

NRA-WATER QUALITY 82

Macroinvertebrates of the River Nar,

Great Ouse catchment

Macroinvertebrates of the River Nar, Great Ouse catchment, Anglian Region of the National Rivers Authority



ENVIRONMENT AGENCY

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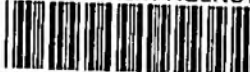
ANGLIAN REGION

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Peterborough PE2 5ZR

**Ecology Unit
University of Leicester**

Operational Investigation: Draft Report (Version 1) March 1993

ENVIRONMENT AGENCY



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1. INTRODUCTION

The River Nar is a small chalk stream tributary of the lower Great Ouse, in Norfolk. Part of its length is an SSSI, and it is known both for its rich aquatic plant community and for its dragonfly fauna.

A preliminary study was carried out in February 1993 to ascertain the biological value of the invertebrate communities along the whole length of the river and certain tributaries.

1.1 Scientific background

Water quality assessment using macro-invertebrates relies upon identification to family level, of fauna present at a site. This is followed by the addition of scores allocated to each family (except oligochaeta, worms, which remain as the class) on the basis of their tolerance to organic pollution (largely their sensitivity to oxygen concentrations), to achieve a site score.

The BMWP score, as this is called, gives a reasonably accurate estimate of the degree of pollution, or the quality of water at a site. The ASPT (total site score divided by the number of contributing taxa) often gives a more accurate estimate because this overcomes distortion caused by low taxonomic representation at a site, caused for example by habitat restriction in a canalised reach.

BMWP score is not very versatile because of its taxonomic basis, and so more accurate information is gained when samples are analysed to lower taxonomic levels - to genus and species wherever possible. This yields information about the basic ecology of a site, particularly about the habitats present and subtle water quality differences such as caused by nutrient enrichment.

Invertebrate data may also be interpreted by functional classification of the feeding guilds from which inferences may be made concerning the organic matter processing of the stream.

1.2 Project objectives

This project was established to provide a preliminary analysis of the fauna of the River Nar by high spatial resolution; at 45 sites throughout the river; and high scientific resolution, identifying the major taxa to species.

The results are interpreted in terms of the impact of known changes along the river.

1.3 Methodology

The sites were selected by the NRA and all those marked on the map supplied were, with two exceptions, visited. The two exceptions were insurmountably fenced. The list of sites and the original maps supplied by the NRA are shown on the next 4 pages.

Samples were collected by standard kick-sample with hand-netting and removed to a tray on the bankside. Tricladida were removed from the tray for identification that day, but all other fauna were then preserved in buckets in 70% alcohol and returned to the laboratory for removal and identification.

Various taxonomic levels were required by the contract and these were achieved in all cases except where specimens were too immature for identification to be achieved with confidence. A full taxonomic list is provided in the Appendix to this report. All specimens

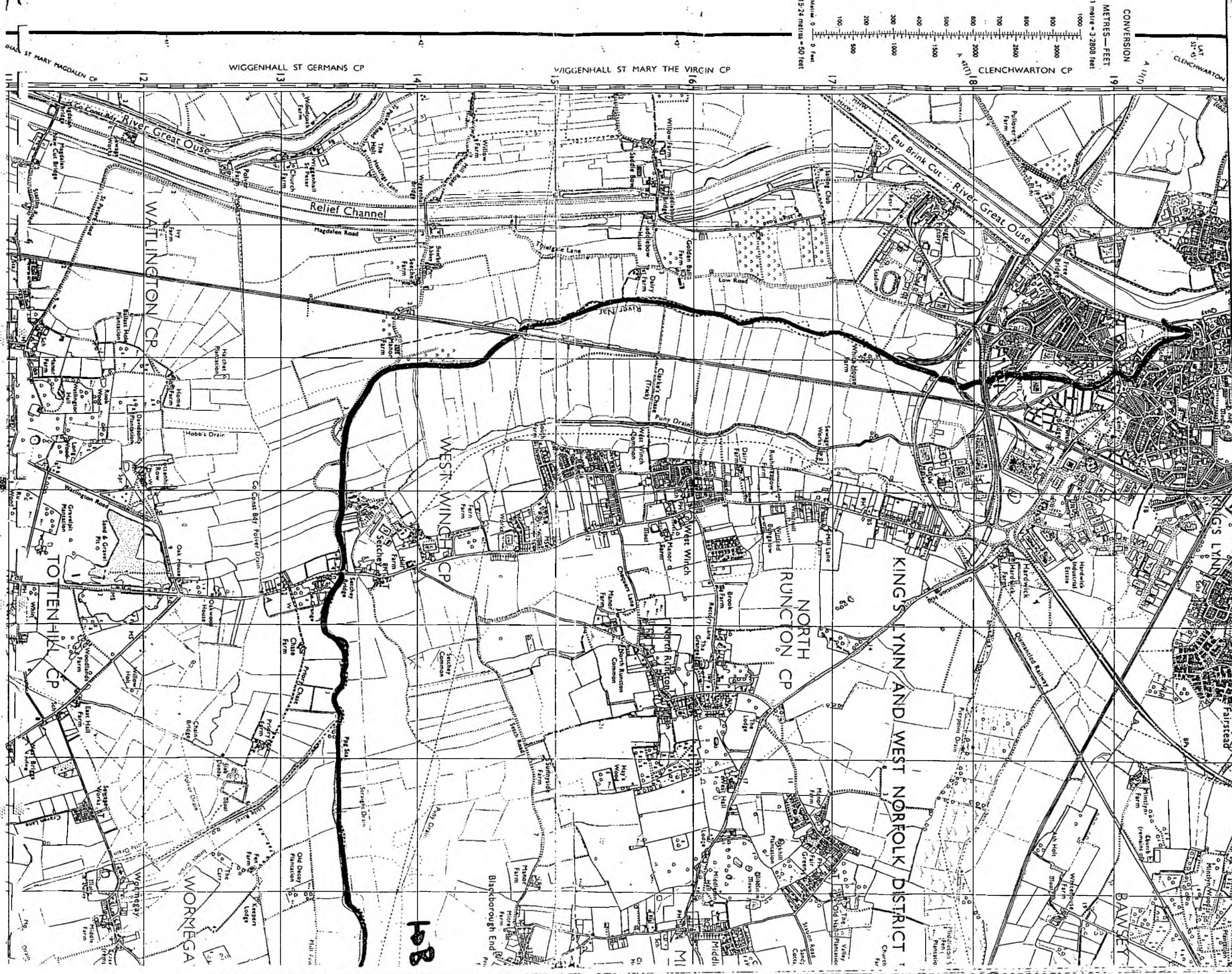
removed and identified have been retained for further use and for quality control.

1.4 Limitations

The sampling was conducted over one 3-day period in February. many specimens were too small for accurate identification and many species could have been missed due to their larvae being too small or absent. Thus the taxonomic list obtained should be regarded as an indication of the value of the river, rather than a definitive statement.

Site Locations and Grid references

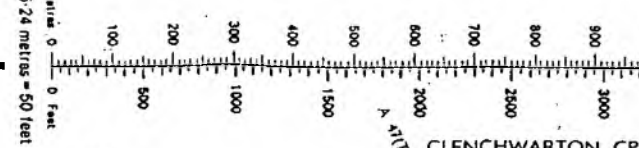
Site number	Site Location	Grid reference
1	King's Lynn	TF 622183
2	High Bridge, Blackborough (Nar)	TF 672135
3	High Bridge, Blackborough (Trib.)	TF 671136
4	Priory, Blackborough	TF 674141
5	Middleton Common, Blackborough	TF 689141
6	Lower Farm, East Winch	TF 868146
7	Park Farm, East Winch	TF 703149
8	West Bilney	TF 715155
9	Denton's Farm, West Bilney Warren	TF 688134
10	High Plantation, West Bilney Warren	TF 699133
11	Long Rough, West Bilney Warren	TF 698137
12	Magpie Cottages, on A 47	TF 735145
13	Magpie Farm, Pentney	TF 737145
14	Abbey Farm, Nr. Pentney	TF 698121
15	Ashwood Lodge, Nr. Pentney (Trib.)	TF 722124
16	Ashwood Lodge, Nr. Pentney (Nar)	TF 725121
17	West Common, Pentney	TF 738135
18	Narborough West (Trib.)	TF 747133
19	Narborough West (Nar)	TF 746134
20	Narborough North-East	TF 757132
21	Bradmoor Plantation, Narford	TF 765145
22	NO ACCESS	TF 767147
23	NO ACCESS	TF 771146
24	West Acre, South	TF 779148
25	Mill House Ford, West Acre	TF 788152
26	Castle Acre Common	TF 807153
27	Peddar's Way Ford, Castle Acre	TF 816145
28	Castle Acre South, (Nar)	TF 818147
29	Castle Acre South, (Trib.)	TF 817145
30	Castle Acre East	TF 823152
31	Castle Acre Road, Newton	TF 826155
32	Church Farm, Newton	TF 827154
33	Newton Mill	TF 832163
34	A 1065 Nr. West Lexham	TF 838170
35	Sidestock, Nr. West Lexham	TF 838167
36	East Lexham	TF 859169
37	Lexham Hall (Broad Waters)	TF 868169
38	Lexham Hall (Nar)	TF 870168
39	Litcham (Centre)	TF 888175
40	Litcham (Below Priory)	TF 886173
41	Bridge Farm, Litcham	TF 892172
42	Below Litcham Sewage Works	TF 892175
43	Drury Square, Litcham	TF 893176
44	The Warren, Litcham	TF 903179
45	Mill Farm, Mileham	TF 905188



CONVERSION

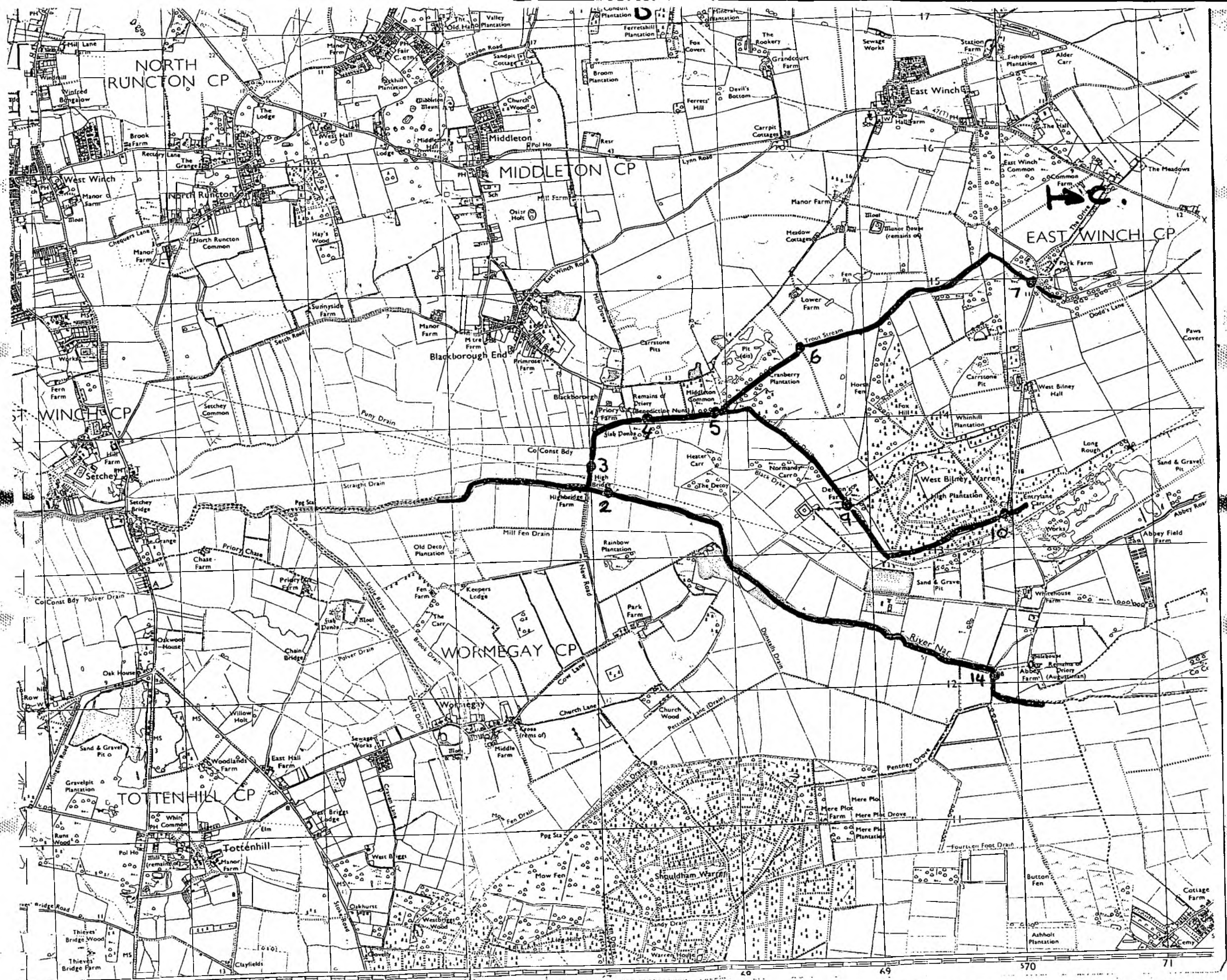
METRES — FEET

1 metre = 3.2808 feet



108







2. RESULTS

Ninety two species, and forty-eight families were recorded in the whole river system. Approximately half this total taxonomic richness was achieved at the most rich sites. This is fairly high considering that the major taxonomic richness of lowland rivers is usually in the Diptera, which in this case were only identified to family. Six species of Hirudinea, thirteen of Mollusca and four of Malacostraca confirm the calcareous nature of the river. Six species of Odonata, eleven of Ephemeroptera and twenty four of Trichoptera confirm its generally high habitat and water quality.

Interesting ecological features include the co-existence of *Asellus aquaticus* and *A. meridianus* throughout the river, and of *Crangonyx pseudogracilis* with *Gammarus pulex*, although the former tended to be more abundant in the lower sites, the latter in the upper sites. *Ephemera danica* (a sand-burrowing species) and *E. vulgata* (silt-burrowing) were also found; although not together.

2.1 The main river

The overall quality of the main river is summarised in three ways; by total taxa per site, by BWMP score per site, and by ASPT per site.

Generally the number of taxa declined from confluence to source, with the lowest four sites being the most taxonomic rich. This richness, despite habitat uniformity (the lower four sites correspond to the fenland stretch, see photographs), is a result of the preponderance of lotic calcifuge taxa such as Mollusca, Crustacea, Ephemeroptera and Odonata.

The trends shown by taxonomic richness are not shown so clearly in the score systems, where a cluster of middle sites - 21/24, 32 and 34/36 achieve the highest quality though pollution-sensitive families of Ephemeroptera, Trichoptera and Plecoptera. No site could be considered badly polluted; the lowest scoring sites were all the size-restricted upper sites, where the stream course was dominated by silt and leaf litter.

In the middle reaches slight depressions of water quality were associated with villages and trout farms (Narborough, above site 19, Castle Acre, above site 27).

It is possible that the taxonomic depressions in the upper sites are the reflections of low flows over the past few years as the species composition indicates siltation and detritus accumulation, but it is impossible to be sure of this.

CHART SHOWING THE TOTAL NUMBER OF TAXA FOUND AT EACH SITE

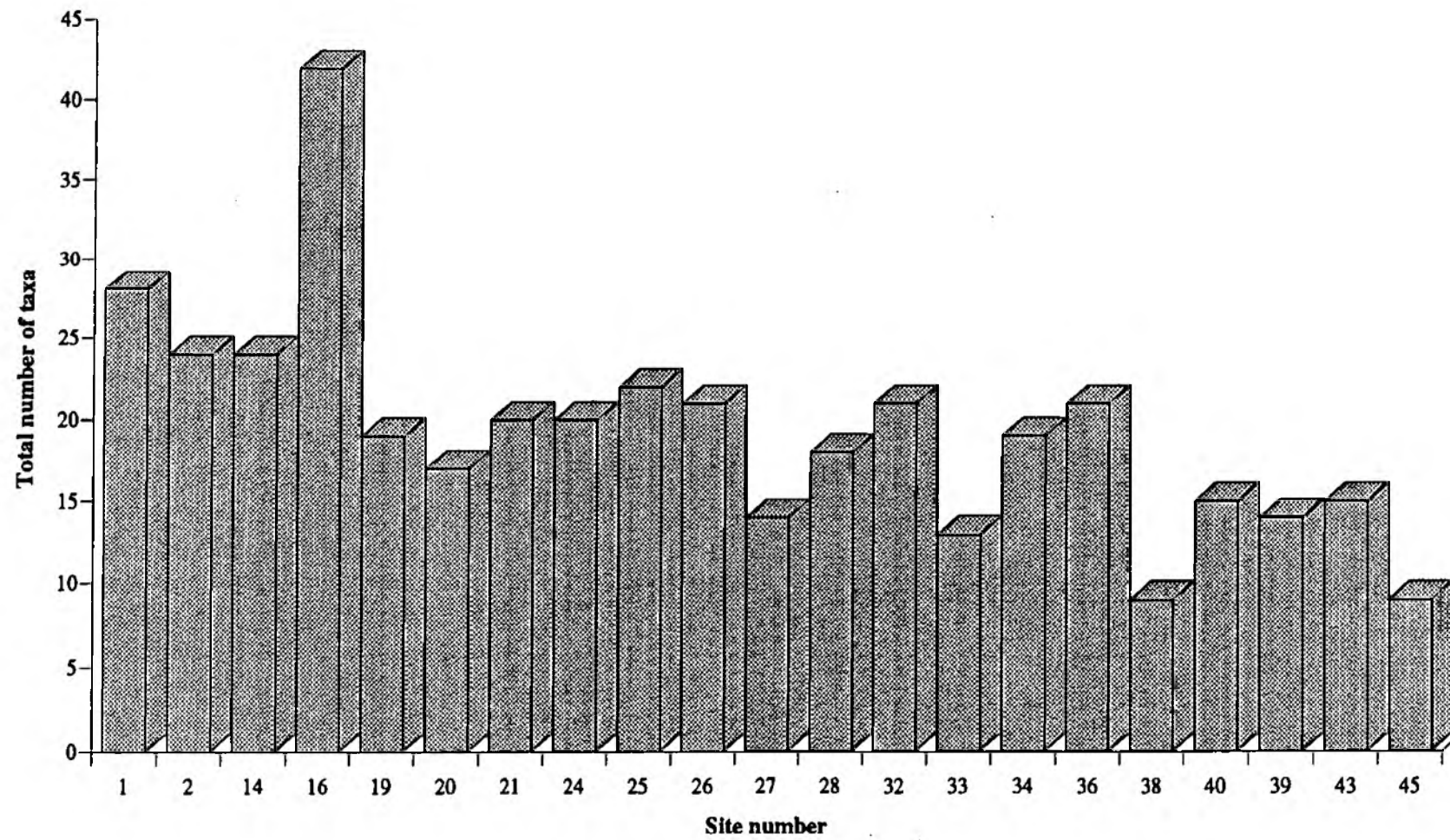


CHART SHOWING THE AVERAGE SCORE PER TAXON AT EACH SITE

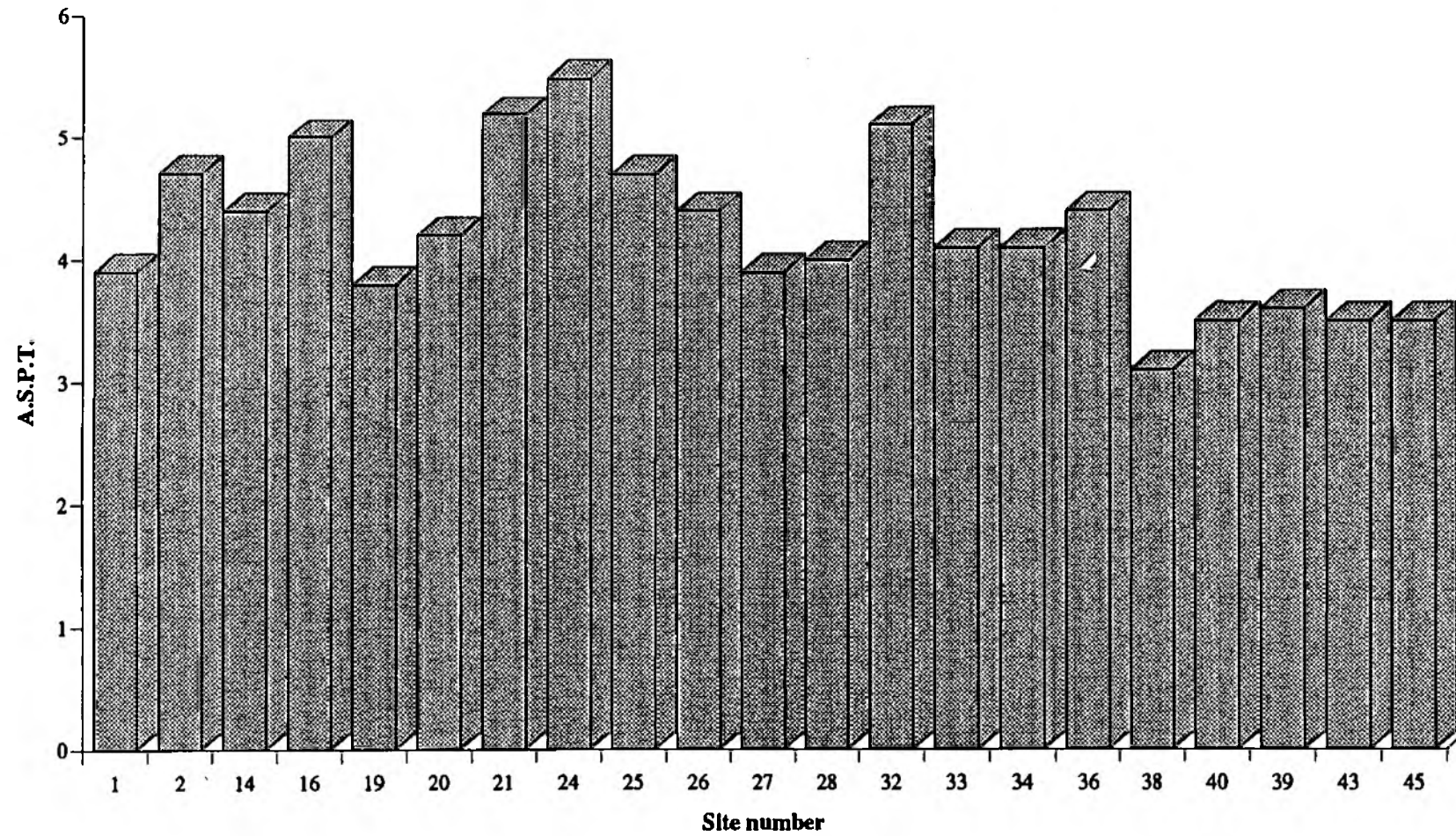
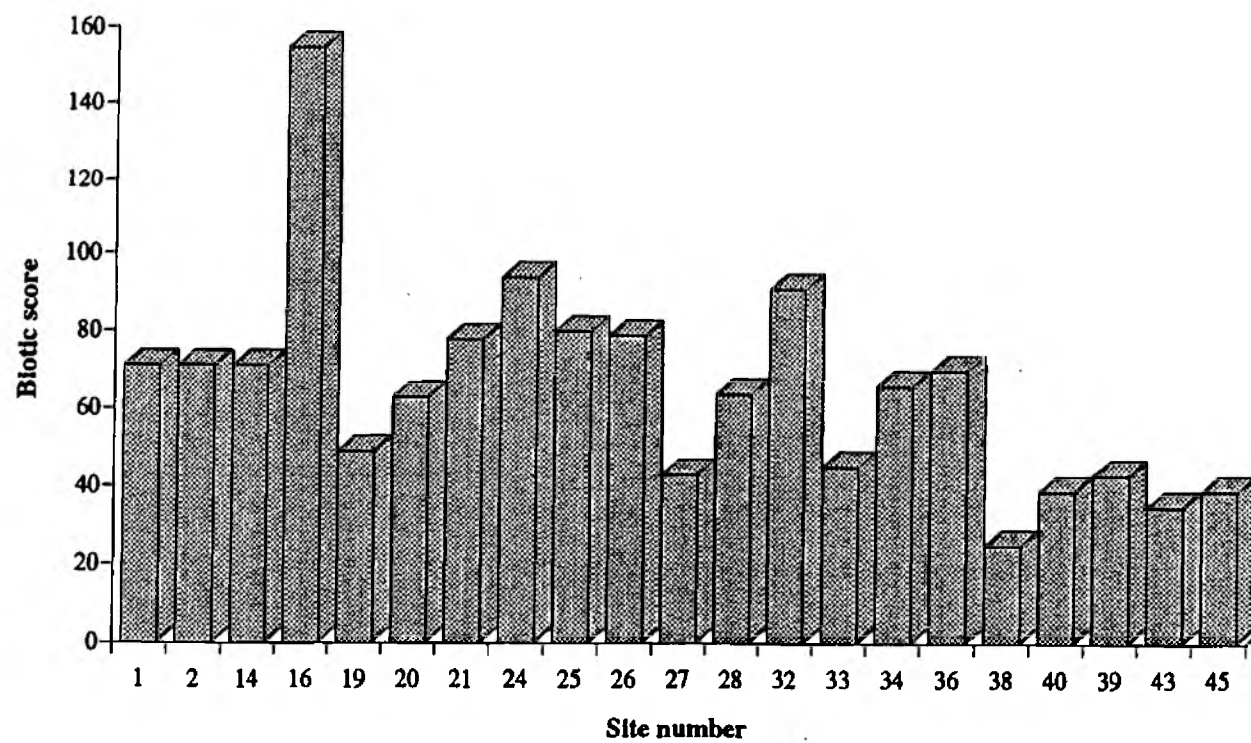


CHART SHOWING THE BIOTIC SCORE OF EACH SITE



2.2 Tributaries

There was one main tributary, at Middleton in the lower part of the river with eleven sample sites, and eleven separate sites on small brooks or side arms further upstream.

2.2.1 Lower tributary - Middleton

The sites along the two arms of this lower tributary were uniformly high in quality with average scores close to 5. One site, 12, had a high taxonomic richness for no apparent reason, otherwise all sites were fairly similar. One of these tributary sites, site 5, contained the highest number of Odonata found in the river, 5 species including one specimen which could have been *Ceragrion tenellum* but was too small to be certain.

2.2.2 Smaller tributaries

The smaller tributaries and side arms were also generally clean, as indicated by their ASPT scores, but they separated into two groups taxonomically. The five middle-reach tributaries, sites 15-30, were markedly richer than the six upper-reach tributaries. This is probably for similar reasons that there is an upstream decline in richness in the main river as five of the the upper six tributaries are smaller in size and flow than the middle five; the exception is site 37, which is lentic rather than lotic.

**CHART SHOWING THE TOTAL NUMBER OF TAXA FOUND AT EACH SITE ON THE LOWER
ARM OF THE TRIBUTARY**

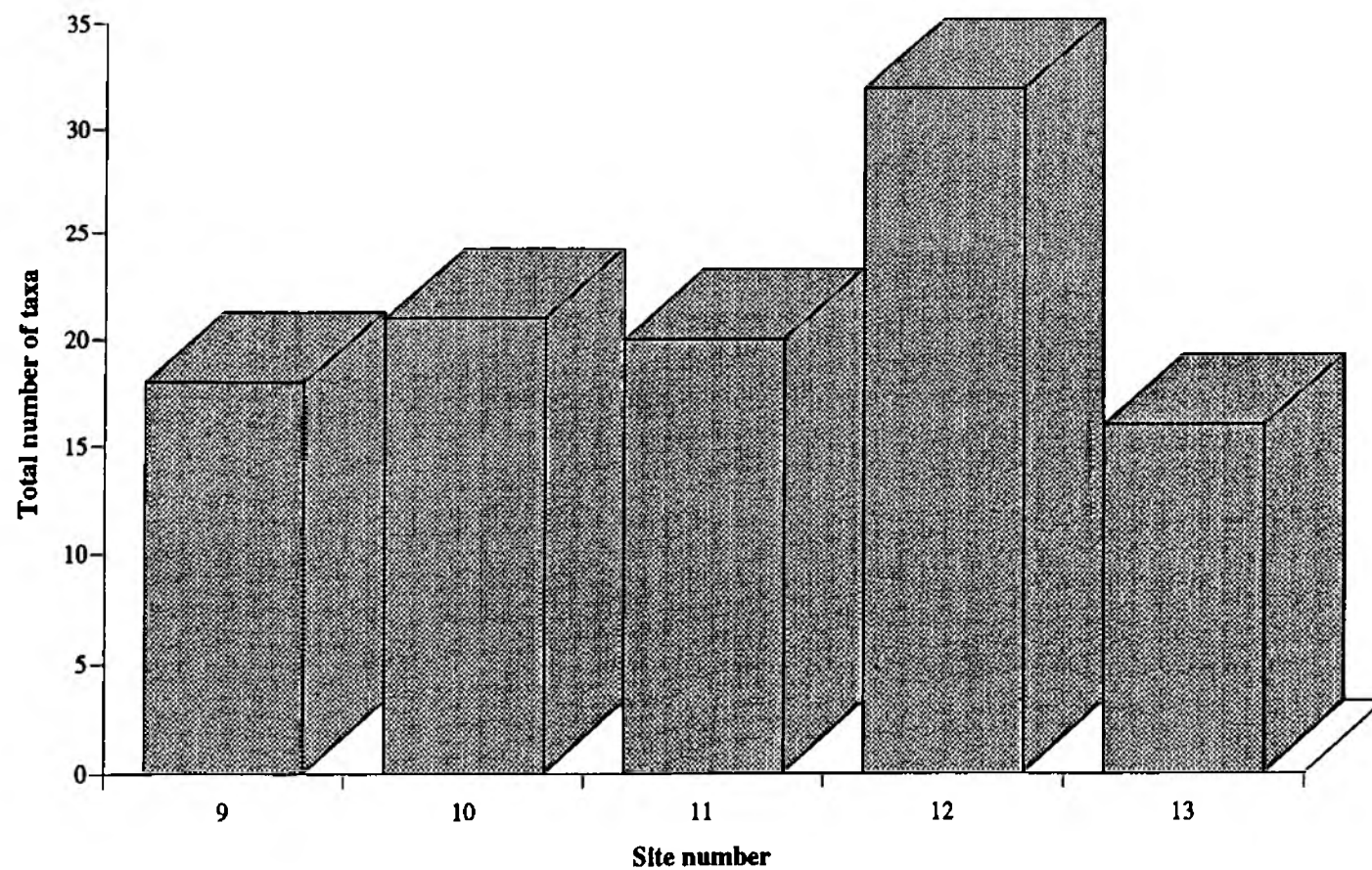
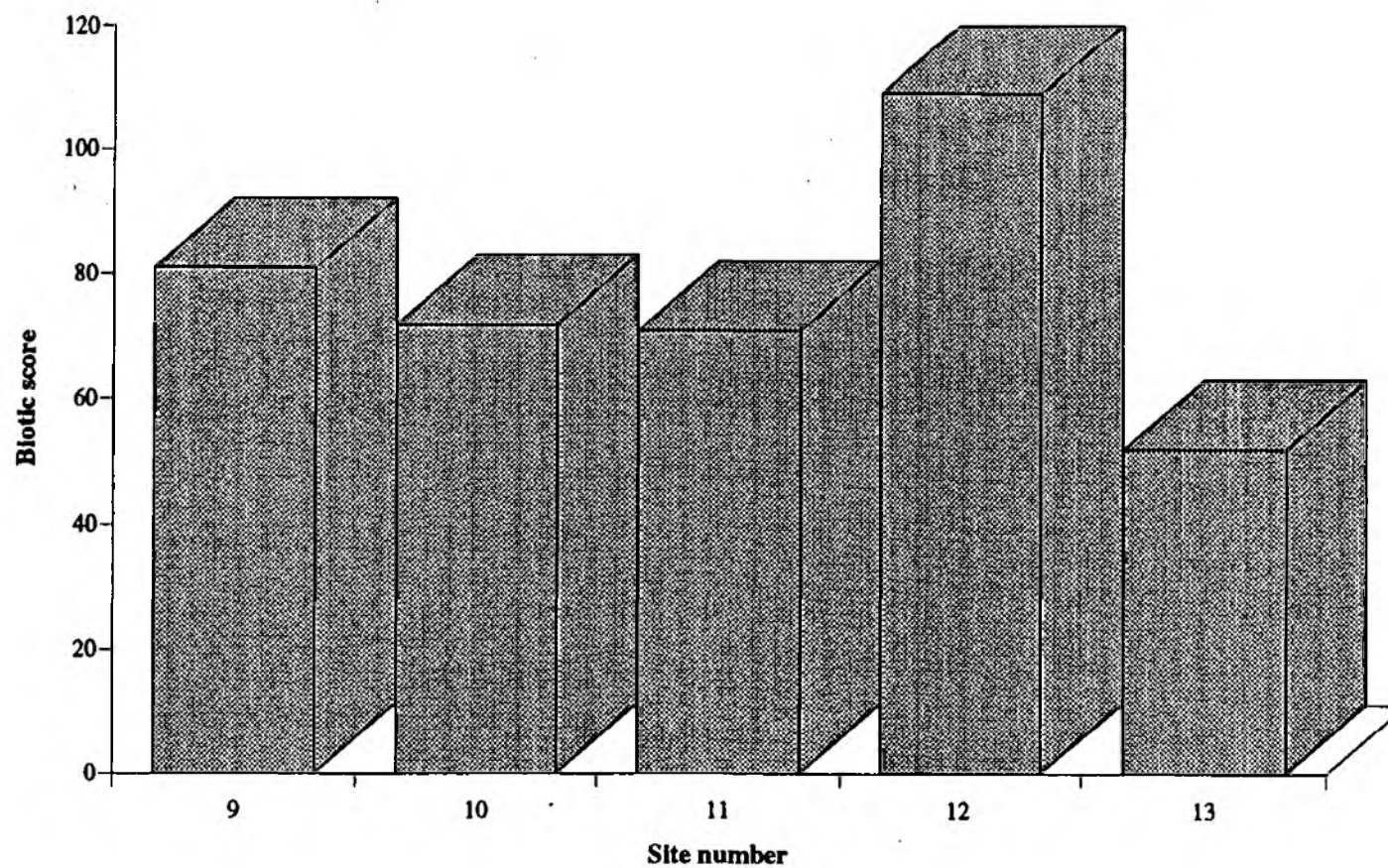
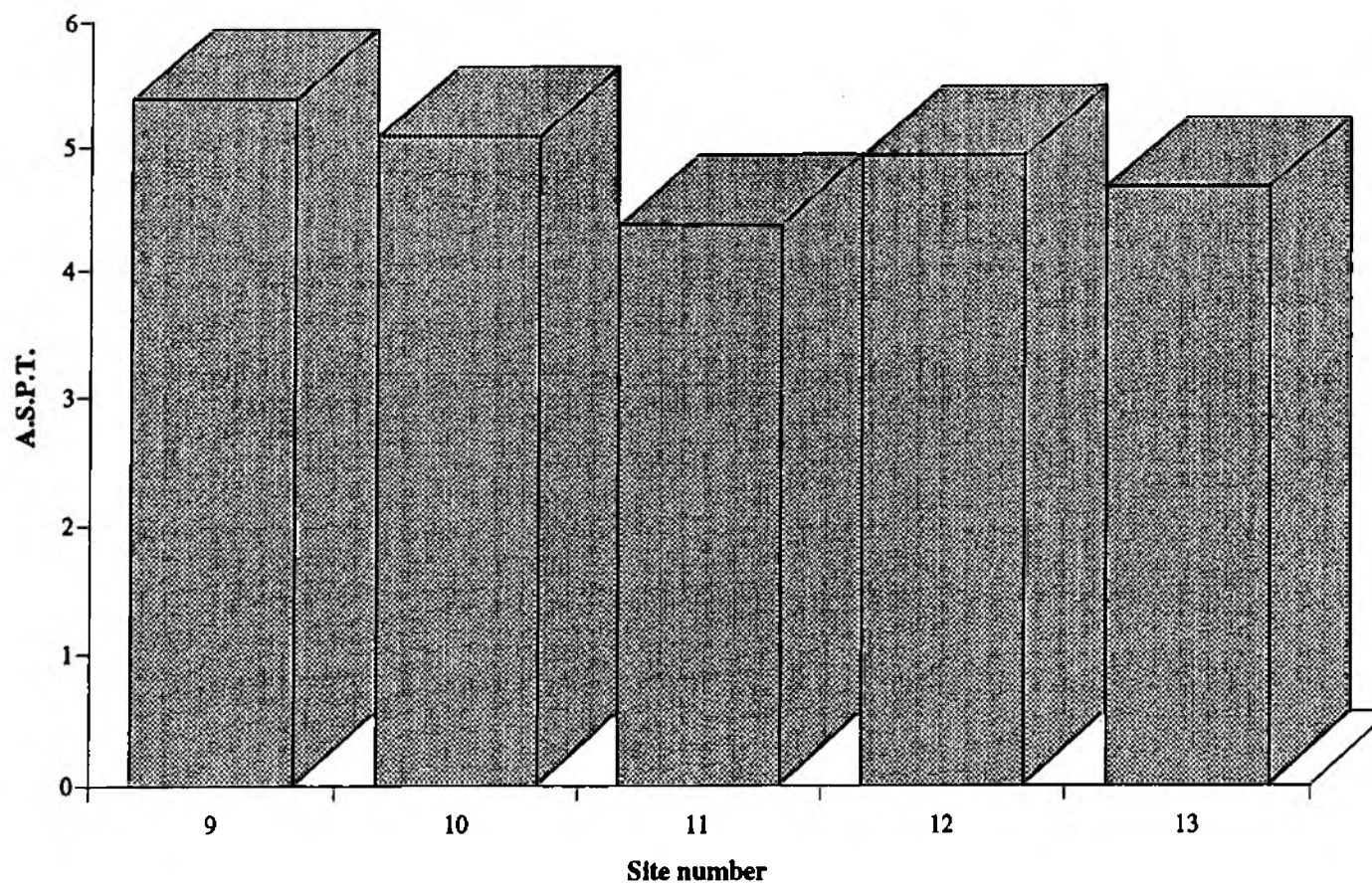


CHART SHOWING THE BIOTIC SCORE AT EACH SITE ON THE LOWER ARM OF THE TRIBUTARY



**CHART SHOWING THE AVERAGE SCORE PER TAXON AT EACH SITE ON THE LOWER ARM
OF THE TRIBUTARY**



**CHART SHOWING THE TOTAL NUMBER OF TAXA AT EACH SITE ON THE UPPER ARM OF
THE TRIBUTARY**

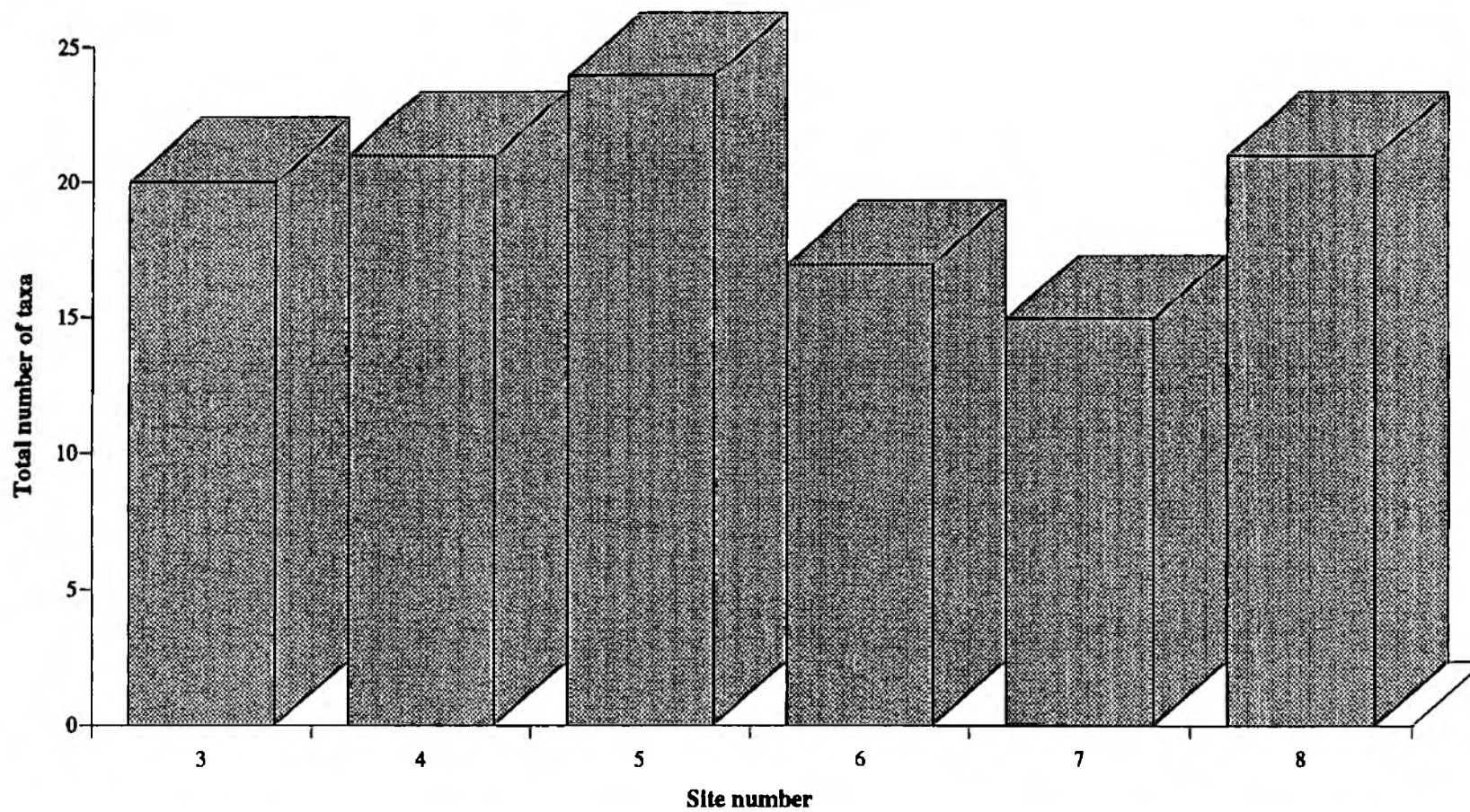


CHART SHOWING THE BIOTIC SCORE OF EACH SITE ON THE UPPER ARM THE TRIBUTARY

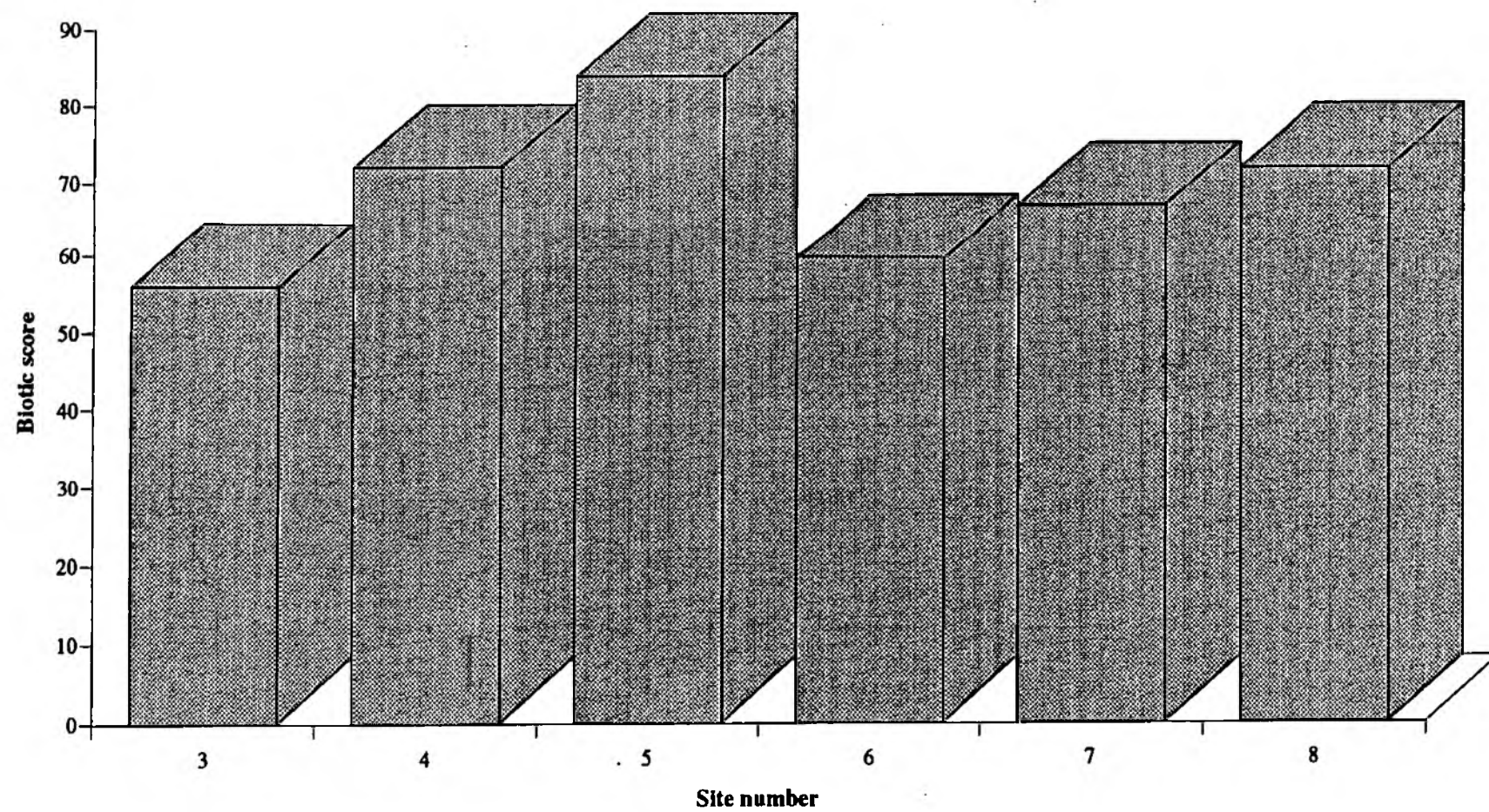


CHART SHOWING THE AVERAGE SCORE PER TAXON AT EACH SITE ON THE UPPER ARM OF THE TRIBUTARY

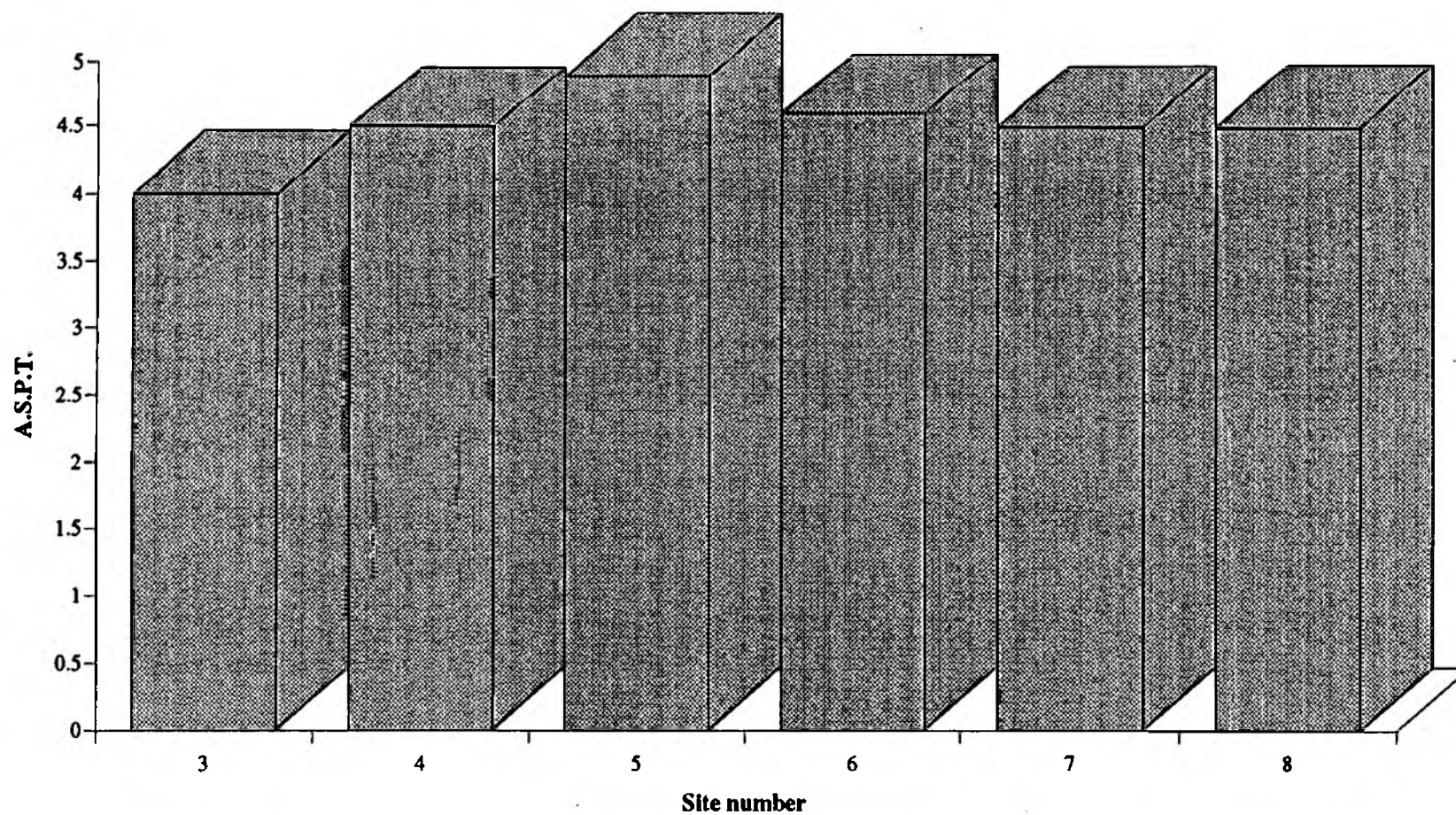


CHART SHOWING THE TOTAL NUMBER OF TAXA AT SITES ON SEPARATE TRIBUTARIES

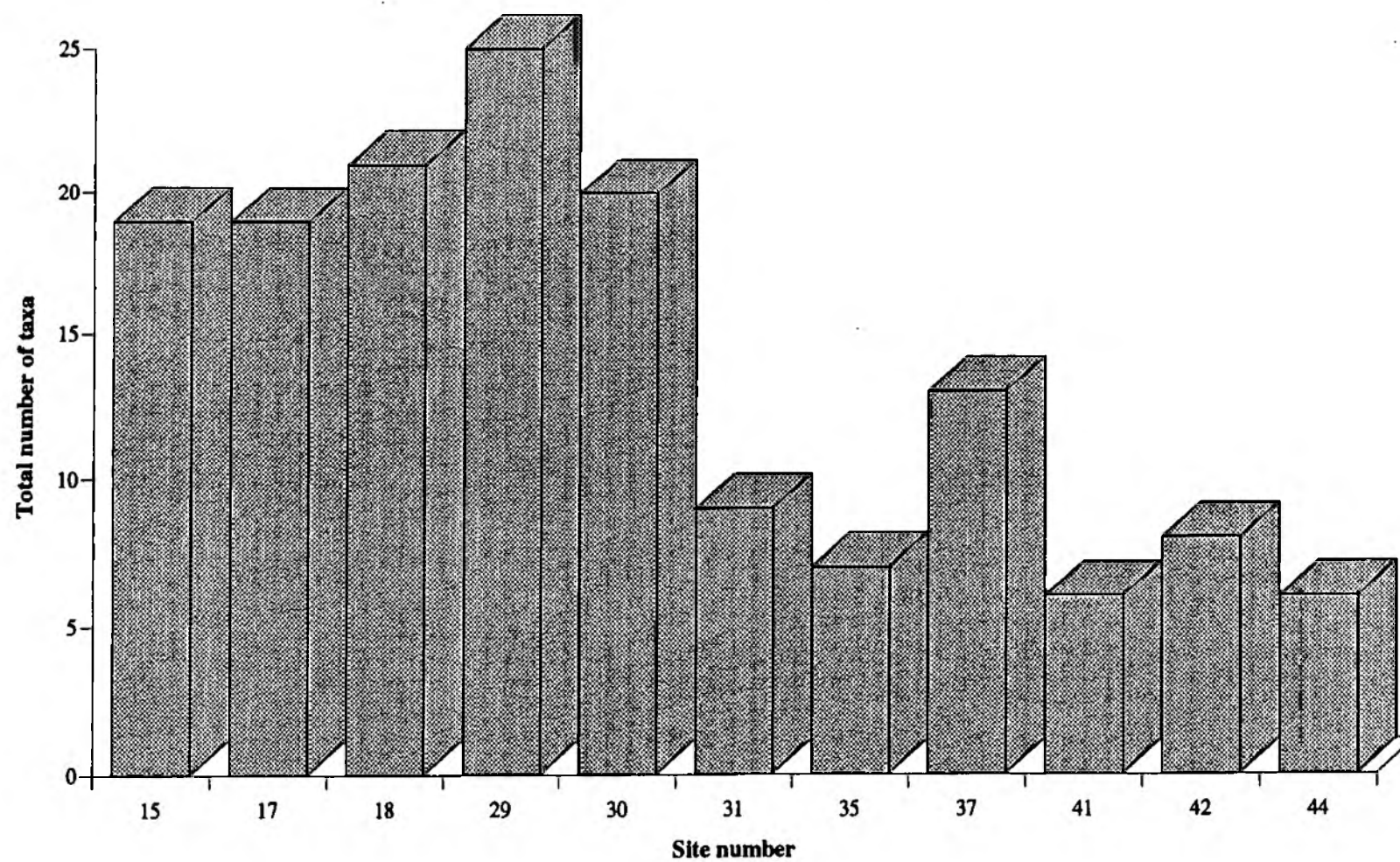
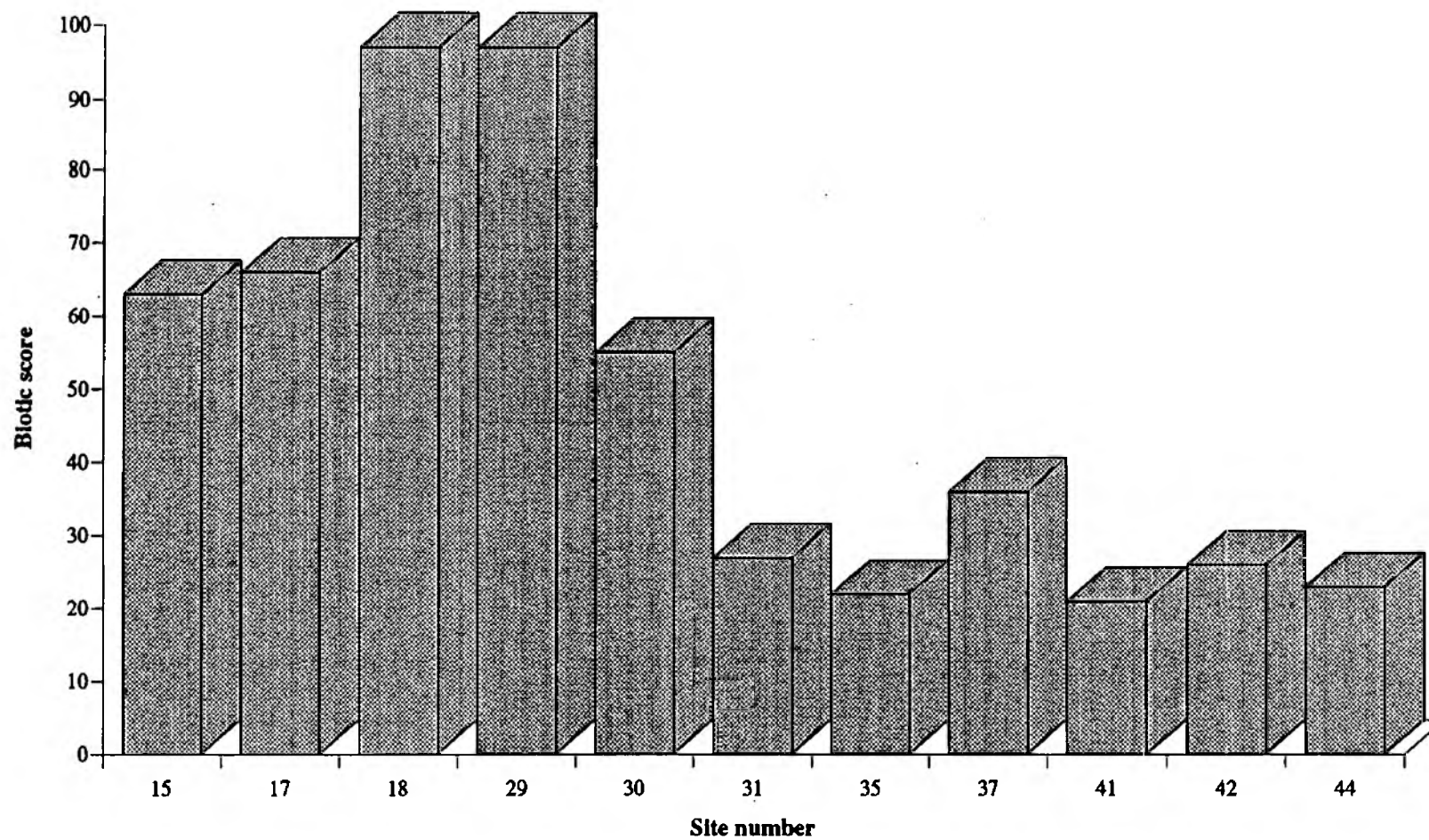
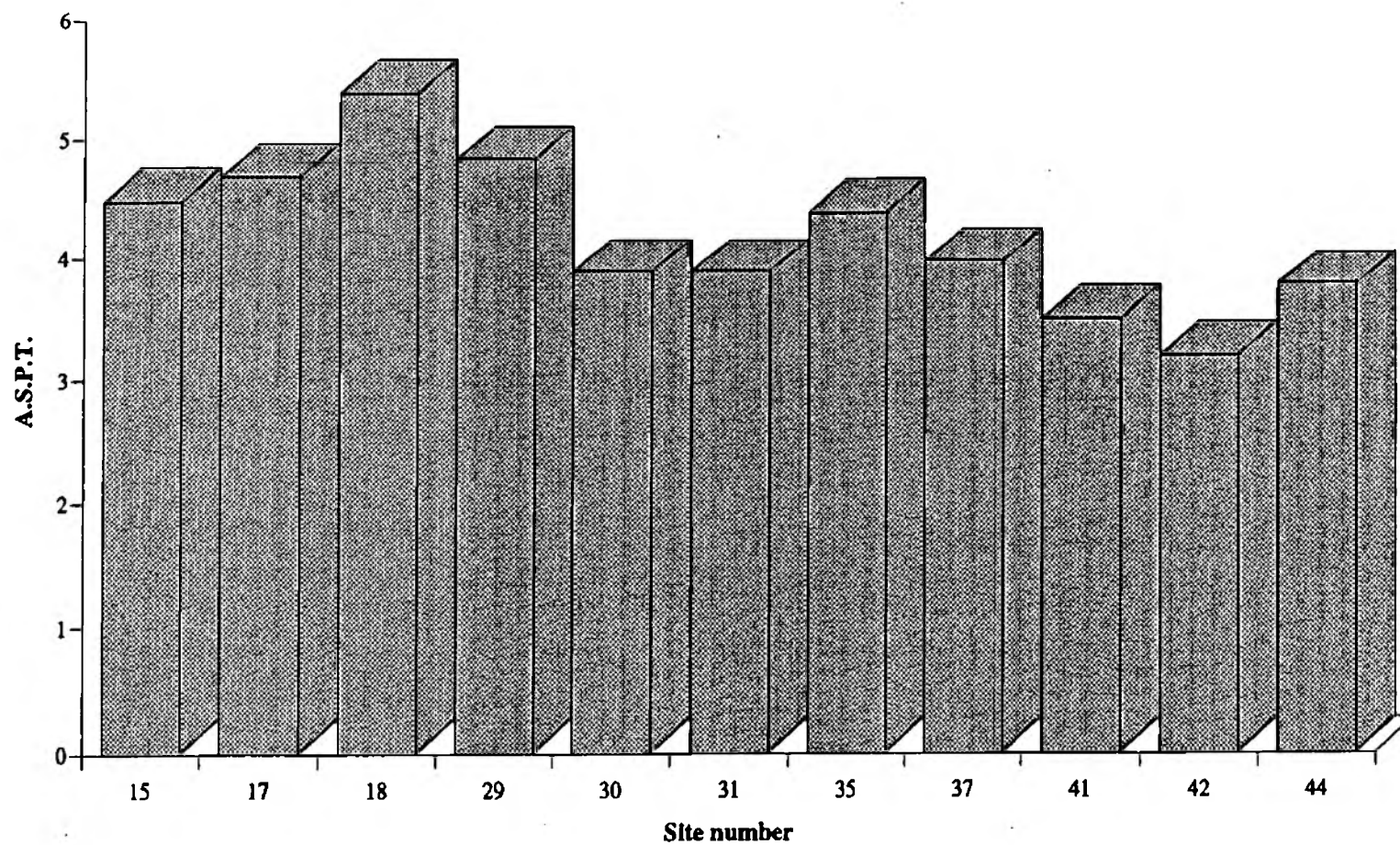


CHART SHOWING THE BIOTIC SCORES OF EACH SITE ON SEPARATE TRIBUTARIES



**CHART SHOWING THE AVERAGE SCORE PER TAXON OF EACH SITE FOUND ON SEPARATE
TRIBUTARIES**



2.3 Relative Abundance of taxa

The abundance rankings of taxa at each site have been charted and are displayed in the following histograms. They are also in the process of multivariate analysis using TWINSpan. This will be finished in early April and inserted into the final report.

The chart comparisons confirm that the taxon-rich sites contain a wide range of taxa mostly at low levels of abundance (ranks 1-2). Nowhere were sites dominated by taxa of rank 5 (over 1000), and rank 4 (over 100) was uncommon.

The taxa most abundant throughout the river system were Oligochaeta, Chironomidae and Gammaridae, joined at some sites by Sphaeriidae and Limnephilidae. Occasionally, more lotic sites were dominated by Simuliidae and Hydropsychidae; lentic sites by Physidae and Baetidae.

CHART SHOWING THE RANK ABUNDANCE OF EACH IDENTIFIED TAXA AT SITE 1

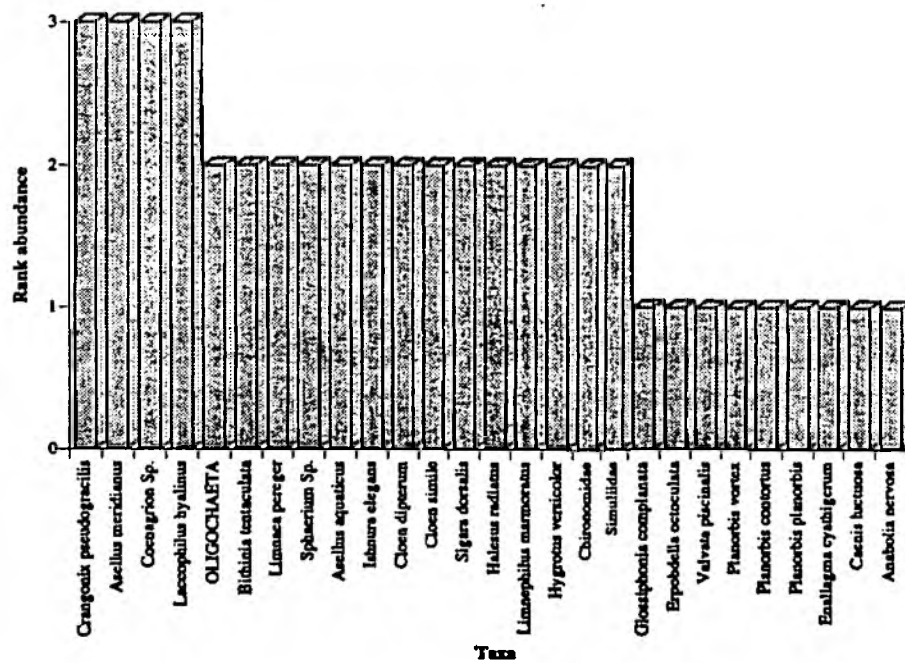


CHART SHOWING THE RANK ABUNDANCE OF EACH FAMILY FOUND AT SITE 1

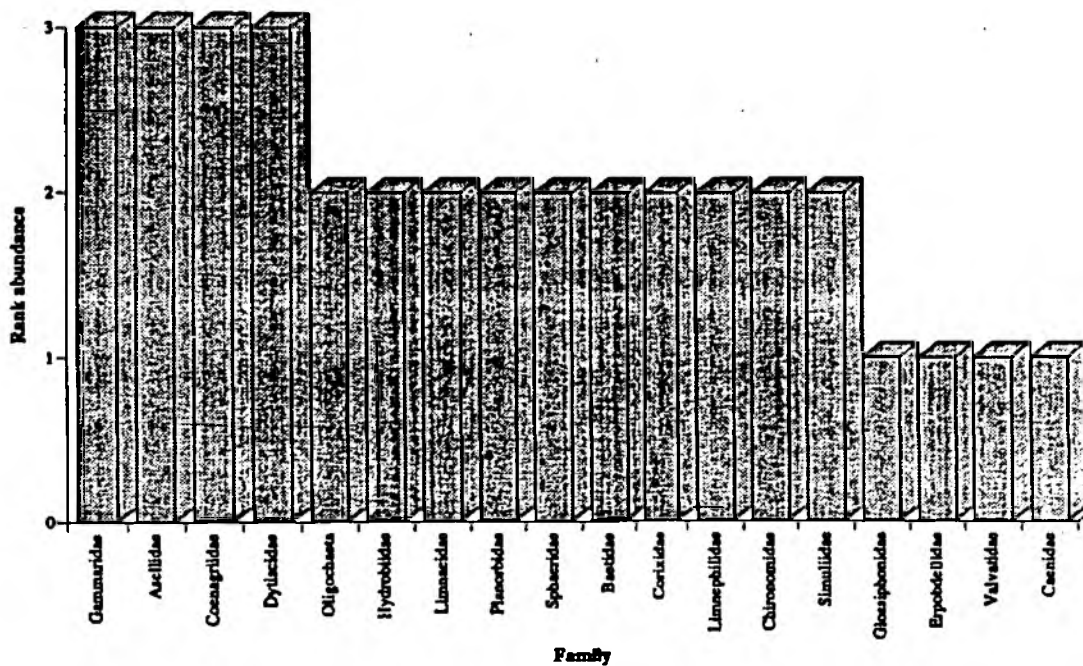


CHART SHOWING THE RANK ABUNDANCE OF EACH IDENTIFIED TAXA AT SITE 2

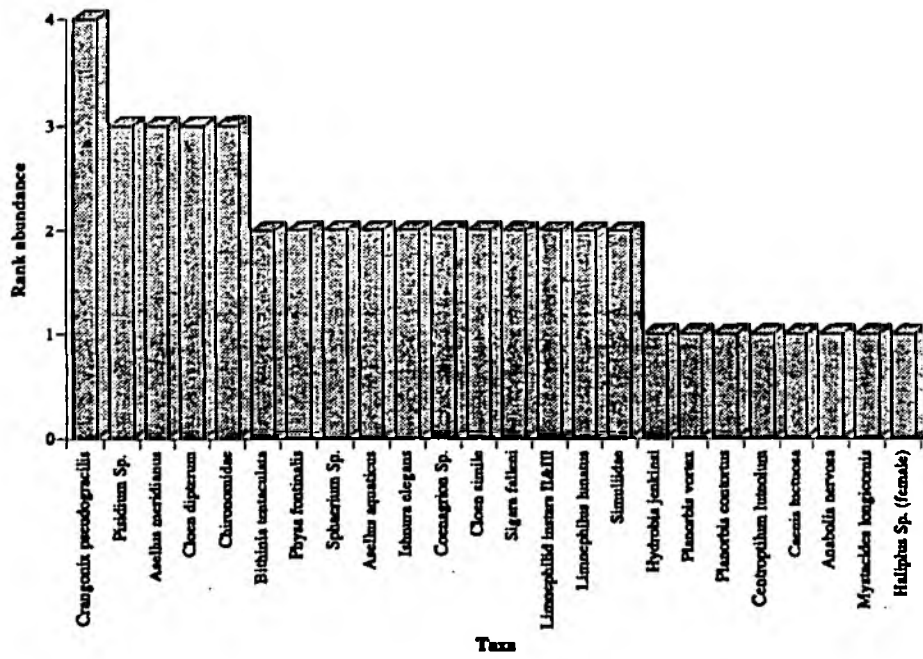


CHART SHOWING THE RANK ABUNDANCE OF EACH FAMILY FOUND AT SITE 2

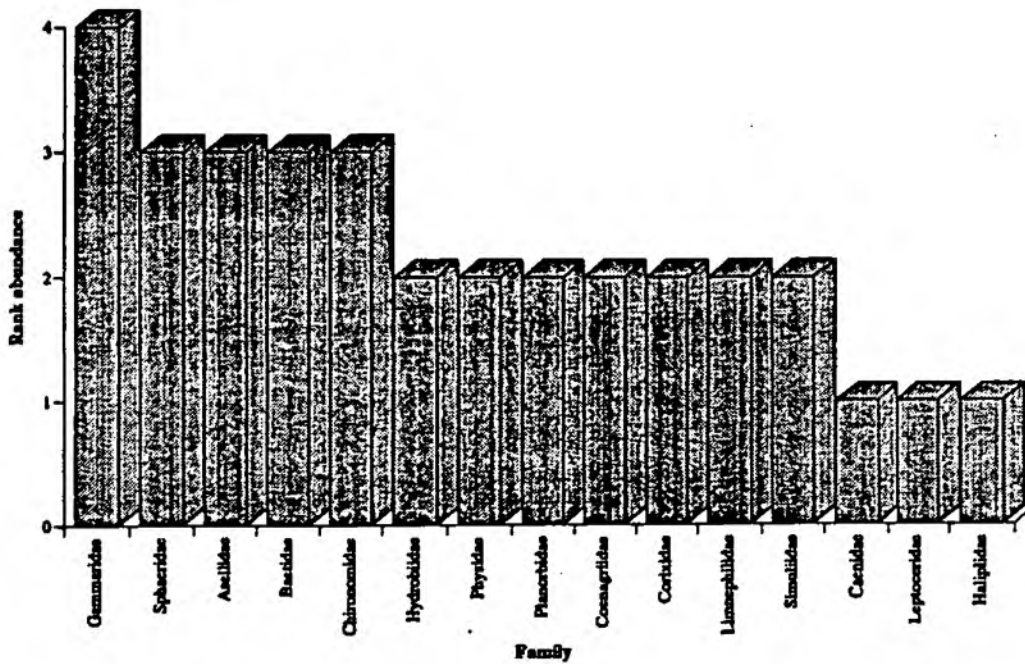


CHART SHOWING THE RANK ABUNDANCE OF EACH IDENTIFIED TAXA AT SITE 3

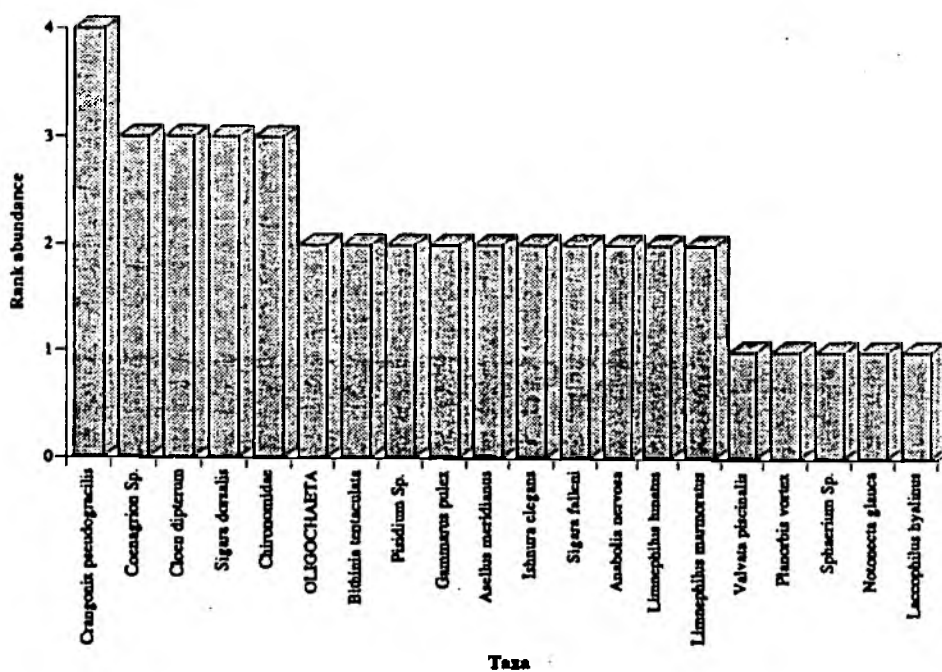


CHART SHOWING THE RANK ABUNDANCE OF EACH FAMILY FOUND AT SITE 3

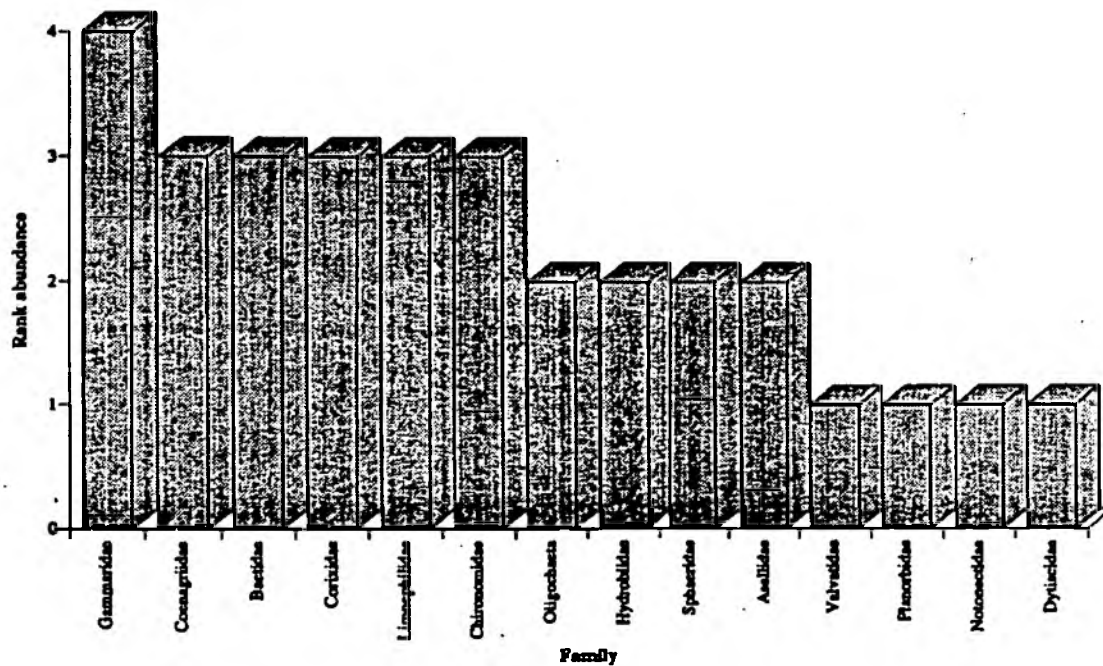


CHART SHOWING THE RANK ABUNDANCE OF EACH IDENTIFIED TAXA AT SITE 4

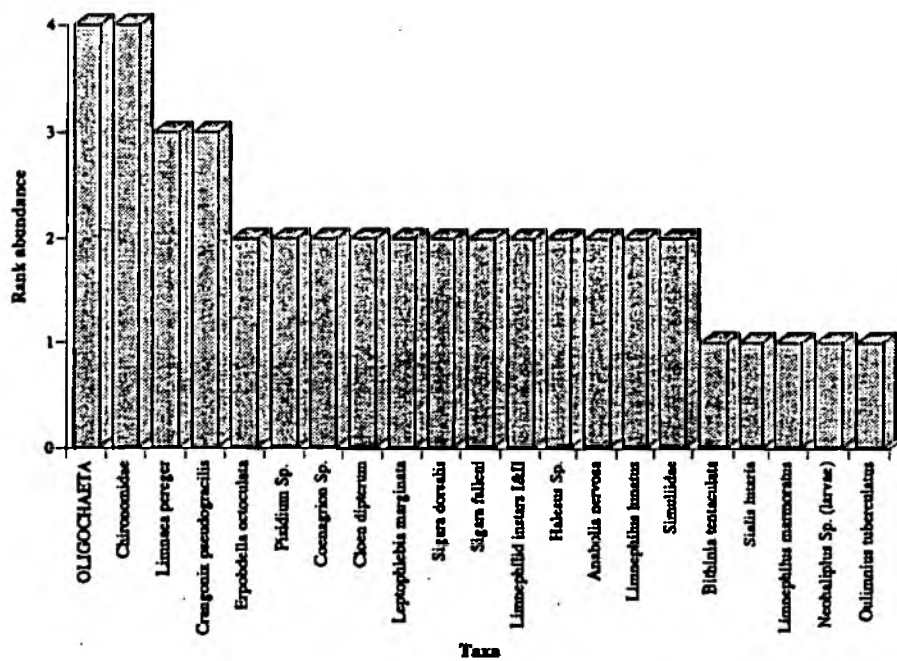


CHART SHOWING THE RANK ABUNDANCE OF EACH FAMILY FOUND AT SITE 4

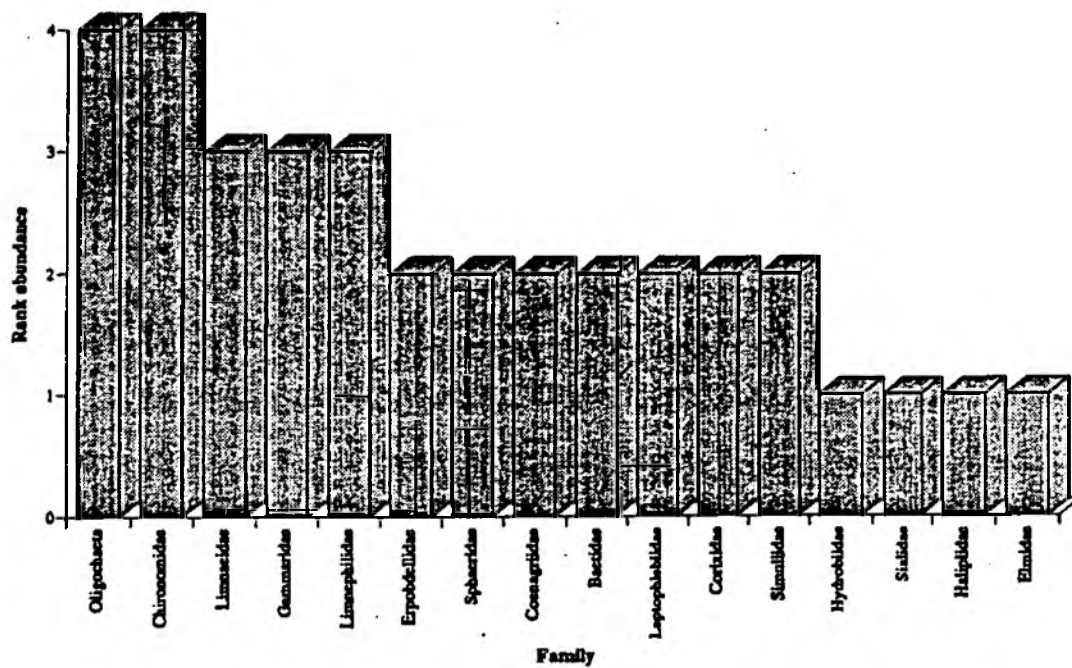


CHART SHOWING THE RANK ABUNDANCE OF EACH IDENTIFIED TAXA AT SITE 5

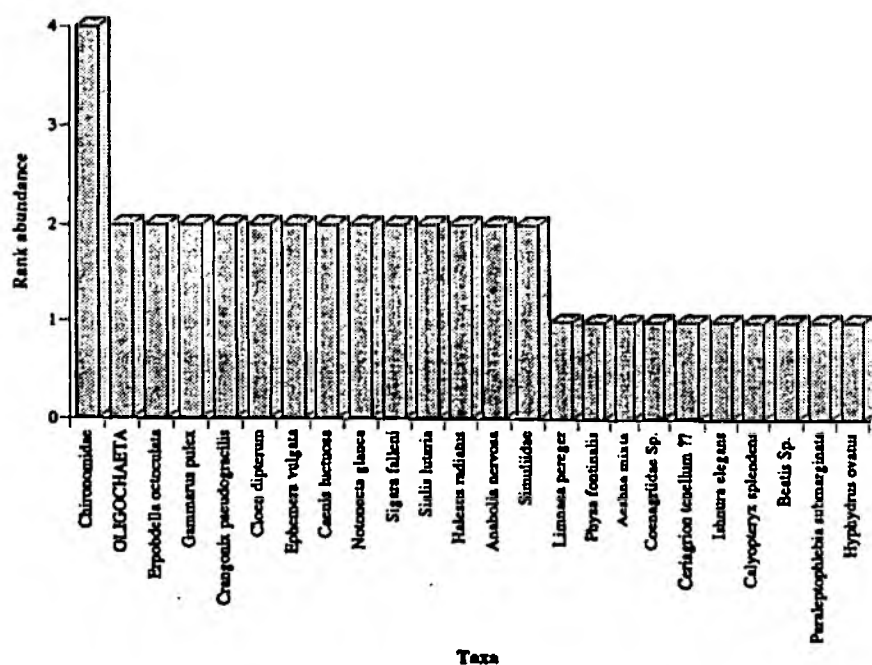


CHART SHOWING THE RANK ABUNDANCE OF EACH FAMILY FOUND AT SITE 5

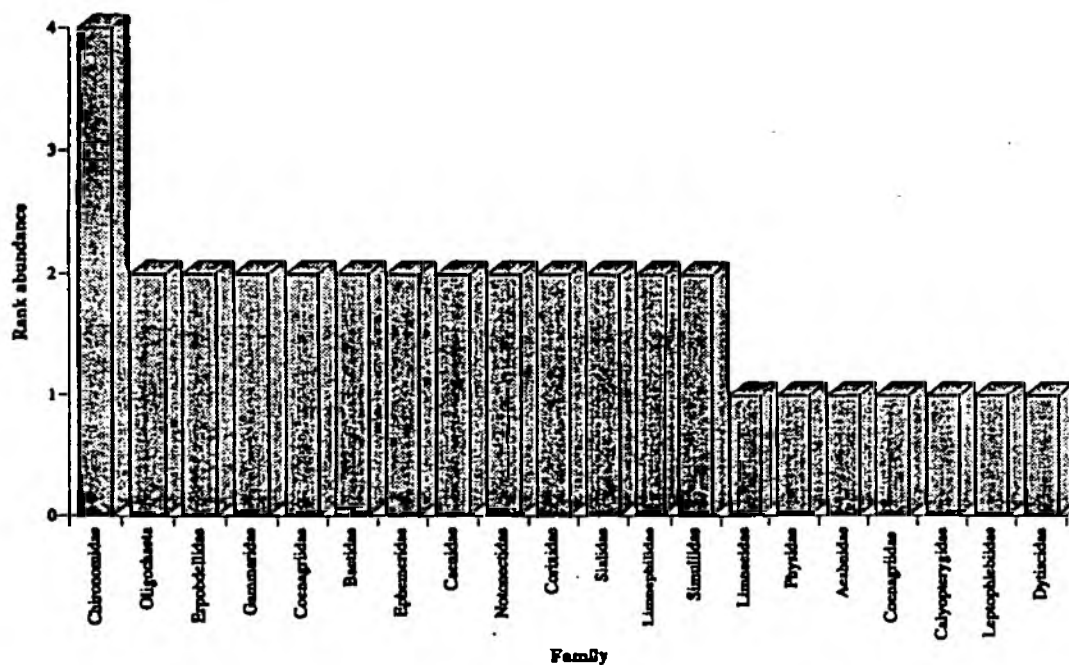


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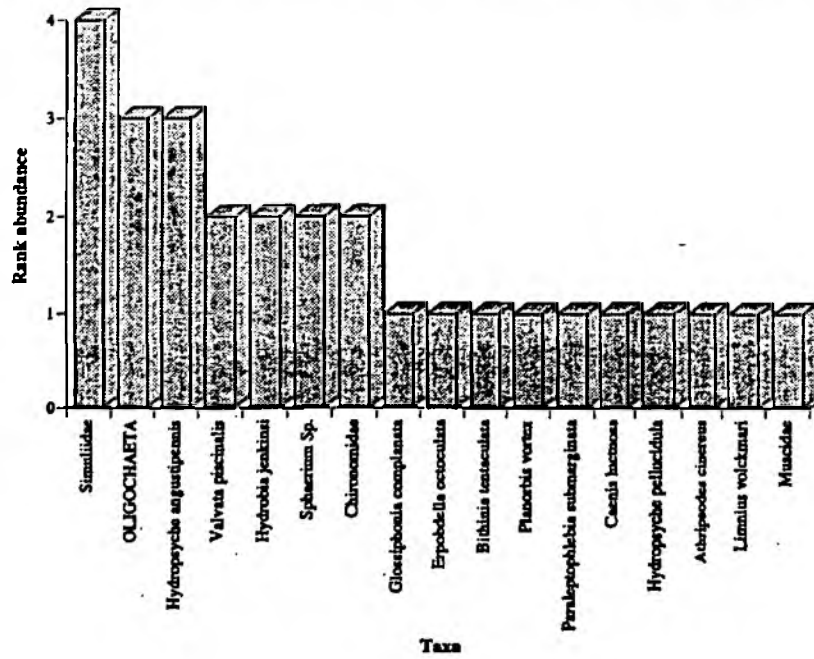


CHART SHOWING THE RANK ABUNDANCE OF EACH FAMILY FOUND AT SITE 6

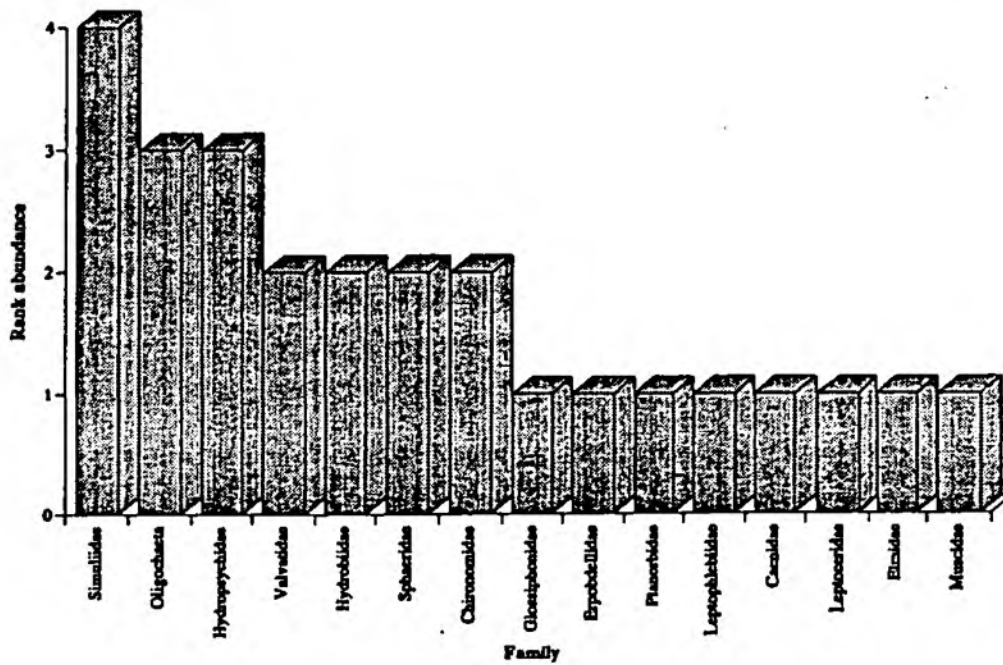


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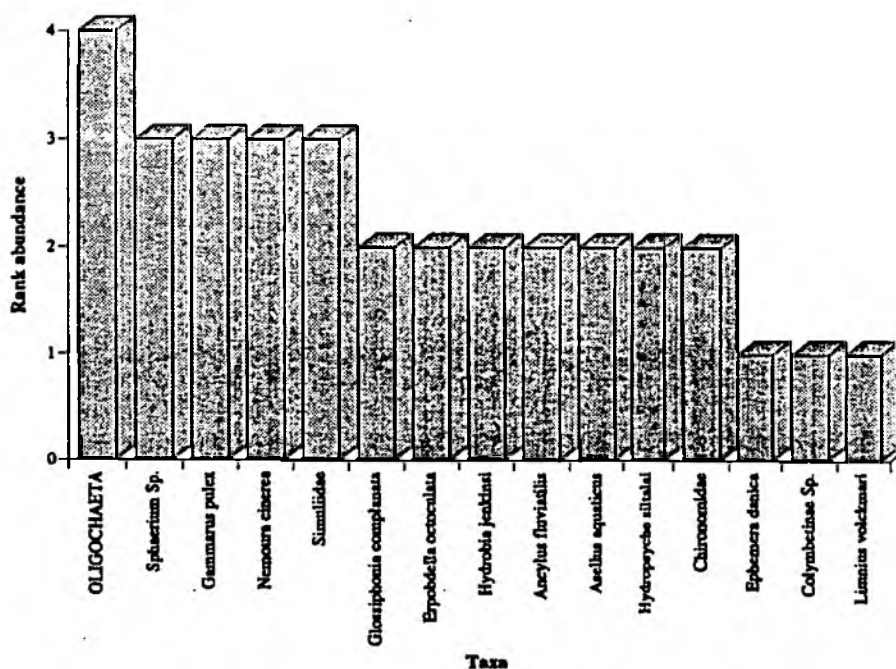


CHART SHOWING THE RANK ABUNDANCE OF EACH FAMILY FOUND AT SITE 7

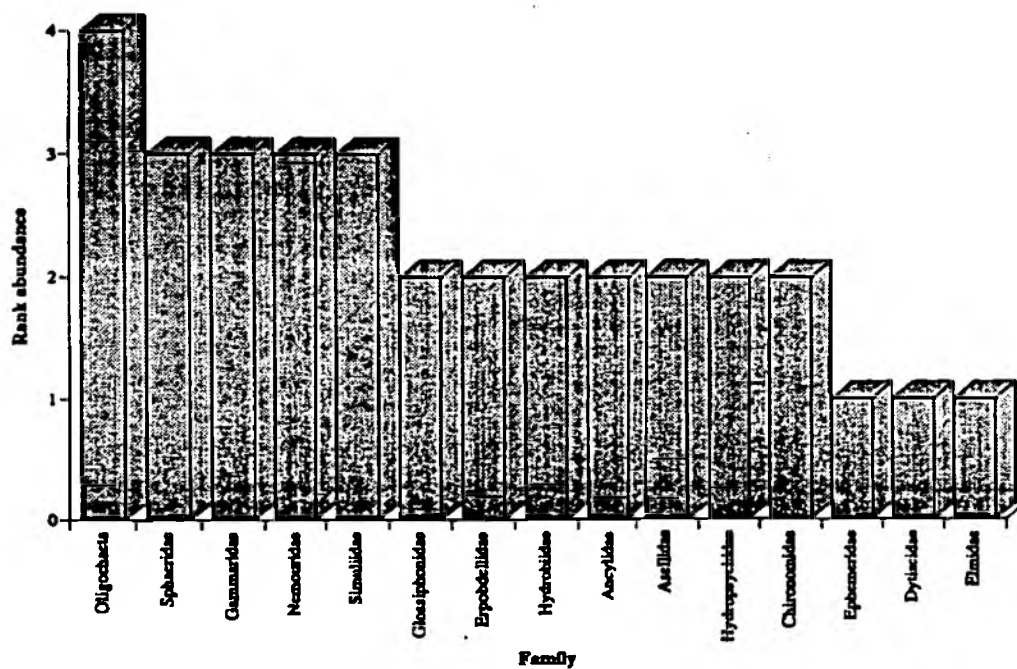


CHART SHOWING THE RANK ABUNDANCE OF EACH IDENTIFIED TAXA AT SITE 8

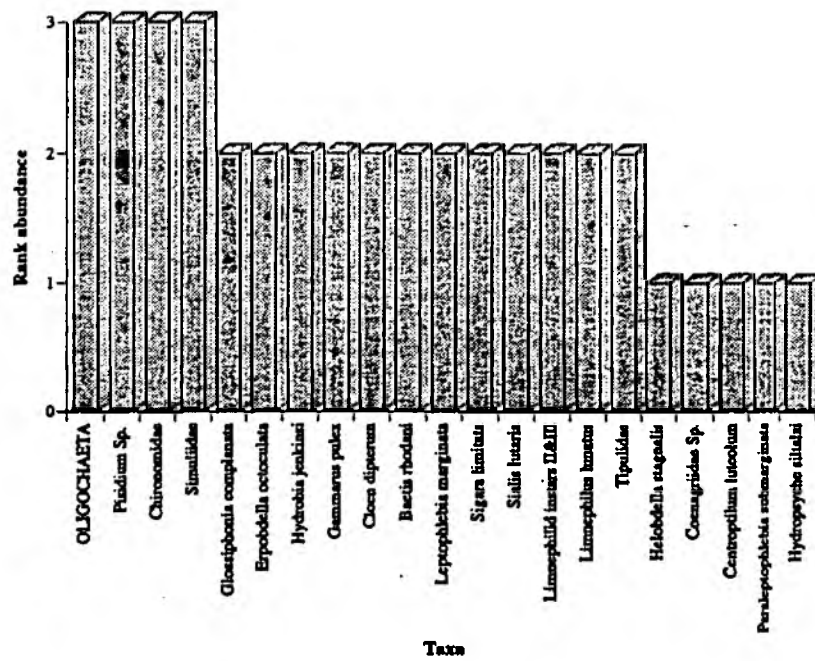


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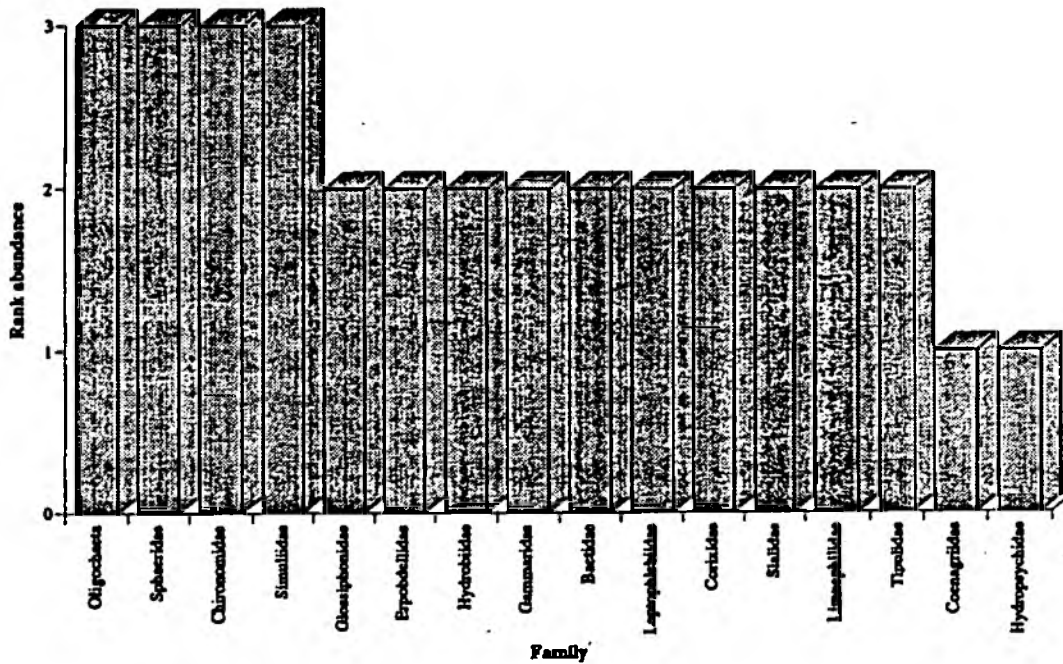


CHART SHOWING THE RANK ABUNDANCE OF EACH IDENTIFIED TAXA AT SITE 9

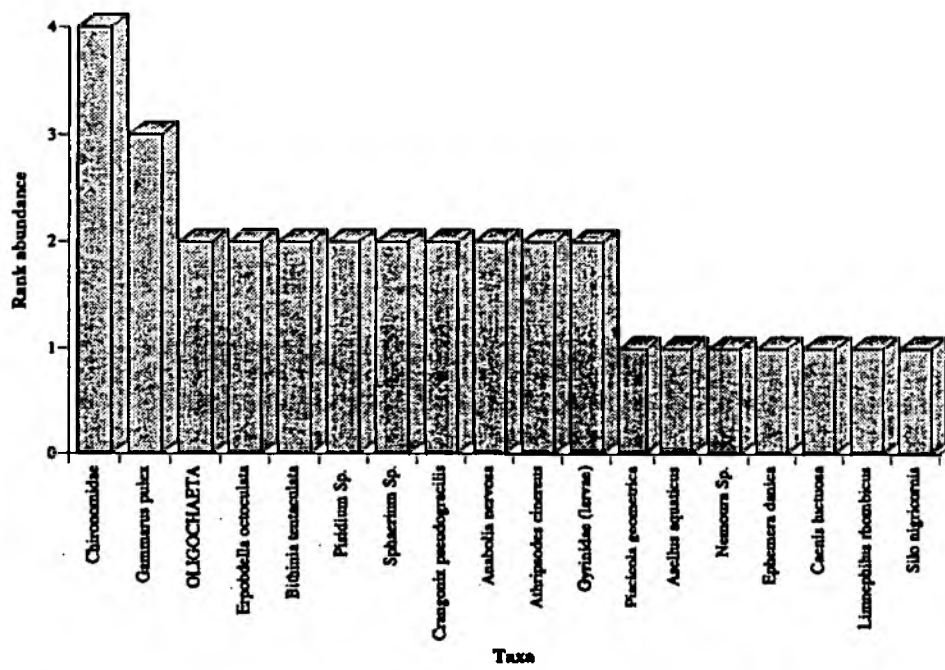


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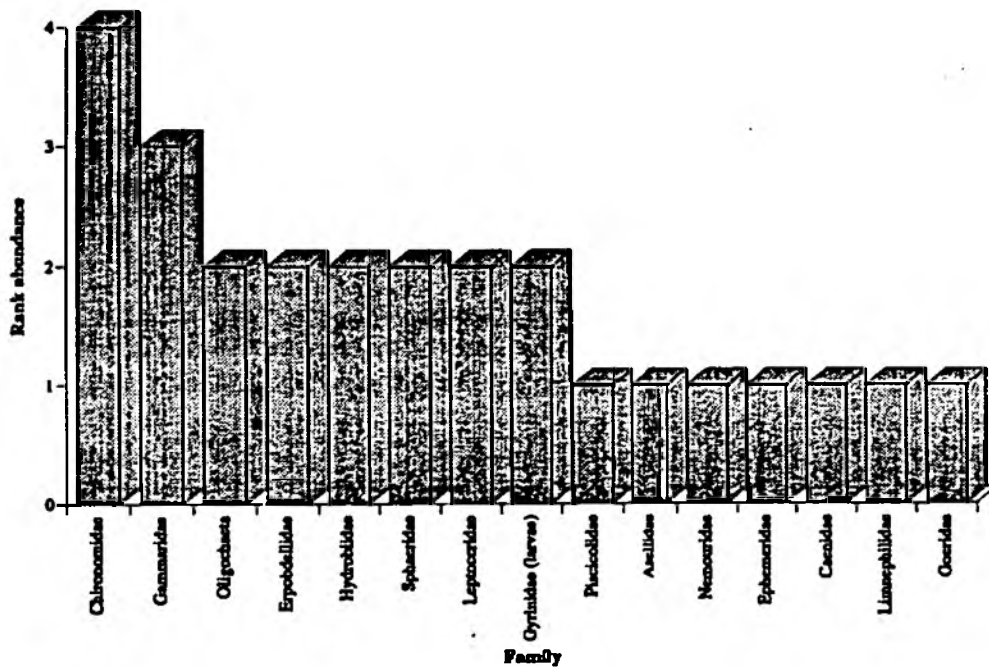


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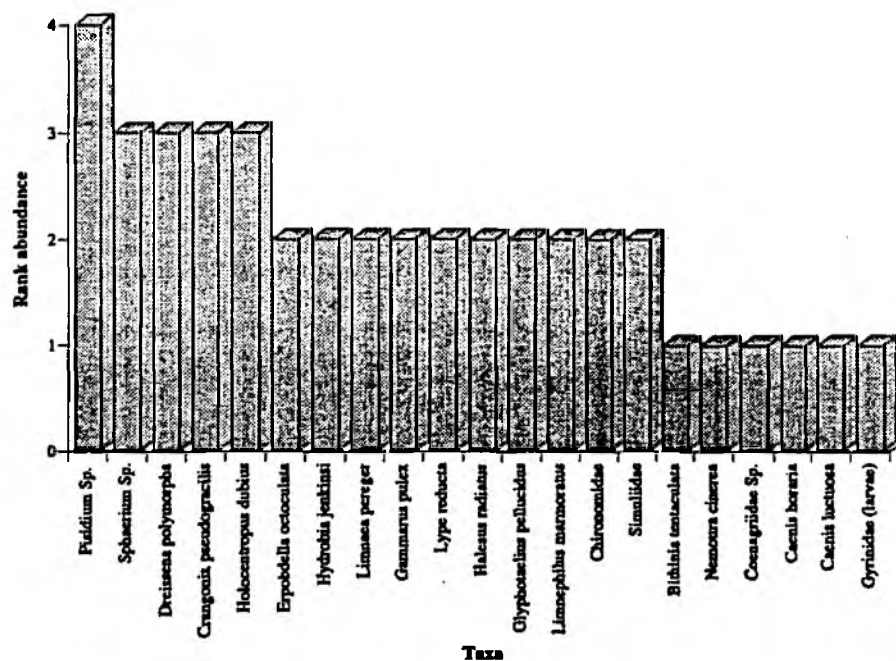


CHART SHOWING THE RANK ABUNDANCE OF EACH FAMILY FOUND AT SITE 10

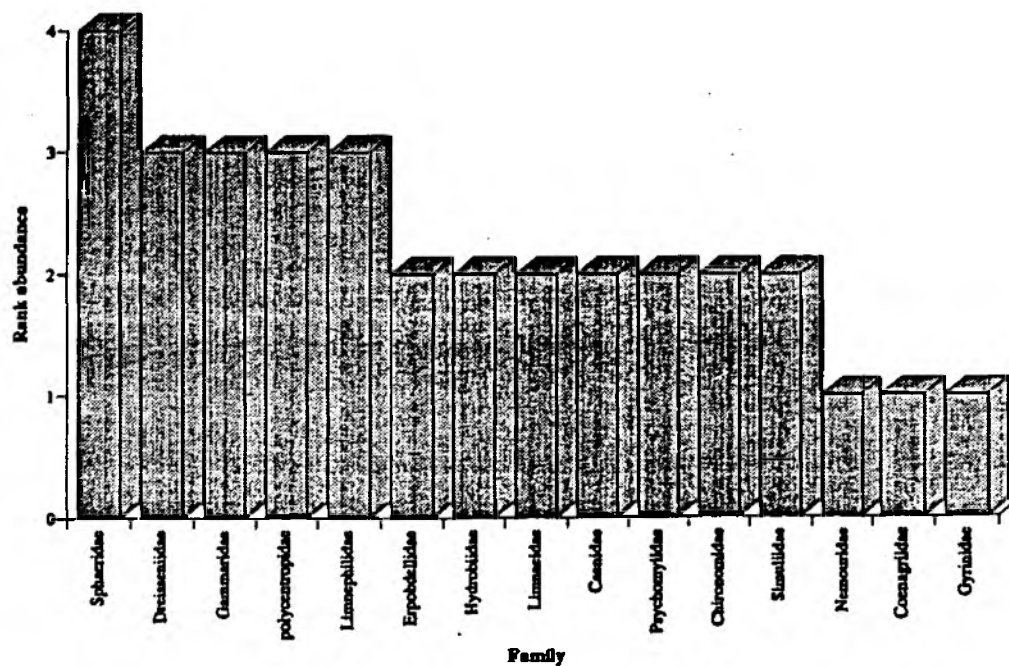


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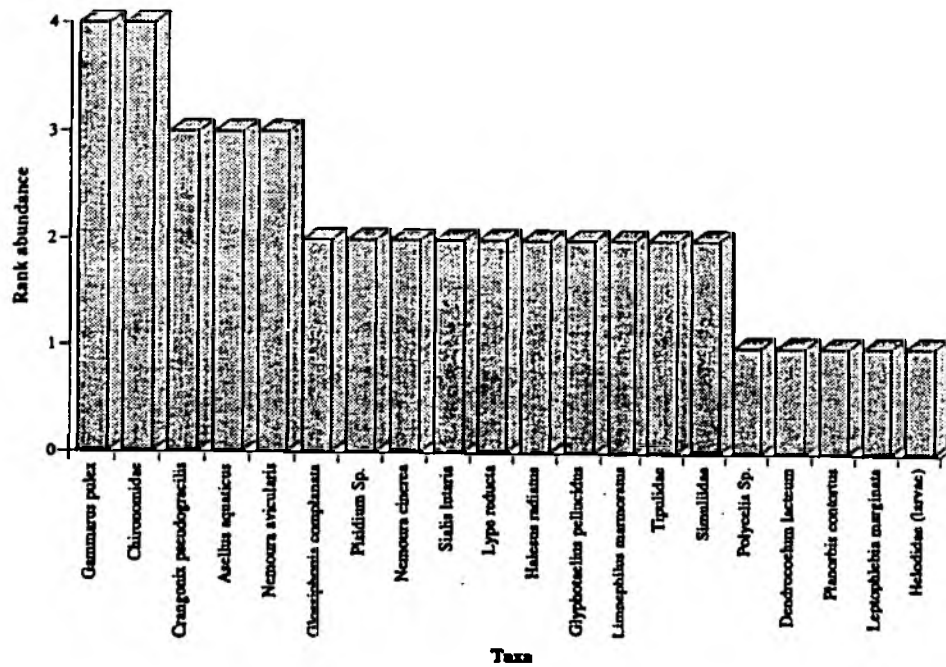


CHART SHOWING THE RANK ABUNDANCE OF EACH FAMILY FOUND AT SITE 11

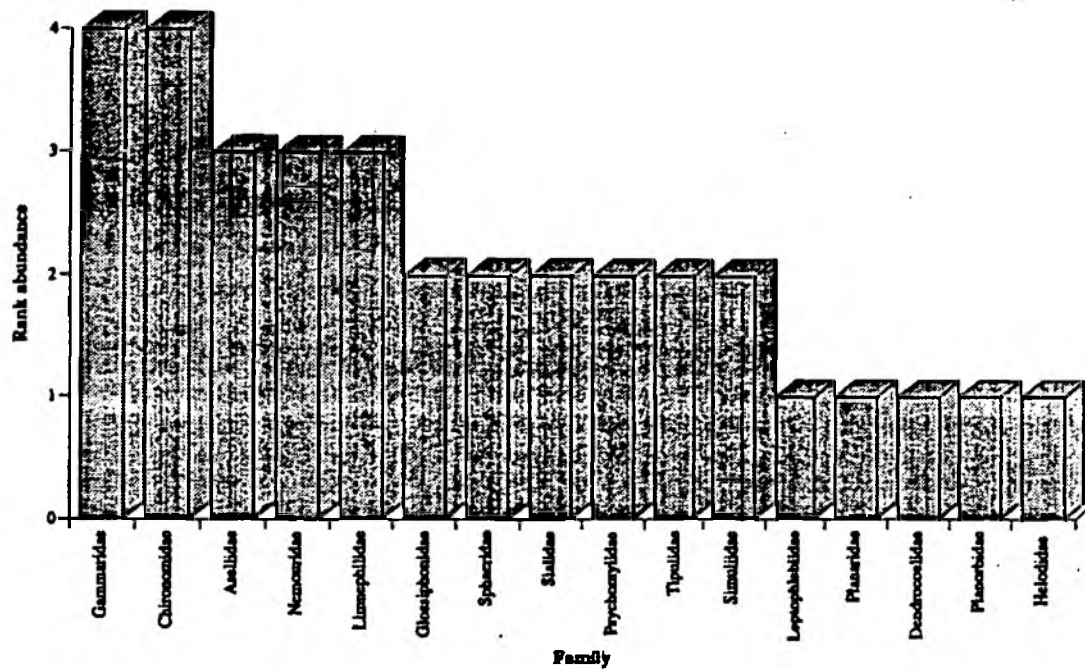


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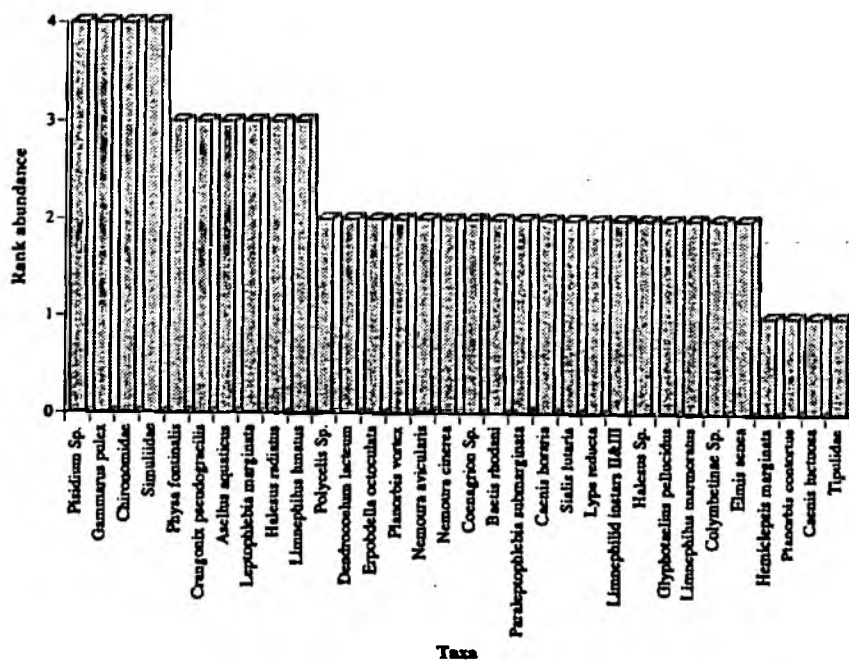


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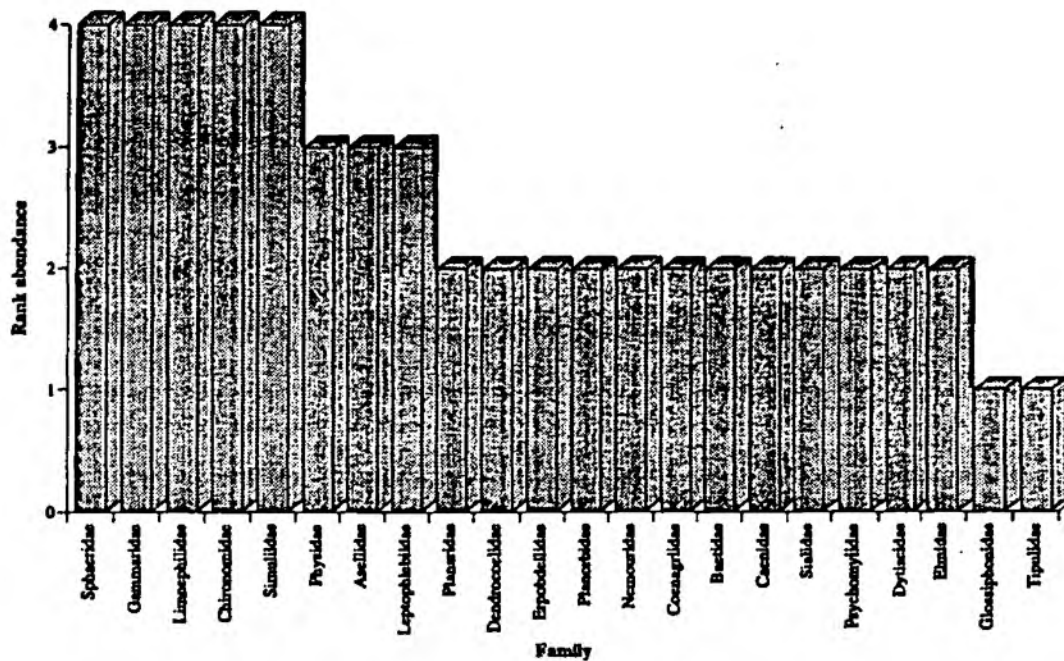


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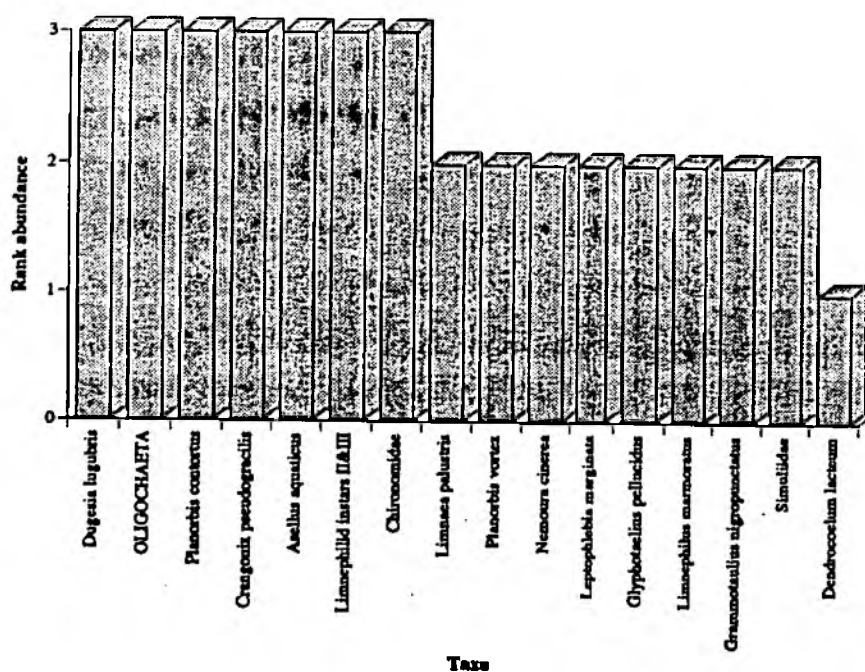


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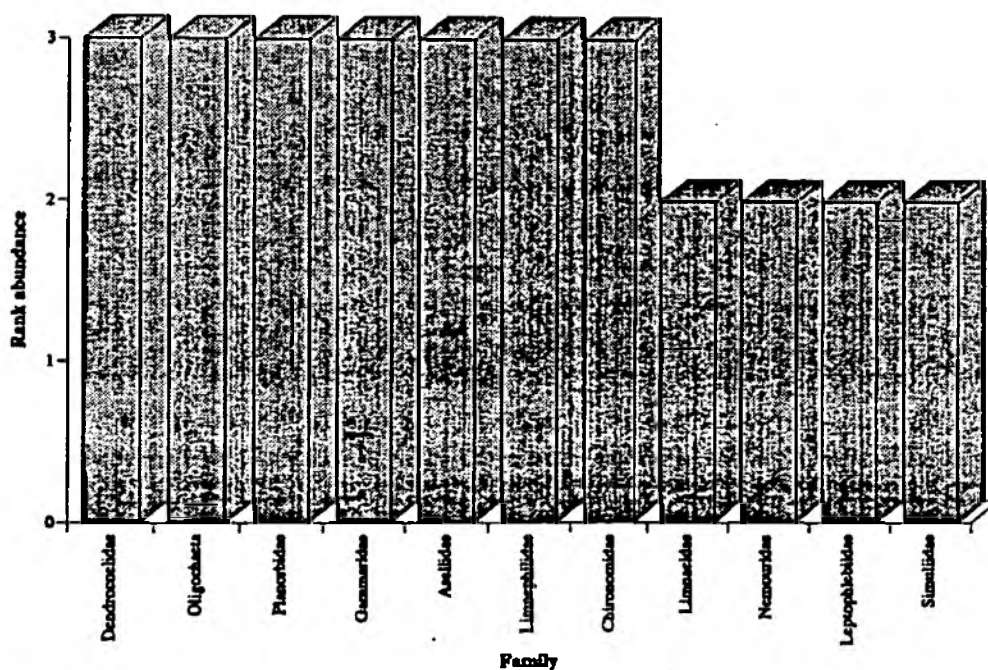


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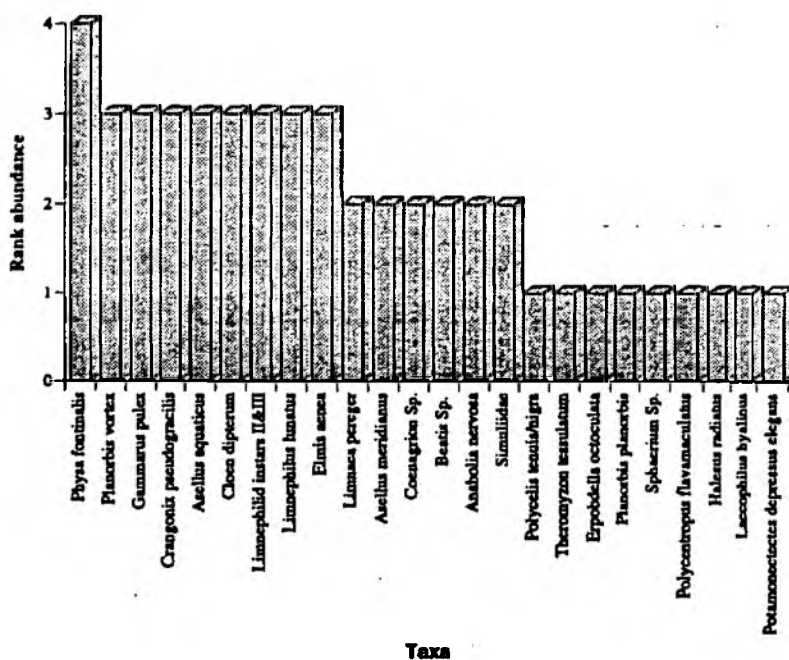


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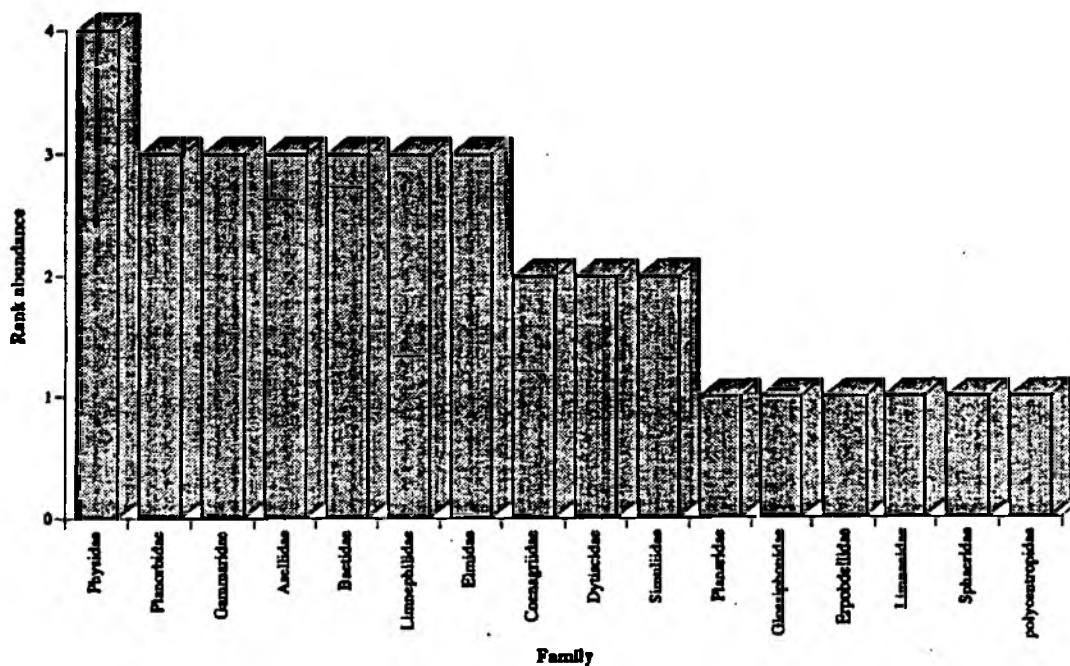


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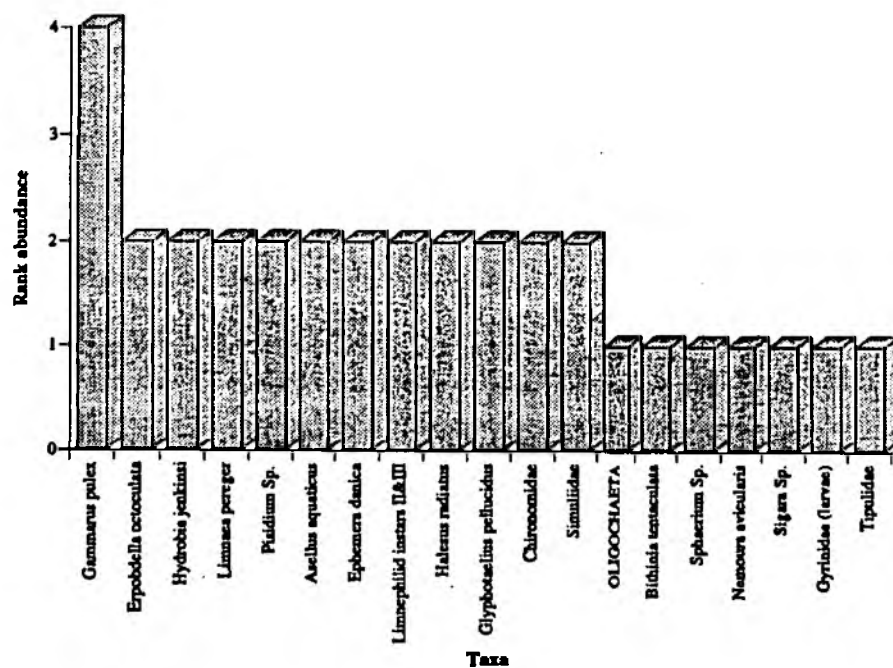


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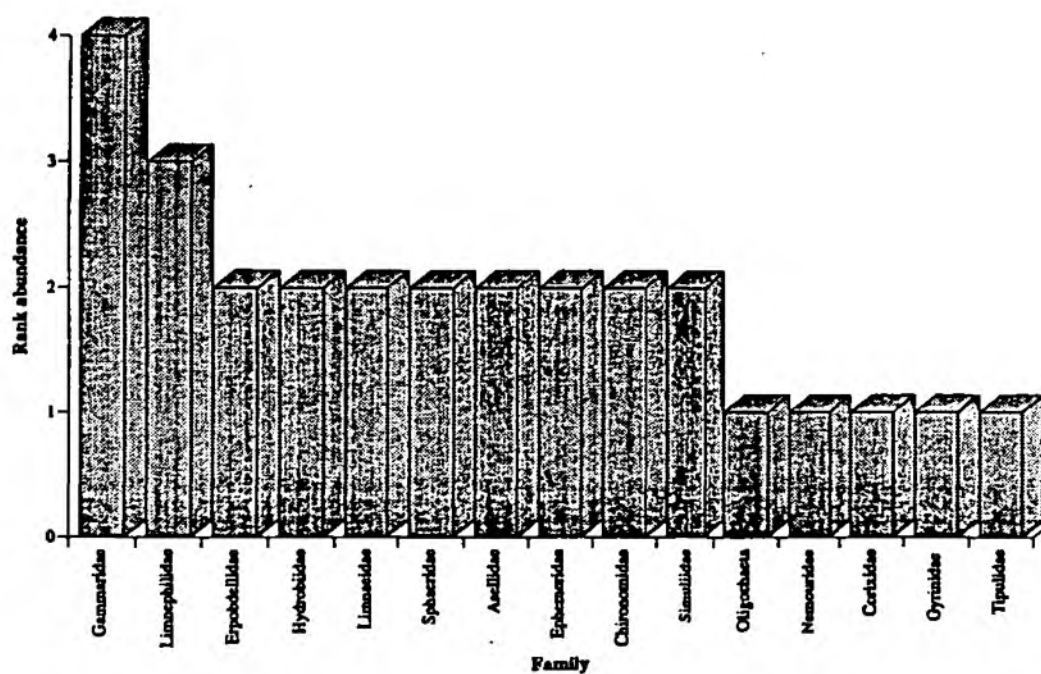


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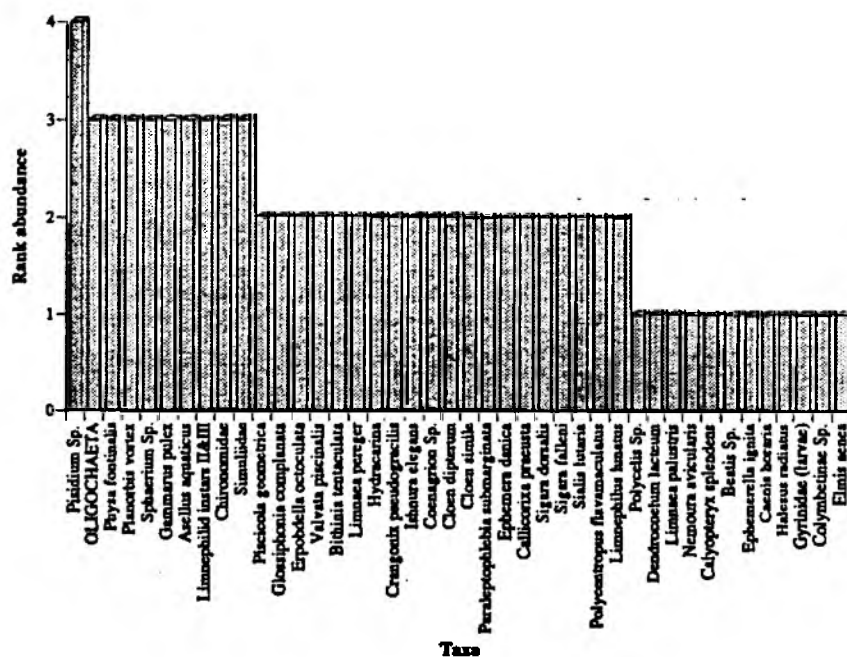


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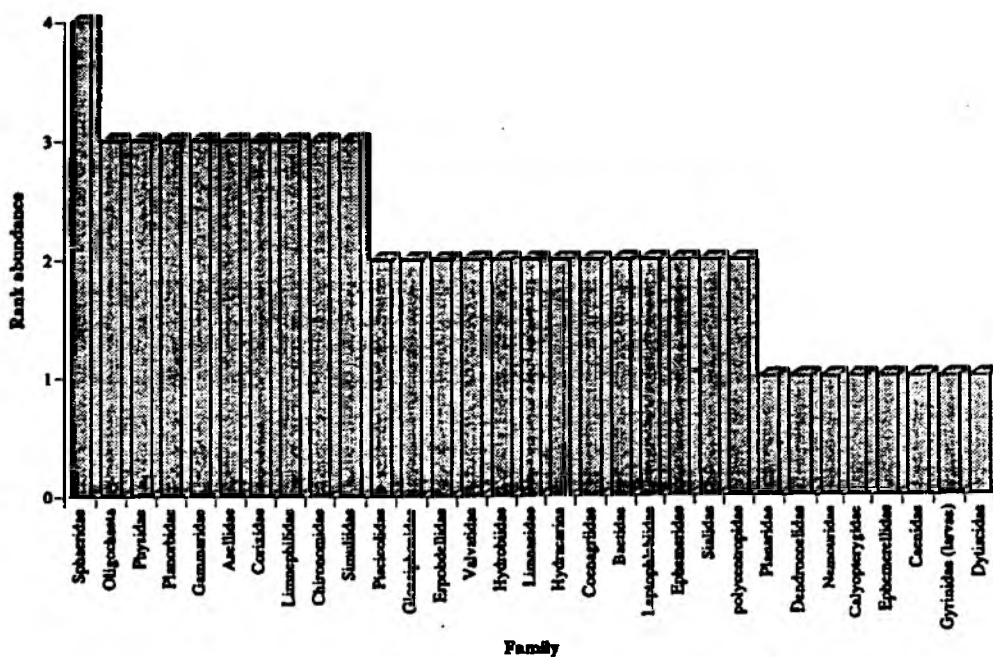


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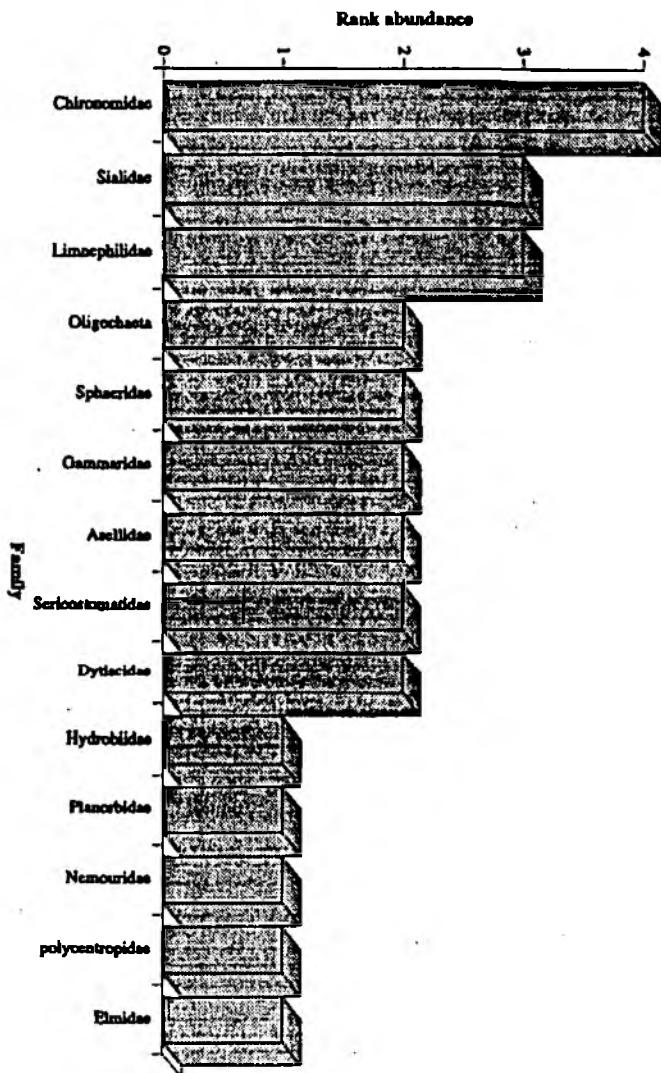


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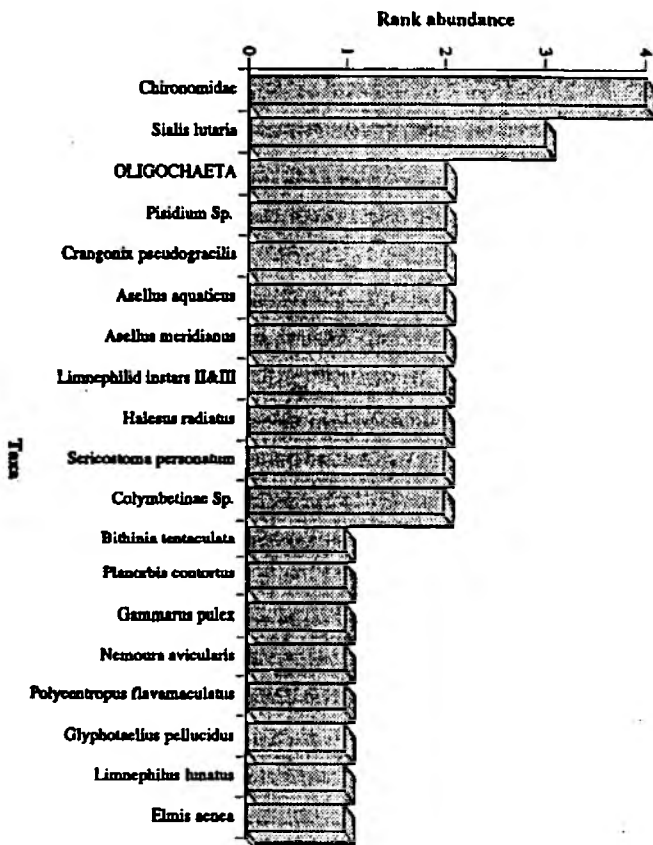


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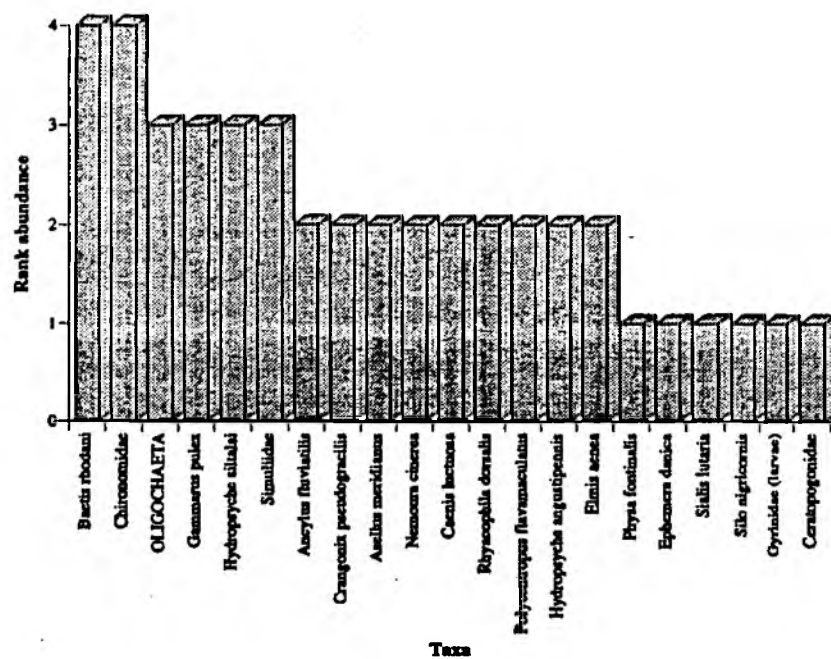


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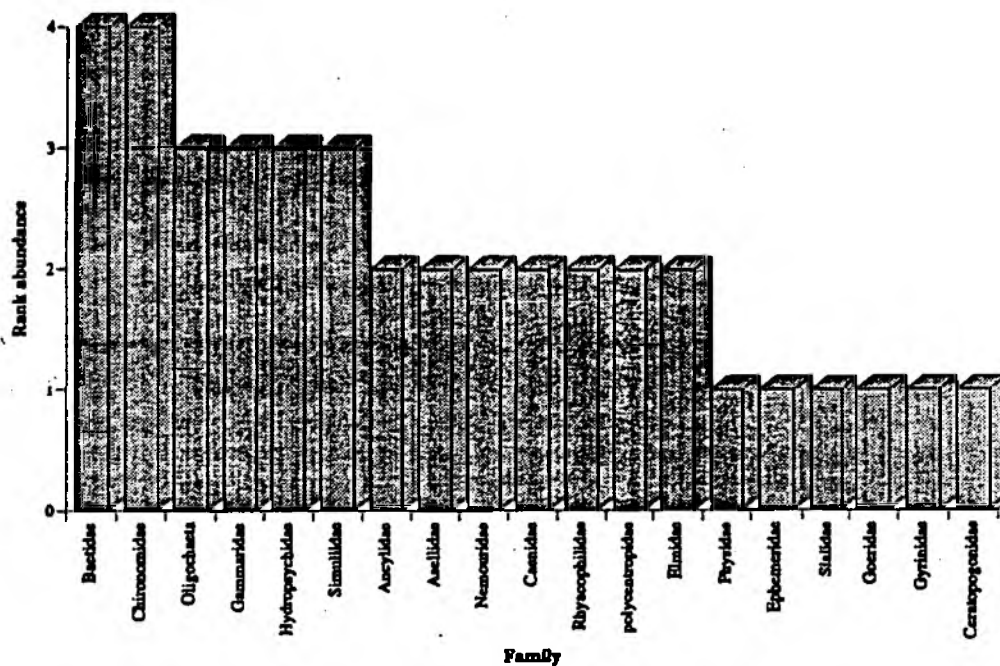


CHART SHOWING THE RANK ABUNDANCE OF EACH IDENTIFIED TAXA AT SITE 19

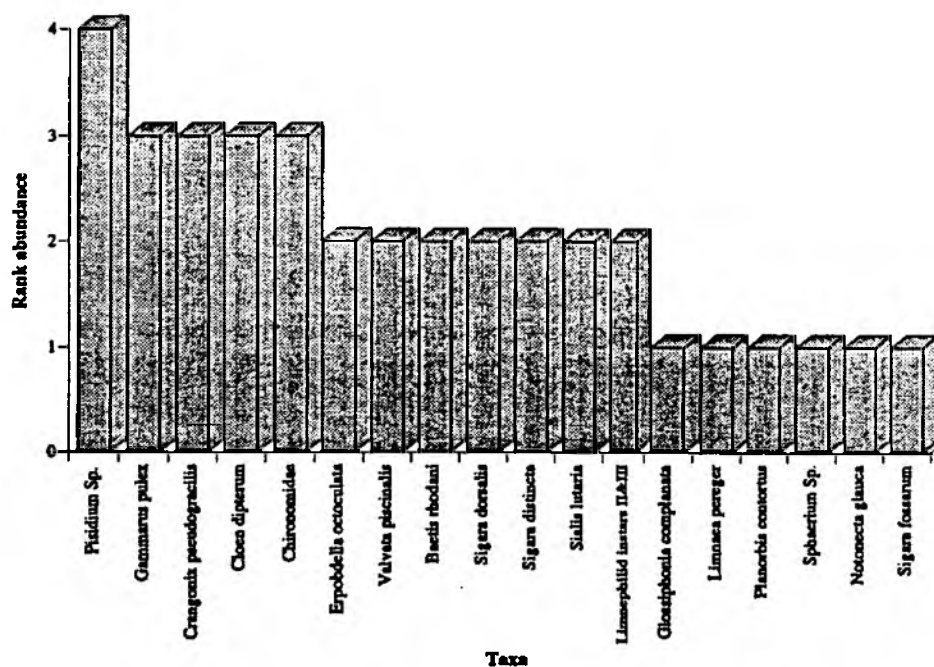


CHART SHOWING THE RANK ABUNDANCE OF EACH FAMILY FOUND AT SITE 19

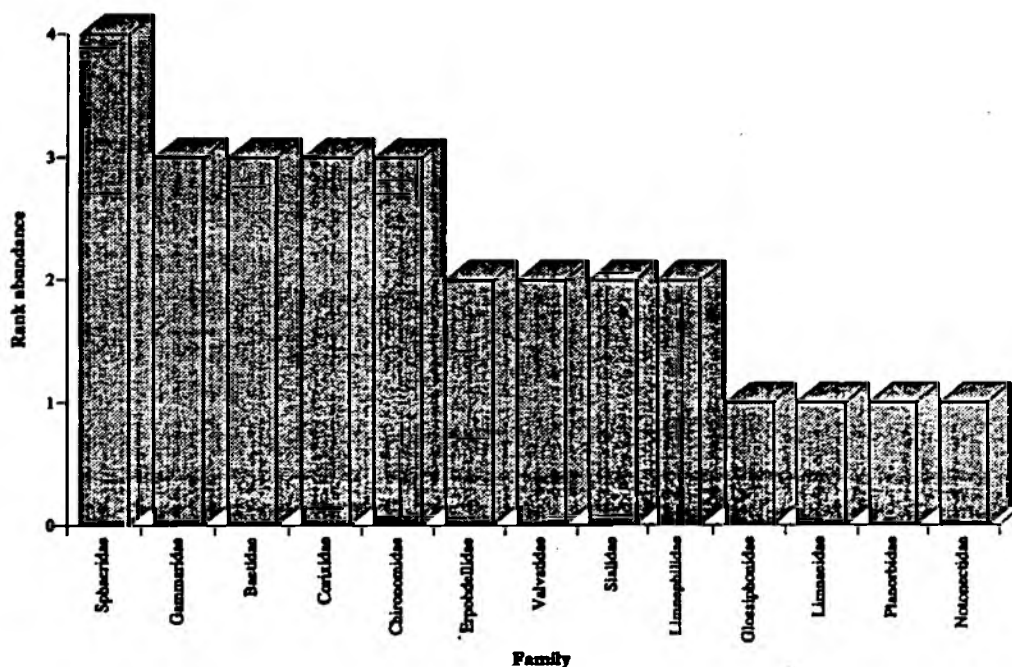


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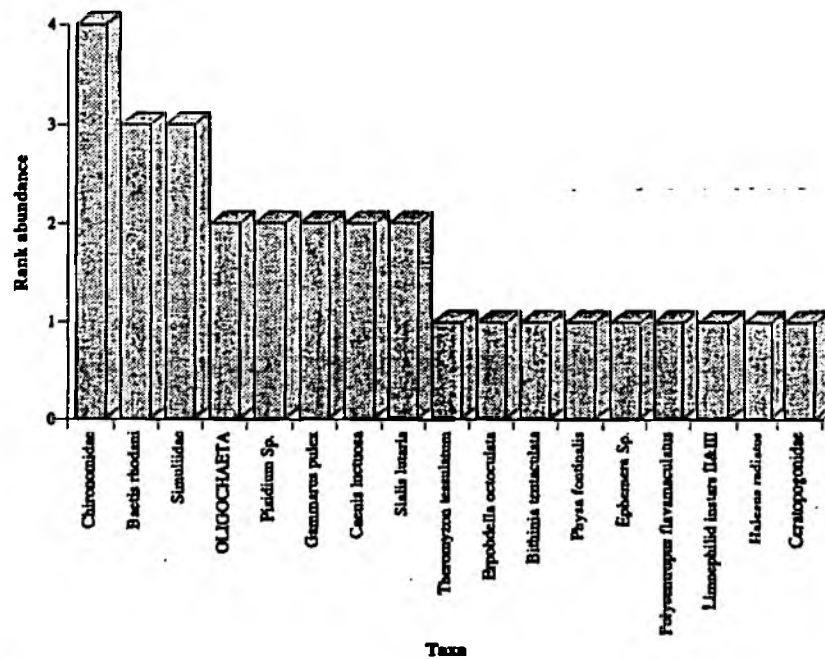


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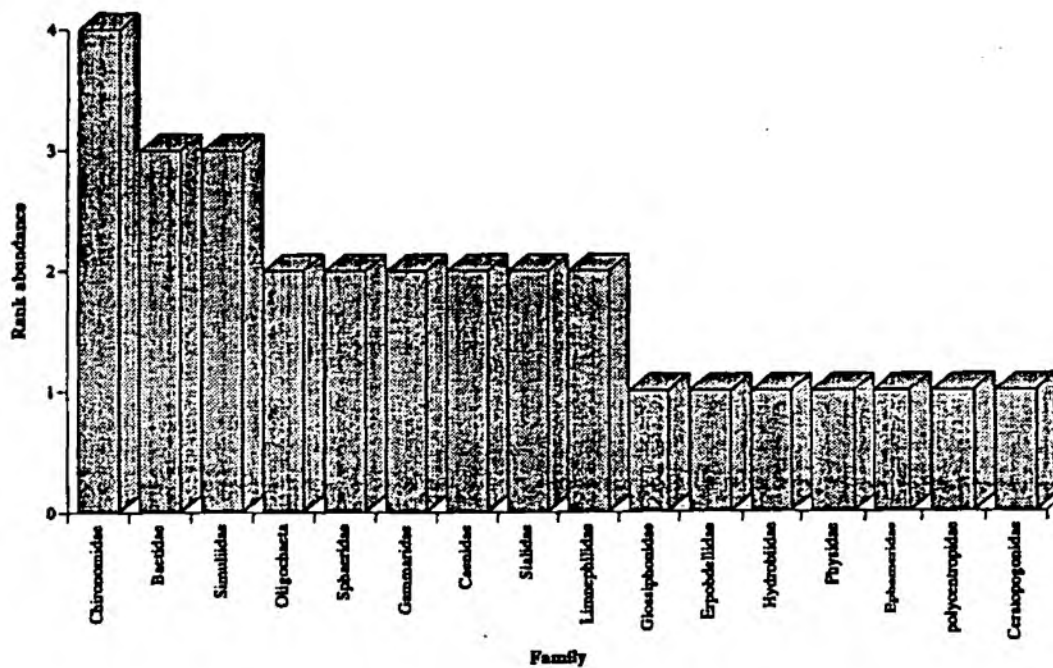


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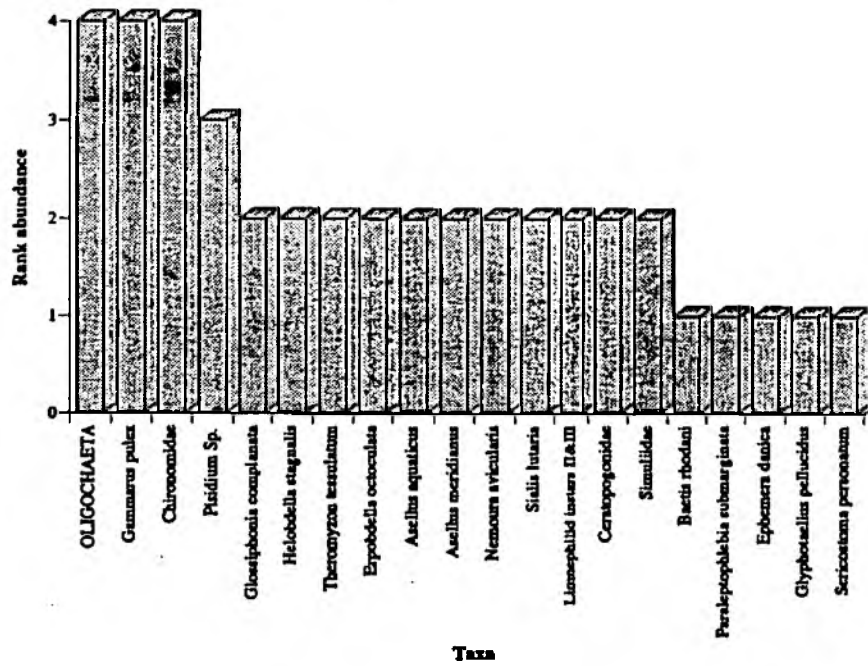


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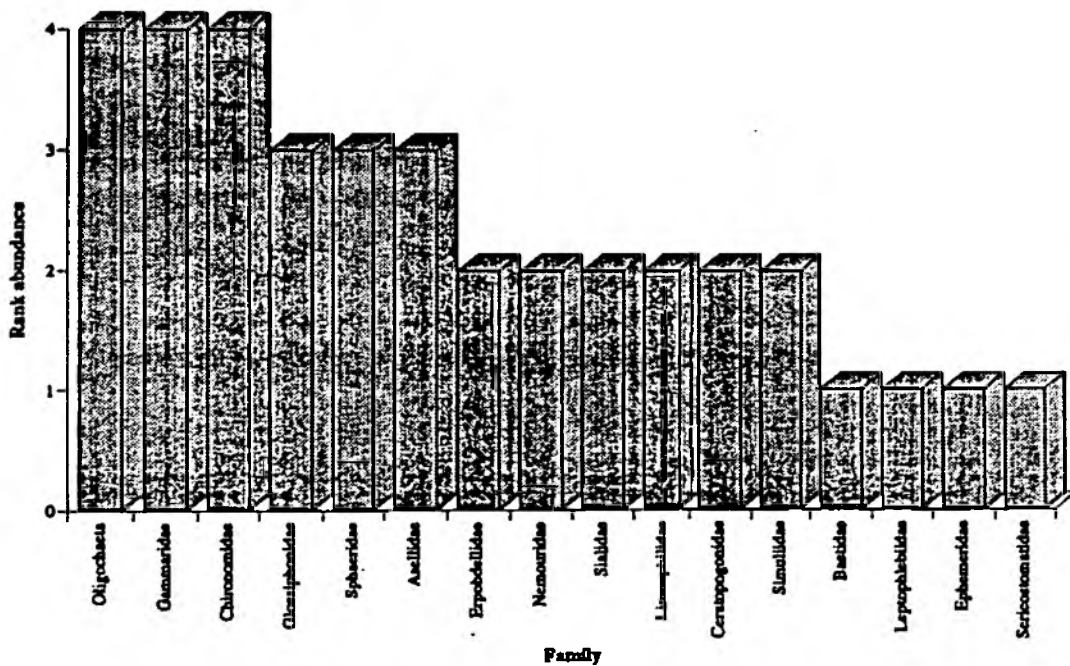


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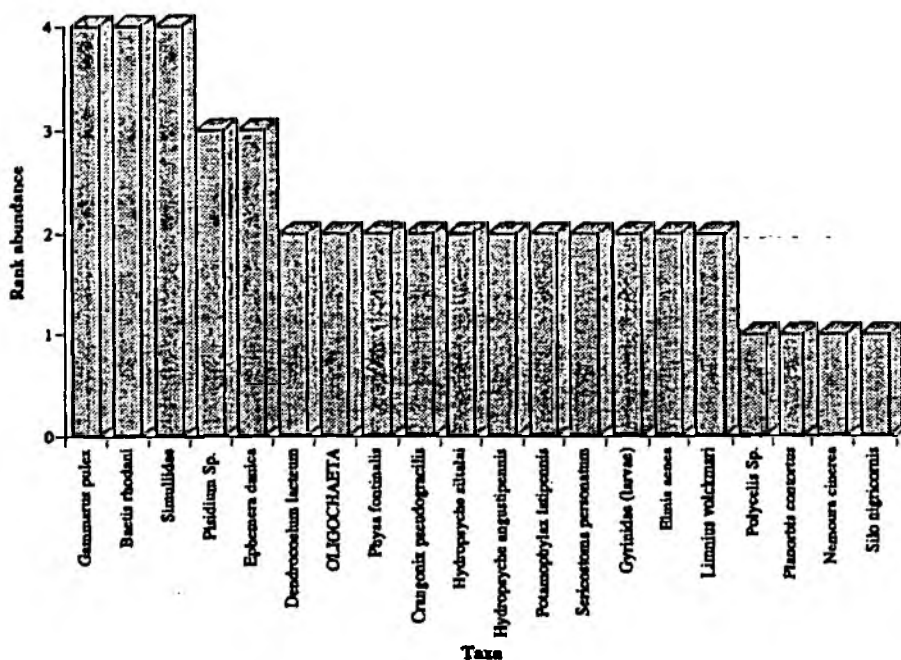


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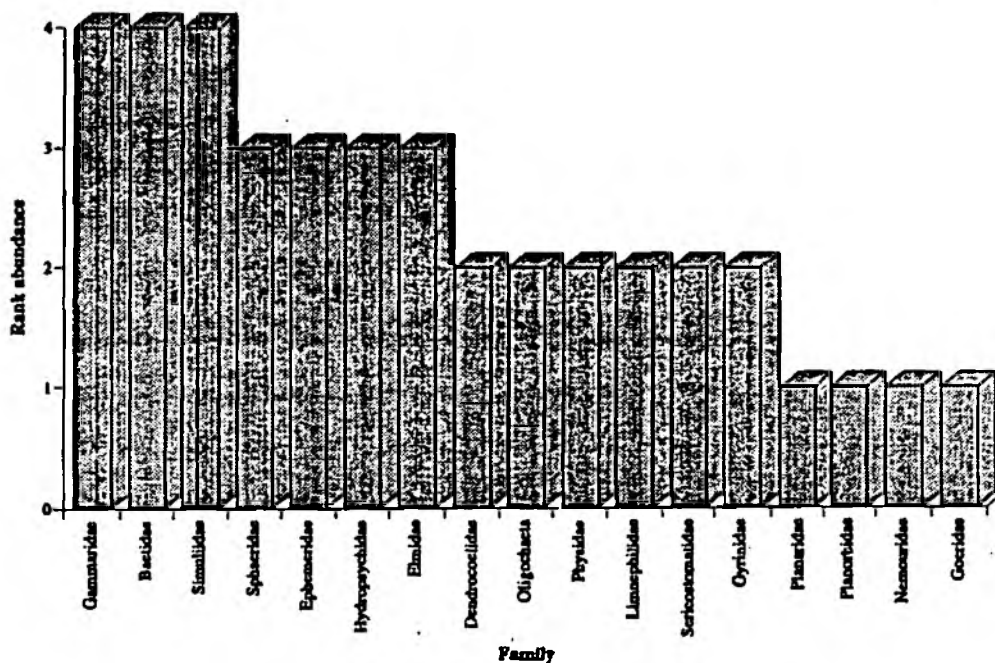


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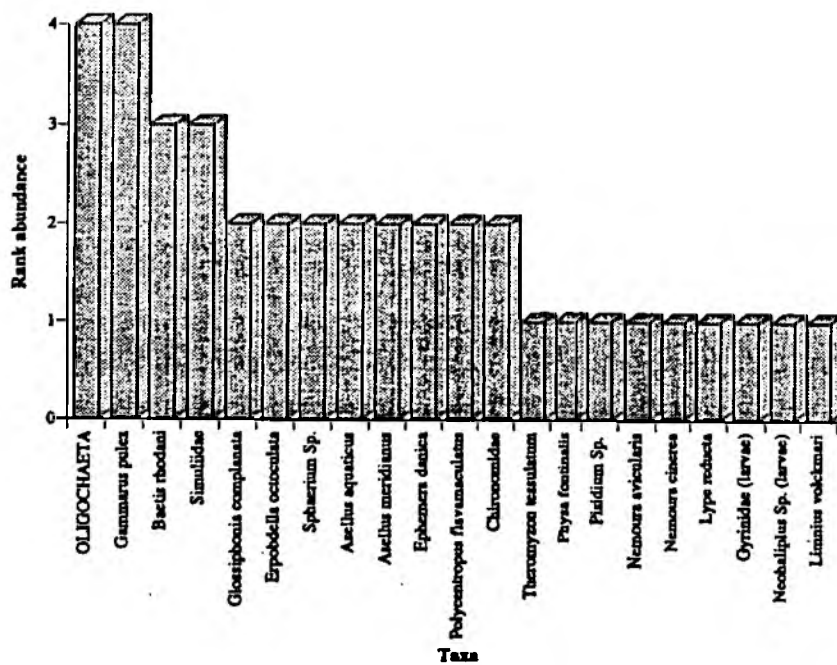


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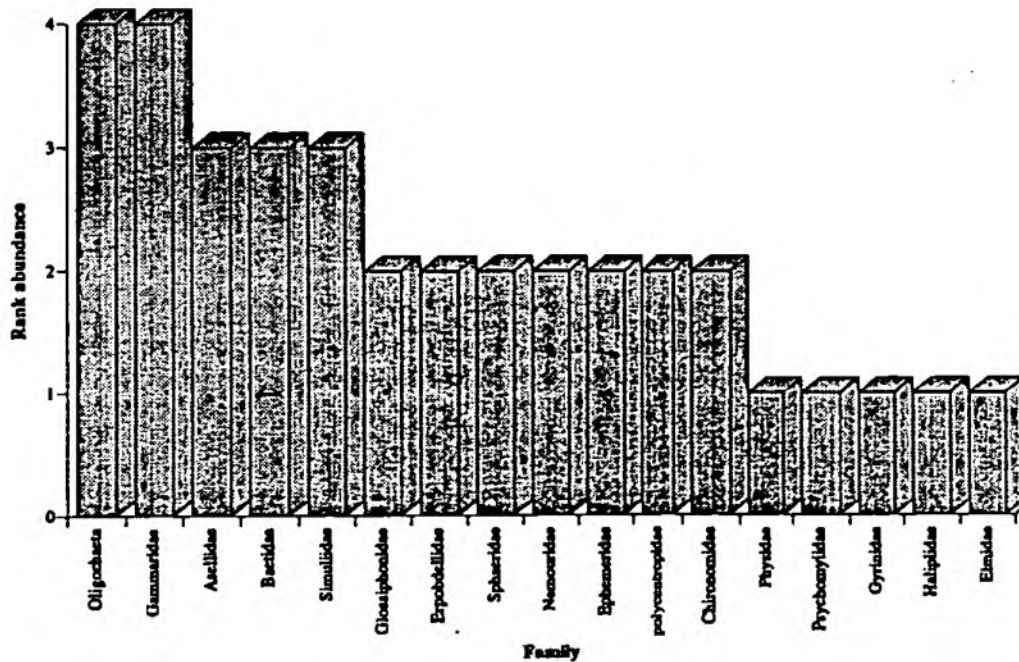


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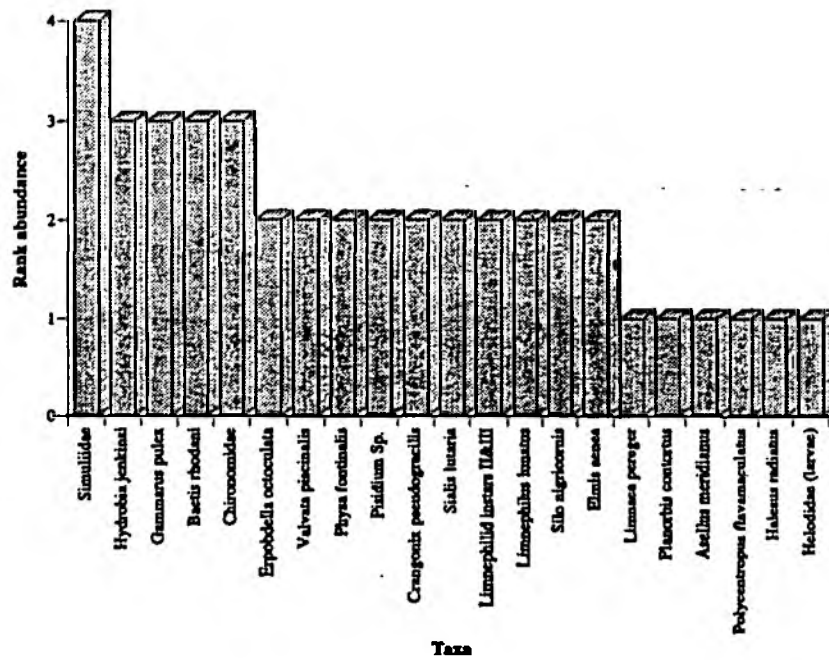


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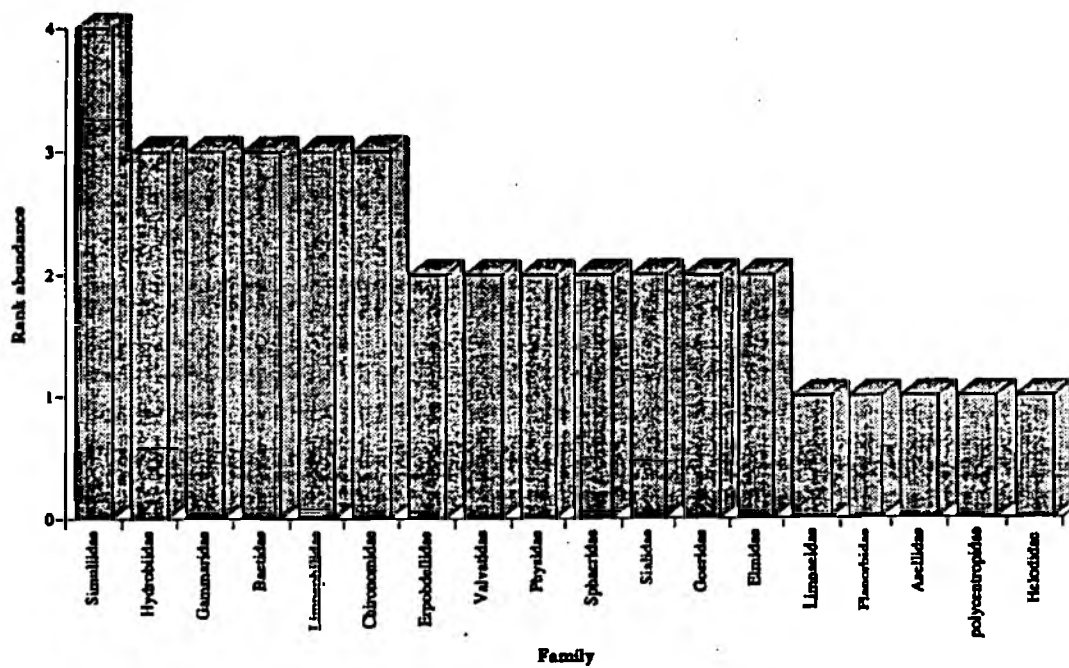


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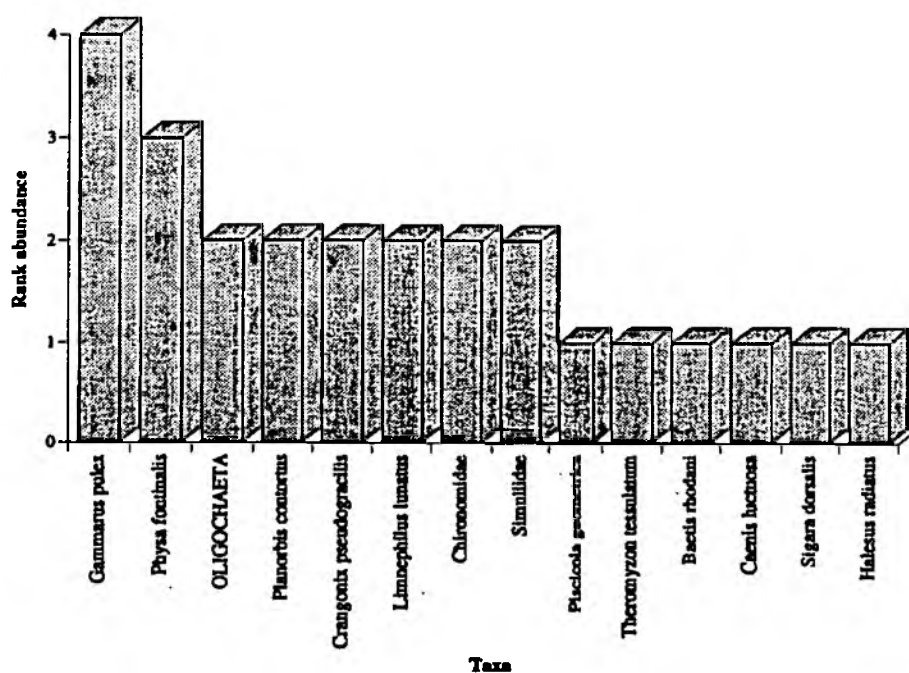


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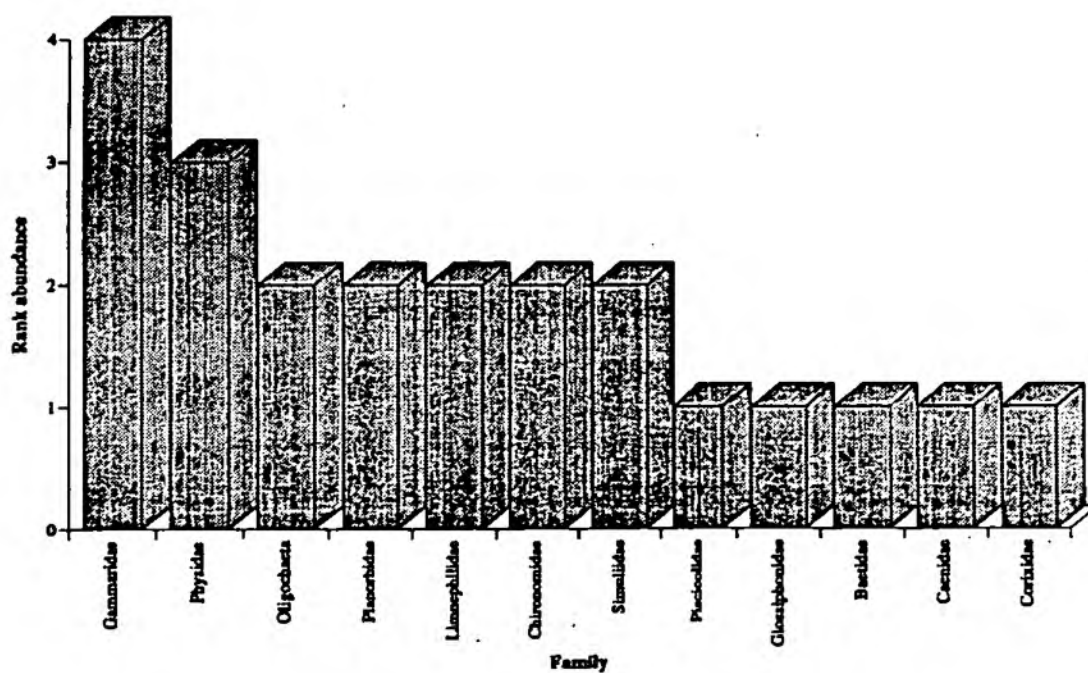


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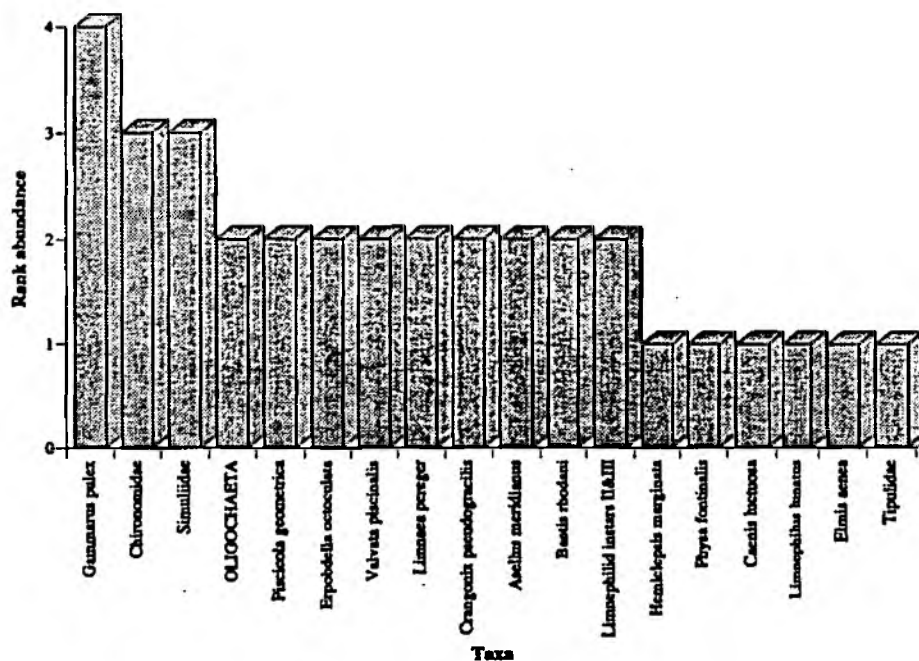


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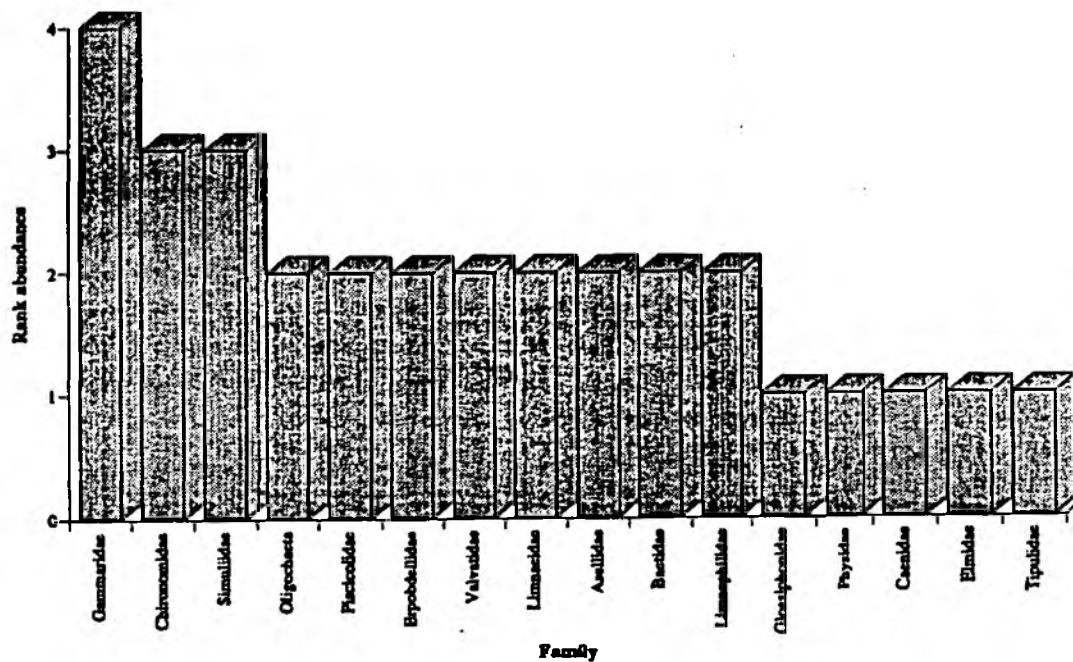


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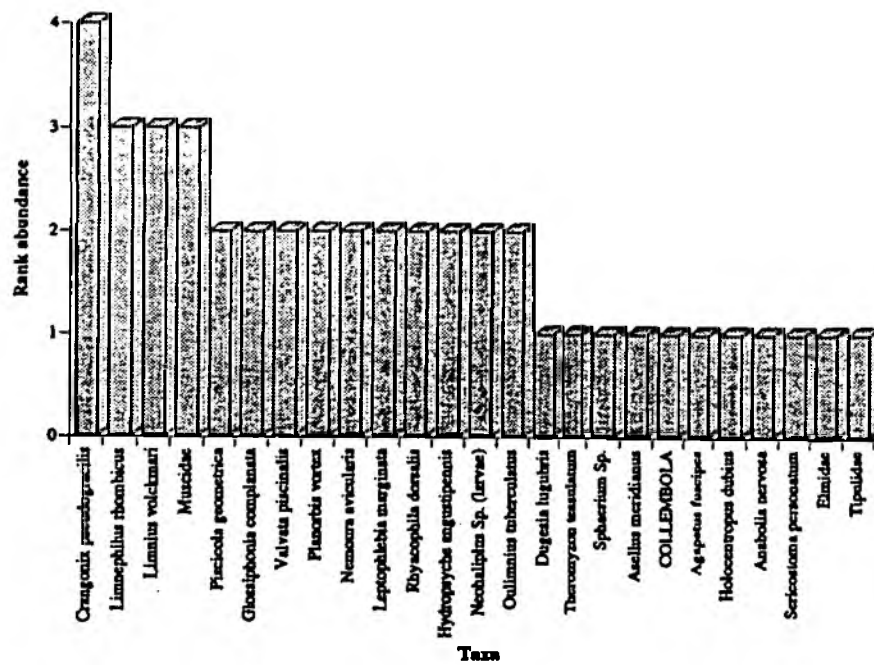


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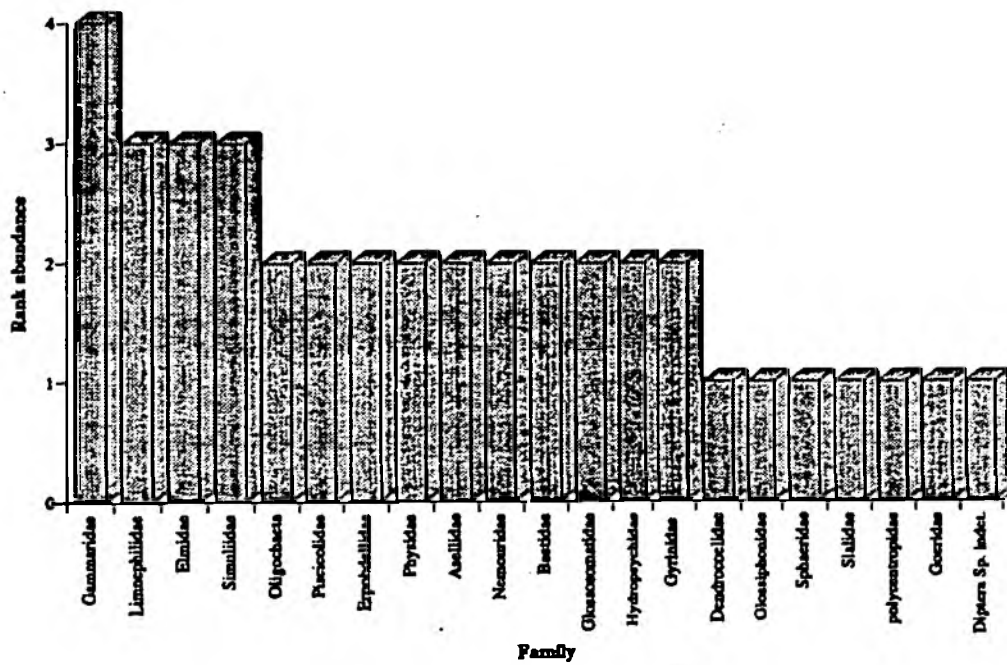


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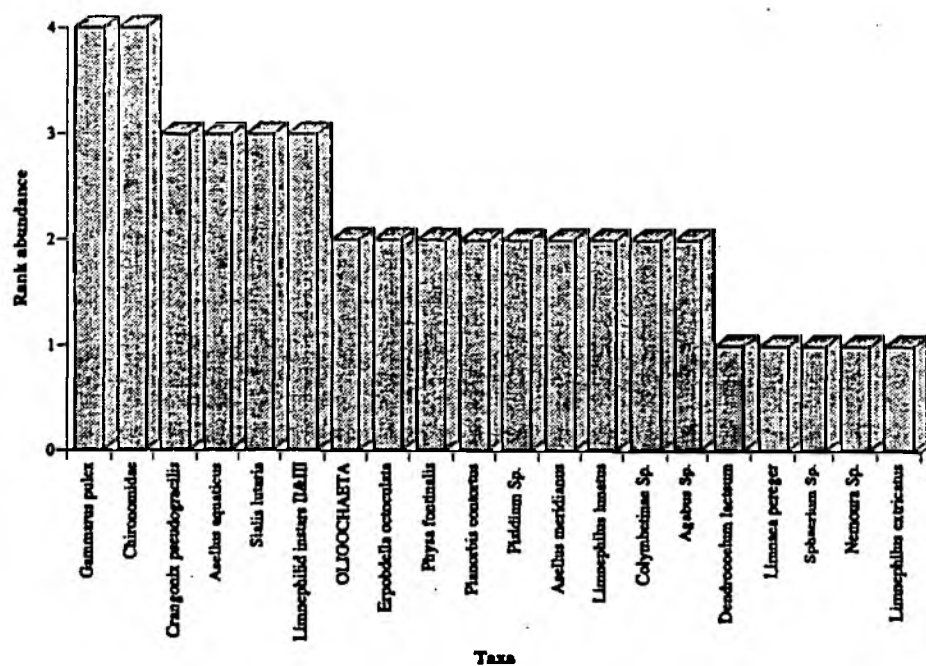


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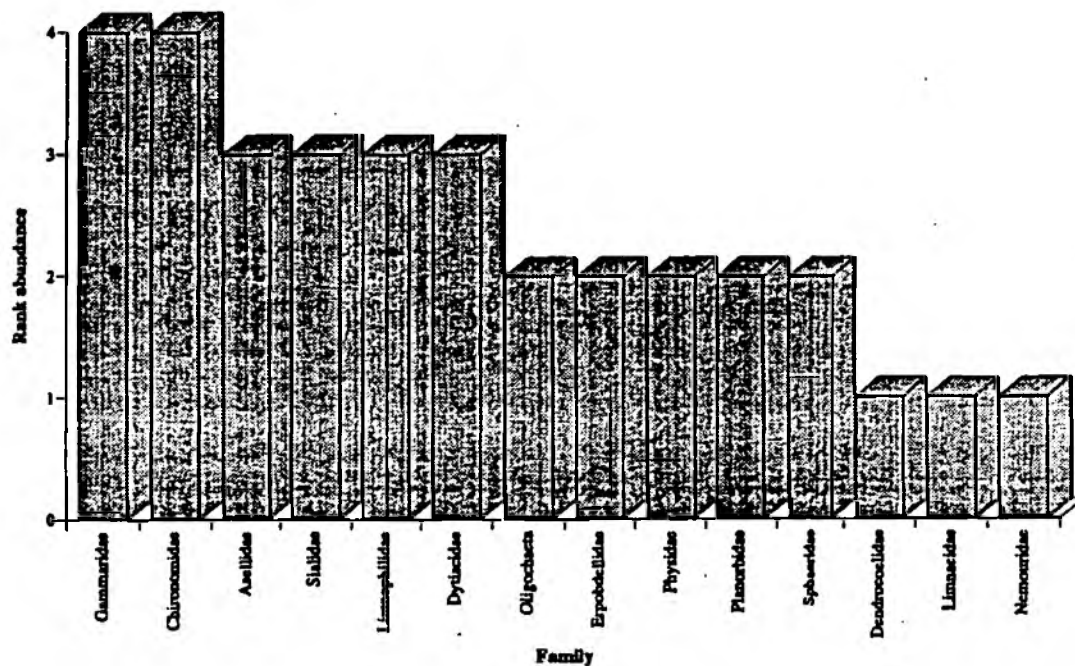


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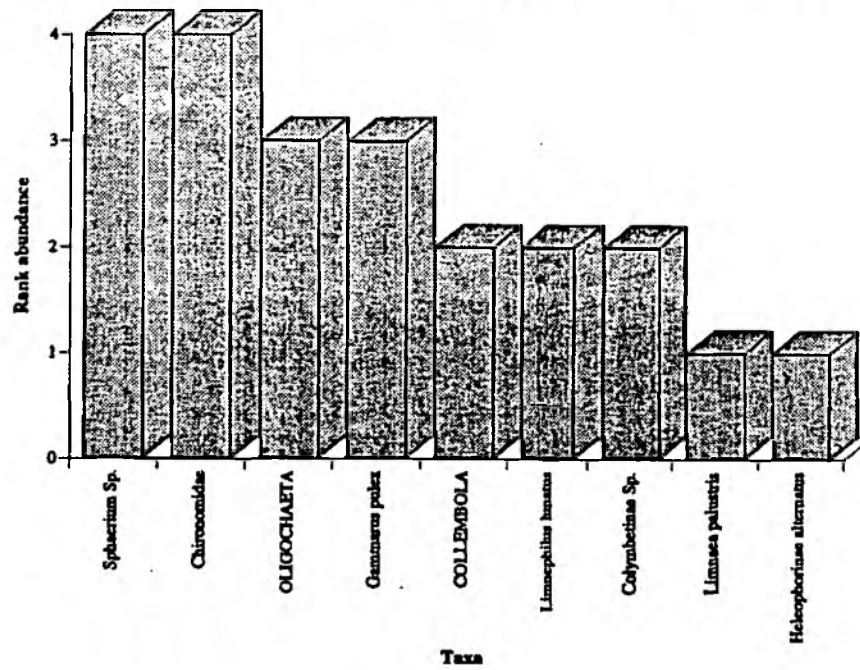


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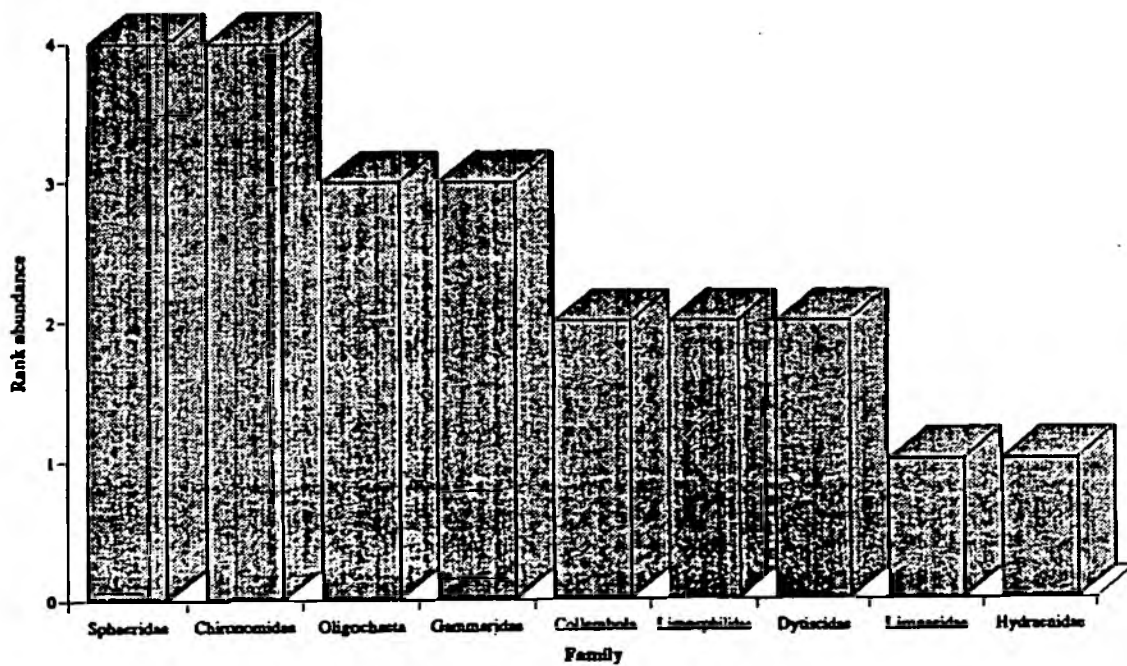


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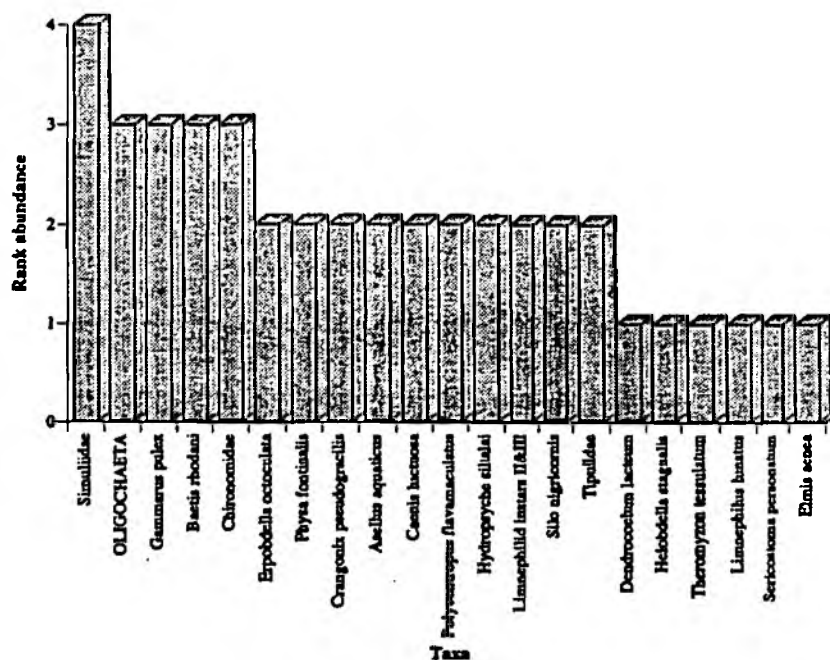
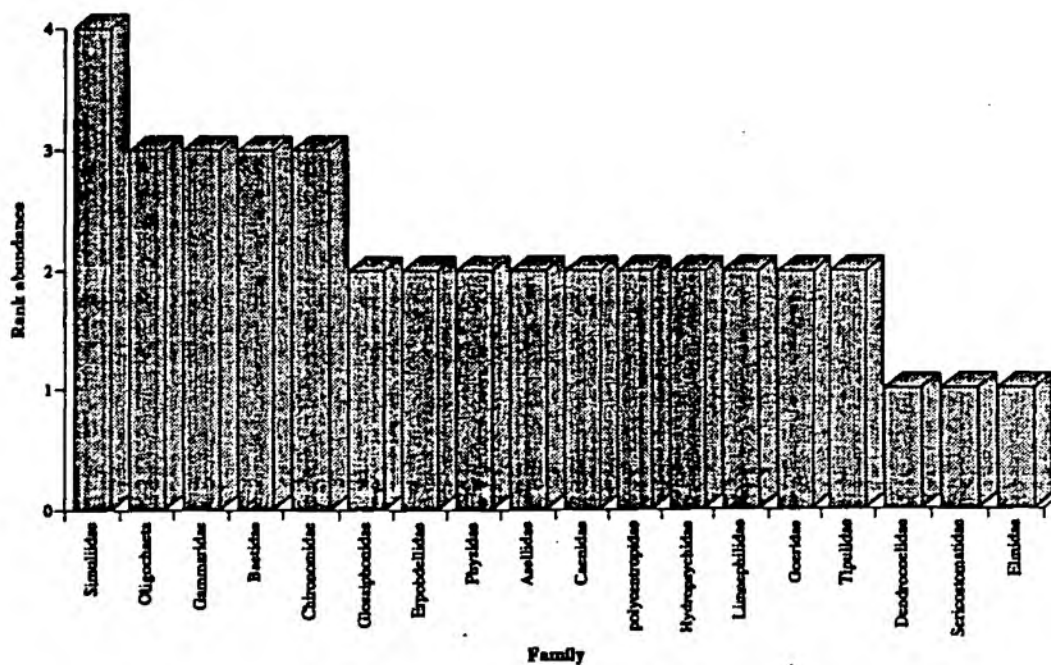


CHART SHOWING THE RANK ABUNDANCE OF EACH FAMILY FOUND AT SITE 32



CAHRT SHOWING THE RANK ABUNDANCE OF EACH IDENTIFIED TAXA AT SITE 33

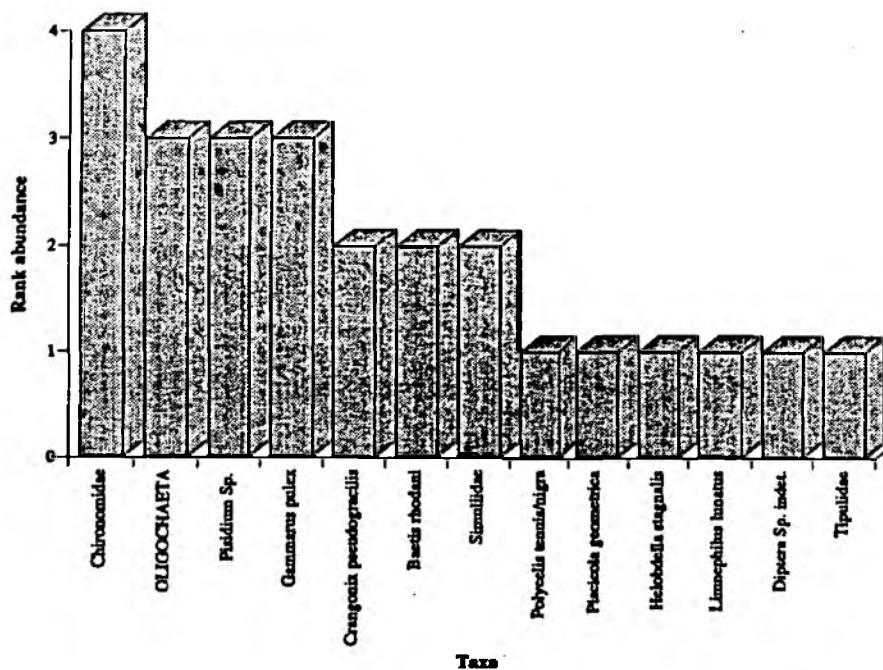


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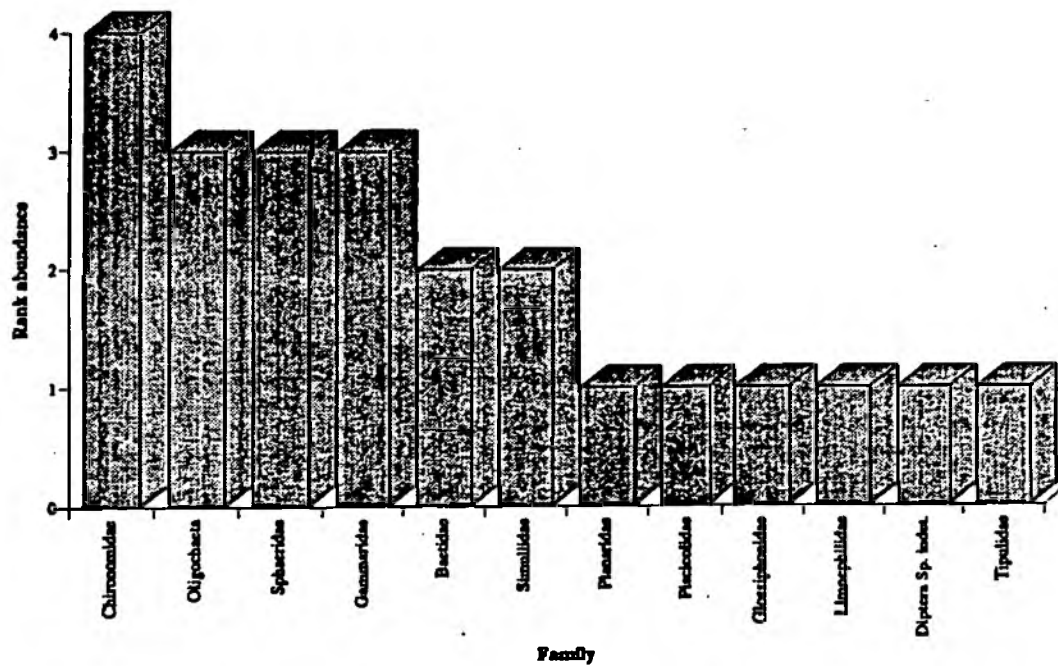


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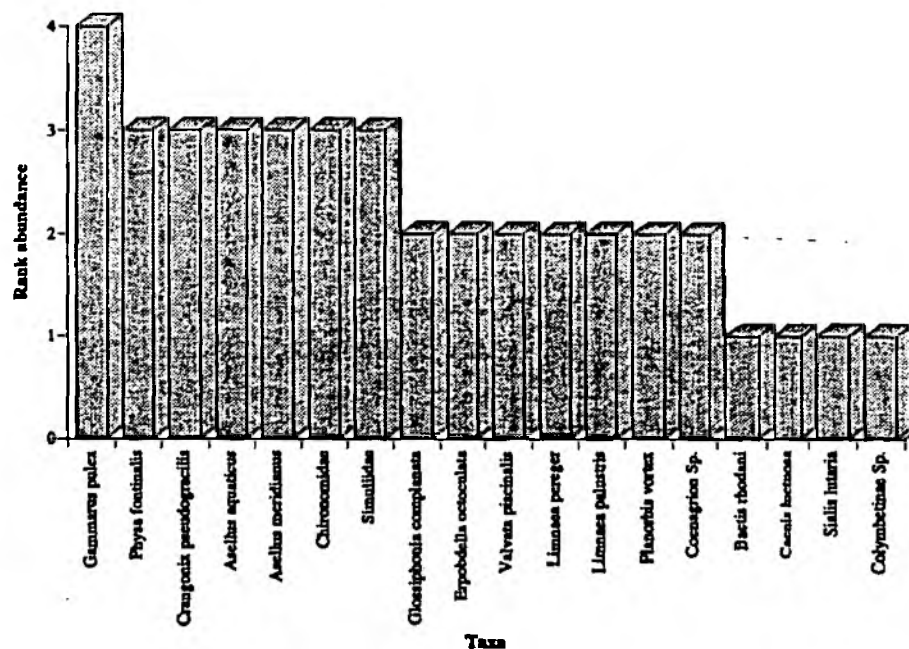


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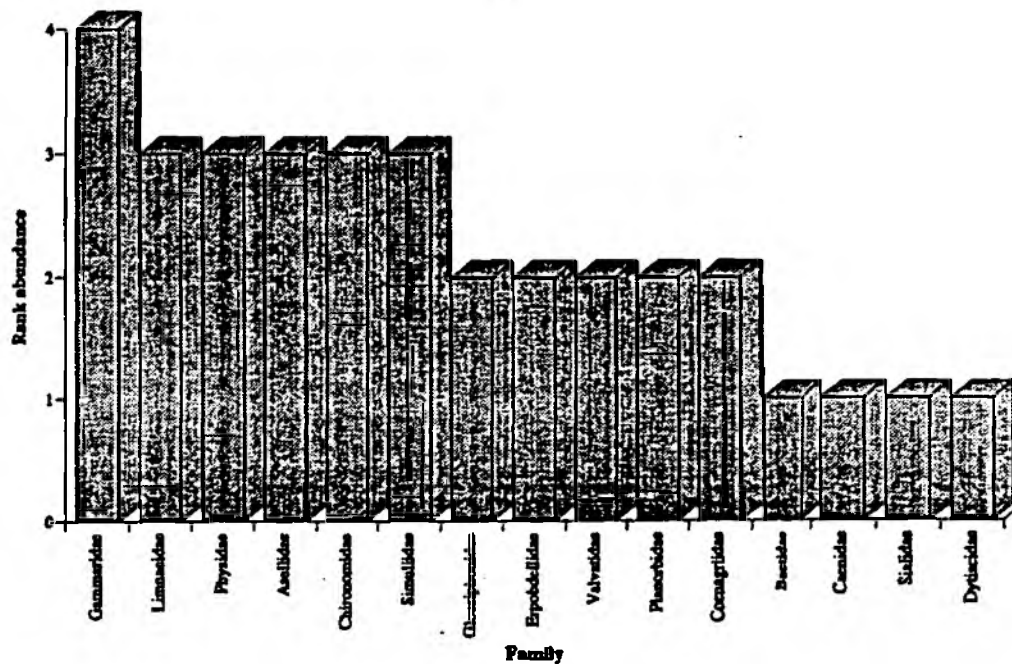


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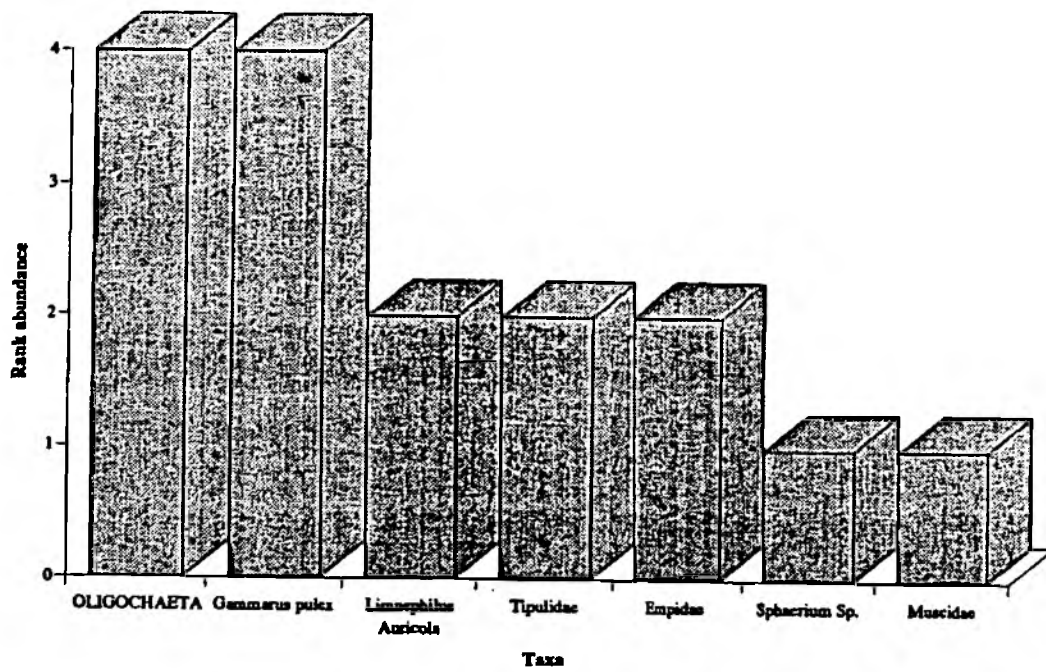


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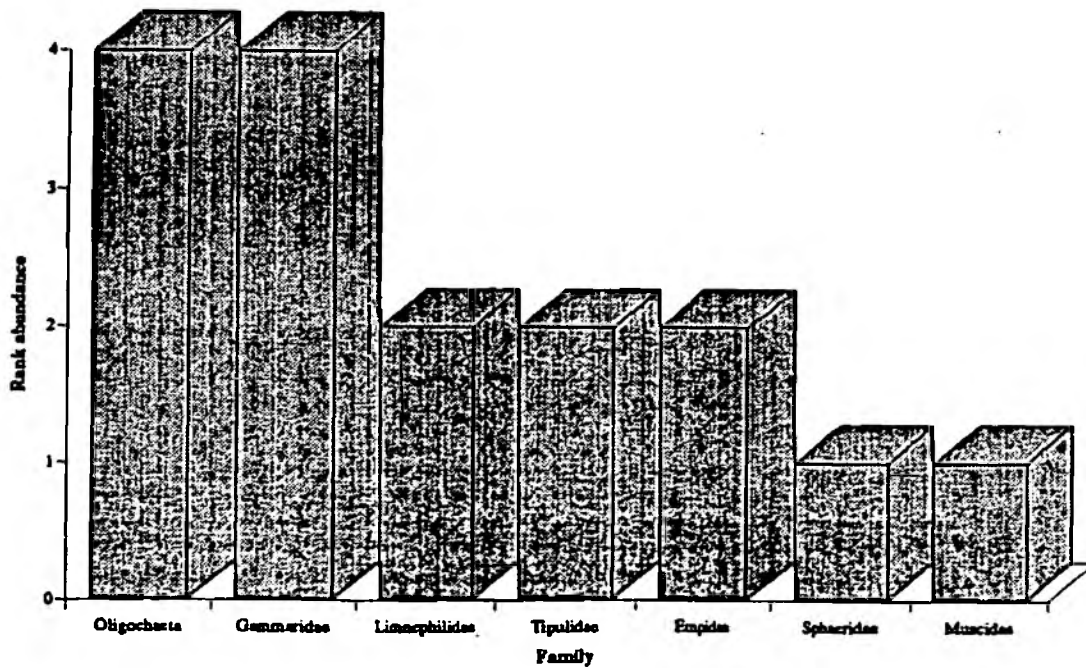


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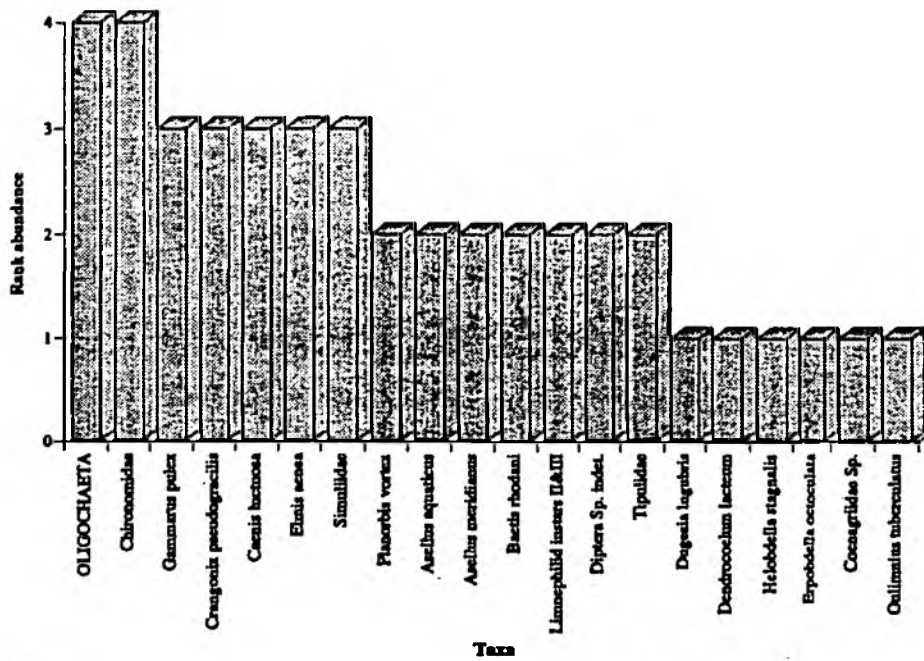


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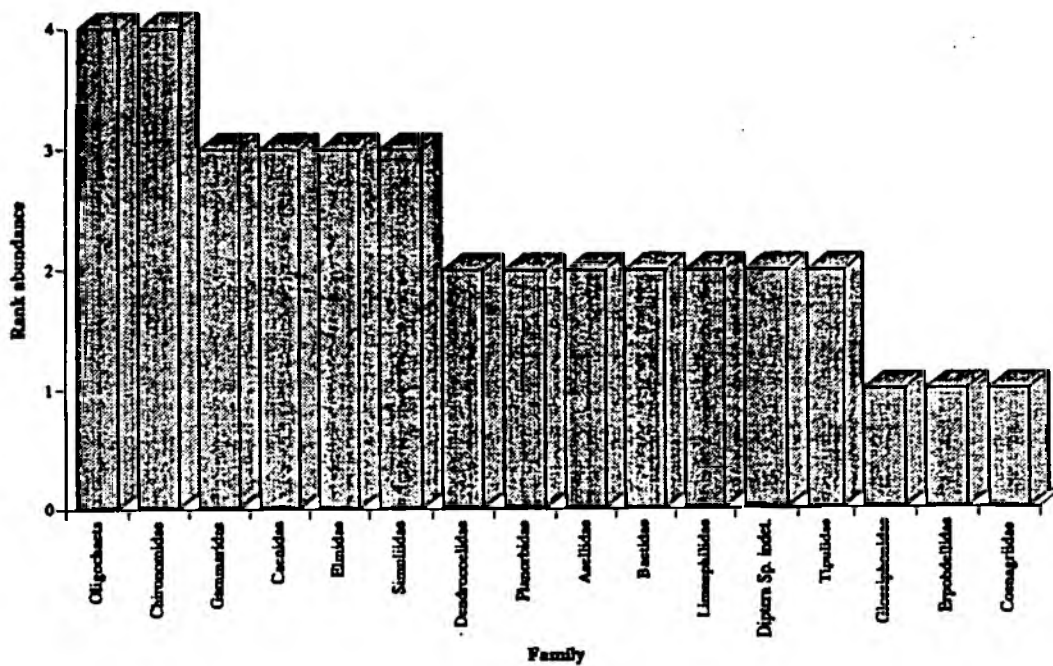


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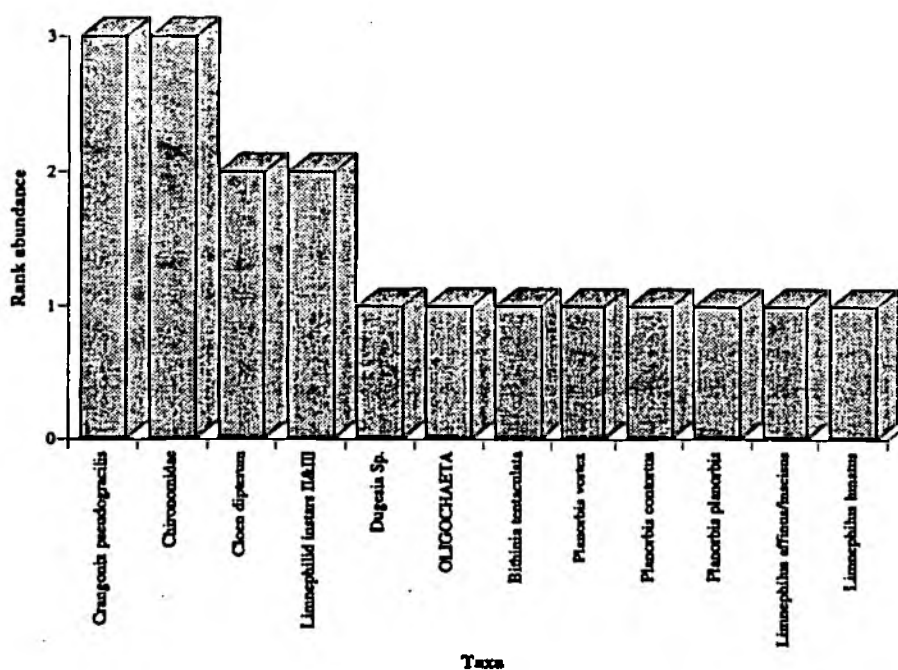


CHART SHOWING THE RANK ABUNDANCE OF EACH FAMILY FOUND AT SITE 37



CHART SHOWING THE RANK ABUNDANCE OF EACH TAXA IDENTIFIED AT SITE 38

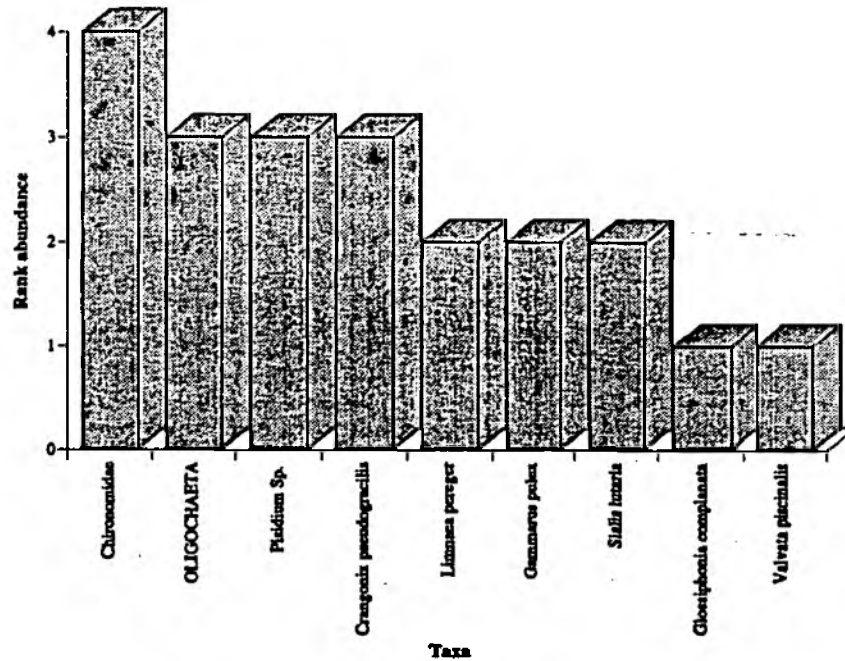


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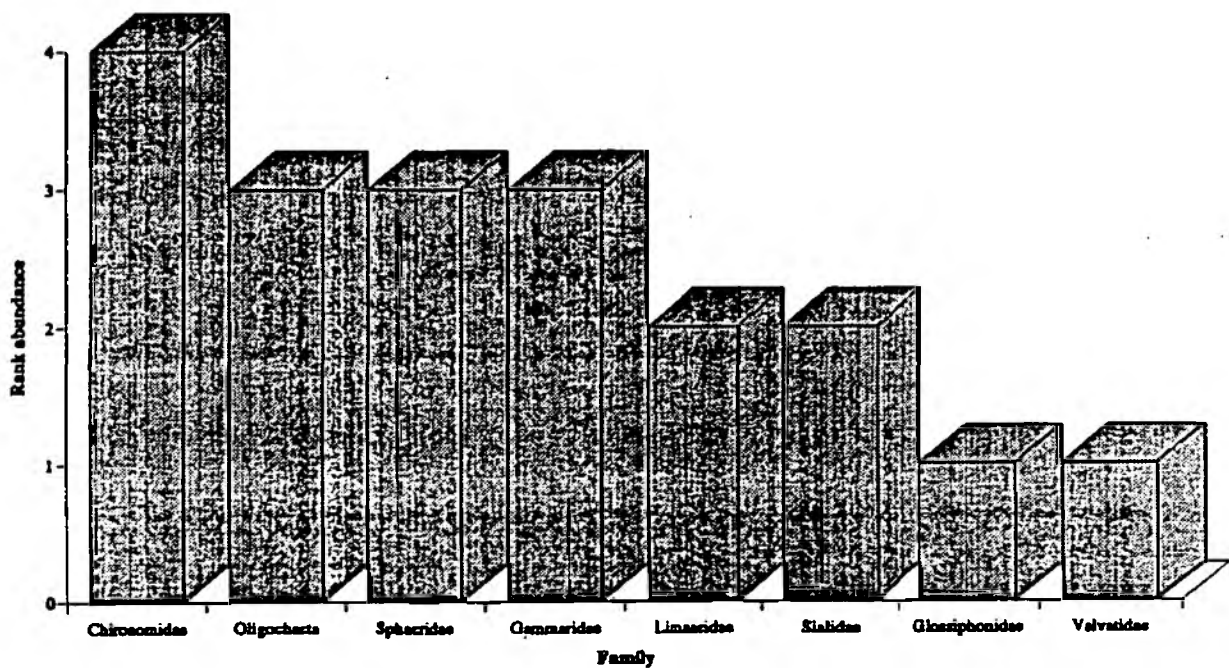


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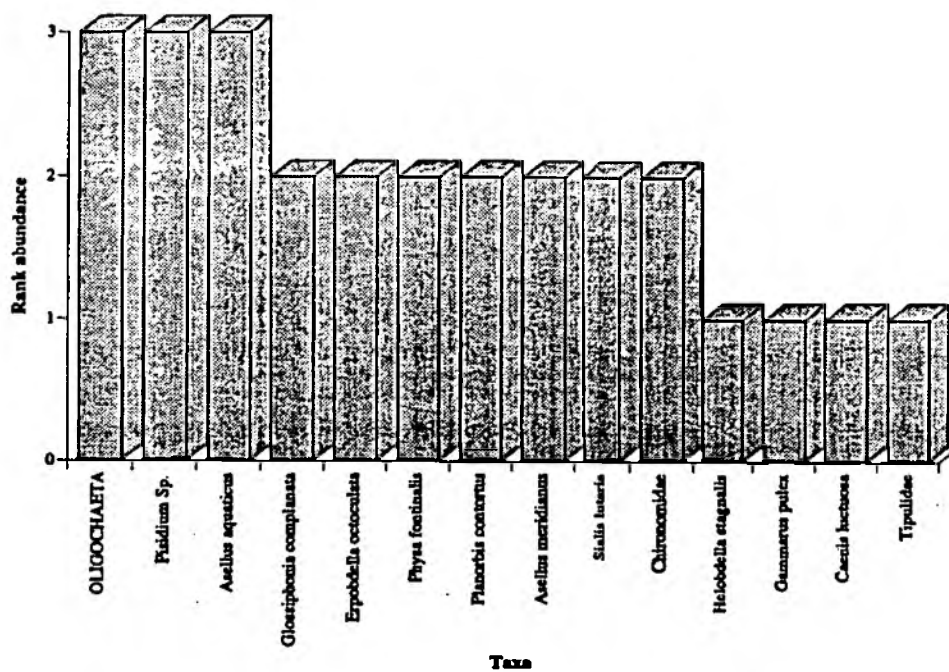


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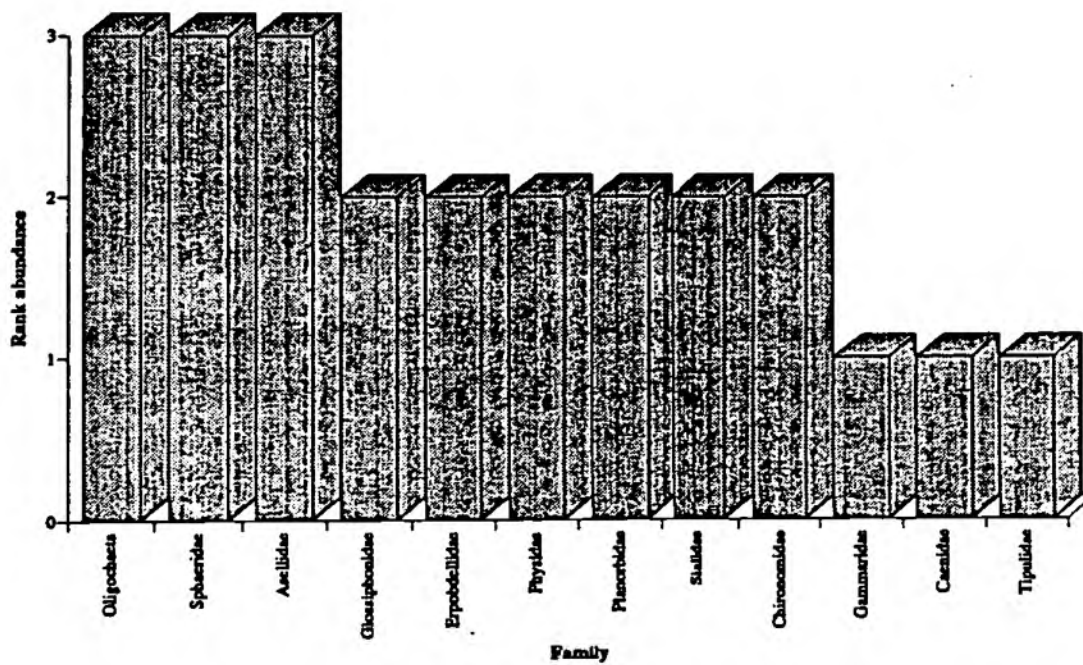


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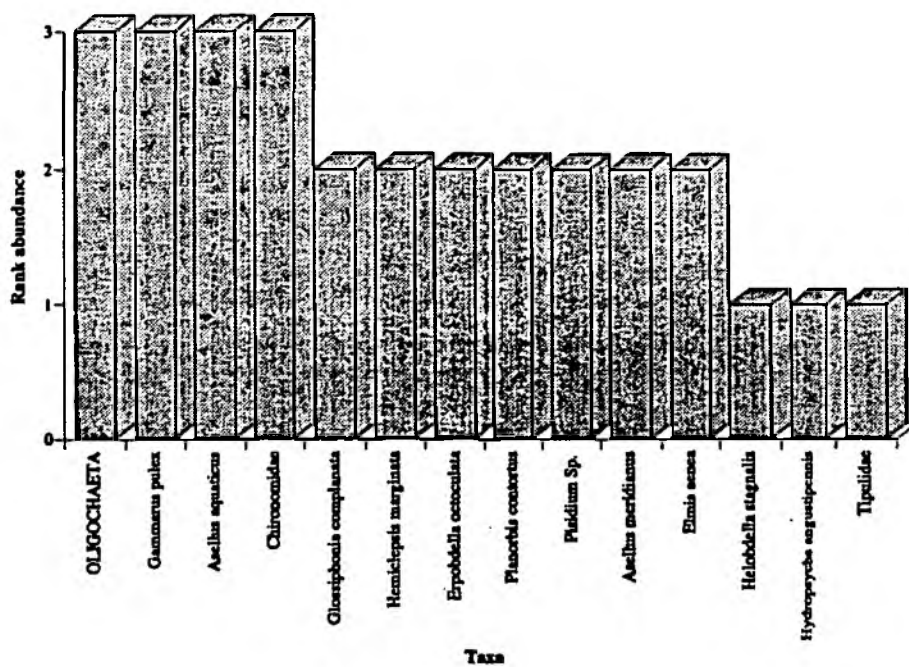


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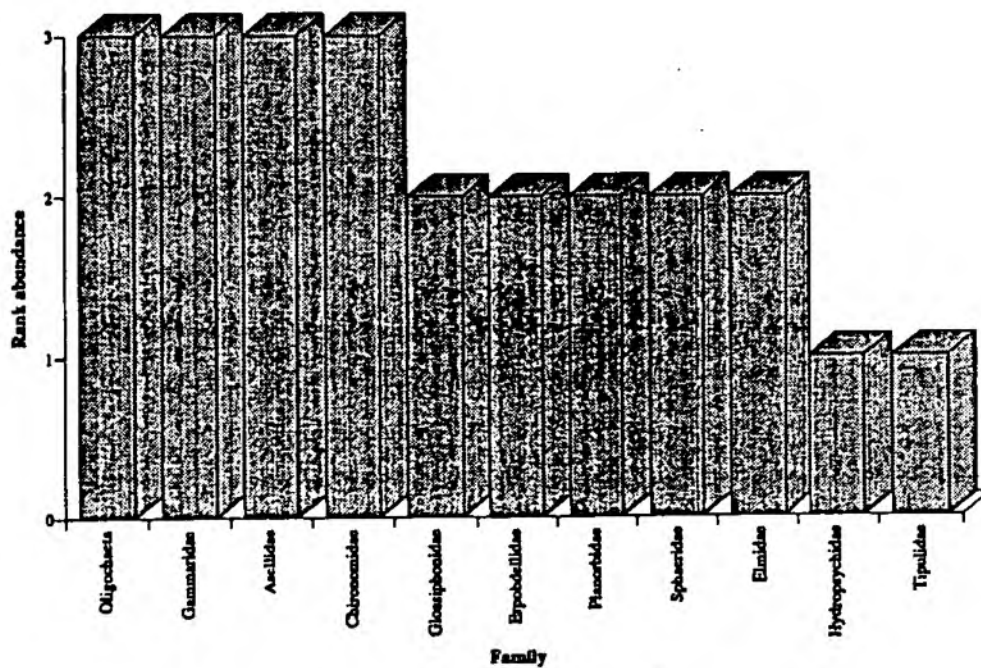


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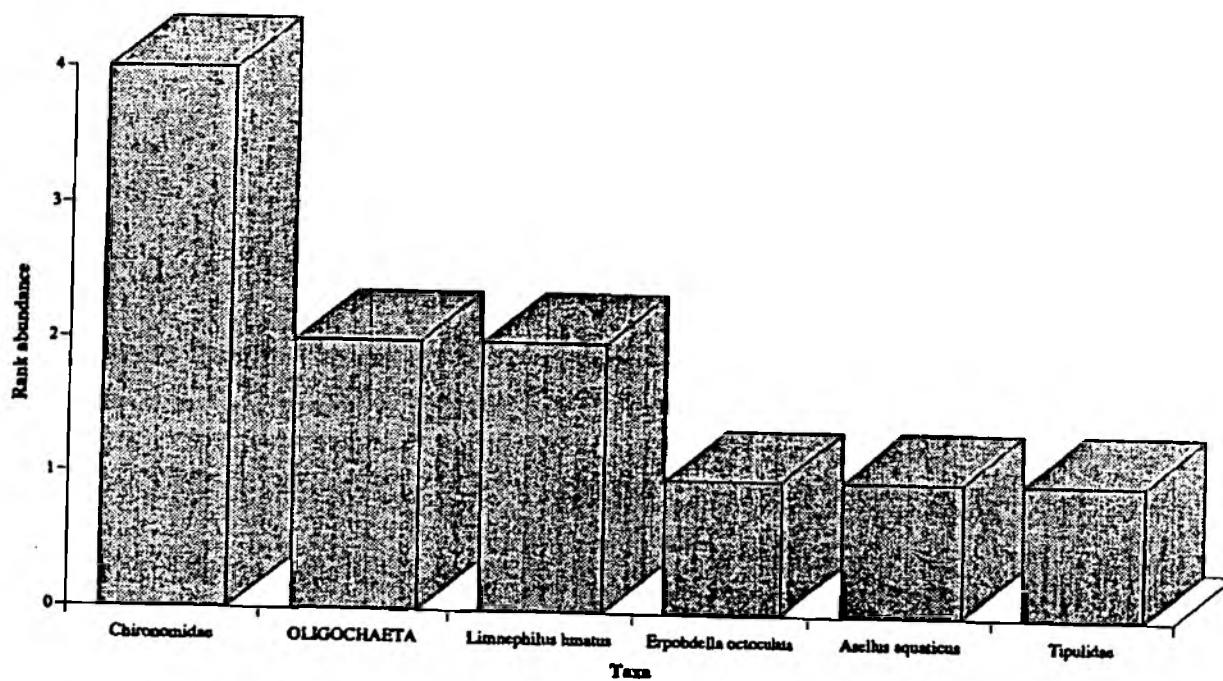


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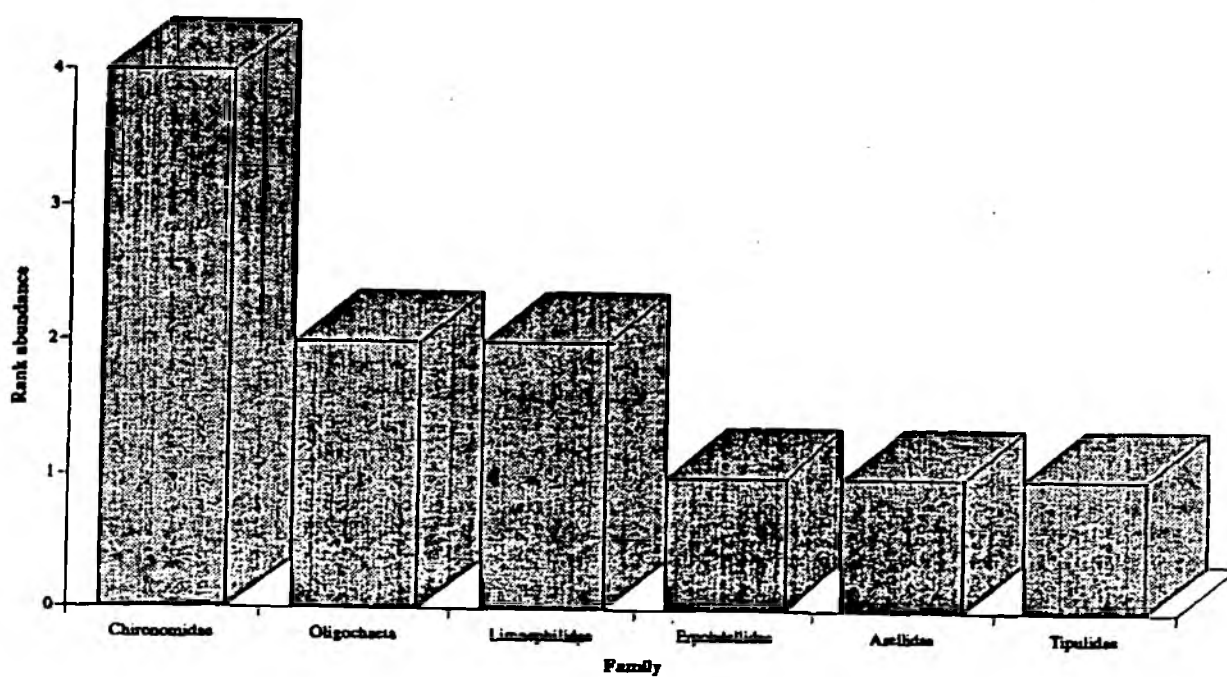


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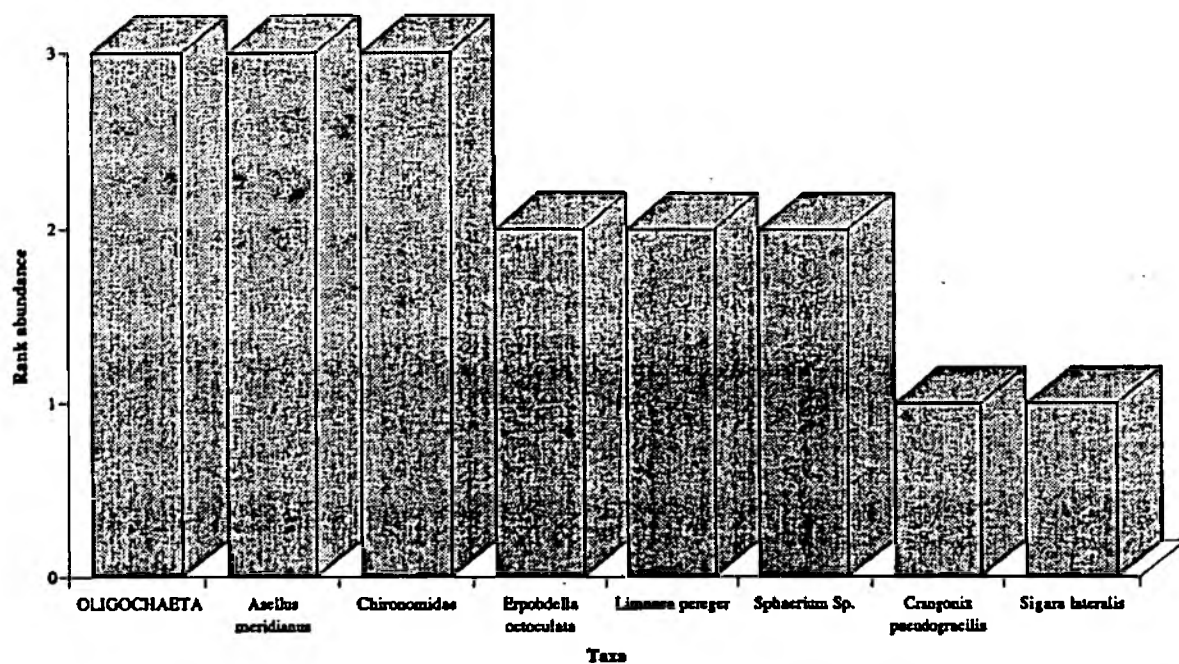


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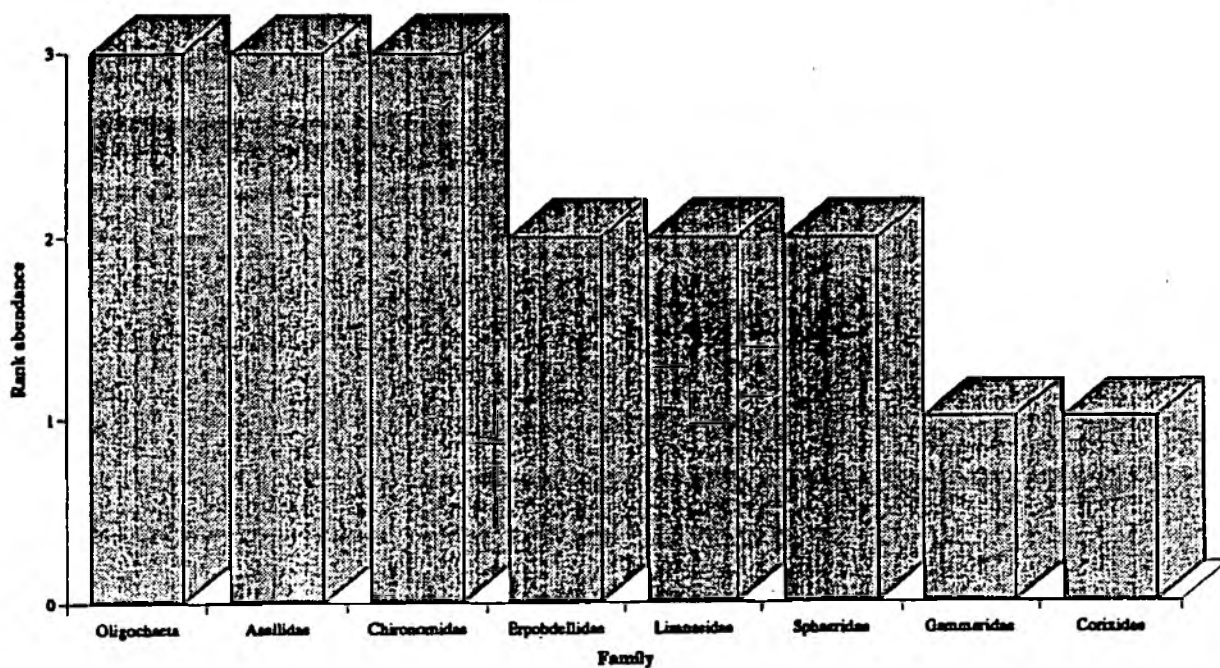


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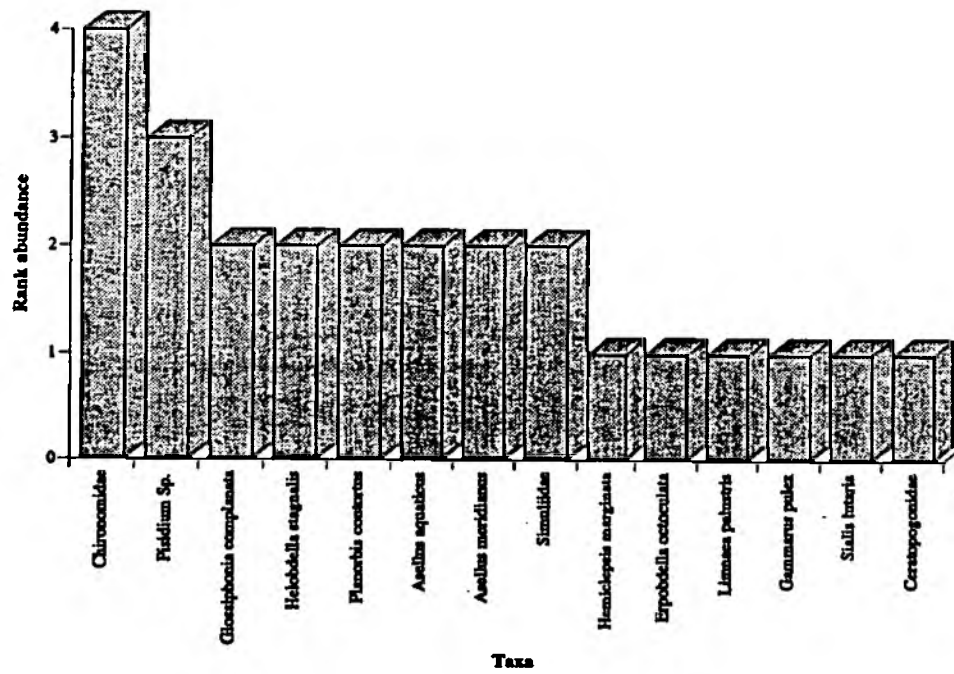


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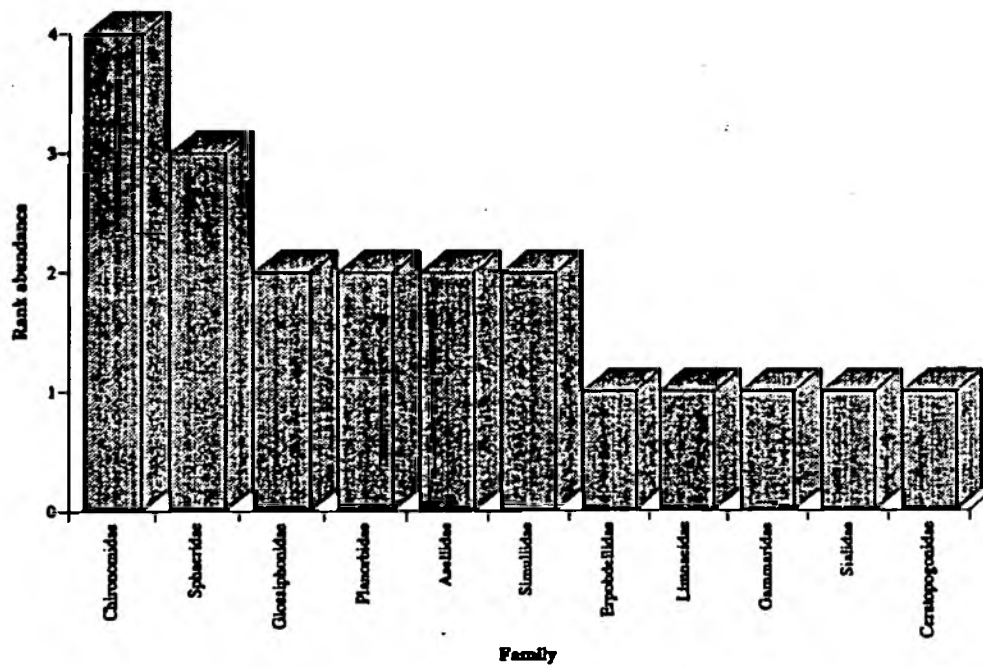


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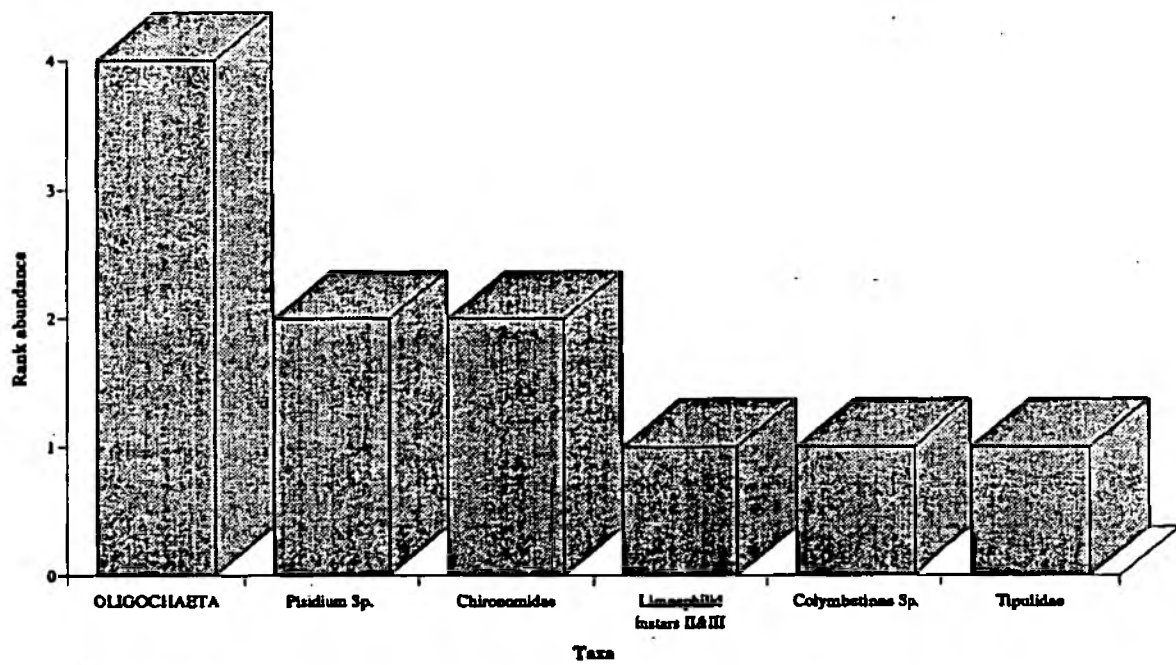


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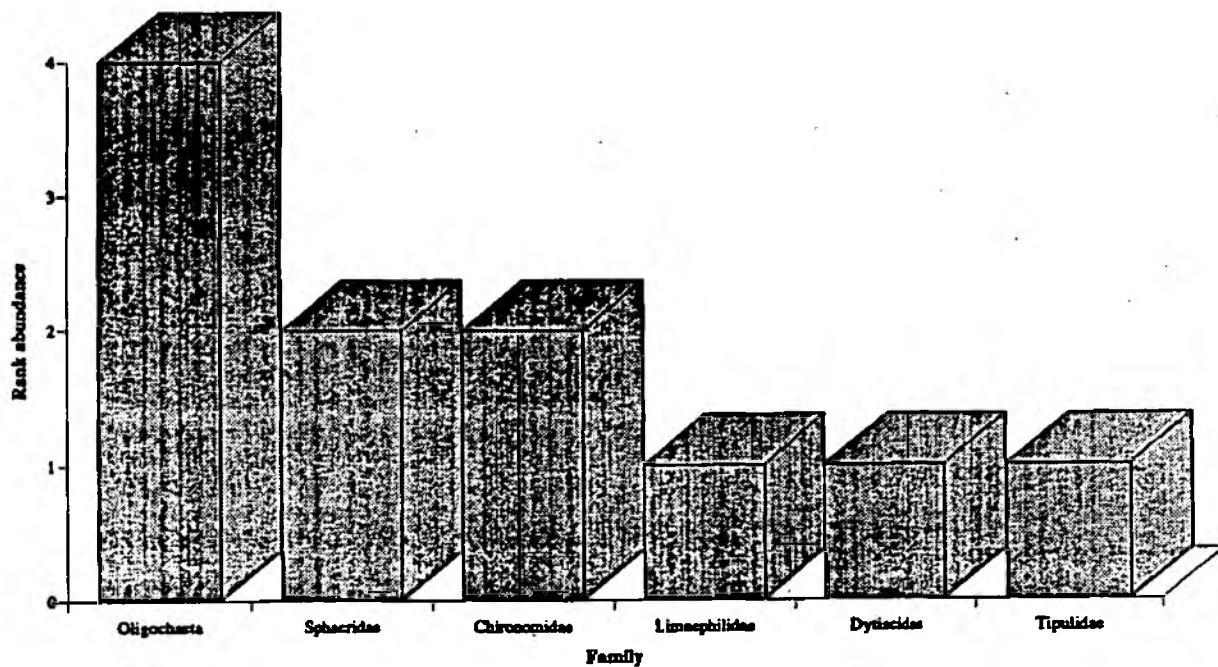


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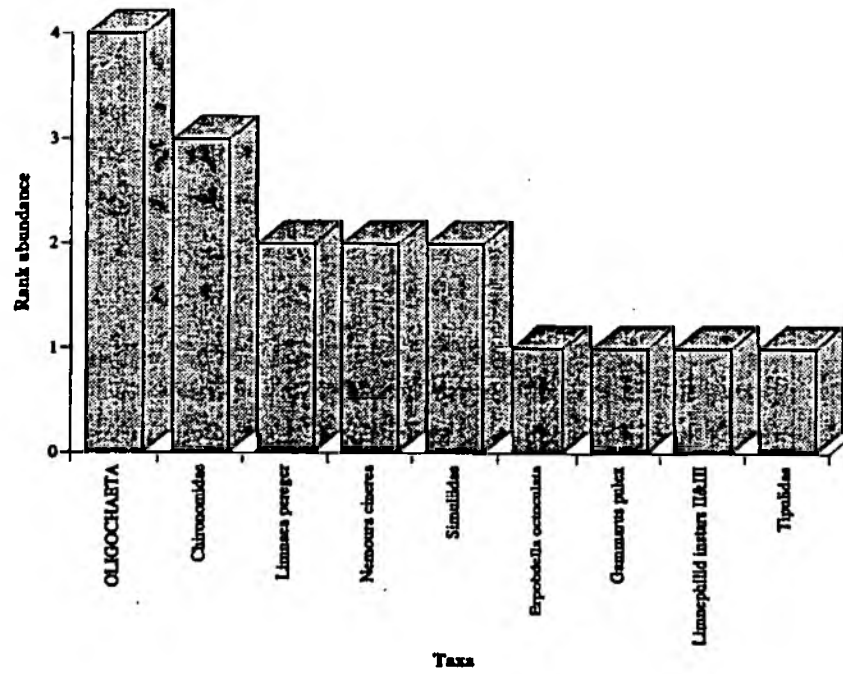
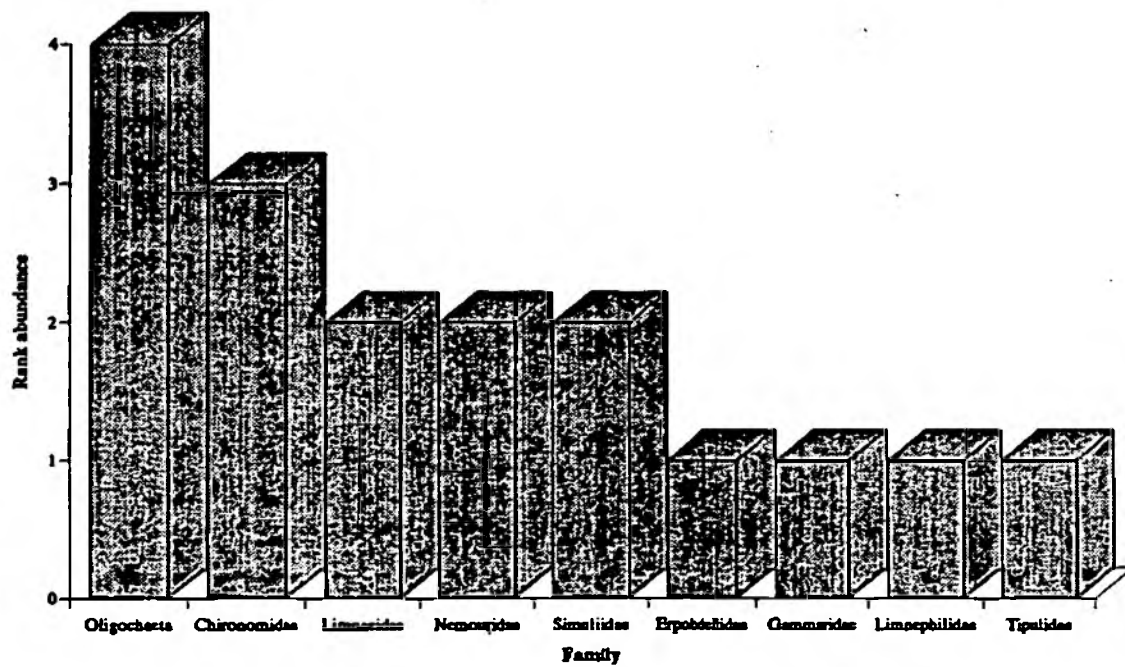


CHART SHOWING THE RANK ABUNDANCE OF EACH FAMILY FOUND AT SITE 45



2.4 Feeding guilds

Feeding guild analysis was distorted somewhat by the presence of Chironomidae, which contains a variety of guilds, chiefly grazers, collectors and predators. Only taxonomic analysis to sub-family or genus allows feeding guilds to be correctly ascribed.

Generally the predominant guilds at the lower sites are grazers, reflecting a more open environment with periphyton abundant on surfaces such as leaves; shredders, reflecting detritus from macrophytes; and collectors, (both gatherers and filters) reflecting fine organic material coming from upstream. Occasionally mobile predators such as bugs or beetles are abundant.

In tributaries and upper sites grazers become less abundant as shading and siltation restricts algal growth. Shredders (dead leaf material) and collector-gatherers (silt) are generally dominant.

These patterns are typical of the downstream sequence in small streams. Occasionally they may be disrupted by human influence, but there is no clear indication that this has happened in the Nar. In the sites where quality is depressed, there is no pattern of change in dominance to collector-gathers, which is often a sign of high organic input and settlement.

CHART SHOWING THE RANK ABUNDANCE OF THE DIFFERENT FEEDING GUILDS FOUND AT SITE 1

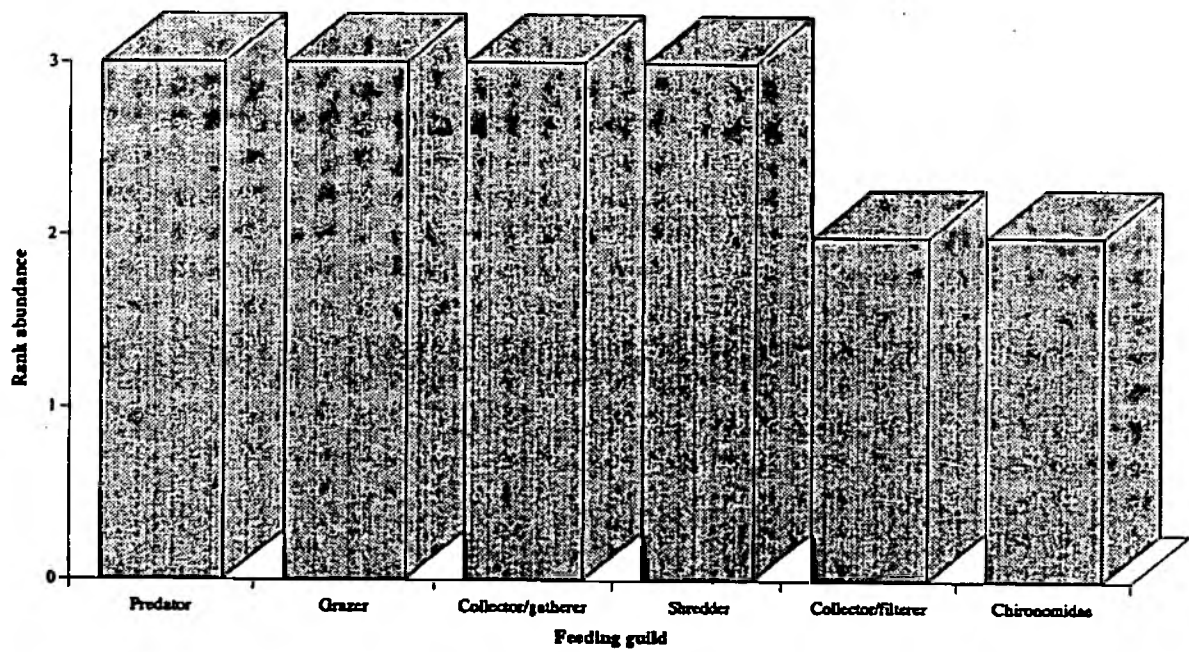


CHART SHOWING THE RANK ABUNDANCE OF THE DIFFERENT FEEDING GUILDS FOUND AT SITE 2

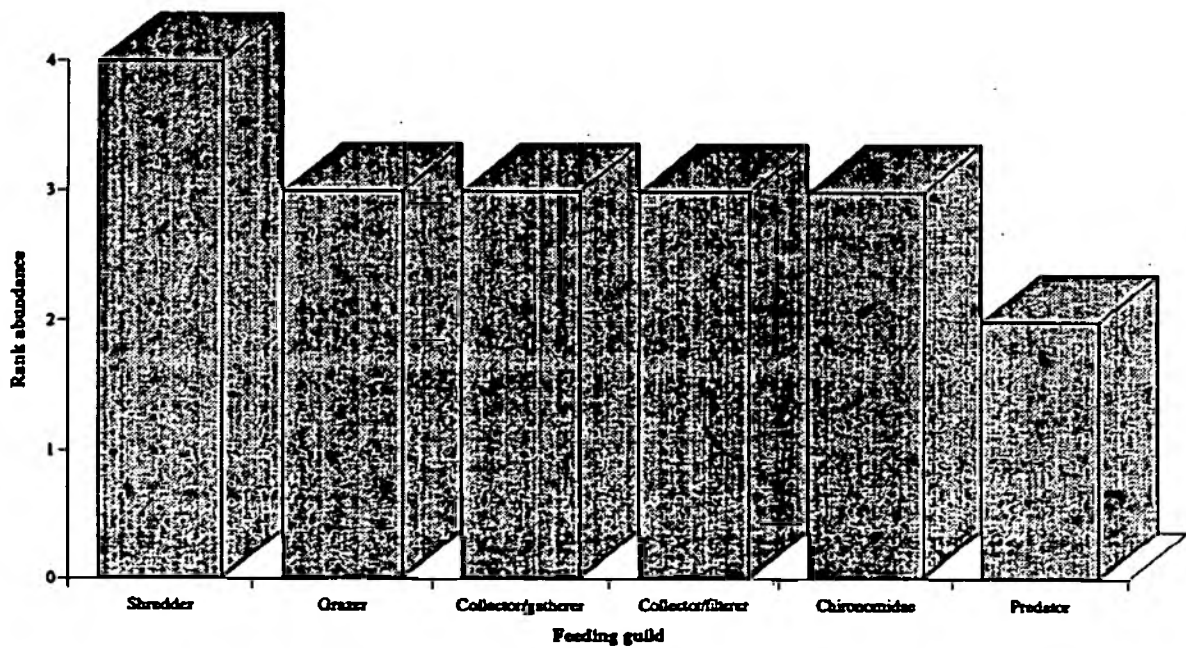


CHART SHOWING THE RANK ABUNDANCE OF THE DIFFERENT FEEDING GUILDS FOUND AT
SITE 3

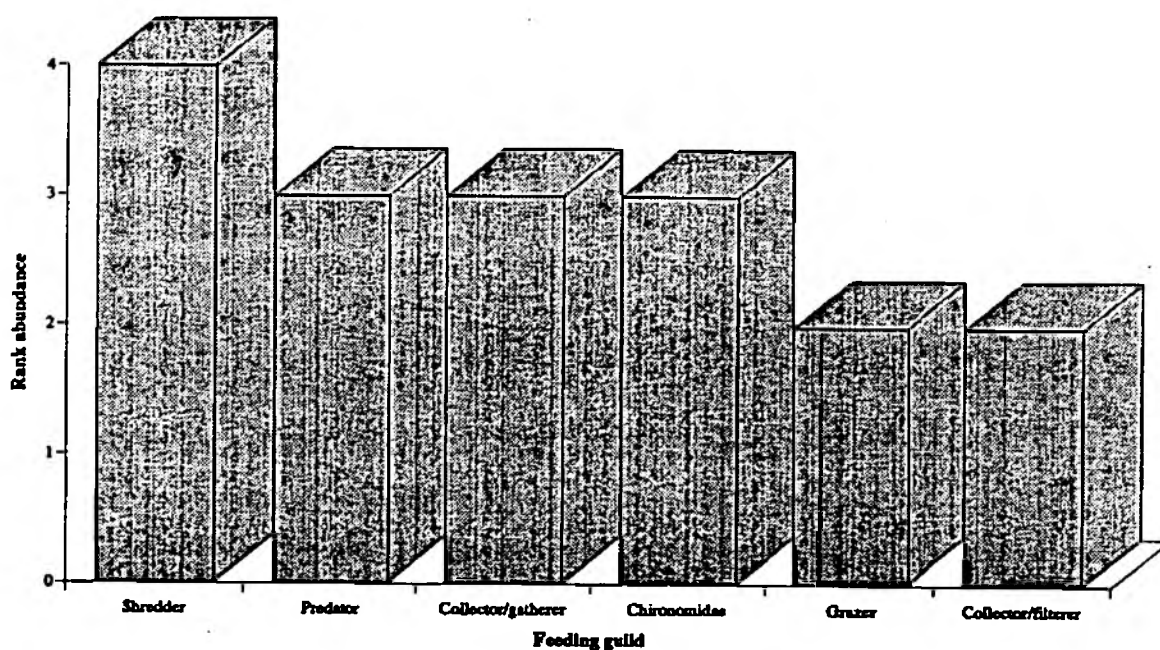


CHART SHOWING THE RANK ABUNDANCE OF THE DIFFERENT FEEDING GUILDS FOUND AT
SITE 4

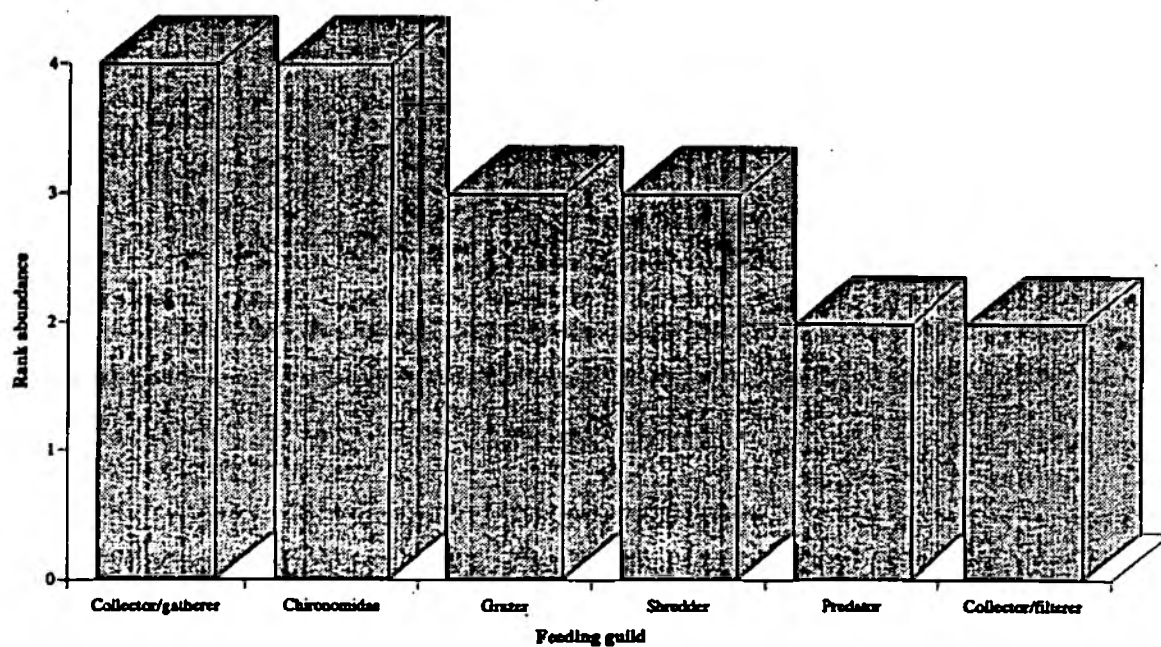


CHART SHOWING THE RANK ABUNDANCE OF THE DIFFERENT FEEDING GUILDS FOUND AT
SITE 5

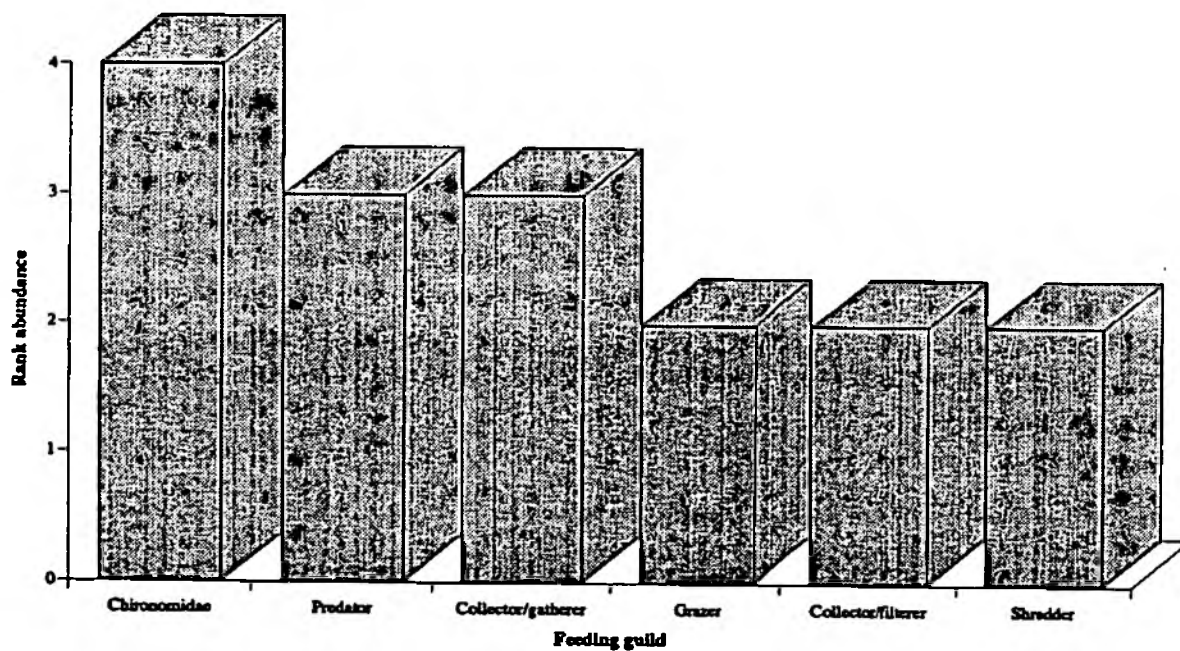


CHART SHOWING THE RANK ABUNDANCE OF THE DIFFERENT FEEDING GUILDS FOUND AT
SITE 6

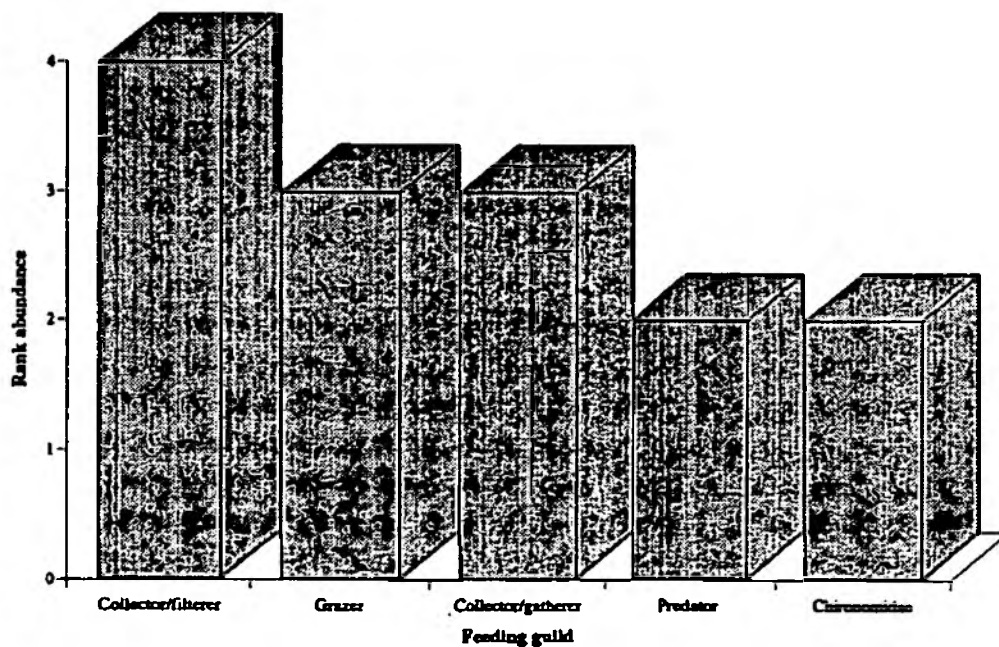


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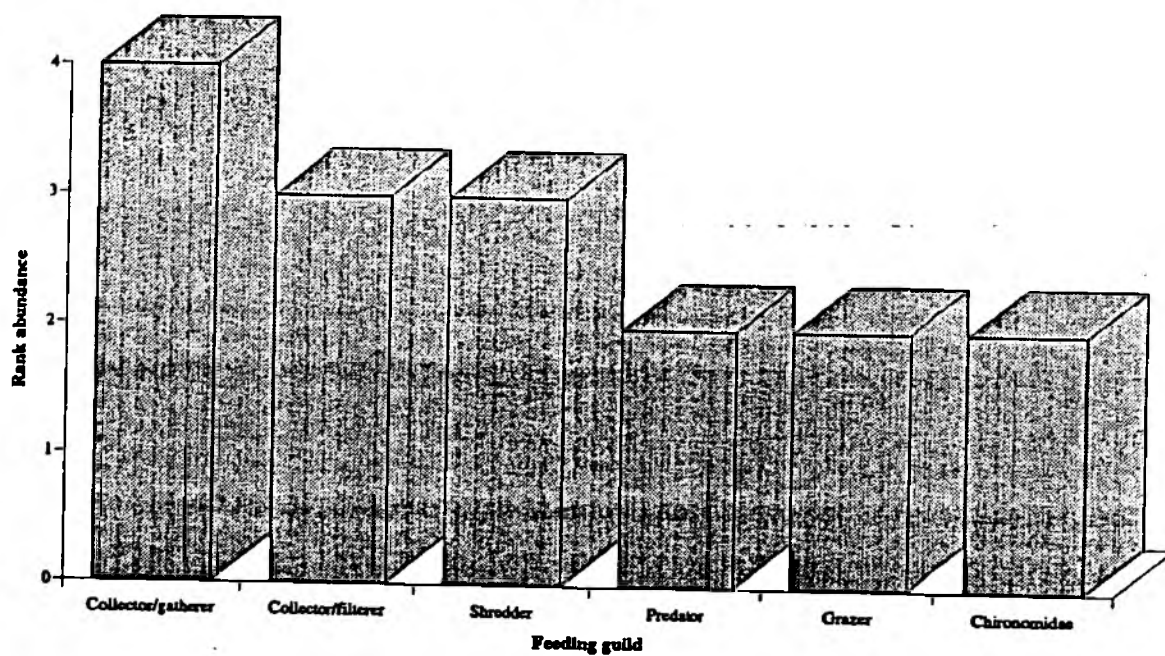


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SITE 8

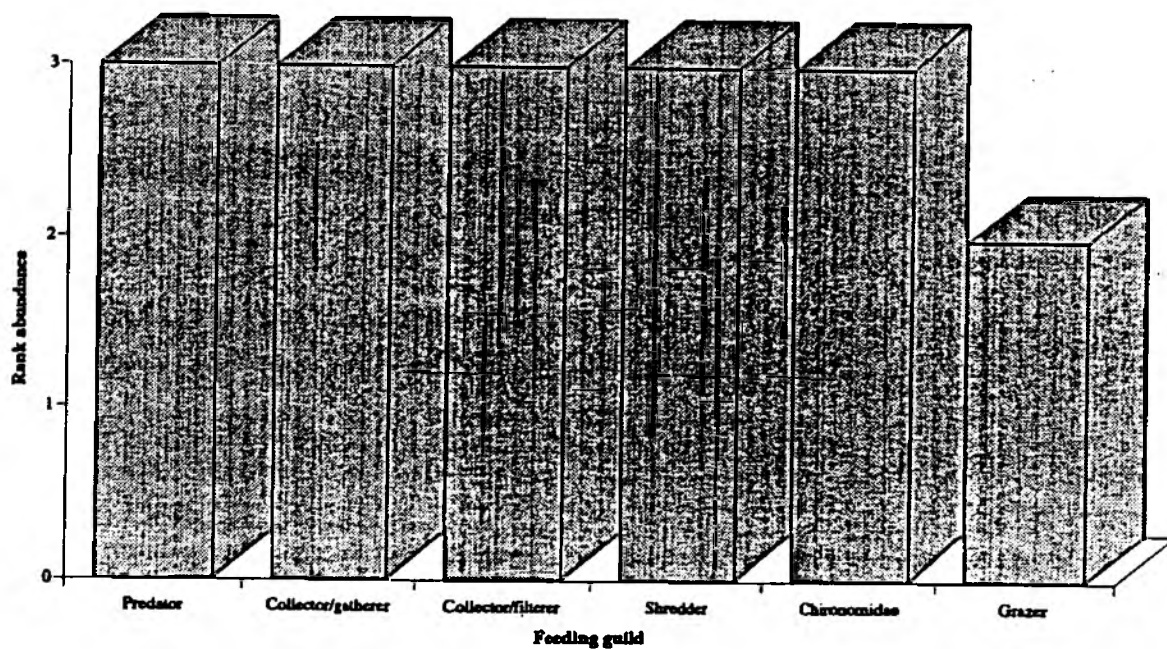


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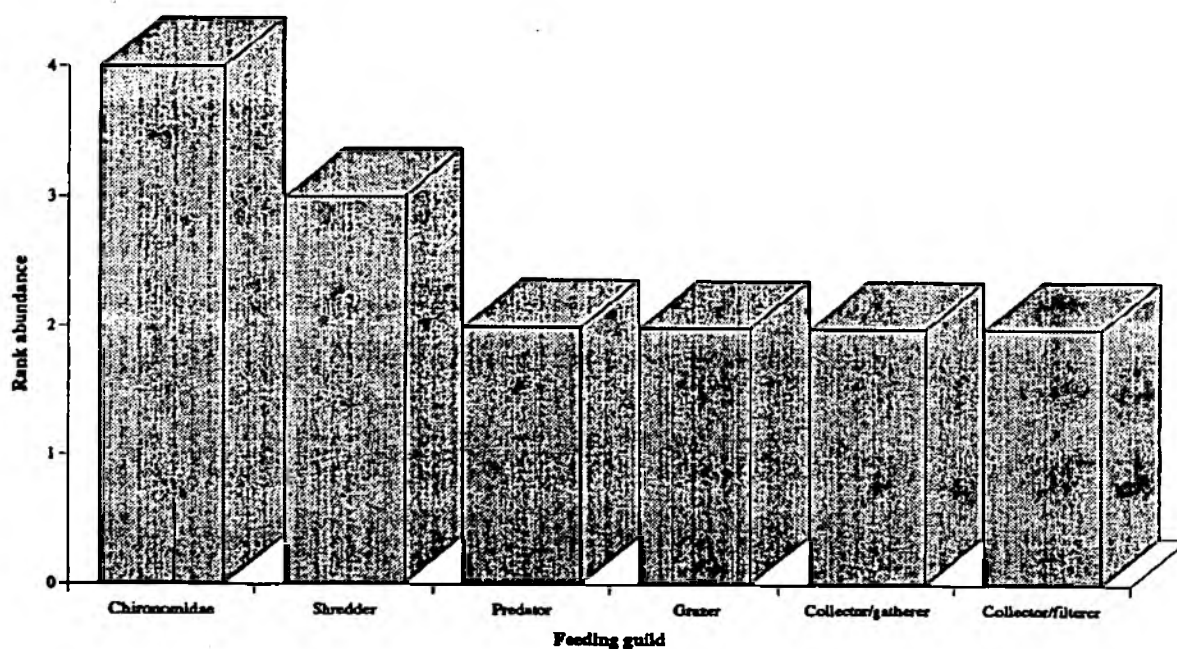


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SITE 10

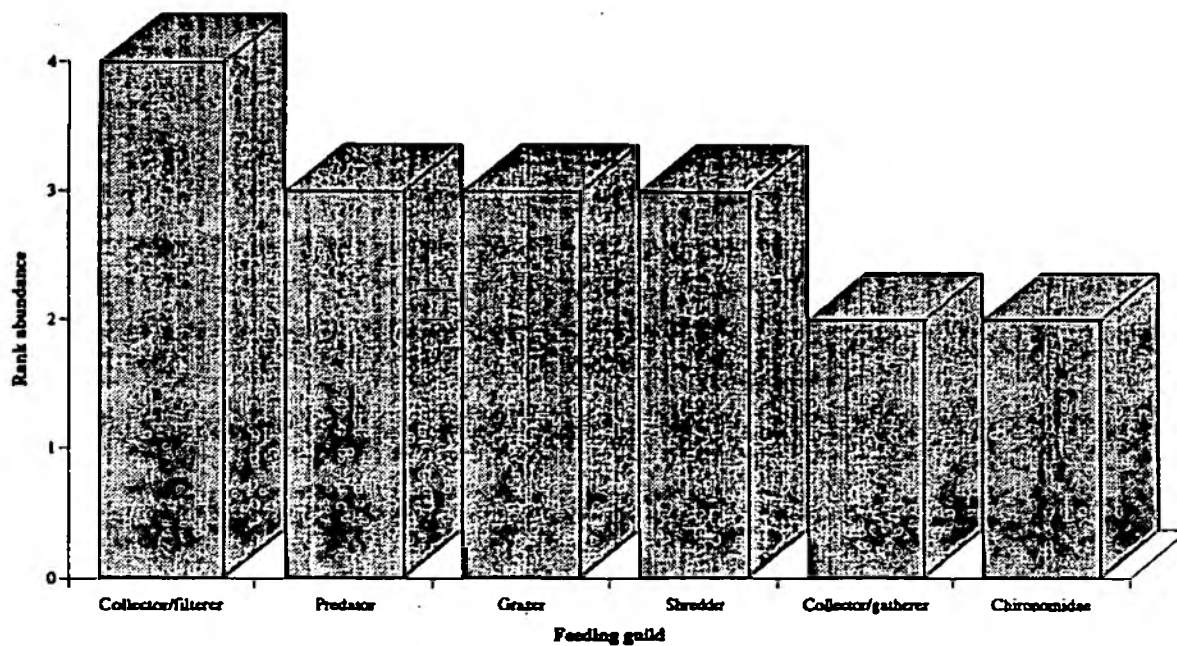


CHART SHOWING THE RANK ABUNDANCE OF THE DIFFERENT FEEDING GUILDS FOUND AT
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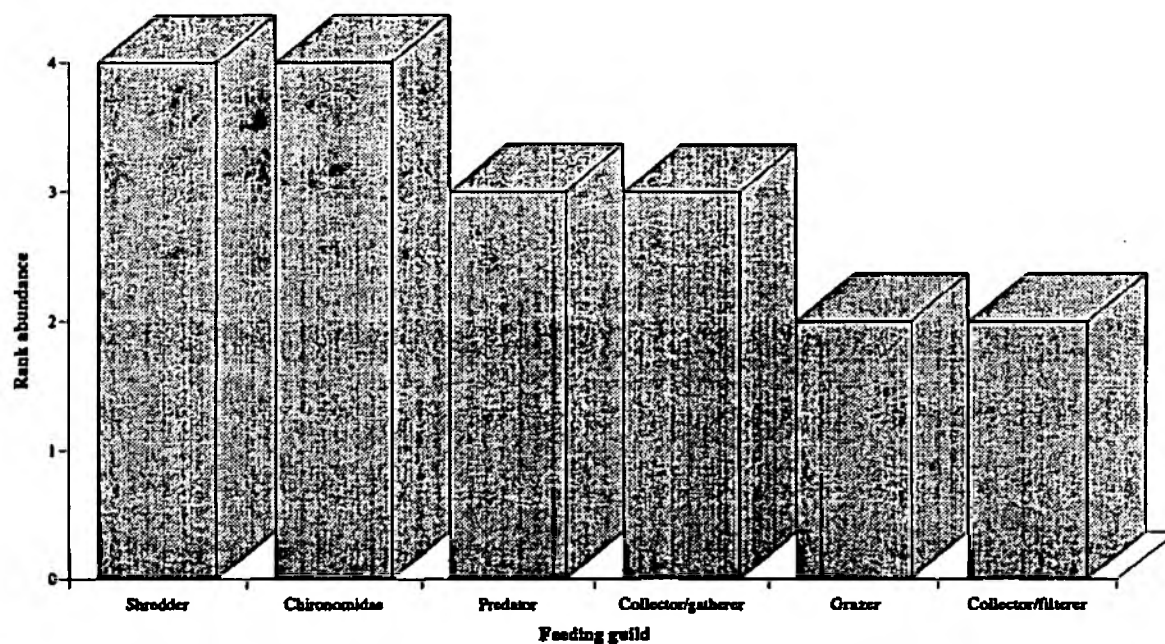


CHART SHOWING THE RANK ABUNDANCE OF THE DIFFERENT FEEDING GUILDS FOUND AT
SITE 12

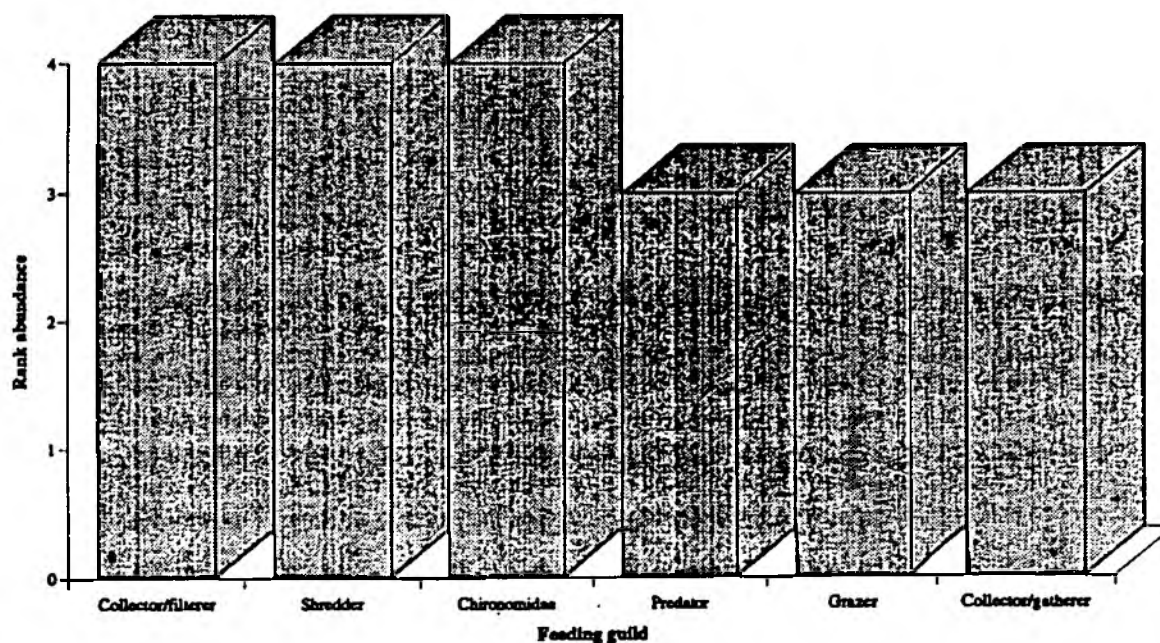


CHART SHOWING THE RANK ABUNDANCE OF THE DIFFERENT FEEDING GUILDS FOUND AT
SITE 13

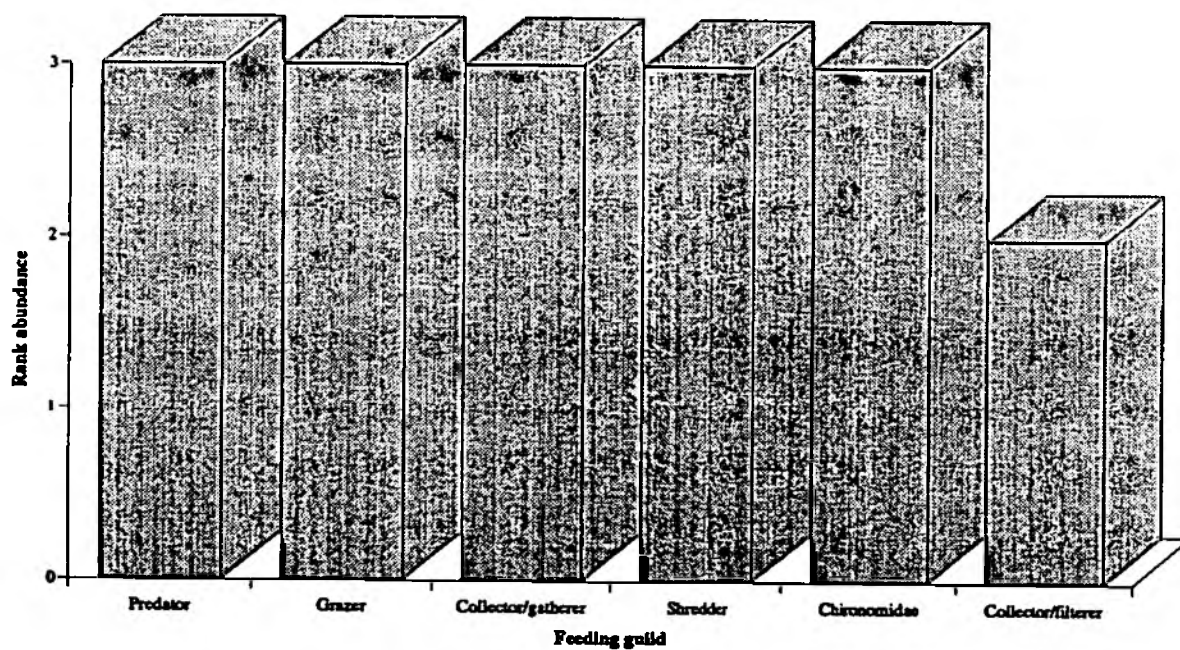


CHART SHOWING THE RANK ABUNDANCE OF THE DIFFERENT FEEDING GUILDS FOUND AT
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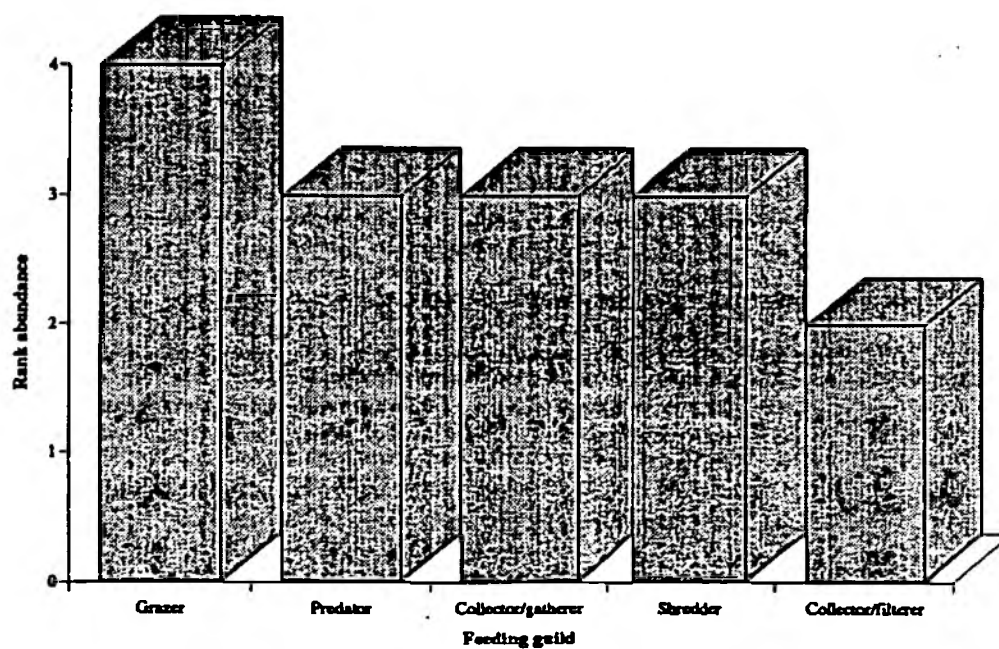


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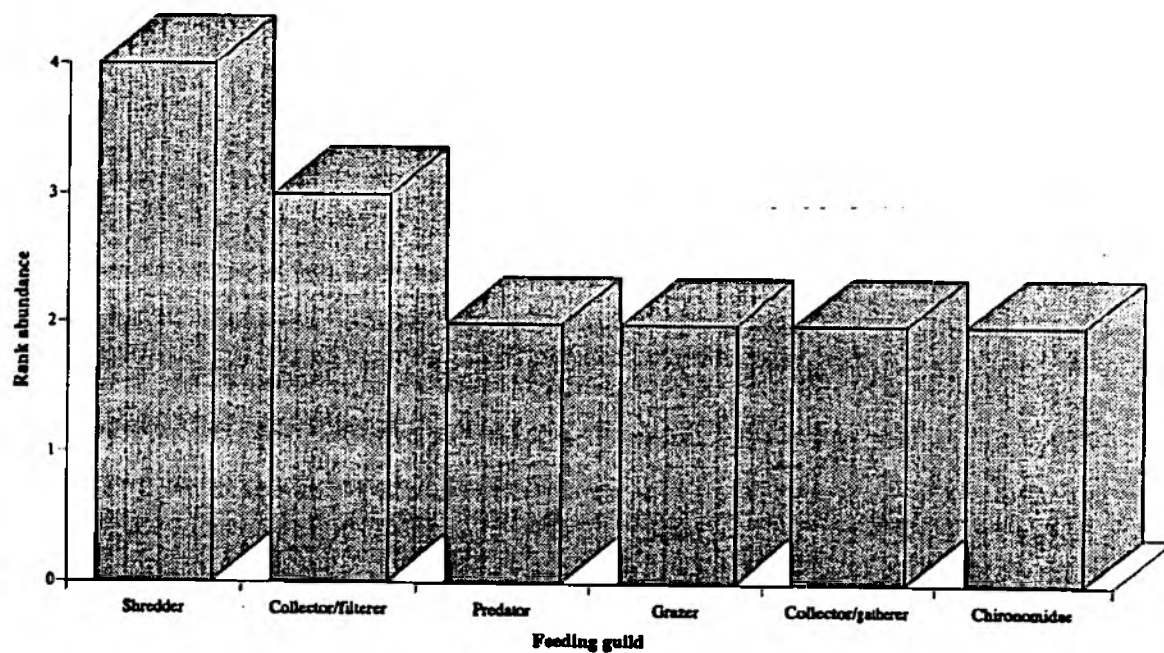


CHART SHOWING THE RANK ABUNDANCE OF THE DIFFERENT FEEDING GUILDS FOUND AT
SITE 16

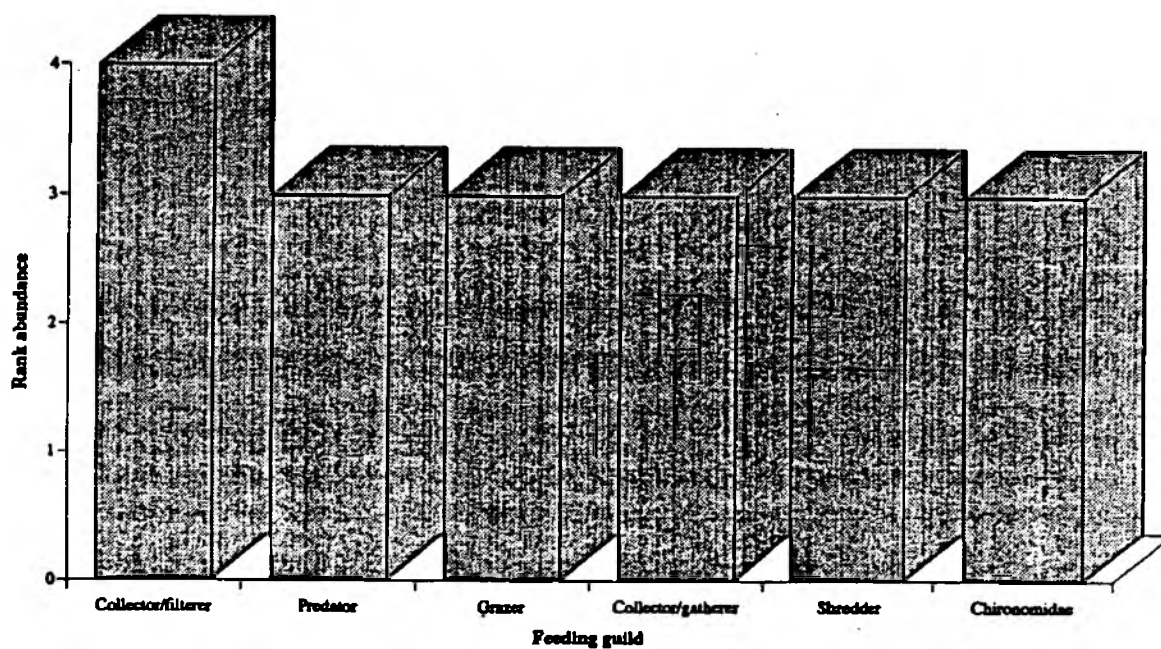


CHART SHOWING THE RANK ABUNDANCE OF THE DIFFERENT FEEDING GUILDS FOUND AT SITE 17

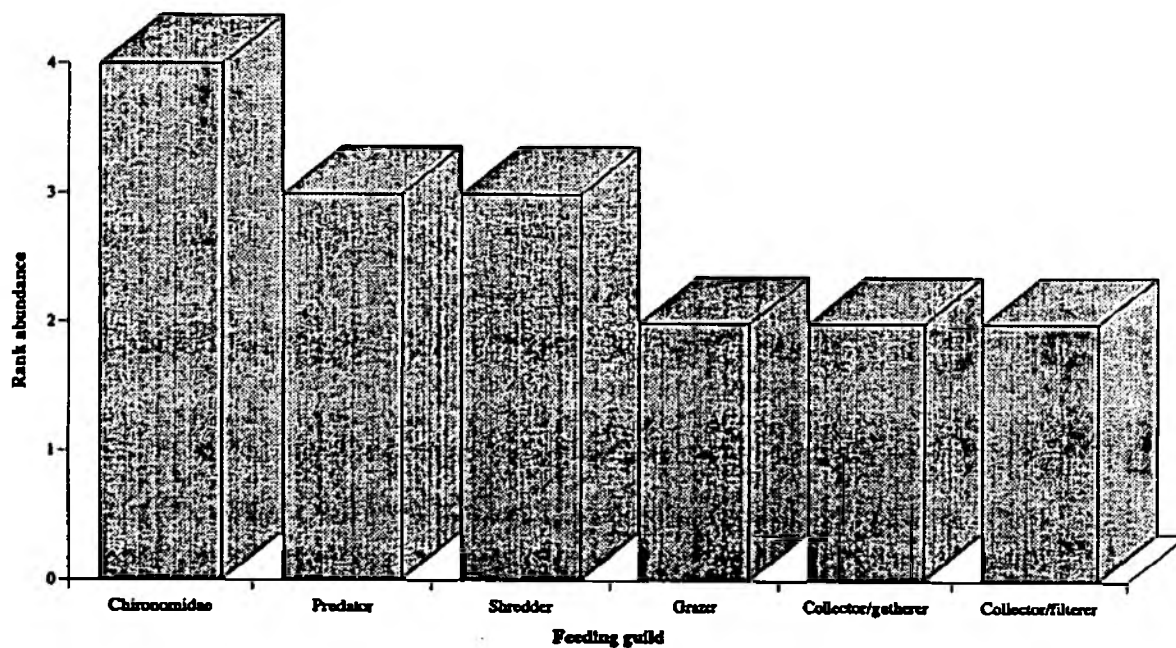


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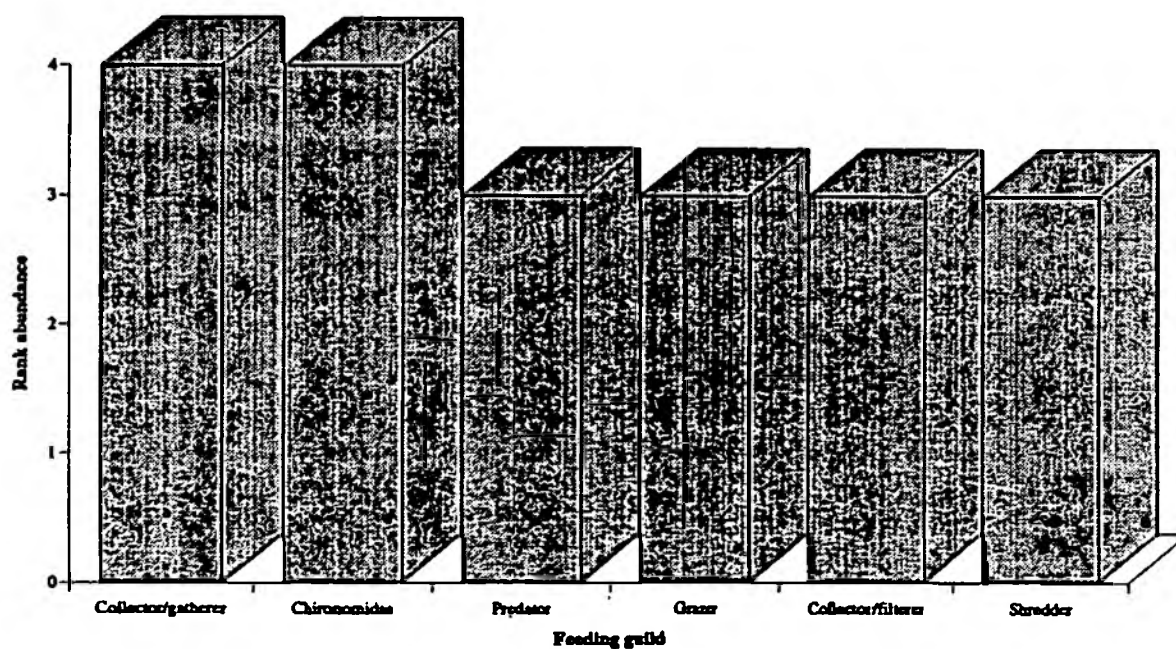


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SITE 19

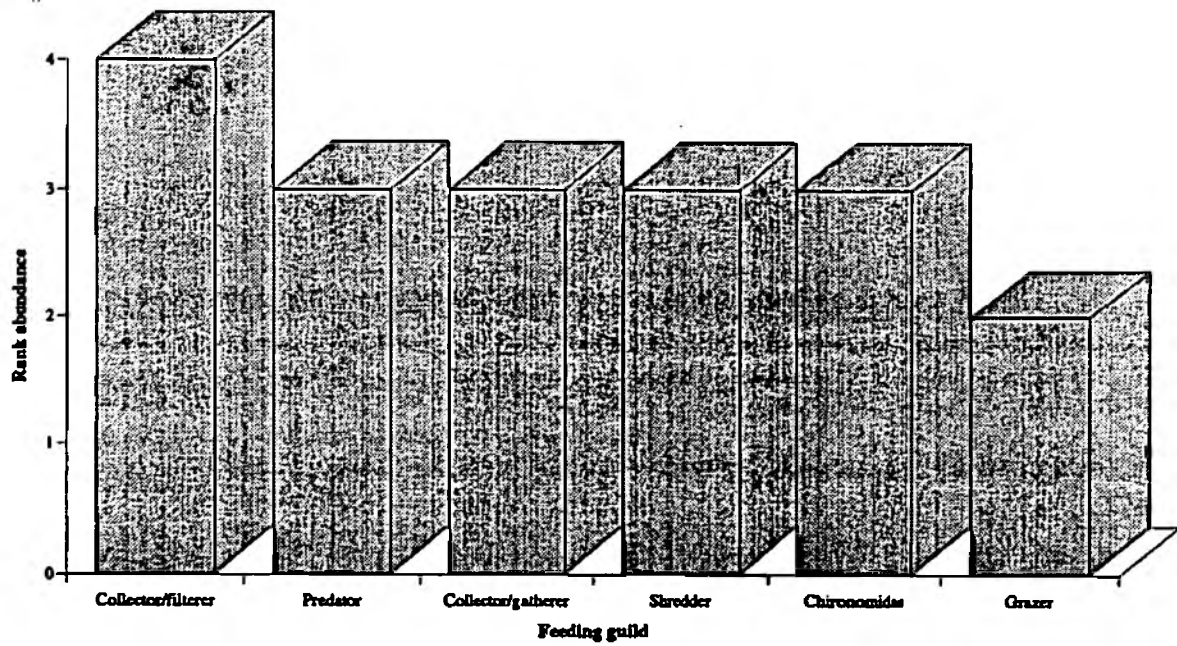


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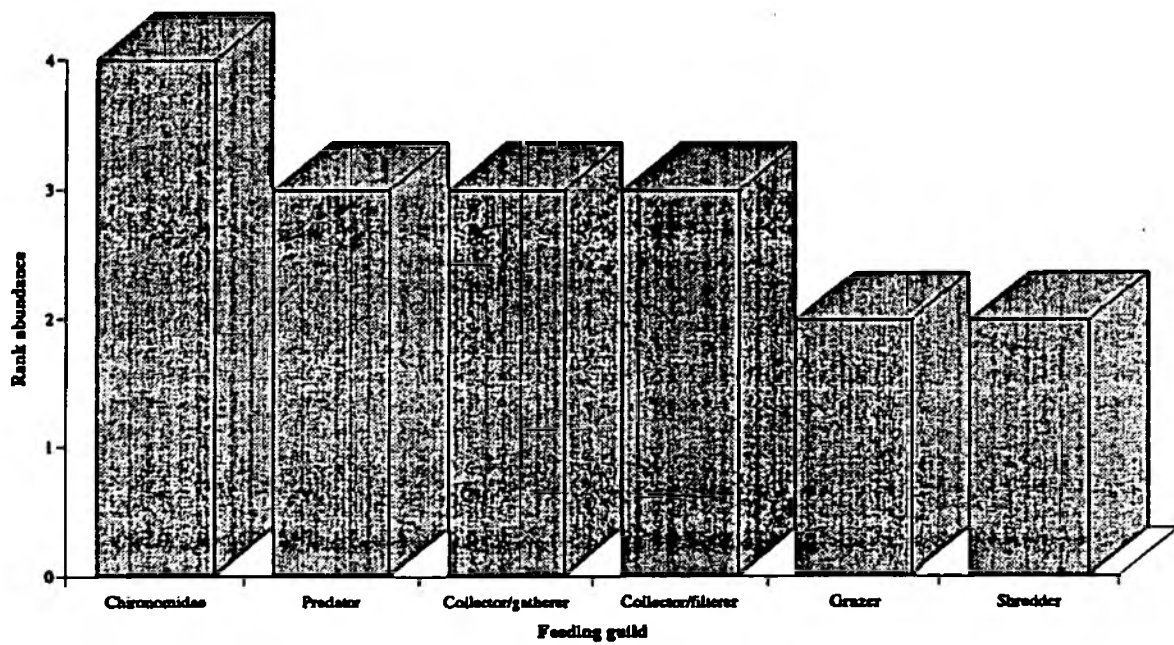


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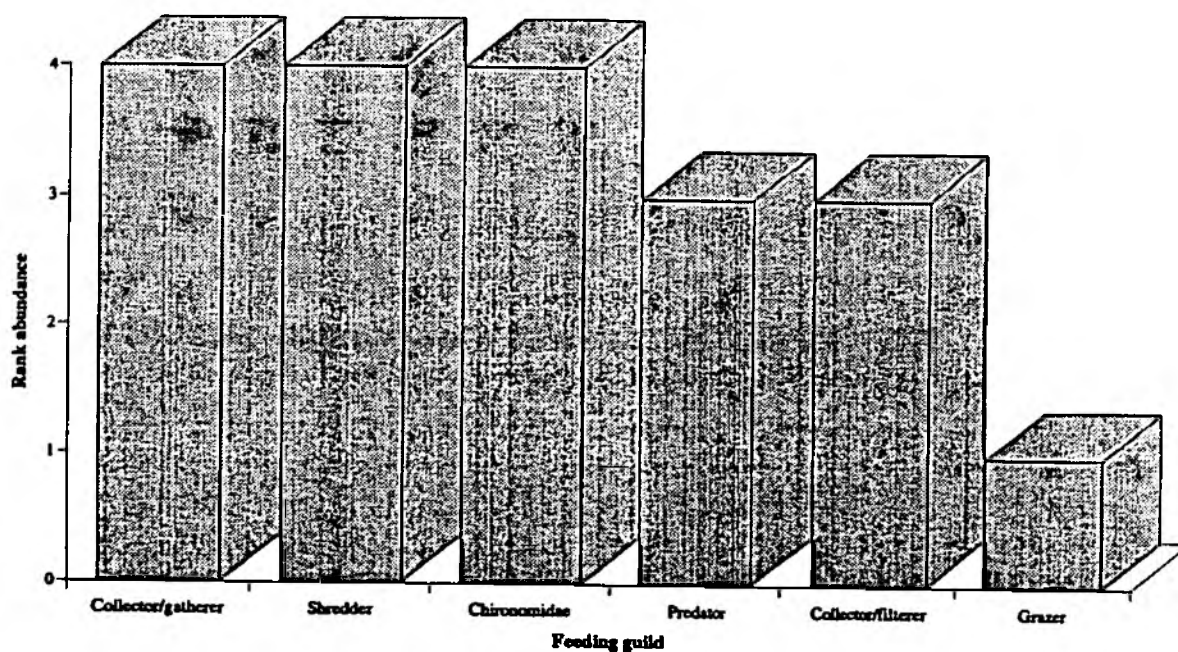


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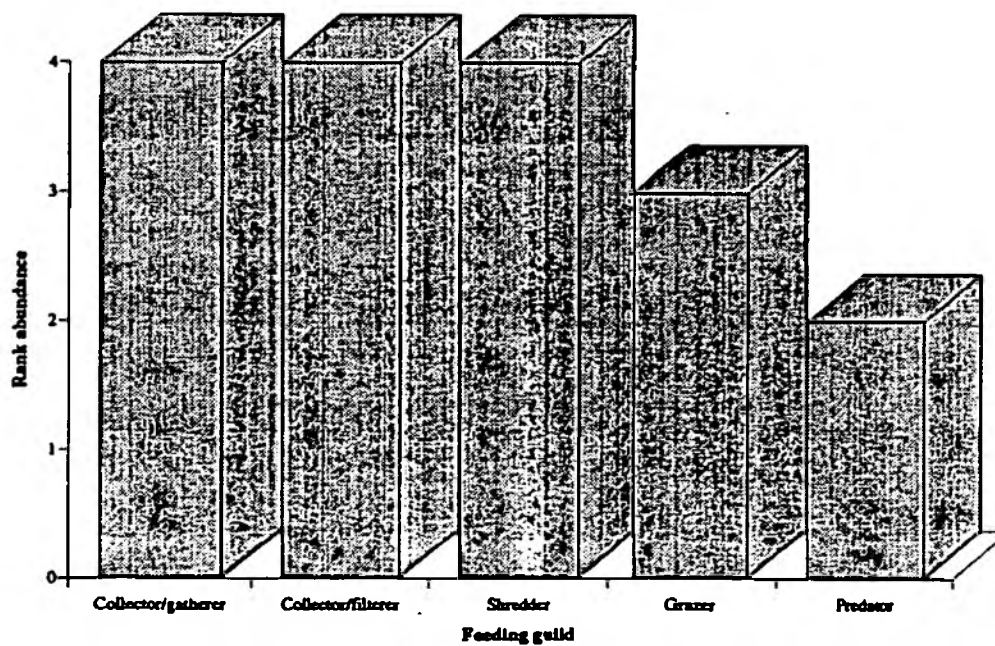


CHART SHOWING THE RANK ABUNDANCE OF THE DIFFERENT FEEDING GUILDS FOUND AT
SITE 25

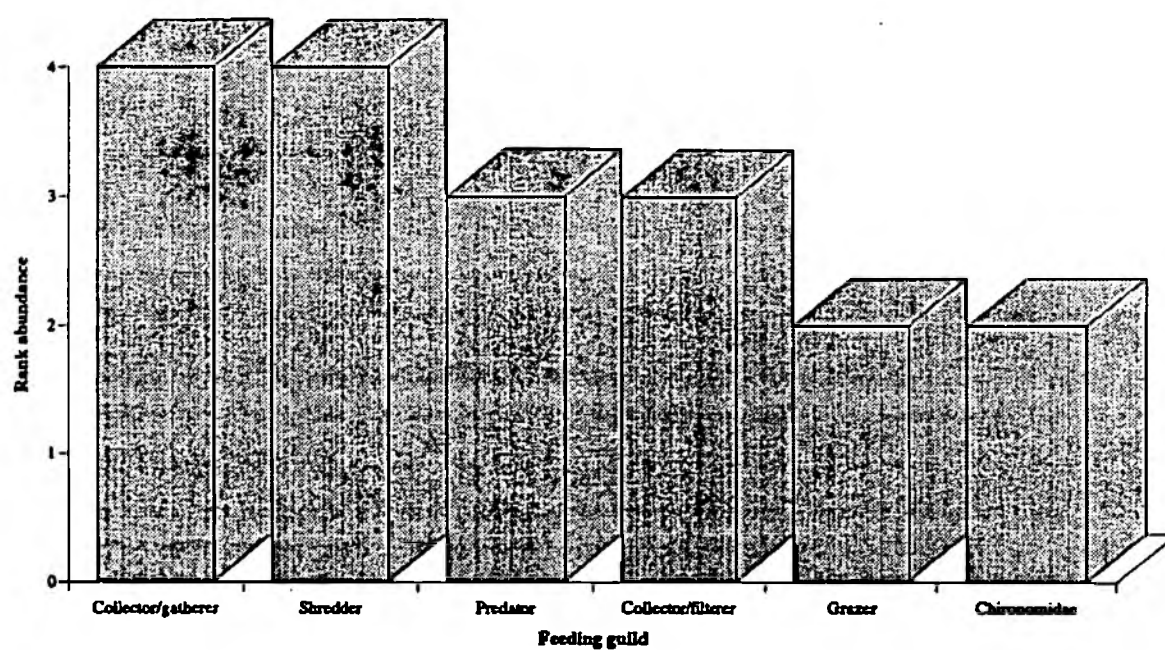


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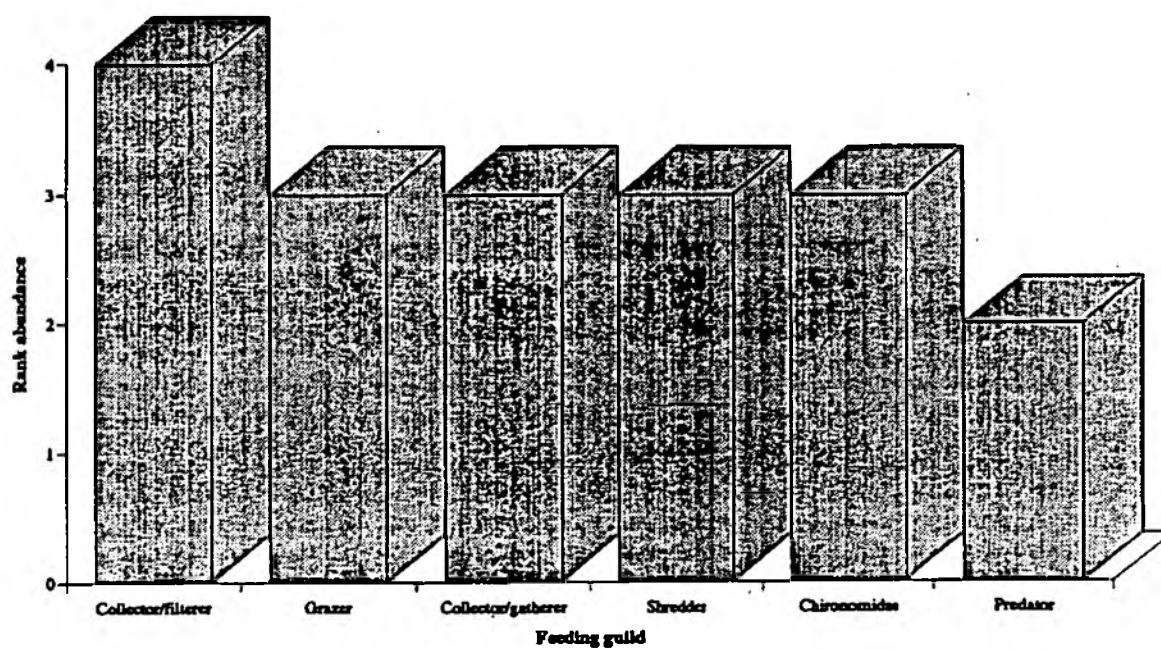


CHART SHOWING THE RANK ABUNDANCE OF THE DIFFERENT FEEDING GUILDS FOUND AT
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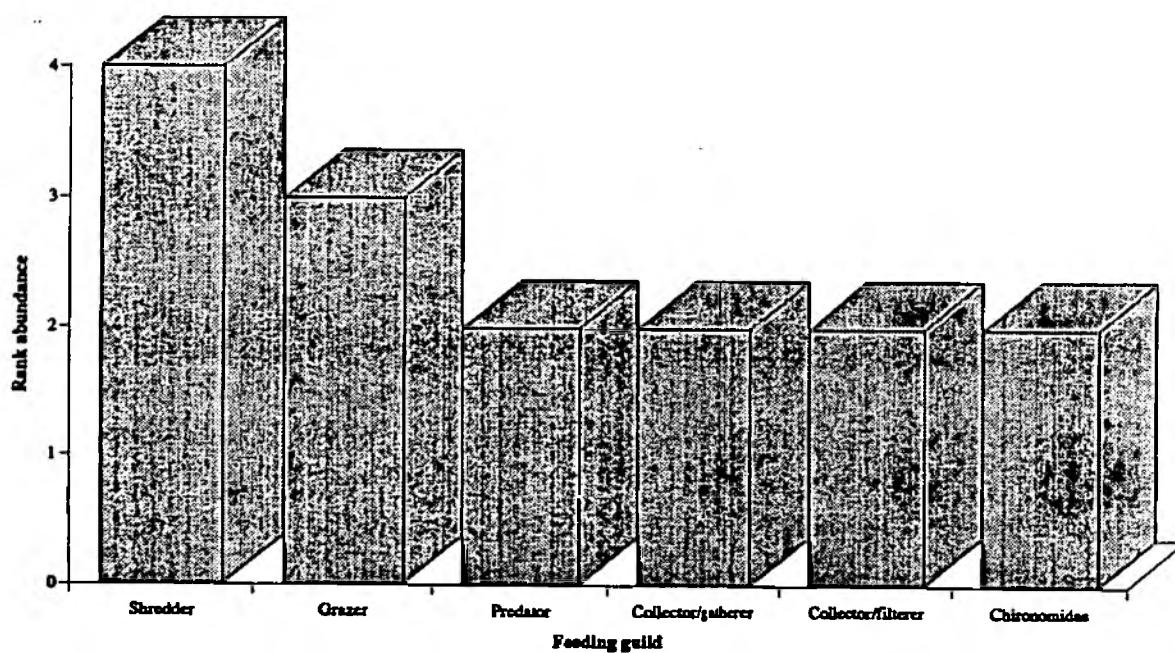


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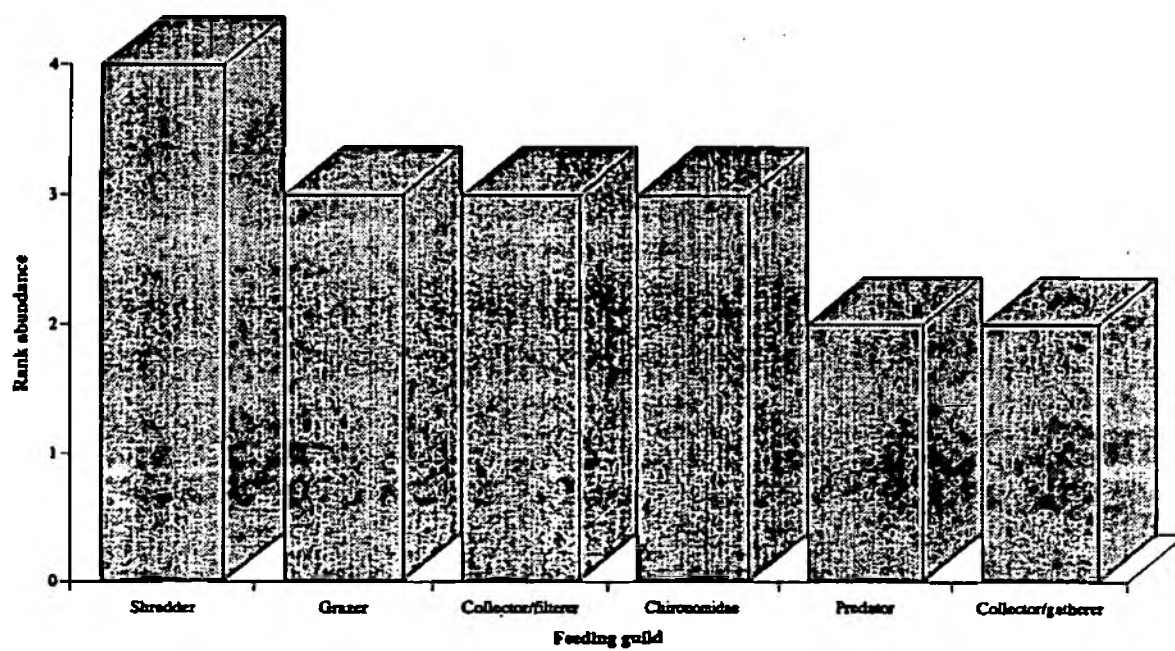


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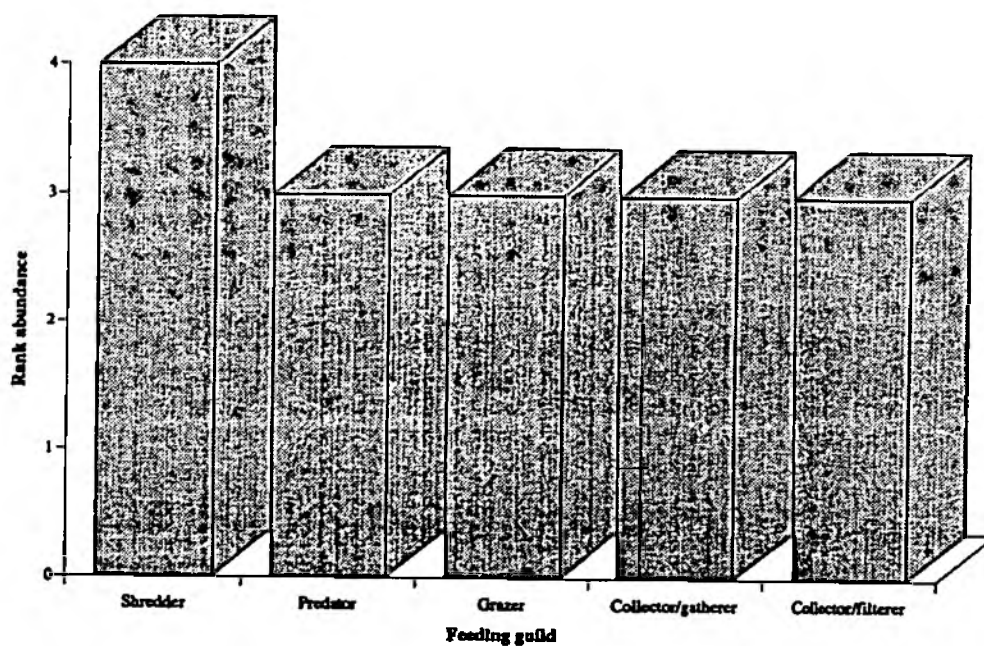


CHART SHOWING THE RANK ABUNDANCE OF THE DIFFERENT FEEDING GUILDS FOUND AT
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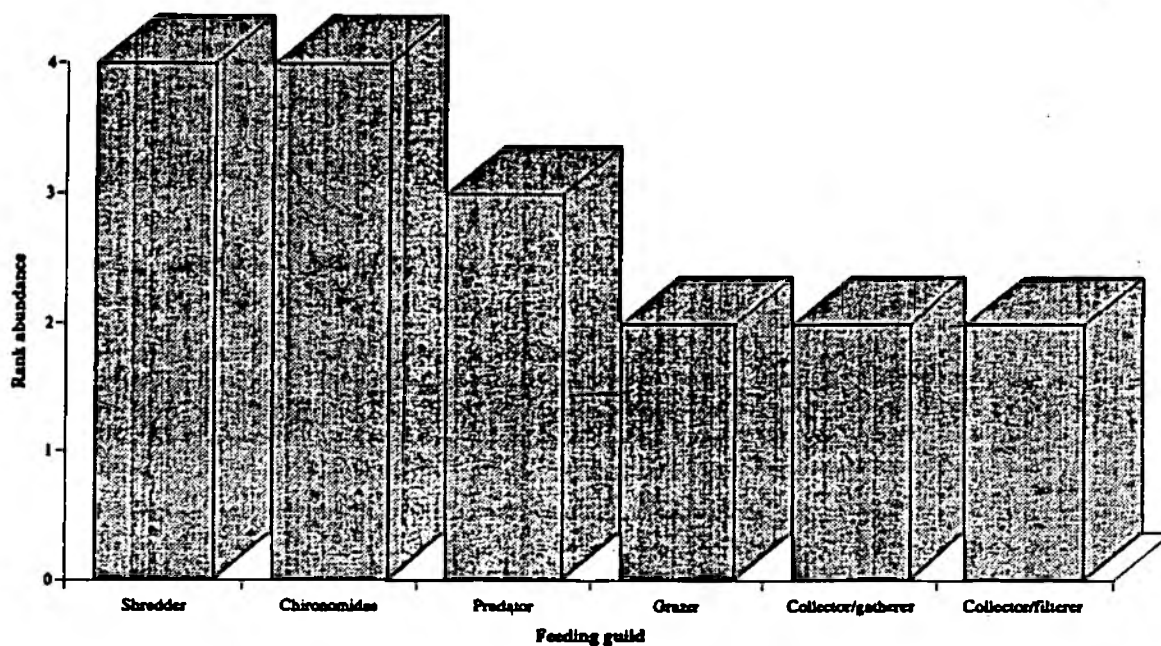


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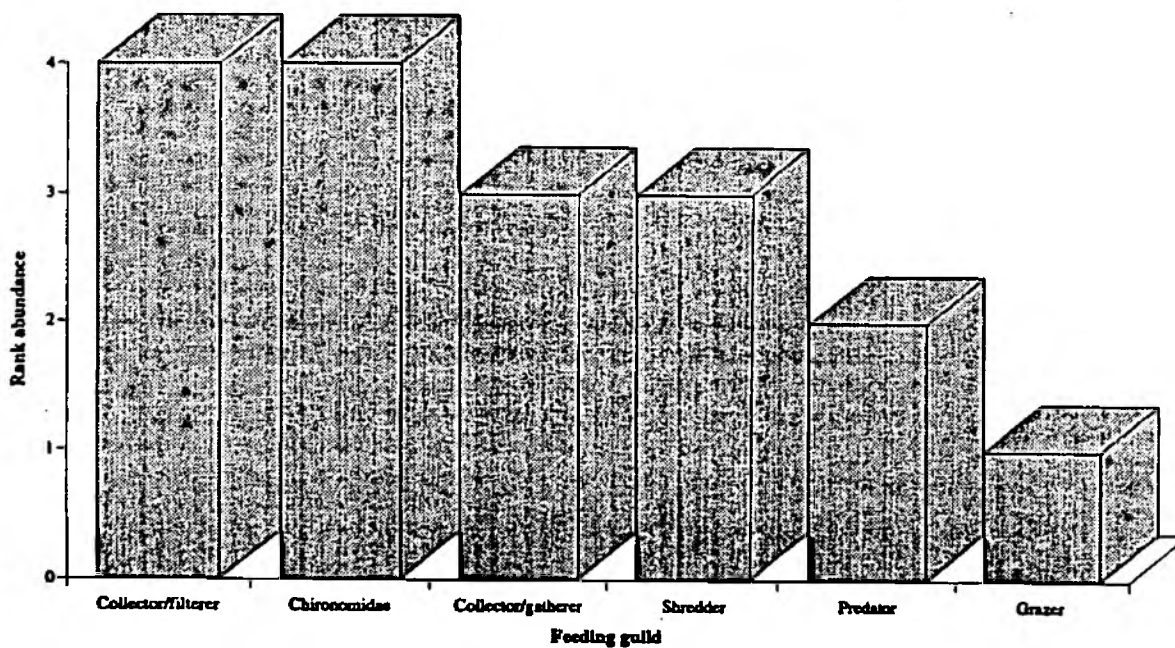


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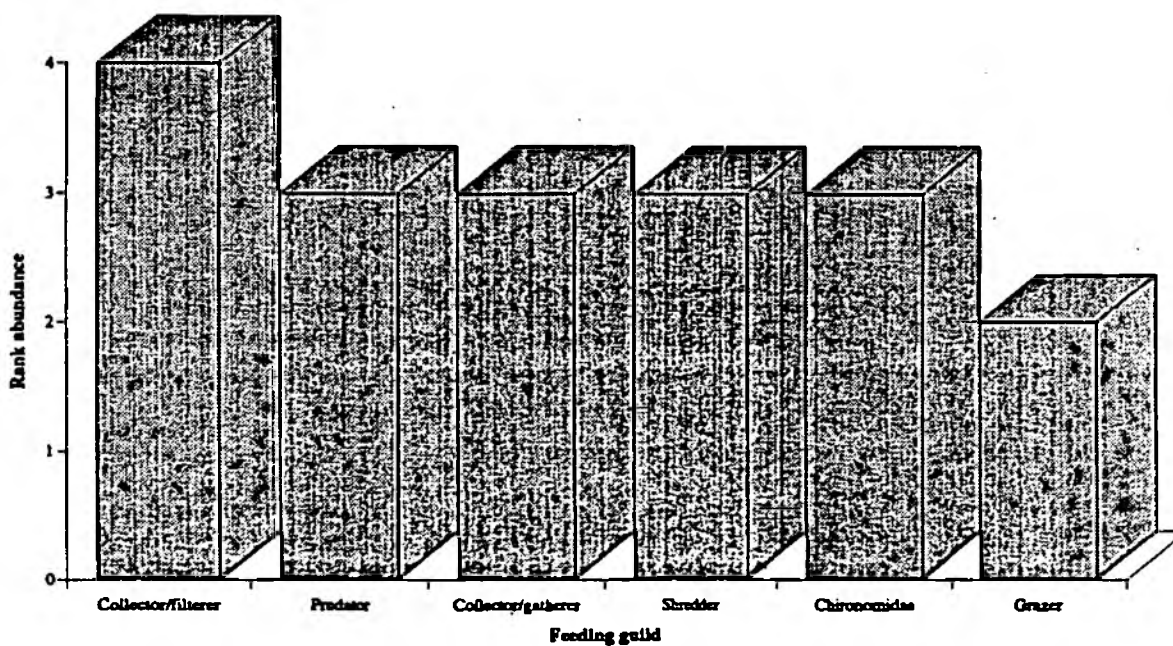


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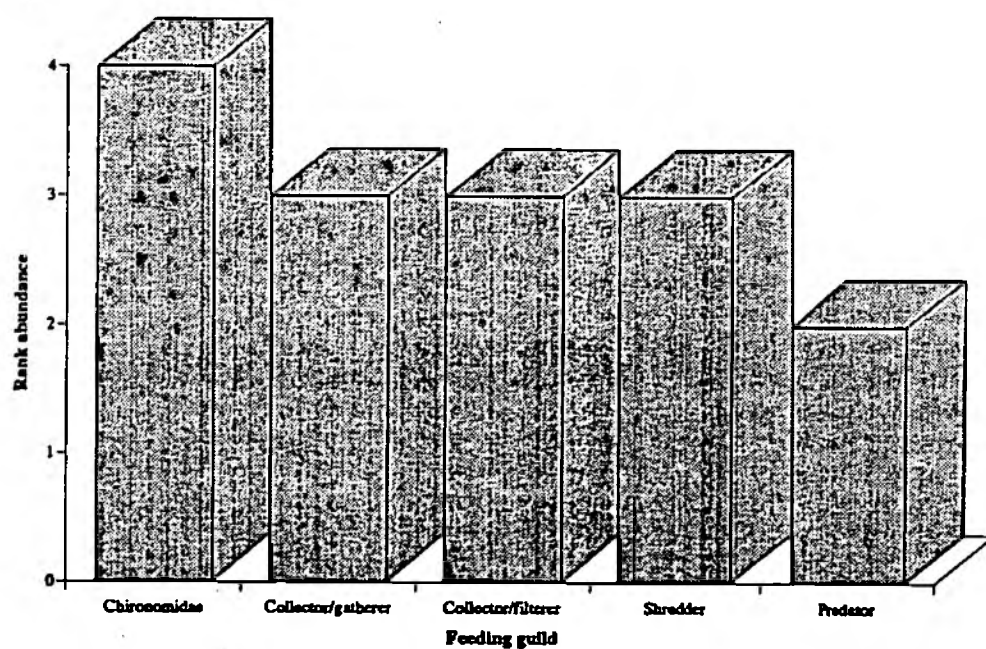


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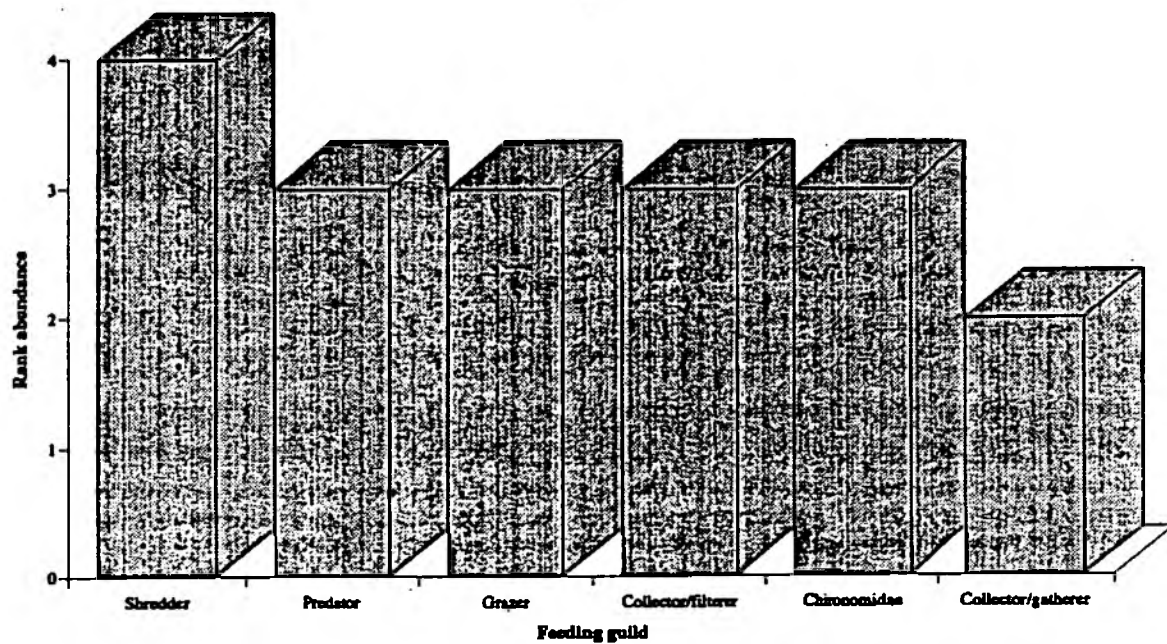


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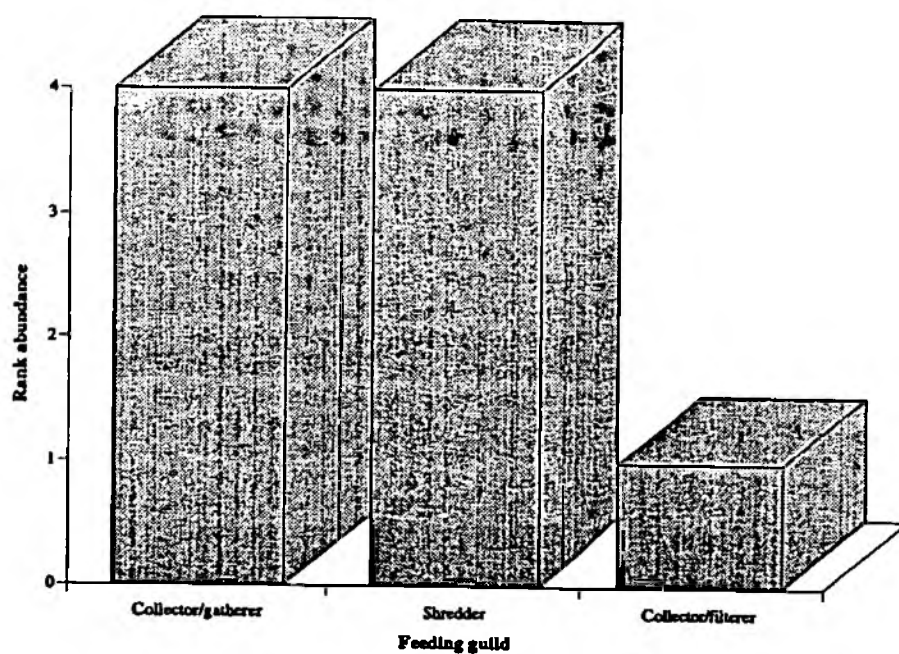


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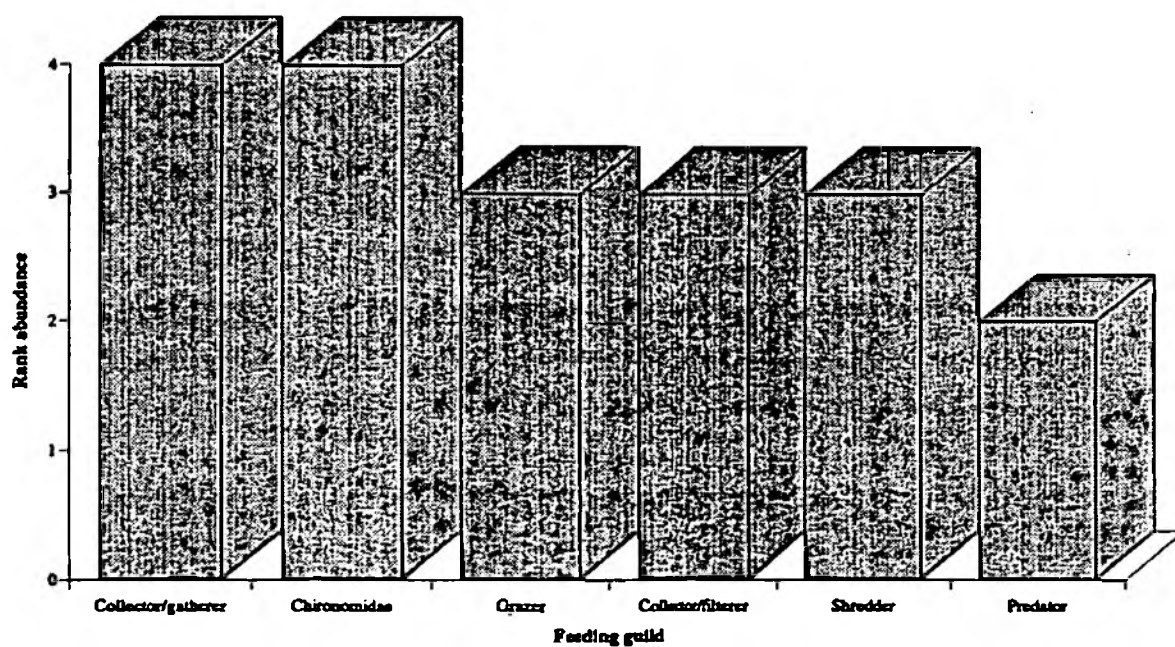


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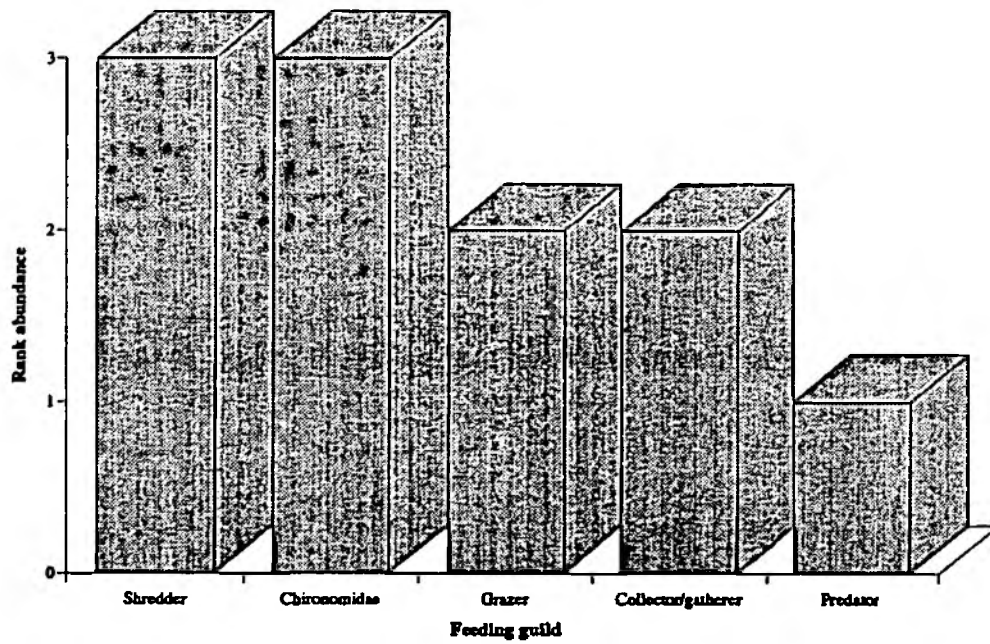


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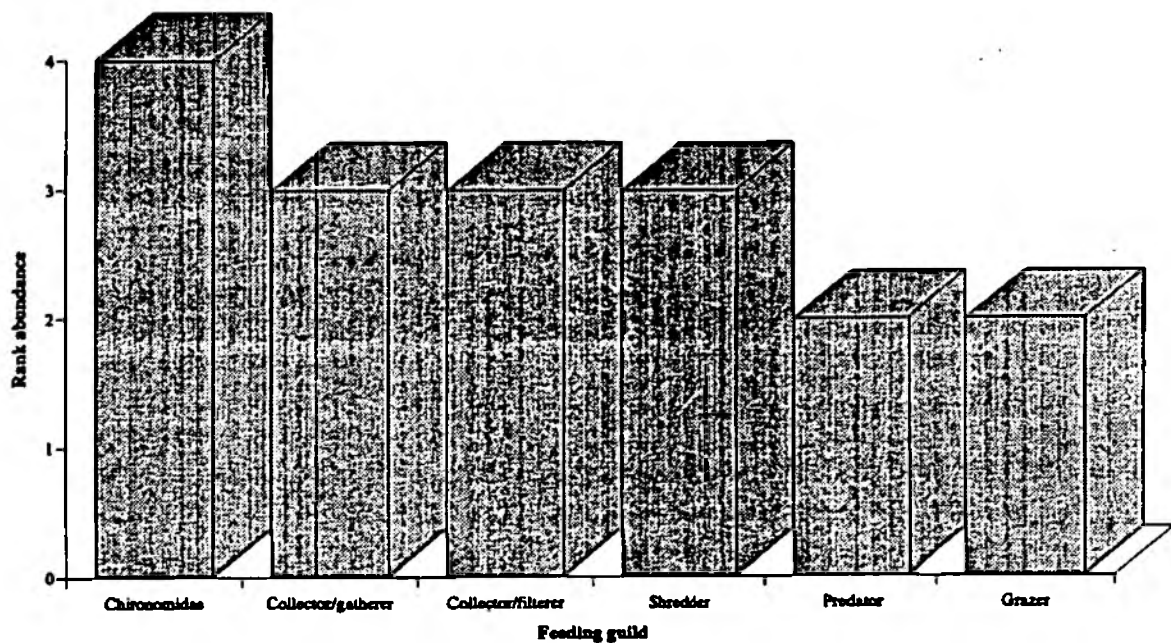


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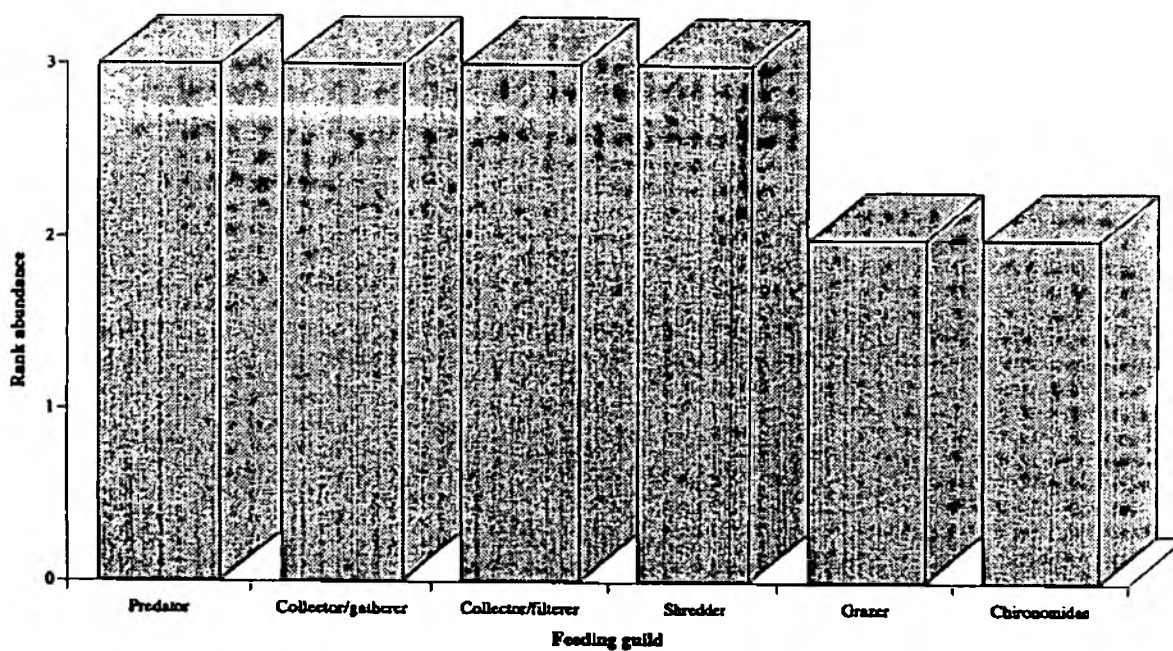


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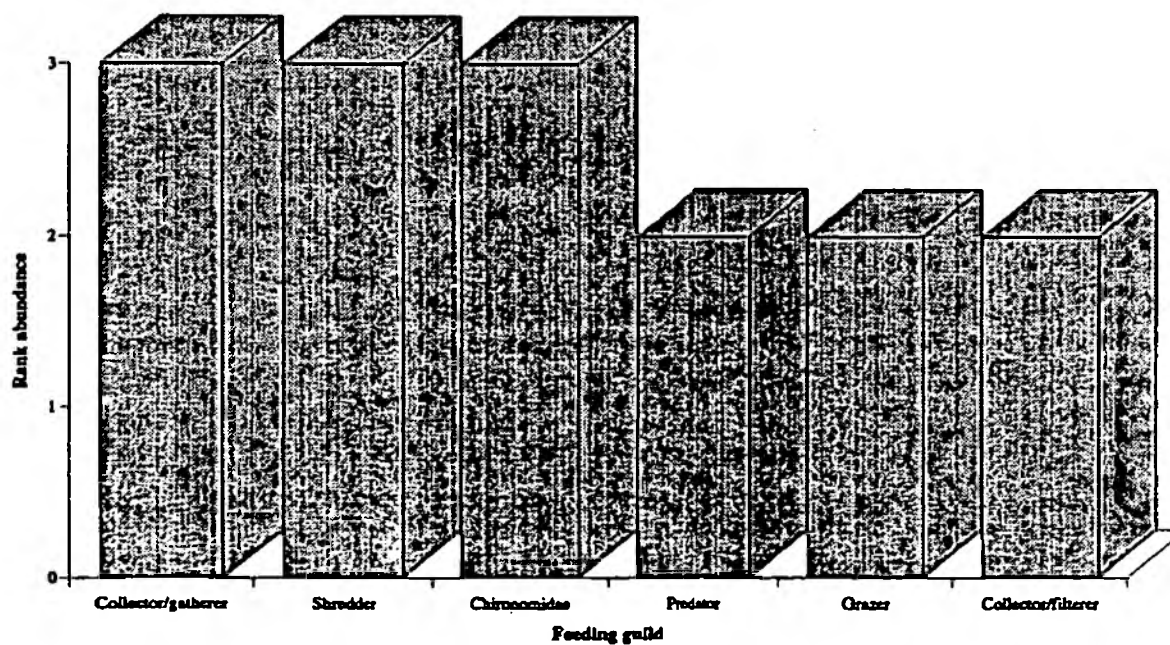


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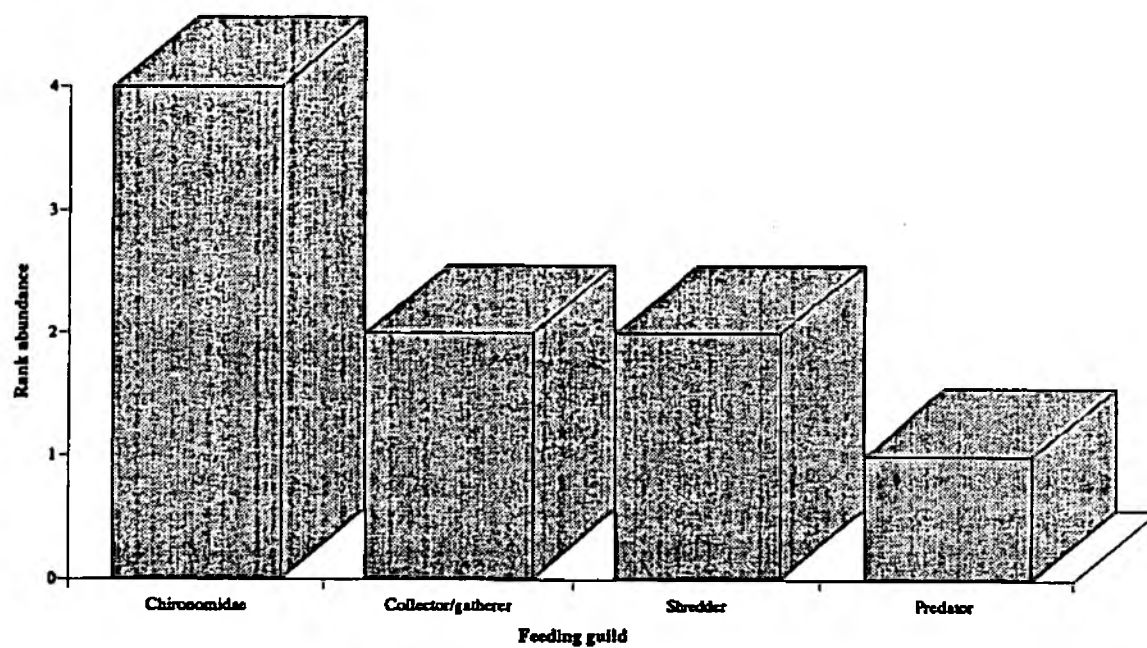


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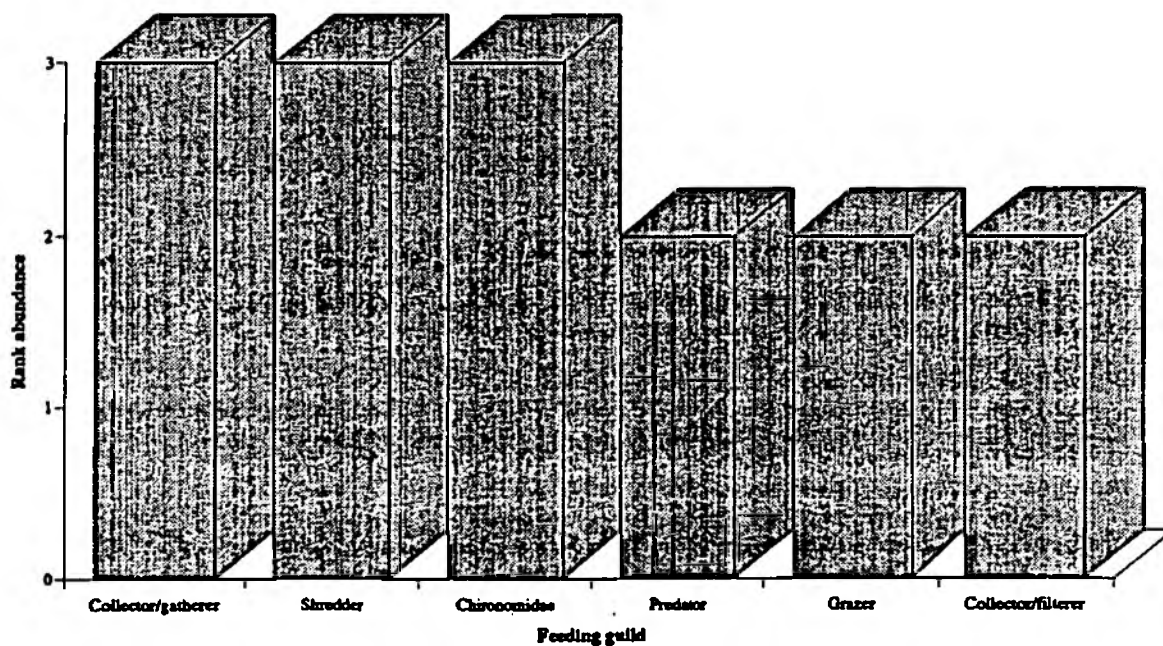


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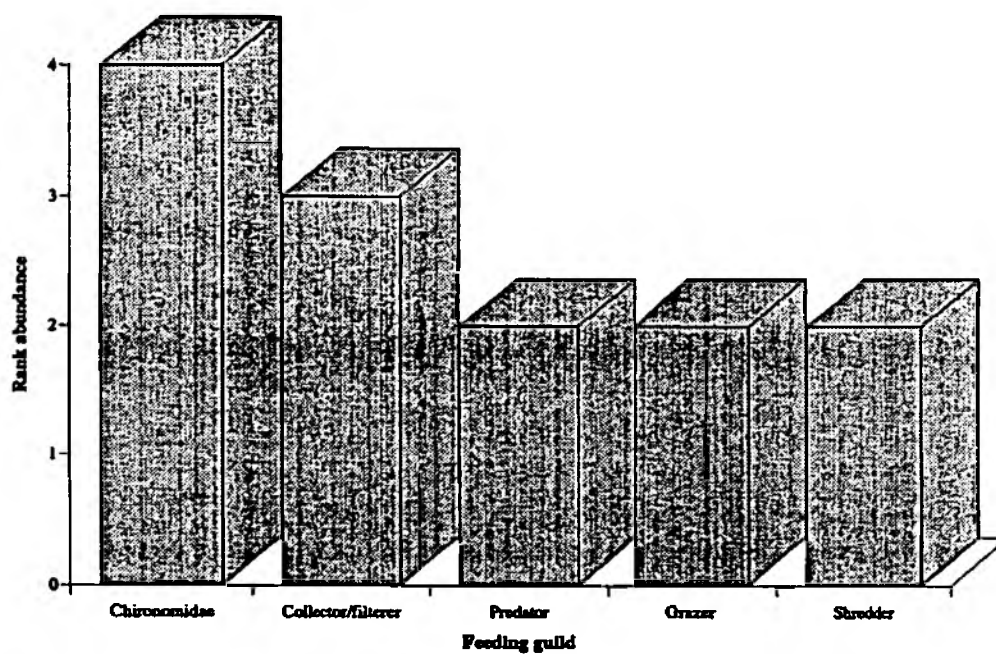


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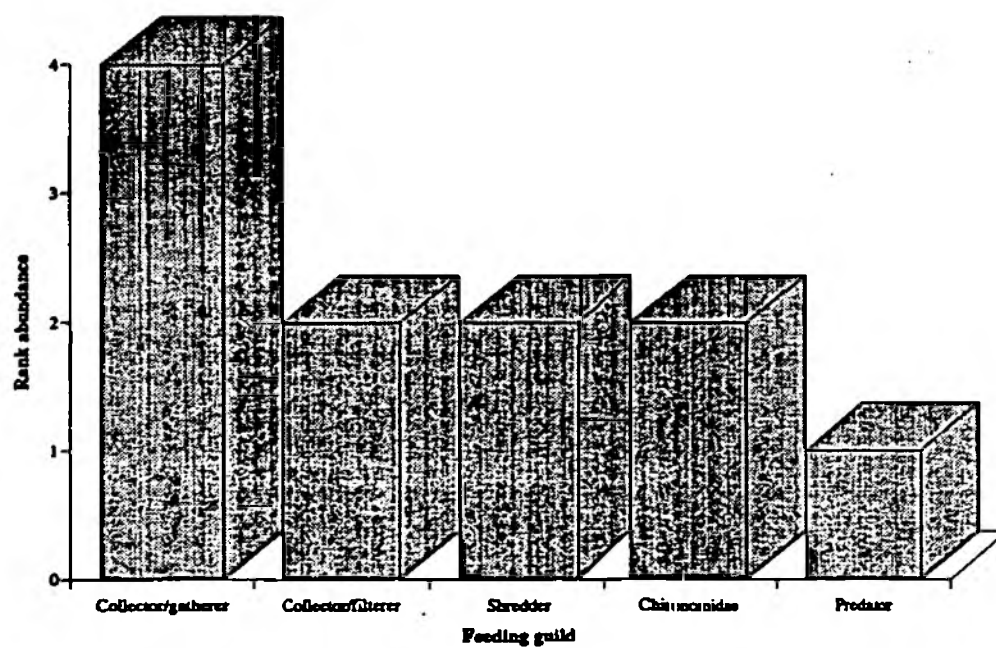
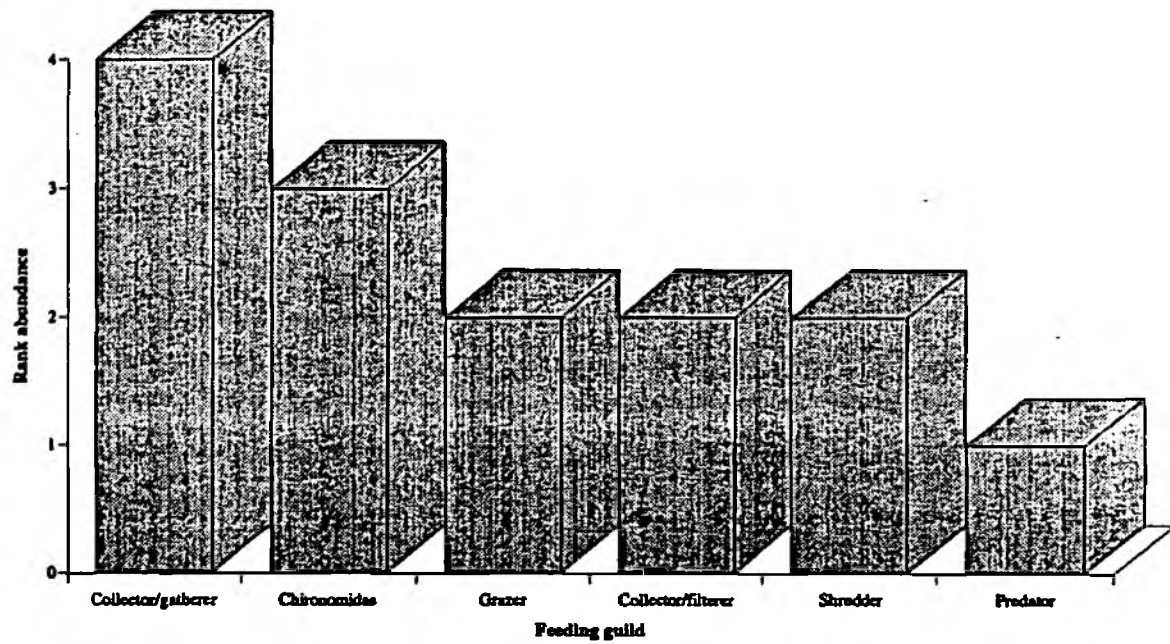


CHART SHOWING THE RANK ABUNDANCE OF THE DIFFERENT FEEDING GUILDS FOUND AT
SITE 45



3. DISCUSSION AND RECOMMENDATIONS

The results described here, coming as they do from just a single set of samples, cannot readily be compared with other rivers, since published work almost always is based upon repeat samplings which build up taxonomic richness with each additional sample occasion. Recent intensive investigations of the lower rivers Welland and Wissey (Anglian O.I. A13-38) yielded 98 comparable taxa from the former and 89 from the latter; these were from a single site and sample occasion (in summer) but over 50 samples from all habitats. The Nar could be considered to be at least as rich as these larger rivers, probably more so in view of the time of year and standard nature of the sample collection. not ?

Much of the taxonomic richness appears to be habitat-based, superimposed upon a water quality which is rich (calcareous and productive) but not polluted (hence the abundance of Malacostraca and Chironomidae). The habitats of greatest value are the lotic habitats of the lower reaches, where a rich fauna of macrophyte-associated species (eg. grazing Mollusca and Ephemeroptera, predatory Odonata) occurs. Lentic habitats of riffles and upstream reaches (filter-feeders such as Hydropsychidae, shredders such as Limnephilidae) are well represented on the lower tributary; these two lower stretches combined provide almost all the taxonomic richness of the river and would make the ideal focus for any conservation efforts.

If firm decisions concerning river or catchment management are to be made from this study, it ought to be repeated in the summer period; both to confirm the preliminary trends and to obtain as full as possible a species list from the most productive time of the year. Ideally, samples should be processed at one greater stage of detail - an estimation of abundance rather than a log-type ranking, because that allows more accurate rank comparison of samples and estimation of proportions of feeding guild abundance. For any conservation purposes, a few specimens of the rarer species should be sought for particular identification rather than just collected by chance in hand-netting; these results give an indication of the location of suitable sites (eg for Odonata).

A further important step in the analysis of these data would be to evaluate them in conjunction with chemical water quality data and river corridor survey data. These would enable clearer explanations of the distribution patterns to be advanced: the authors would be pleased to do this in the final report if those data can be extracted and forwarded.

Conservation objectives on the river Nar should be to enhance the habitat value of the lower reaches in the following ways:

- 1) by maintaining a physical diversity of macrophytes (try to ensure that neither channel nor marginal macrophytes are all cut together in summer; leave one side or patches uncut)
- 2) by creating a physical vegetation diversity in the riparian zone for emerging and egg-laying insects, by allowing the development in patches of overhanging riparian trees
- 3) by maintaining depth and current speed variations wherever possible to create a mosaic of substrate and three-dimensional habitat.

MANAGEMENT AND CONTACTS:

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