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Population dynamics and biomass production of aboveground insects in a tropical grassland

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Abstract. Population dynamics and biomass of aboveground insects were studied in a tropical grassland. A total of 30 species belonging to five insect orders viz., Odonata, Mantoidea, Blattoidea, Neuroptera and Diptera were collected. Maximum population density and biomass values on stands I and II were determined.

Keywords. Aboveground insects; population density; biomass.

1. Introduction

Numerically, arthropods dominate the animal populations of natural ecosystems. There have been relatively few studies on the population density and biomass of total insect fauna both under temperate and tropical conditions. While majority of the studies are confined to the taxonomic composition of insect fauna (Ricou 1967; Evans and Murdoch 1968; Igarshi 1973; Riegert *et al* 1974; Janzen and Pond 1975; Lamotte 1975 and Vats and Singh 1978) attempts to evaluate population density and biomass of insecta as a whole are few (Ricou 1967; Riegert *et al* 1974; Lamotte 1975 and Vats and Singh 1978).

The present paper records the population density and biomass of five insect orders Odonata, Mantoidea, Blattoidea, Neuroptera and Diptera during period June 1976 to May 1978.

2. Materials and methods

Materials and methods have been discussed in our earlier paper.

3. Results and discussion

3.1 *Species composition*

Species composition was first considered (table 1). A total of 30 species belonging to 15 families of five orders were recorded. Of the 30 species, 2 were confined to stand I and 4 to stand II; whereas the remaining species were common to both the stands. On both the stands, the maximum number of individuals belonged to family Mantidae (table 1).

Species composition in different communities has been reported earlier. Ricou (1967) reported 44 species from sown plants at site La Breteque and 96 species from

Table 1. Species composition, number of individuals collected and their per cent contribution on two stands during June 1976 to May 1978.

Taxon	Number on stand I		Number on stand II	
	Total	%	Total	%
	Odonata			
Coenagriidae				
Ceriagrion coromandelianum F.	1	0.47	2	1.04
Rhodischnura nursei Morton	7	3.29	—	—
Tetrathemis platyptera Sclys.	6	2.82	1	0.52
Agriidae				
Ischnura senegalensis Rambur	7	3.29	10	5.18
Libellulidae				
Crocothemis servilia Drury	13	6.10	4	2.07
Pantala flavescens Fabr.	3	1.41	2	1.04
Orthetrum sabina Drury	3	1.41	2	1.04
	Mantoidea			
Mantidae				
Didymocorypha lanceolata Fabr.	13	6.10	13	6.73
Ephestisula intermedia Werner	3	1.41	1	0.52
Humbertiella ceylondica Sauss.	—	—	2	1.04
Mantis religiosa Linn.	25	11.73	33	17.10
Schizocephalus bicornis Linn.	8	3.75	7	3.63
	Blattoidea			
Blattidae				
Blatella humbertiana Sauss.	6	2.82	4	2.07
Mareta sp.				
	Neuroptera			
Hemerobiidae				
Palpares paldus Rbr.	1	0.47	—	—
Suphalomitus verbosus Walk.	4	1.88	1	0.52
Myrmeliontidae				
Heliocomitus dicax	2	0.94	5	2.59
	Diptera			
Tabanidae				
Tabanus sp.	19	8.92	3	1.55
Tabanus hilaris Walk.	6	2.82	4	2.07
Bombyllidae				
Anthrax sp.	—	—	1	0.52
Asilidae				
Promachus sp.	3	1.41	2	1.04
Calliphoridae				
Chrysomia sp.	3	1.41	10	5.18
Lucilla sp.	2	0.94	5	2.59
Rhynchomyia sp.	5	2.34	6	3.11
Strongyloneura sp.	6	2.82	4	2.07
Sarcophagidae				
Sarcophaga sp.	1	0.47	8	4.14
S. albiceps Meigen	—	—	2	1.04
Tachinidae				
Unidentified	47	22.06	30	15.54
Muscidae				
Orthelia caesarion Meig.	18	8.45	24	12.43
Trypetidae				
Unidentified	—	—	1	0.52

permanent pasture at site La Vielle in France during 1967-68; Evans and Murdoch (1968) recorded a total of 437 species (35 Odonata, 8 Neuroptera and 394 Diptera) in an alfalfa field over a period of 11 yrs during IBP studies at Kawatabi, Japan; Igarshi (1973) reported 17 species (1 Mantoidea, 1 Neuroptera and 15 Diptera); Pimental and Wheeler (1973) recorded 87 species (14 Odonata, 1 Mantoidea, 7 Neuroptera and 65 Diptera); Janzen and Pond (1975) reported 99 species (1 Neuroptera and 98 Diptera) at Bridford and 104 Dipterans at Michigan in 1972.

3.2 *Population density and biomass*

Data on the population density and biomass of insecta (sum total of all five orders) are plotted in figures 1-4. The minimum values were obtained either in summer (April-June) or in winter (October-February) and the maximum values during the rainy season (late June-September). Maximum biomass values were also obtained during rainy season on both the stands.

Seasonal variations in population density and biomass of all the insect orders were discussed earlier (Kaushal 1979). The maximum values of population density, biomass, families and species are given for each of the insect order. Table 2 shows the per cent contribution of different orders towards total insect population density and biomass and table 3 shows the per cent contribution of families within that order.

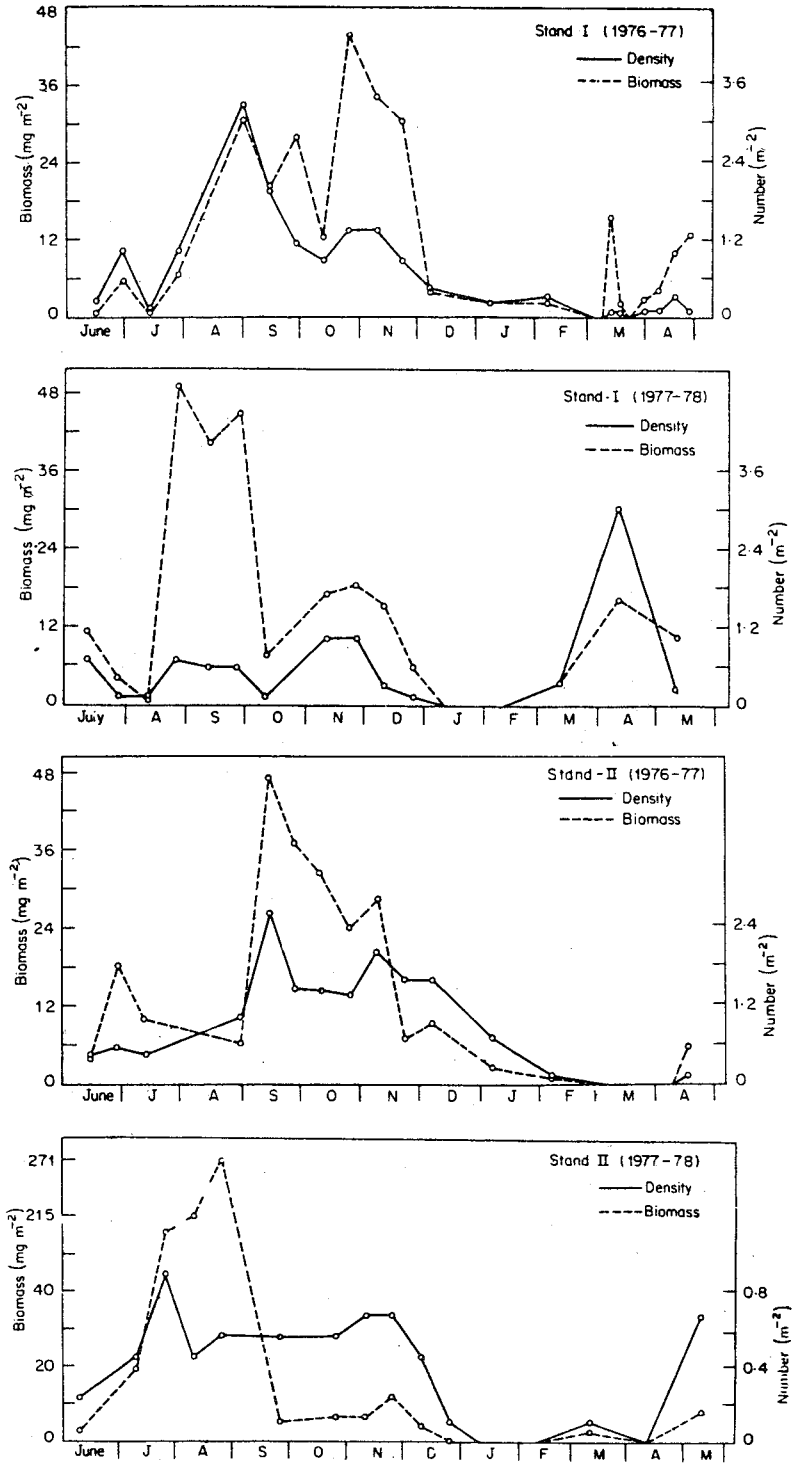
Maximum population density of order *Odonata* was 0.9 m^{-2} on stand I and 0.57 m^{-2} on stand II, whereas the maximum biomass values were 25.94 and 22.78 mg m^{-2} on stands I and II, respectively. Agriidae and Libellulidae were equally dominant in terms of density (0.68 m^{-2}) but Libellulidae alone was dominant with a maximum biomass of 25.94 mg m^{-2}, *I. senegalensis* and *R. nursei* had a maximum density of 0.68 m^{-2}, whereas *O. sabina* accounted for the maximum biomass.

Mantidae had a maximum population density of 1.02 and 1.14 m^{-2} and maximum biomass values were 33.61 and 267.11 mg m^{-2} on stands I and II respectively. *M. religiosa* was the most dominant species with a maximum density (1.02 m^{-2}) and a maximum biomass (267.11 mg m^{-2}).

Maximum population density for *Blattidae* was 0.23 and 0.45 m^{-2}, whereas maximum biomass was 5.02 and 10.54 mg m^{-2} on stands I and II respectively. *B. humbertiana* was dominant in terms of density (0.34 m^{-2}) and *Mareta* sp. had the maximum biomass (9.19 mg m^{-2}).

The maximum population density for *Neuroptera* on both the stands was 0.23 m^{-2}, whereas the maximum biomass values were 43.8 and 23.19 mg m^{-2} on stands I and II. A maximum density (0.23 m^{-2}) was recorded for both the families, while maximum biomass (43.8 mg m^{-2}) was recorded for Hemerobiidae. *P. paldus* and *H. dicax* were equally dominant with a density of 0.23 m^{-2} but *P. paldus* alone was dominant in terms of biomass (43.8 mg m^{-2}).

Maximum population density of *Diptera* was 2.74 and 1.98 m^{-2} and maximum biomass values were 8.6 and 13.47 mg m^{-2} on stands I and II respectively. Tabanidae with a density of 1.71 m^{-2} and Calliphoridae with a maximum biomass of 6.74 mg m^{-2} were the dominant families. *Tabanus* sp. had the maximum density (1.71 m^{-2}) whereas *Lucilla* sp. had the maximum biomass (6.74 mg m^{-2}).



Figures 1—4. Variation in population density and biomass of insects.

Table 2. Per cent contribution of various insect orders to total density and biomass (m^{-2}) during June 1976 to May 1978.

Taxa	Stand I		Stand II		Grassland as a whole	
	Density	Biomass	Density	Biomass	Density	Biomass
Orthoptera*	74.35	91.41	68.93	90.17	71.64	90.79
Homoptera*	4.04	1.06	0.85	0.18	2.45	0.62
Heteroptera*	1.94	1.06	3.65	1.64	2.79	1.35
Lepidoptera*	0.90	0.43	3.20	1.63	2.05	1.03
Hymenoptera*	10.49	1.80	14.23	1.52	12.36	1.66
Coleoptera*	2.50	0.82	2.66	0.70	2.58	0.76
Odonata	1.12	1.03	0.66	0.61	0.89	0.82
Mantoidea	1.27	1.39	1.84	2.14	1.56	1.76
Blattoidea	0.18	0.08	0.35	0.22	0.26	0.15
Neuroptera	0.17	0.25	0.17	0.42	0.17	0.34
Diptera	3.04	0.67	3.46	0.77	3.25	0.72

*These orders have been discussed separately elsewhere.

Table 3. Per cent contribution of different families to total density and biomass within an order during 1976-78.

Family	Stand I		Stand II		Grassland as a whole	
	Mean den.	Mean bio.	Mean den.	Mean bio.	Mean den.	Mean bio.
			Odonata			
Coenagriidae	35.03	11.36	10.95	4.55	22.99	7.96
Agriidae	17.62	7.21	55.72	35.42	36.67	21.31
Libellulidae	47.35	81.43	33.33	60.03	40.34	71.73
			Neuroptera			
Hemerobiidae	77.78	57.32	16.18	12.65	47.03	34.99
Myrmeliontidae	22.22	42.68	83.82	87.35	52.97	65.01
			Diptera			
Tabanidae	22.70	25.39	6.89	9.98	14.80	17.68
Bombyllidae	—	—	0.96	1.47	0.48	0.74
Asilidae	2.72	4.26	1.92	5.74	2.32	5.00
Calliphoridae	14.47	6.94	24.85	20.10	19.66	13.52
Sarcophagidae	0.88	2.23	9.85	12.26	5.37	7.25
Tachinidae	43.00	36.48	29.82	30.51	36.41	33.49
Tripetidae	—	—	2.09	1.94	1.04	0.97
Muscidae	16.23	24.70	23.62	18.00	19.92	21.35

den. = density; bio. = biomass.

Moore (1953) recorded a density of 0.42 m^{-2} for Odonata, whereas Vats and Singh (1978) reported Libellulidae to be dominant in terms of density (0.33 m^{-2}) and biomass (26.62 mg m^{-2}). Lamotte (1975) reported a maximum density (0.71 m^{-2}) and biomass (84.06 mg m^{-2}) in a tropical savannah for Mantoidea. Data on population density and biomass of Blattidae and Neuroptera are lacking. Ricou (1967) reported dipterans with a density of 55 m^{-2} in the control plot but in the sown plot, it remained under 30 m^{-2}. Riegert *et al* (1974) recorded a mean density of 7.22 m^{-2} and a mean biomass of (56.18 mg m^{-2}) for Diptera in a natural untreated grassland.

Vats and Singh (1978) found Diptera to be insignificant in terms of density and biomass. In comparison, maximum density of Insecta in the present study was 3.3 m^{-2} on a stand I and 2.63 m^{-2} on stand II, whereas biomass values were 49.01 and 271.12 mg m^{-2} on stands I and II respectively.

The absence of insects during summer and winter seasons was due to high temperature during summer (March-June) and low temperature during winter (October-February). Putnam (1962) and Davis and Gray (1966) pointed out that extremely high and low temperatures cause high mortality of insects. Vegetational cover influenced the number of species (Bhatnagar and Pfadt 1973). The absence of insects on some dates in the same month does not confirm their absence in that month but might have escaped collection.

Thus it can be concluded that type of vegetation and climatic factors played an important role in determining the number of species and population density of insects.

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