International Journal of Multidisciplinary Research and Development
Online ISSN: 2349-4182, Print ISSN: 2349-5979, Impact Factor: RJIF 5.72
www.allsubjectjournal.com
Volume 4; Issue 2; February 2017; Page No. 99-102

Impact of climatic change and food availability on diversity of grasshopper population in Amirdhi forest and its adjoining places

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Abstract
Industrial revolution plays a vital role on country's development at the same time the pollution created by these industries has high impact on change in climatic conditions of the Environment. Climate has a strong influence on biological processes and thus exerts direct control on the distribution, abundance, and interactions of the biota. Indirect effects arise from human activity in response to climate change. As a result, the biodiversity status of India will almost certainly change in response to climate in the course of the present century. In the present study the influence of climatic changes on the biodiversity of grasshoppers of Amirdhi forest and adjoining cultivable lands of Vellore were analyzed for six months (October 2013 to March 2014) in three different stations. The result shows that the climatic changes and availability of food sources in the environment has influenced the biodiversity of grasshopper population.

Keywords: Climatic change, Biodiversity, food availability, Grasshoppers, Amirdhi forest

1. Introduction
Environmental groups have been warning climatic changes for many years. It is through that a relatively a small increase in small temperature could have very significant effects on patterns of biodiversity. Changes in climate could affect the ability of a species to survive and reproduce in areas they currently inhabit. The climatic change also disrupts the agriculture world -wide. Biogeographically India is situated at the tri junction of three realms namely Afro tropical, Indo Malaysian and Paleo artic realms and therefore has characteristic element formed in each of them. This assemblage of three distinct realms makes the country rich and unique in biological diversity. Based on the available data India ranks 10th in the world and 4th in Asia in Plant diversity. Also ranks 10th in number of mammalian species and 11th in the number of endemic species of higher vertebrates in the world. Insects are the most varied and predominant organisms on the planet and they comprise nearly half of the total living species. Grasshoppers are phytophagus insects belonging to the order orthoptera of phylum Arthropoda. Being phytophagus grasshoppers are always attracted the attention of the biologists. The damage caused by the 'migratory grasshoppers' species are well known. In recent years Entomologists tend to concentrate on low density grasshoppers species for their latent pest potential. Numerous reports on the range land grasshoppers (Capinera *et al.* 1983- Kemp *et al.* 1990, 92 a) [2], extensive damage brought on agro ecosystem (COPR, 1982) [4] and range land ecosystems (Hevitt and Onsegar, 1983) are available. Generally warm weather is observed to favour growth, reproduction and survival of grasshoppers (Gage and Mukerjee, 1977). Further a positive correlation has been established between grasshopers abundance and hot dry weather in temperate latitudes and high elevation with seasonal rainfall in arid regions (Capineria 1987- Capinera and Thomson, 1987) [9]. Likewise soil moisture was found to promote hatching (Gage and Mukerjee, 1978) [7]. Weather may affect grasshopper density indirectly also by modifying the quality (White 1976) [15] and quantity of its food (Belovsky, 1986) [1]. Even application of fertilizers is found to influence the grasshopper population in agro ecosystem (Joern, 1987) [9]. Nutrition forms the most important extrinsic factor in the majority of insect species (Engelmann, 1970; Dadd 1985) [6, 5]. Thus the abundance and distribution of grasshoppers are found to be dependent on several factors. It is therefore worth studying the biodiversity and distribution patterns of grasshoppers in specified ecosystem. Hence in the present study the influence of climatic change on Grasshopper population was studied in Amirdhi forest area.

2. Materials and Methods
Study Area – Amirdhi Forest and Adjoining area.
Amirdhi forest is a dry mixed deciduous forest. It is situated at a distance of 20 km from Vellore towards south west direction. It is classified as low land forest category of the Eastern Ghats. It contains lot of vegetation like sandal wood, tamarind, kadukkai, bamboo, avaram bark, konnai bark, wood apple, pungan, soap-nut and grasses.

2.1 Collection procedure
Selection of study area
Three different stations were selected for sample collection
Station 1 is a typical forest area,
Station 2 is the area converted in to agricultural land,
Station 3 near the bank of Amirdhi river (naga nathi) three stations represented diversity and distribution pattern of various grasshopper species. (Fig – 1, 2 and 3).

2.2 Collection of rainfall and temperature data
The rainfall and temperature data was collected from the metrological department for the months from October 2013 to March 2014.

2.3 Collection of grasshoppers
The grasshoppers were collected using sweep net (Fig - 4) Choosing nearly 6 to 8 random sites of 10 square meters within the selected region (100 square meters)of the three different stations (Fig 1, 2 & 3).Insects were suitably killed using Ether and Chloroform and preserved latter. Find confirmation with regard to identification of different species was obtained from Gill Research Centre, Chennai.

2.4 Preservation of Grasshoppers
The grasshoppers collected were preserved in intact conditions and kept in insect boxes for identification and photography. Naphthalene and camphor phenol soaked cotton were kept in the insect box for preservation.

3. Result and Discussions
3.1 Temperature
The temperature recorded during the Period of investigation is depicted in figure 1. The highest temperature was recorded in March 2014 and the lowest in November 2013.

3.2 Rainfall
The rainfall data is shown figure 2 and table 2. The highest rainfall was recorded in October 2013 and the lowest in January 2014.

3.3 Grasshopper's density
The present survey on grasshopper density in Amirdhi forest is shown in table 3, 4, 5 and 6. As seen in table 3, grasshopper population varied from station to station. Station 1 showed large number of grasshoppers compared to other station. As requested by Muraliragan *et al.* forest ecosystem (Natural) taken as a whole are found to be more diverse having more number of grasshoppers. The present findings also support this concept, since this station-1 reports typical forest zone the number was more in October because it was a rainy season has observed by Suresh, 1993. Station-2 revealed an increase in the population during October 2013, during which there were plantation of paddy land the population declined after the harvest and this decline in population may be due to migration to the adjoining areas. Root (1973) [13] has observed abundance in *acridid* number in the agro ecosystems and this abundance was mainly due to few individual species in the ecosystem and the present findings support this view. Station-3 did not show much variation in grasshopper density except in December 2013, which only reflects freshly grown vegetation which forms their food immediately after the rain. The weather has a direct influence on the species in agricultural fields, but in the forest it is felt that the population is controlled more indirectly by the cyclic availability of food (Rish, 1977). The table 2 summarizes the total number of grasshoppers recorded during the period of six months. It was noticed that the number was more during the month of October 2013 and March 2014. During which the warm weather prevailed mostly. Our observation is in direct agreement with the earlier observation that growth, survival and reproduction of grasshoppers is generally in March favoured by warm and dry weather (Gage and Mukerjee, 1977). Hence in the present study the climatic change and food availability has its impact on fluctuation of grasshopper's population was confirmed.

Table 1: Levels of Temperature during October 2013 to March 2014

S. No	Month	Maximum ($_0$C)	Minimum ($_0$C)
1	October	32.7	22.8
2	November	29.0	20.5
3	December	29.1	17.1
4	January	29.2	18.5
5	February	33.2	20.0
6	March	35.2	22.8

Table 2: Levels of Rain fall during October 2013 to March 2014

S. No	Month	Rainfall (mm)
1	October	145.0
2	November	55.8
3	December	3.8
4	January	0.1
5	February	4.7
6	March	5.6

Table 3: Fluctuation in Grasshopper population due to seasonal variation (climatic change)

S. No	Name of the station	Oct 2013	Nov 2013	Dec 2013	Jan 2014	Feb 2014	Mar 2014
1	Station - 1 Scrub jungle area	122	49	99	112	87	101
2	Station – 2 Cultivated Land area	169	29	109	74	52	62
3	Station – 3 Near the river bed	77	37	131	48	82	86

Table 4: Grasshopper collection data at station – I

S. No	Name of the Species	Oct 2013	Nov 2013	Dec 2013	Jan 2014	Feb 2014	Mar 2014
1	*Cyrtacanthris tetarica*	2	4	5	1	4	3
2	*Atractomorpha crerulata* (green)	1	0	4	3	2	0
3	*Atractomorpha crerulata* (brown)	3	2	2	2	2	5
4	*Acrida exaltata* (green)	1	0	5	7	1	0
5	*Acridaexaltata* (green banded)	8	3	2	11	2	2
6	*Heteracris pulcher*	12	4	7	6	7	7
7	*Trilophidia annulata*	6	4	6	20	12	8
8	*Tastrimargus africanes africanus*	23	4	3	7	11	11
9	*Diabolo catantops pinguis*	8	8	16	16	9	15

10	*Morphacris fasciata sulcata*	3	3	9	3	5	12
11	*Orthacris maindioni*	16	4	10	15	7	9
12	*Phlaeoba penteli*	20	7	7	14	9	7
13	*Oedaleus abruptius*	14	4	9	2	7	5
14	*Spathosternum prasniferum*	3	1	11	3	5	8
15	*Truxalis indica*	2	1	3	2	4	9
	Total	122	49	99	112	87	101

Table 5: Grasshopper collection data at station – II

S. No	Name of the Species	Oct 2013	Nov 2013	Dec 2013	Jan 2014	Feb 2014	Mar 2014
1	*Cyrtacanthris tetarica*	6	1	5	5	3	1
2	*Atractomorpha crerulata* (green)	23	8	10	15	9	5
3	*Atractomorpha crerulata* (brown)	19	4	12	13	7	7
4	*Acrida exaltata* (green)	31	6	11	11	10	9
5	*Acridaexaltata* (green banded)	17	3	19	12	5	11
6	*Heteracris pulcher*	5	0	6	0	4	0
7	*Trilophidia annulata*	3	0	5	4	2	2
8	*Tastrimargus africanes africanus*	2	0	6	2	1	4
9	*Diabolo catantops pinguis*	8	2	7	0	3	3
10	*Morphacris fasciata sulcata*	2	3	3	0	1	0
11	*Orthacris maindioni*	7	0	4	1	0	2
12	*Phlaeoba penteli*	3	0	9	5	2	5
13	*Oedaleus abruptius*	10	2	5	1	1	6
14	*Spathosternum prasniferum*	28	0	4	3	1	3
15	*Truxalis indica*	5	0	3	2	3	4
	Total	169	29	109	74	52	62

Table 6: Grasshopper collection data at station – III

S. No	Name of the Species	Oct 2013	Nov 2013	Dec 2013	Jan 2014	Feb 2014	Mar 2014
1	*Cyrtacanthris tetarica*	6	3	9	4	4	2
2	*Atractomorpha crerulata* (green)	1	0	5	0	1	1
3	*Atractomorpha crerulata* (brown)	8	1	4	0	2	2
4	*Acrida exaltata* (green)	2	2	5	0	5	3
5	*Acridaexaltata* (green banded)	2	0	6	3	2	0
6	*Heteracris pulcher*	8	4	9	4	9	9
7	*Trilophidia annulata*	7	3	7	5	7	7
8	*Tastrimargus africanes africanus*	4	2	9	3	6	10
9	*Diabolo catantops pinguis*	8	5	15	5	9	15
10	*Morphacris fasciata sulcata*	3	4	5	6	15	5
11	*Orthacris maindioni*	8	2	14	4	4	9
12	*Phlaeoba penteli*	6	3	9	7	7	2
13	*Oedaleus abruptius*	9	4	12	4	1	5
14	*Spathosternum prasniferum*	2	1	7	1	6	7
15	*Truxalis indica*	3	3	15	2	4	9
	Total	77	37	131	48	82	86

Fig 1

Fig 2

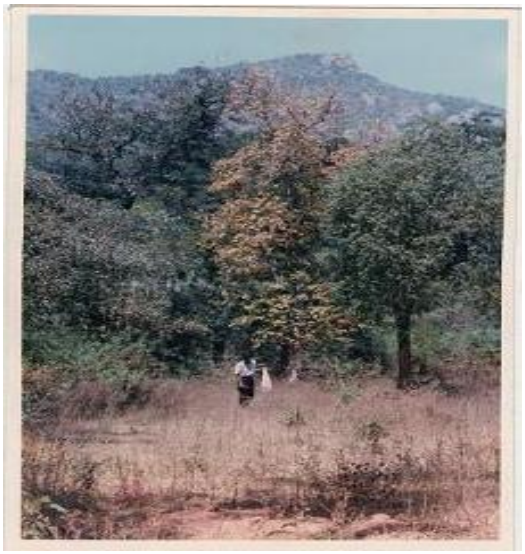

Fig 3

Fig 4

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