knowledge to an understanding of how ecosystems will respond to increasing environmental variability and arthropod diversity in different habitats of Mettur and adjoining areas. Loss of terrestrial arthropod species appears to be most severe in tropical forests, at least as extrapolated from the rate of habitat destruction (Simberloff, 1986; Pimm, 2001). Although perhaps presently non-urgent, the threat of extirpation and extinction and associated challenges are real and ecologically significant with respect to the Canadian fauna and northern forest arthropod faunas in general (Hanski, 2007). The study attempted to study the role of ecosystem functioning and climatic effects on biodiversity of arthropods. Biodiversity will play a key role in how ecosystems respond to global change (Hansen & Dale, 2001) as loss of species can lead to reduced ecosystem function (Cardinale *et al*., 2006). The main aim of the present study was to demonstrate the diversity of Arthropod species found in the study area. In recent times many human influences have had varied impacts on the biodiversity in the Mettur. The studies was focusing the agricultural development depending the insect biodiversity, as well as provide opportunities for enhancing the resilience of soil ecosystem services by conserving soil arthropods biodiversity. Hence, the present study is to explore all the available fauna, to and record the diversity of arthropods in the different habitats of Mettur. It also aims to analyze the abundance and evenness of arthropods in the study area.

MATERIALS AND METHODS

Study Area

The Mettur is an Industrial Town municipality in Salem district in the state of Tamil Nadu, India. It is one of the largest dam constructed in 1934. The maximum level of the dam is 120 ft. (37 m), length is 1700 meters and the maximum capacity is 93.4 tmcft. The dam Latitude is 11.82752 and longitude is 77.7817. The SAIL's Salem Steel plant is nearby. Mettur is called 'Power City', Having Thermal Power Station, Hydro Power Station is Dam and Tunnel and Several Barrage Power Stations. The large number of factories can be seen here including those of soaps and detergent manufacturing factories, galvanizing plants, Vanaspathi units etc. The study area was divided into four different sites based on the habitats, Agricultural area, Undisturbed area, Thermal power station and Mettur dam. The temperature, Humidity and rainfall and is represented in table was recorded (November 2011- April 2012).

Collection Methods

There are many methods for collecting the specimens. We sampled arthropods collected from 4 selected locations from the study area. The undisturbed area has the mixed type of plants and trees. The agriculture land has variety of crops namely rice, sorghum, black gram, cowpea and cotton. The monoculture plantation consists of the Mango tree plantation, Coconut plantation and sugarcane plantation. At each location, we installed one pitfall trap (75mm diameter) filled with soapy water and left it for 15 hours (overnight) before collecting the Invertebrates. Litter sample was collected by playing a 1/4m² wooden quadrate frames on to the litter and scraping up all litter and loose humus from within the frame area into a large polythene bags. Samples were collected as quickly as possible to prevent escape of animals. Litter collections were not unclear taken for at least four days the wet forest floor may discourage foraging by ants (Brulch *et al*., 1998). Light traps, Malaise traps, Sticky traps, Hand picking methods were employed randomly. This method has been useful in identifying arthropod communities in different forest stands (Hutcheson & Kimberley, 1999). And data was analyzed by using Shannon's diversity index (H'). Diversity and evenness values for litter and soil arthropods were estimated using Shannon's diversity index (H') (ludwing and Reynolds, 1988).

RESULTS AND DISCUSSION

The present study during November 2011- April 2012 we observed nearly 32 species of insect belonging to 5 orders. Based on the overall occurrence Lepidoptera (479) occur dominantly followed by Hymenopterans (446), Orthoptera (418), Odonata (390), Araneae (385). Lepidoptera insects belonging to Seven families representing Lepidopteron order namely *Danaidae*, *Arctiidae*, *Lycaneidae*, *Pterophoridae*, *Nymphalidae*, *Pieridae*, *Papolionidae*, *Lepidopteran* insects were dominant in Plot B (Natural forest) that showed higher diversity and plot C (Thermal Power station) showed lower diversity.

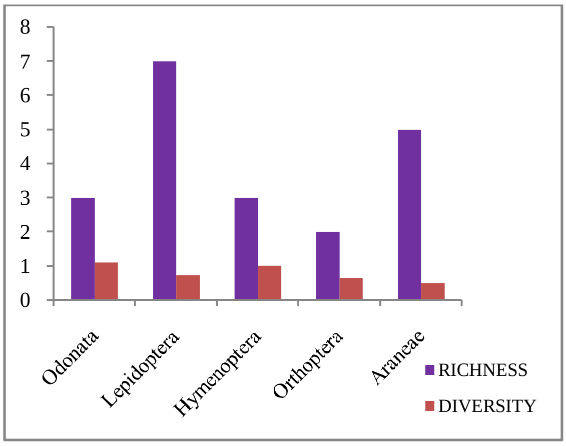

Fig: 1 Shows the Richness and Diversity of arthropods observed in PLOT A (Agricultural land)

Dense vegetation is the most important variable for explaining insect diversity and abundance is in support of study with *Lepidopteran*. In this study high grazing levels were found to have negatively affected the abundance and diversity of beetles, our results is therefore, in agreement with those of Mysterud and Austrheim (2005). Grazing seems to render accessible to insect larvae, the insects, spiders and other arthropods had a negative correlation. The effect of temperature on arthropods is however difficult to predict as the habitat in which they live is already harsh and highly variable (Coulson *et al.*, 1996).

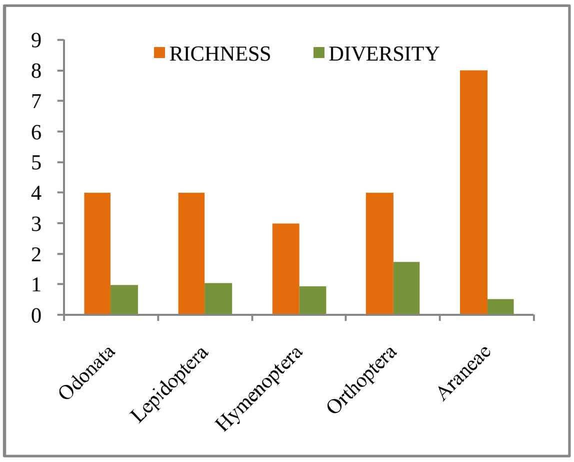

Fig: 2 Shows the Richness and diversity of arthropods observed in PLOT B (Natural forest)

Hymenoptera insects recorded during the study period were *Apidae, Pomplidae, Formicidae, Iehneumonidae*. Higher number of hymenopterans insects were recorded in Plot D (Mettur dam) and in Plot C (Thermal Power station) shows the low diversity. Dominant of Hymenoptera is attributed to the habitat complexity, stability and food availability (Allan, 1995). The complex habitat structure, traps litter and woody debris promoted colonization insect knuckles forest reserve at lower elevation where the highest bee species diversity was recorded, high temperature and dry weather conditions are prevalent for most months of years.

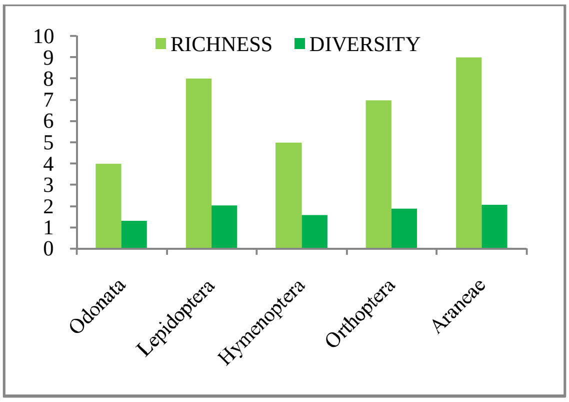

Fig: 3 Shows the Richness and Diversity of arthropods observed in PLOT C (Thermal Power Station)

Aranea the spider composition in plantation showed the most dissimilar assemblage in comparison with those of other vegetation type spider diversity of the present study was shown dominant Plot C (Thermal Power station) low in Plot B (Natural forest). Possible reason may be the scarcity of understory vegetation. This Pattern probably resulted from lack of suitable microhabitats for orb web construction vegetation dominated by a few species of dense and short grasses with low densities of herbaceous ground flora as well as exposes with orb weaver's space weavers can endure a higher level of disturbance, which may explain why they are more abundance. Odonata, and Orthoptera orders show more abundance in dominant Plot D (Mettur Dam) and Plot B (Natural Forest) and low in plot C (Thermal power station).

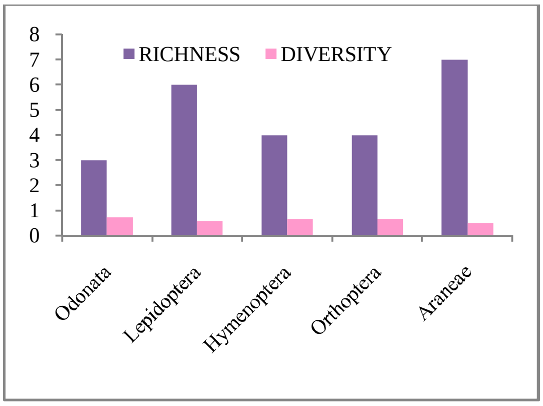

Fig: 4 Shows the Richness and Diversity of arthropods observed in PLOT D (Mettur Dam)

In general, ants are well known to reflect the level of habitat disturbance and succession, as well as to be good bio-indicators of the degree of ecosystem condition (Andersen, 1997; Vasconcelos, 1999). The meteorological data was recorded throughout the study period. The average temperature is 26°C and rainfall 0.31mm during November to April. The average humidity was 81.21% in the study area. Changes in climate may result in changes in geographical distribution of species. It will have a major effect on geographic distribution of insect and lowtemperatures are often more important than high temperatures in determining distribution of insects. Biodiversity plays an important role in abundance of insect and their natural enemies (Alteiri, 1994). There is a need to increase functional diversity in agro-ecosystems vulnerable to climate change to improve system resilience, and decrease the extent of losses due to insect. However, changes in cropping patterns will drastically affect the balance between insect pests and their natural enemies. Since climate change will lead to a shift in cultivation of crops in non-traditional areas and crop rotations, this may influence the prevalence and importance of specific insect. System diversity can be exploited to enhance the resilience of agro-eco-systems, improve resource utilization, and stabilize yields to cope with the effects of global warming and climate change on food security.

Table: 1 The Average climatic Data and Rain fall, temperature and humidity of the Study area

S.NO	MONTHS	Average Temperature (° C)	Average Rainfall (mm)	Average humidity (%)
		Monthly	Monthly	Monthly
1.	November	26.8	0.2	89
2.	December	23.5	0.9	74.7
3.	January	25.3	0.5	75.1
4.	February	27.0	0.3	79.3
5.	March	29.8	0.0	82.8
6.	April	26.5	0.0	86.4

In general, conservation actions must address the overwhelming threats to habitat loss and high level disturbance, by assuring the stability of protected areas and by defining new protected areas. When new urban development strategies are introduced their effects on urban biodiversity are often unknown and may have serious consequences for conservation. Long live species require more habitats. The results of the study encompass the conservation of Forest and its design during urban development planning. Hence, the results of the study conclude that the diversity of Arthropods is highly influenced by soil nutrients. Studying the Agriculture ecosystem becomes one of the possible ways in preserving the biodiversity. According to these findings Arthropod diversity is maintained also by means of nice plantations in the study areas. Also this artificial vegetation and the dam provide the best environment for the pollinators and the other insects. The preliminary analyses of arthropod diversity suggest the Mettur serve as an ecological niche for arthropods in that area. Climatic change which affects the diversity of the natural vegetation and the diversity of insects. From the above results it could be concluded that human interference can alter species richness as well as its diversity in a destructive manner. Further government should take necessary actions maintain the ecosystem of those areas.

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