THE MACRO-ARTHROPOD COMMUNITY OF SUGARCANE FIELDS AND OF *CYPERUS IMMENSUS* STANDS

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Abstract

Arthropods associated with sugarcane seven to eleven months old, and with the sedge *Cyperus immensus* (C.B.CL.) were collected at two monthly intervals over a fifteen month period. The search was carried out in each of four regions in the sugar industry. This work formed part of a project designed to study the predators of the sugarcane borer *Eldana saccharina* Walker. Generally greater number of arthropods were found on stools of *C. immensus* than on sugarcane. It is suggested that the lower numbers of arthropods associated with sugarcane may be related to agricultural practices. Of the twenty taxa identified, the Formicidae and Araneida were the most abundant. These two taxa are considered to include the more important predators of *E. saccharina* primarily because of their abundance. In all regions the highest numbers of arthropods were collected in April or June. The recording of the highest numbers of arthropods in samples collected in these two months may be associated with peaks in a number of climatic factors recorded in preceding months.

Introduction

In a study of the insect pests of a crop, a knowledge of the arthropod community is important. The work reported here concerns an examination of the arthropods present in two plant communities, those of sugarcane and of the sedge *Cyperus immensus* (C.B.CL.). The sugarcane borer *Eldana Saccharina* Walker occurs in both communities, *C. immensus* being the preferred wild host (Atkinson[1] and Carnegie and Smaill[6]). This borer is currently the major pest of the South African sugar industry and causes severe damage to sugarcane stalks in certain regions.

The surveys discussed below form part of a larger project in which natural predators of *E. saccharina* were examined. They were designed to answer the following questions :

1. What arthropods occur in the two communities ?
2. Are there any differences in the taxa recorded from the two communities ?
3. Are there any seasonal or geographical trends in arthropod distribution ?
4. Which arthropods recorded are potential predators of *E. Saccharina ?*

Methods

Surveys were conducted in four regions of the sugar industry. These were the Eastern Transvaal region, the North Inland region, the North Coastal region, and the South Coastal region (see Figure 1).

The choice of sampling sites within each region was dictated by several factors, the most important of which was stool size. Stools of sugarcane having approximately fifteen stalks and ten to sixteen joints per stalk were sampled. Similarly *C. immensus* stools comprising twenty to thirty stalks were selected. Stools having these characteristics could be sampled efficiently.

Sampling method

Vacuum sampling was found to be cumbersome and unsuitable because moderately sized arthropods could avoid capture. Hand sampling allowed the collection of large as well as small arthropods (of a few millimeters in size). A third technique was tested. A plastic tent was placed over a stool and a fumigant insecticide released beneath it. After a suitable period the tent was removed and the stool carefully examined for arthropods. However, this technique also was

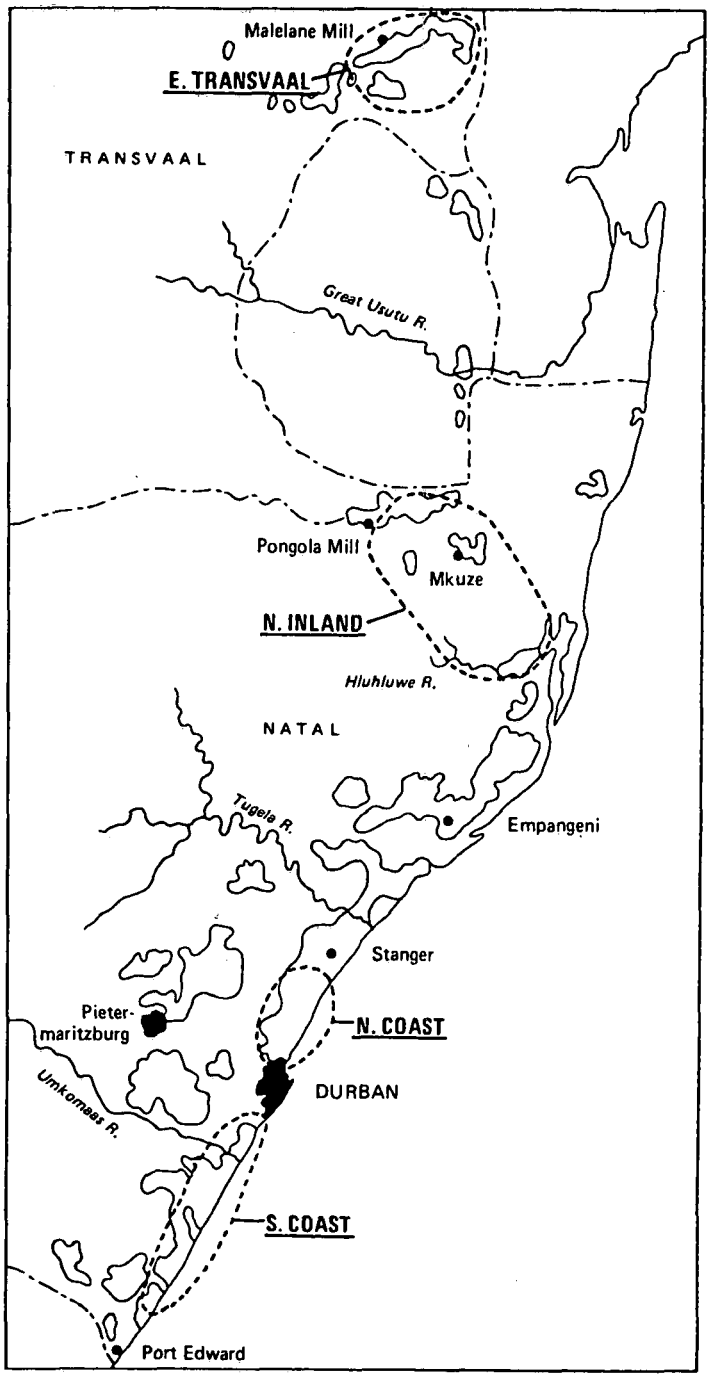

FIGURE 1 Regions of the Sugar Industry from which samples of arthropods were collected.

TABLE 1
Size and number of stools sampled from the four regions
Date of Sample

	Sampling Date	12/77		2/78		4/78		6/78		8/78		10/78		12/78		2/79	
	Region	CI*	CN*	CI	CN	CI	CN	CI	CN	CI	CN	CI	CN	CI	CN	CI	CN
No of Stools	South Coast			8	2	5	4	8	6	9	8	8	8	8	6	8	5
No of Stalks				92	22	161	53	199	76	232	146	221	124	170	202	75	75
No of Stalks/Stool				11,5	11,0	32,2	13,3	24,9	12,7	25,8	18,3	27,6	15,5	21,3	17,0	25,3	15,0
No of Stools	North Coast	3	3	4	2	4	3	5	5	8	6	7	6	6	5	8	6
No of Stalks		71	35	63	20	137	60	145	70	245	88	184	88	131	68	222	89
No of Stalks/Stool		23,7	11,7	16,0	10,0	34,3	20,0	29,0	14,0	30,6	14,7	26,3	14,7	21,8	13,6	27,8	14,8
No of Stools	North Inland	12		5	3	5	3	5	3	6	4	7	6	6	7	8	6
No of Stalks		192		121	50	89	40	109	36	112	45	168	90	127	96	155	80
No of Stalks/Stool		16,0		24,2	16,7	17,8	13,3	21,8	12,0	18,7	11,3	24,0	15,0	21,1	13,7	19,4	13,3
No of Stools	Eastern Transvaal			5	4	3	3	3	3	5	6	6	6	5	6	6	6
No of Stalks				117	82	48	48	63	52	152	91	163	90	148	94	136	101
No of Stalks/Stool				23,4	20,5	16,0	16,0	21,0	17,3	30,4	15,2	27,1	15,0	29,6	15,7	22,7	16,8

CI = Cyperus immensus CN = Sugarcane

found to be cumbersome and time consuming. A comparison of vacuum sampling and other techniques is discussed by Byerly *et al*[4].

At each site to be sampled at least two stools were selected. The second stool chosen was at least 20 metres from the first. This reduced the chance of the same ant colony (if one was present) being sampled at two points.

Assistants were positioned around a stool which was then carefully examined for arthropods. Any live arthropods found were collected and preserved in 70% methanol. The samples were taken to the laboratory where they were sorted into order and, in some cases, into family or genus. In each region samples were taken once every two months between 08h00 and 16h00.

For the early ant surveys, which are discussed later, a different technique was used. Forty samples were taken from each site in a field of sugarcane. Each sample was taken from one cane stalk from a stool as well as an area (30 cm^2) of ground at the base of the stool. Sample sites were ten paces apart. All sites were sampled monthly.

Results and Discussion

Data relating to the samples are presented in Table I. The average number of stalks in a stool of *C. immensus* was 24 ± 5, and in a stool of sugarcane it was 15 ± 2.

The arthropod taxa recorded from the four regions are shown in Table 2. Although 20 taxa were recorded, most of the arthropods belonged to seven taxa. These were, in decreasing order of abundance, the Hymenoptera, Araneida, Hemiptera, Isopoda, Blattaria, Orthoptera and Coleoptera. The Formicidae are probably the most abundant arthropod taxon but the data in Table 2 do not show this because colony size was not taken into account.

Together, these seven taxa account for 85-95% of individuals recorded. The fluctuations in numbers of six of the more common taxa with respect to time in each of the regions surveyed are shown in Figure 2. The seventh taxon, not included in these data, is the Hymenoptera (Formicidae). Since the data presented reflect colony frequency rather than actual numbers the Hymenoptera have been excluded from these figures.

TABLE 2
Abundance of arthropod taxa recorded from the four regions surveyed

Taxon		Region							
		Eastern Transvaal		North Inland		North Coast		South Coast	
		CI*	CN*	CI	CN	CI	CN	CI	CN
Araneida		14,5*	9,4	18,0	9,2	14,3	9,6	14,3	11,2
Hymenoptera	N	0,5	0,8	0,4	0,9	0,3	0,9	0,4	1,1
(Formicidae)	I	1,2	1,4	1,0	1,4	1,1	1,4	1,6	0,8
Hemiptera		15,4	3,7	9,0	4,1	7,6	2,6	8,6	2,5
Isopoda		6,7	5,6	7,6	2,2	7,0	5,3	9,4	9,4
Coleoptera	L	0,9	0,6	3,2	1,1	1,9	1,2	0,8	0,8
	A	4,3	2,2	10,2	4,0	3,4	2,4	3,2	2,1
Orthoptera									
(Saltatoria)		1,6	1,0	2,6	2,0	1,1	1,1	1,5	1,6
(Manteodea)		0,4	0,2	0,3	0,2	0,1	0,5	0,1	0,5
Blattaria		3,2	3,1	4,9	3,8	2,6	1,3	1,1	1,2
Dermaptera		2,0	0,8	0,8	0,5	0,7	1,0	0,6	0,7
Lepidoptera	L	0,8	0,8	0,6	0,6	0,7	0,6	0,7	0,8
	A	0,2	0,0	0,1	0,1	0,3	0,2	0,2	0,2
Chilopoda		0,4	0,3	0,2	0,2	0,2	0,6	1,4	0,4
Diptera		0,2	0,6	0,3	0,3	0,2	0,3	0,4	0,3
Acarina		0,3	0,8	0,2	0,2	0,4	0,3	0,2	0,4
Phalangida		2,5	0,0	0,8	0,1	2,1	0,8	1,4	0,7
Diplopoda		0,0	0,1	1,3	0,6	0,3	0,5	0,8	0,4
Chelonethida		0,1	0,0	0,2	0,3	0,1	0,2	0,1	0,2
Collembola		0,1	0,2	0,1	0,7	0,1	0,3	0,2	0,1
Decapoda (Reptinatia)		0,2	0,0	0,2	0,0	0,1	0,0	0,2	0,0
Scorpionida		0,0	0,0	0,2	0,0	0,0	0,0	0,0	0,0
Malacopoda		0,0	0,0	0,0	0,0	0,1	0,1	0,0	0,1

(* Values are number per stalk × 10)

N = Nests L = Larvae

I = Individuals A = Adults

*CI = *Cyperus immensus*

CN = Sugarcane

As the histograms show, differences in numbers of arthropods recorded with respect to time of sample were greater for *C. immensus* than for sugarcane. However, in both communities the greatest numbers of arthropods were recorded in April or June.

Air temperatures, rainfall and possible sunshine hours over the sampling period are presented in Figure 3. In all regions these three factors were near or at the recorded maximum from December to February. Minima were recorded from May to July.

By referring to Figure 2 it can be seen that peaks in arthropod numbers occurred when temperature, rainfall and sunshine hours were lowest. This probably reflects a response by the arthropod community to favourable climatic conditions in preceding months. Arthropods do respond to climatic conditions. Raw[8] found a positive relationship between rainfall and arthropod numbers and Odum[10] has presented evidence for both photoperiod and temperature effects on arthropods.

Data from the surveys also show that more arthropods were associated with *C. immensus* than with sugarcane (Figures 2 and 4). Cultivation can reduce the numbers of arthropods in a field. In Uganda, Block[2] compared the numbers of micro-arthropods associated with seven types of habitat. His results showed that fewer arthropods were recorded from arable land than from non-arable land. Further evidence is given by Burnett[3] who examined the soil arthropods associated with dry grassland, moist grassland and cultivated land under sugarcane in East Africa. He found that the greatest numbers of arthropods were recorded from moist grassland, ants being the dominant insect. Cultivation had the effect of reducing the numbers of arthropods to two thirds of those recorded from moist grassland.

Thus the fact that fewer arthropods were recorded from sugarcane than from *C. immensus* may be related to cultural practices in sugarcane fields. Which particular practice has the greatest effect on arthropod numbers is not clear. Jones[8] showed that straw burning in winter wheat fields adversely affected Diptera and Hymenoptra. However, spiders were more numerous in burnt than unburnt stubble. Kajak[9] showed that NPK fertilizer had an effect on spiders in a meadow. The spiders responded to treatments by changes in numerical dominance of species; larger species were replaced by smaller species in treated plots.

Probably the single most important practice in sugarcane agriculture that may affect arthropods is harvesting. Here the entire habitat is removed and in many instances the residue is burned. Only soil dwelling arthropods such as ants may avoid the more severe effects of such habitat removal.

Many of the taxa recorded include carnivors or at least omnivors. However only the Araneida and Formicidae were considered to contain the more likely predators of *E. saccarina* and these were selected for detailed study. Support for this choice is given by Waiyaki[12], who observed that the ant *Pheidole megacephala* preyed upon *E. saccharina* eggs and young larvae, and by Girling[7] who made similar observations.

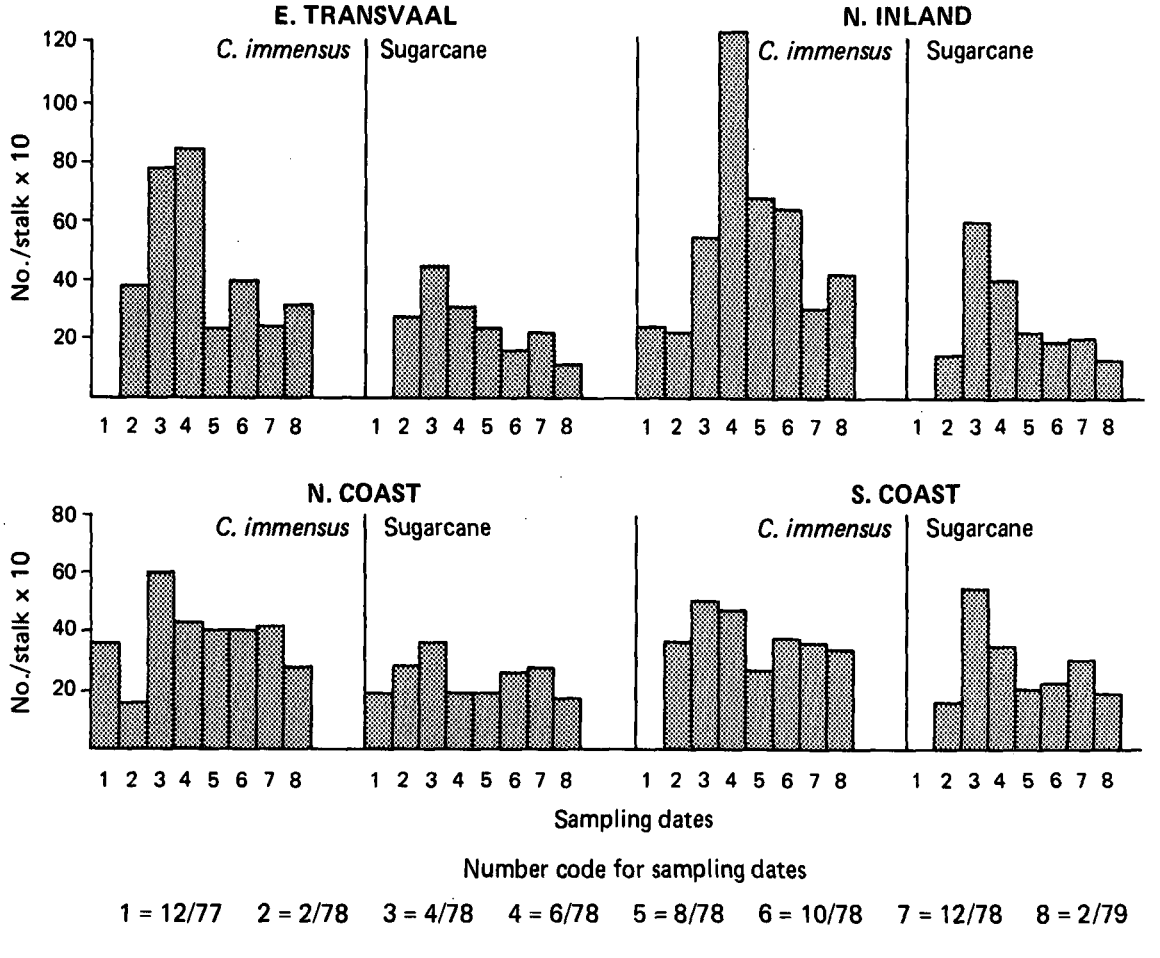

FIGURE 2 Abundance of the six more common arthropod taxa related to time and region of sample.

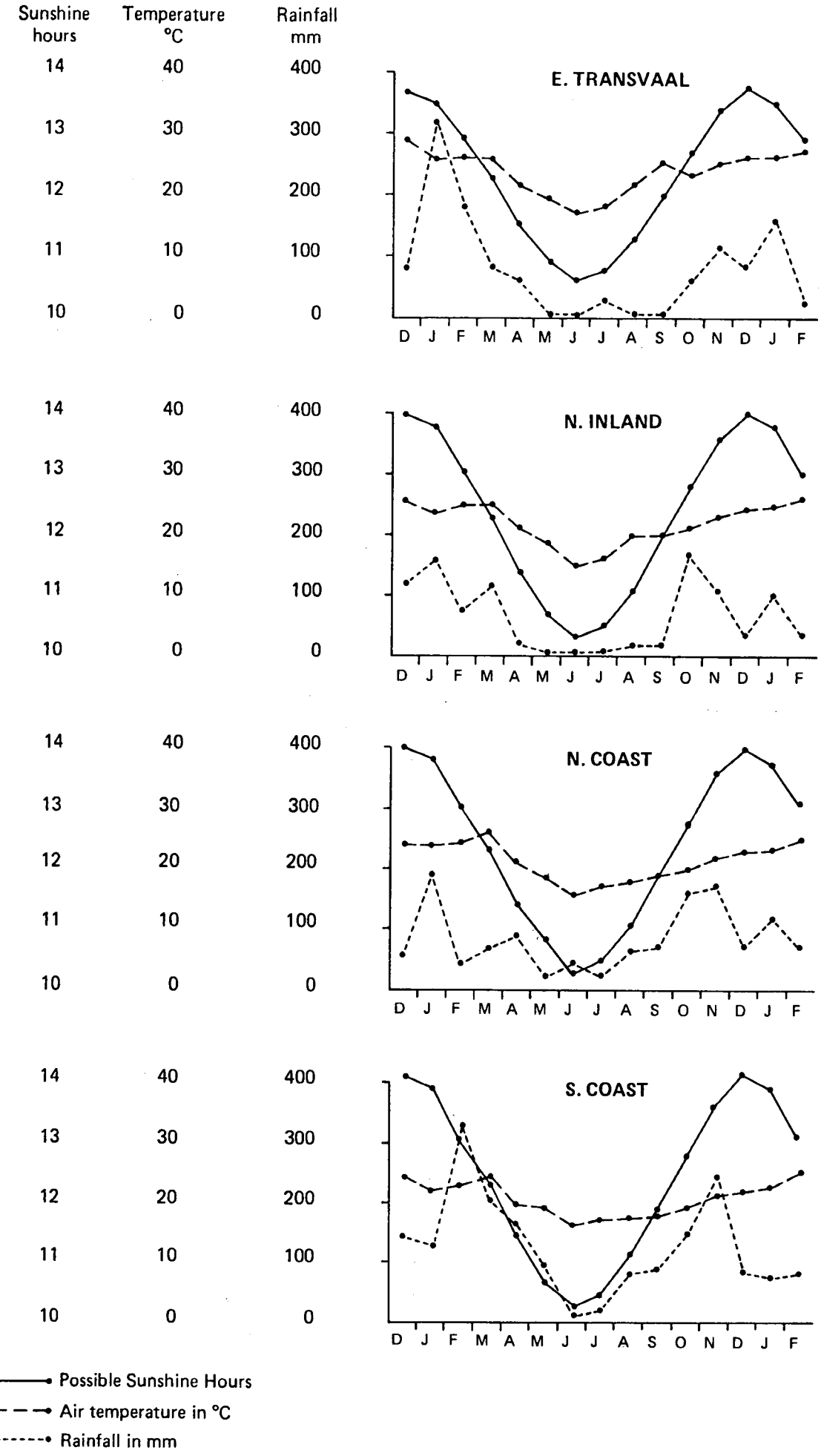

FIGURE 3 Fluctuations of possible sunshine hours, temperature and rainfall during the period December 1977 to February 1979.

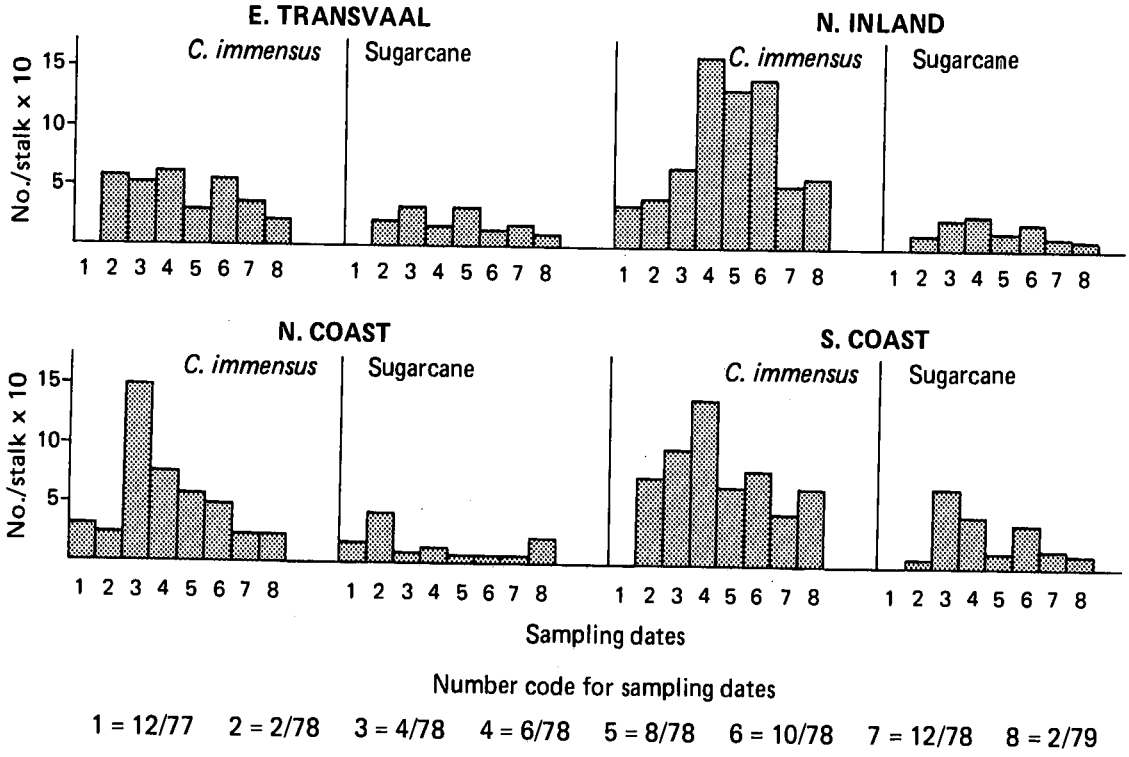

FIGURE 4 Abundance of Lycosid Spiders in the four regions surveyed.

Additionally, direct observation in Natal sugarcane fields has implicated spiders and ants as adult and egg predators respectively.

A breakdown of the Araneida families recorded and their frequency of occurrence is given in Table 3. Note is also made of the usual food-capturing habit of the family, ie whether they trap their prey in webs, or roam and ambush prey. Of the six most common families, four are cursorial in habit and two are web-spinners. They are, in decreasing order of abundance, the Lycosidae, Thomisidae, Salticidae, Clubionidae, Drassidae and Theridiidae. Combined, these six families accounted for 70-80% of spiders recorded.

Figure 4 shows the abundance of the most common spider family, the Lycosidae. Generally, greater numbers were associated with the sedge and most lycosids were recorded from samples taken in April and June.

Many of the remaining families were recorded regularly from all regions sampled. However, certain rare families appeared to have a restricted distribution. For example the Dysderidae and Prodidomidae were recorded from the Eastern Transvaal sites only. Similarly the Uloboridae were recorded only from the South Coastal sites.

The data presented for the Formicidae are drawn from surveys covering the years 1976-1979. An initial survey conducted in 1976 provided basic data on the genera in several regions that were included in the study. The abundance and dominant types were no different from those recorded in the later surveys (see Table 4). Further data from these surveys indicated that more ant colonies and foraging individuals were associated with samples taken from the ground at the base of a stalk, than from samples of stalk alone. No significant differences in numbers of colonies or of foraging individuals were found between samples taken from damp (low) areas and dry (high) areas.

The ant surveys conducted in conjunction with the arthropod surveys previously discussed showed similar trends to those from the earlier surveys. The occurrence of ant colonies and foraging individuals of the different genera recorded are shown in Table 4. The genera are ranked according to the frequency of occurrence of ant colonies in the four regions. Adjacent figures are the ranked values as

TABLE 3
Ranked percentage frequency of occurrence of identified spider families

Family	Feeding Habit*	Region			
		Eastern Transvaal	North Inland	North Coast	South Coast
Lycosidae	H	100	100	100	100
Thomisidae ..	H	100	100	93,8	100
Salticidae	H	100	100	93,8	100
Clubionidae ..	H	100	100	93,8	92,9
Drassidae	H WS?	92,9	100	100	92,9
Theridiidae ..	WS	85,7	86,7	100	85,7
Pisauridae	H	78,6	73,3	68,8	85,8
Erigonidae	WS	50,0	53,3	100	100
Sicariidae	WS?	78,6	73,3	81,3	57,1
Argiopidae ..	WS	85,7	86,7	12,5	100
Linyphidae ..	WS	64,3	60,0	62,5	85,7
Pholcidae	WS	71,4	66,7	43,8	35,7
Selenopidae ..	H	7,1	33,3	87,5	85,7
Agelenidae ..	H WS	35,7	66,7	50,0	35,7
Sparassidae ..	H	42,9	40,0	56,2	35,7
Ctenidae	H	7,1	13,3	50,0	42,9
Dictynidae	WS	0,0	20,0	31,3	14,3
Tetragnathidae ..	WS	0,0	20,0	12,5	21,4
Oecobiidae ..	WS	0,0	6,7	6,3	28,6
Caponiidae ..	H	28,5	6,7	6,3	0,0
Palpimanidae ..	WS	7,1	13,3	6,3	0,0
Dysderidae ..	WS?	21,4	0,0	0,0	0,0
Mimetidae	H/WS	7,1	0,0	12,5	0,0
Prodidomidae ..	H?	7,1	0,0	0,0	0,0
Uloboridae ..	WS	0,0	0,0	0,0	7,1
Archaeidae ..	WS	0,0	6,7	0,0	0,0
Philodromidae ..	H	0,0	6,7	0,0	0,0
Dipluridae	WS	0,0	0,0	6,3	0,0
Eresidae	WS	Present but rare			

*H = cursorial spiders WS = web spinning spiders

determined by the recording of foraging individuals. An individual was considered to be a forager if no colony of the same genus was associated with the sample.

The ranking of ant genera according to numbers of foraging individuals may be used as a crude index of foraging activity. Obviously the more individuals recorded, not associated with a colony, the more active a particular genus may be. Based on this criterion the more active genera are, in decreasing order, *Plageolepis, Polyrhachis* and *Crematogaster*. No observations of dawn, dusk or nocturnal foraging of these or other *genera* were made. However, Carnegie[5] monitored the movement of *Pheidole megacephala* over 24 hour periods and found that temperature was more important than day length in determining ant activity.

The four most abundant genera out of fifteen recorded account for 79% of all occurrences. They are *Paratrechina, Pheidole, Acantholepis* and *Solenopsis*. The distribution of these four genera is shown in Figure 5. The data suggest that for these four ant types more colonies are associated with sugarcane than with the sedge. This might be explained by the fact that many ant species frequently establish their colonies beneath the surface of the soil. The habitat of *C. immensus* which is primarily swamp may prevent colonies of certain ant species from becoming established. However, the comparatively dry habitat of sugarcane fields is possibly more suitable. Changes in abundance of ant colonies with respect to season are not apparent from these data.

One taxon of arthropods not adequately covered in these surveys and which may include important predators of *E.*

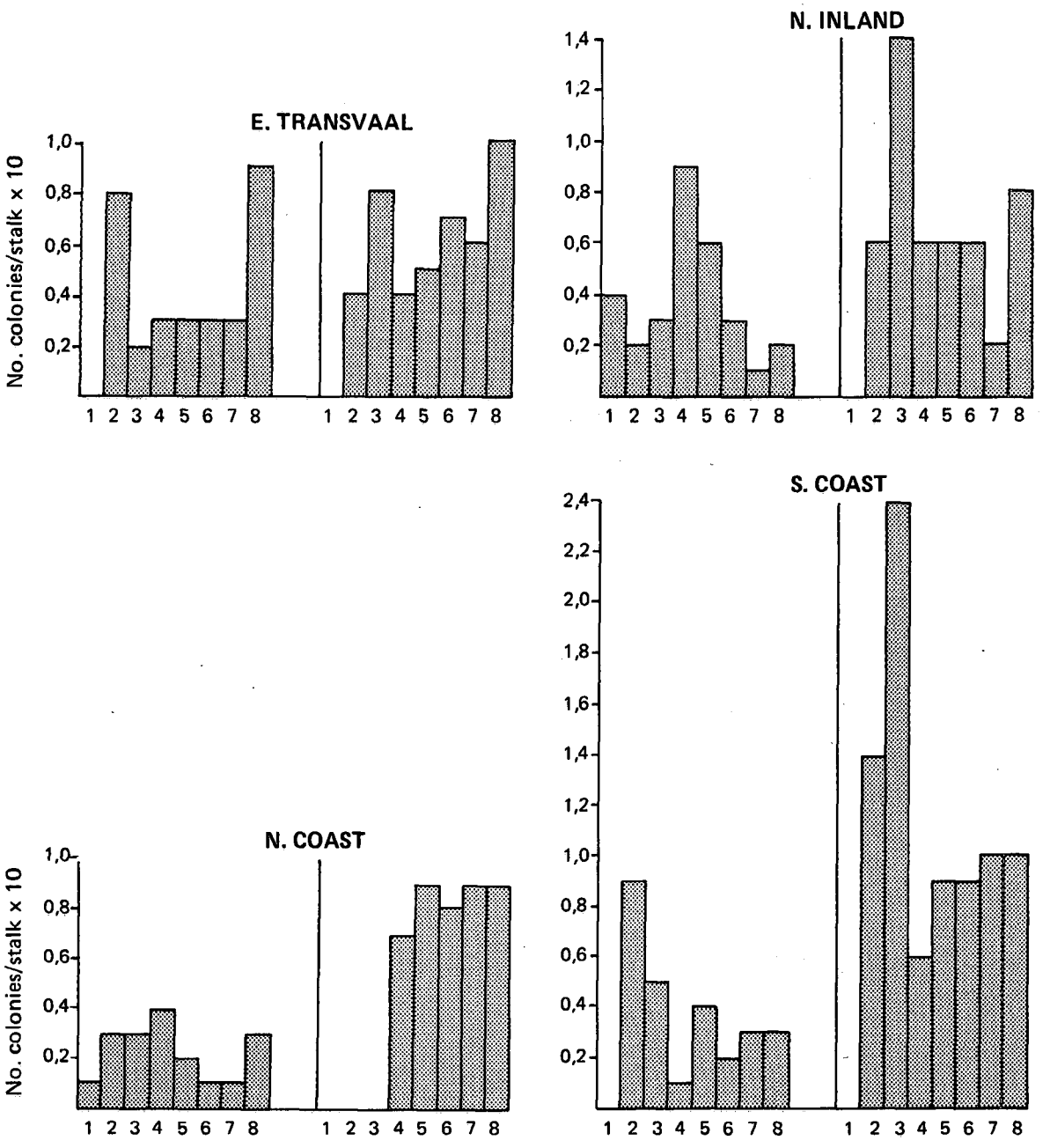

FIGURE 5 Combined distribution of the four more common genera of Ants.

TABLE 4

Ranked percent frequency of occurrence of ant genera in the regions surveyed

Genus	Region				Ranked by Recordings of Individuals
	Eastern Transvaal	North Inland	North Coast	South Coast	
Paratrechina	85,7	93,8	73,2	100	4
Pheidole	78,6	100	59,8	85,7	7
Acantholepis	57,1	49,1	0	71,4	5
Solenopsis	42,9	28,7	27,7	35,7	12
Dorylus	14,3	25,0	7,2	21,5	9
Plagiolepis	14,3	19,7	12,6	14,3	1
Crematogaster	0,0	12,5	12,5	14,3	3
Polyrhachis	14,3	13,4	0,0	14,3	2
Leptogenys	0,0	0,0	13,4	14,3	8
Myrmicaria	14,3	0,0	0,0	0,0	6
Aenictus	Only Individuals recorded				10
Paltothyreus	"	"	"	"	11
Tetramorium	"	"	"	"	11
Tetraponera	"	"	"	"	11

saccharina is the Acarina. Periodic vacuum sampling of sugarcane has shown that mites do occur in fairly large numbers though their abundance would appear to be seasonal.

Conclusions

The data presented suggest that of twenty arthropod taxa recorded, seven accounted for 85-95% of individuals recorded. The two most common taxa recorded were the spiders and the ants. Of the spider families recorded, those having a cursorial habit were most common. Seventy-nine percent of the ant colonies recorded belonged to four genera out of a total of fourteen genera identified.

Greater numbers of spiders were associated with *C. immensus* than with sugarcane. Conversely greater numbers of ant colonies were associated with sugarcane than with *C. immensus*. The comparatively dry condition of sugarcane fields may explain this difference.

The data for all taxa identified (excluding the ants) show that the greatest numbers of individuals were recorded from samples collected in either April or June. This might be related to environmental factors. No geographical trends in abundance were apparent.

Many of the taxa recorded are capable of feeding on *E. saccharina*. However, the spiders and the ants are thought to be the most frequent predators of *E. saccharina* primarily because of their abundance.

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