Research Report 3

A Limnological Survey of the Alligator Rivers Region

I. Diatoms (Bacillariophyceae) of the Region

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Supervising Scientist for
the Alligator Rivers Region

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RESEARCH REPORT 3

A LIMNOLOGICAL SURVEY OF THE ALLIGATOR RIVERS REGION, NORTHERN TERRITORY

PART I. DIATOMS (BACILLARIOPHYCEAE) OF THE REGION

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This Research Report is one of eight in a series which reports the results of a detailed limnological survey of the billabongs of the Alligator Rivers Region, undertaken for the Supervising Scientist by members of the Botany Department, University of Tasmania.

The series is entitled:

A LIMNOLOGICAL SURVEY OF THE MAGELA CREEK SYSTEM, ALLIGATOR RIVERS REGION, NORTHERN TERRITORY

and includes the following reports:

Diatoms (Bacillariophyceae) of the Region	**D.P. Thomas**
Thermal stratification and the distribution of dissolved oxygen in the billabongs	T.D. Walker, J. Waterhouse & P.A. Tyler
The underwater light climate of the billabongs	T.D. Walker, J.T.O. Kirk* & P.A. Tyler
Chemical characteristics and nutrient status in the billabongs	T.D. Walker & P.A. Tyler
Phytoplankton populations in the billabongs	J.A. Kessell† & P.A. Tyler
Algae of the Region (excluding diatoms)	H.U. Ling & P.A. Tyler
Primary productivity of phytoplankton of the Region	T.D. Walker & P.A. Tyler
Review of the limnology of the Region	T.D. Walker & P.A. Tyler

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A Technical Memorandum by J.A. Kessell of the University of Western Australia, entitled "Some effects of heavy metal and nutrient additions on freshwater algae of the Alligator Rivers Region", which also reports results from the survey, is being issued separately.

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Thomas, D.P. (1983). A limnological survey of the, Alligator Rivers Region, Northern Territory. Part I. Diatoms (Bacillariophyceae) of the Region. Supervising Scientist for the Alligator Rivers Region, Res. Rep. 3.

This study was undertaken as part of a study of the algae of the Alligator Rivers Region in general, and of the Magela Creek in particular, to support an investigation into the possible use of native algae as an indicator of any changes in water quality which might occur as a result of uranium mining and milling in the Region. This report deals only with the diatoms (Bacillariophyceae) found in the Alligator Rivers Region, though that flora is compared with the diatom flora of samples from other parts of tropical Australia to give some degree of regional perspective. The diatom flora so far observed numbers more than 160 taxa from 32 genera and contains representatives of both tropical and cosmopolitan distributions. Only two taxa are apparently new to science, though many more have been seen, though rarely, beyond the location in which they were originally collected.

A full account of the sampling and specimen preparation methodology is included, together with a key to the genera for those wishing to use this report for more than comparative iconography.

Finally, remarks on the distribution of taxa and the complexity of the flora in relation to a monitoring program are given.

1 INTRODUCTION

1.1 Diatoms as Monitoring Organisms

Associations of diatoms have been used to determine water conditions since the latter part of the nineteenth century (Patrick 1977). With their high rates of vegetative reproduction, diatoms in particular, and algae in general, have proved to be useful test organisms for various forms of aquatic pollution and variations in water quality. Such tests have revolved around either in situ studies, often based upon the use of artificial substrates, or in vitro bioassays. The wealth of background information (e.g. Lowe 1975) led some workers to propose systems based upon indicator species or changes in relative abundance of certain species to denote the degree of pollution of a body of water (e.g. Cholnoky 1958b; Fjerdingstad 1960; Foged 1954; Kolkwitz and Marsson 1908; Nygaard 1949).

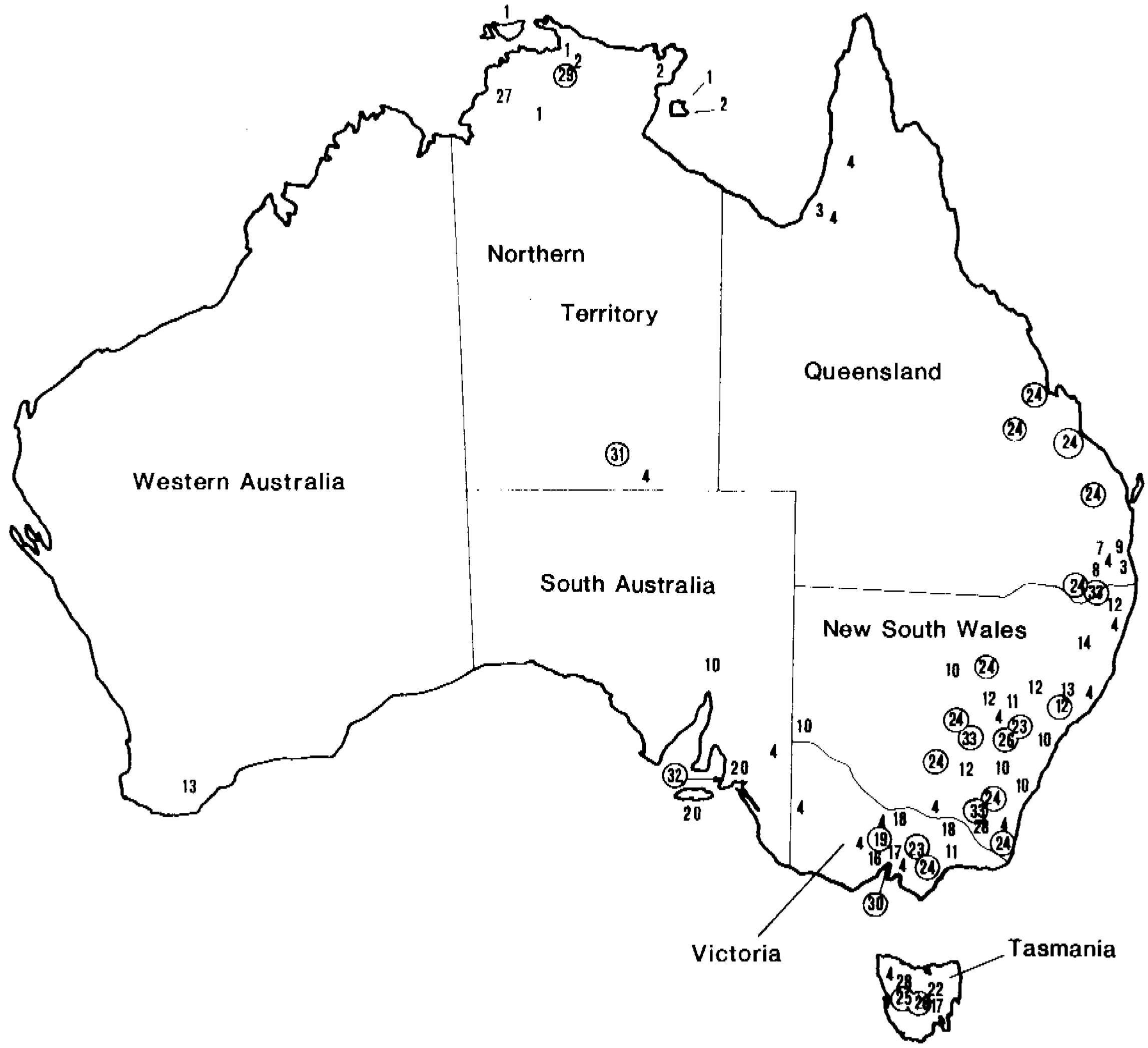
While to some extent complementing each other, the two basic approaches reflect differing philosophies and in general provide different types of information. Typically the in situ study seeks to use variations in community parameters derived mainly from diversity concepts along the lines of Margalef (1967), Patrick (e.g. Patrick 1949, 1973, 1976a,b, 1977; Patrick et al. 1954; Patrick and Strawbridge 1963) or Cairns (Cairns 1974; Cairns et al. 1968; Cairns et al. 1972) to monitor changes in the ambient environment. These field-orientated studies have had their widest acceptance in North America (e.g. Besch et al. 1972; Christensen and Archibald 1976; Collins and Weber 1978; Cooper and Wilhm 1975; Egloff and Brakel 1973; Hohn 1959; King and Ball 1964; Schmidt and Christensen 1975; Stoermer 1978; Weber and Corliss 1978), but are also commonly used in some European countries (e.g. Lange-Bertalot 1978; Tippett 1970; Van Dam 1974) and in South Africa (e.g. Archibald 1972; Schoeman 1976).

Bioassays, on the other hand, have tended to be based on one or a few test organisms of 'known' tolerances to determine the variations in water quality.

Finally, there is an alternative form of bioassay where field collections are subjected to various levels of known pollutants or variations in water quality to investigate the likely effects of such conditions should they occur in the natural environment (e.g. Kilham and Kilham 1978; Weber 1973).

While not attempting a critique of these various strategies, what needs to be noted here is that most of these methods rely heavily upon a basic knowledge of the organisms to be investigated, their taxonomic position and as much as possible about their environmental requirements. Although 42 of the taxa presented here have been characterised by Lowe (1975), the environmental requirements of some differ from those of their namesakes in the northern hemisphere (see Section 3.2 et seq.) which reduces the usefulness of overseas studies in this respect.

This report is seen as the necessary basis for any attempt to form a viable monitoring program using diatoms and should be used in conjunction with a study of Magela Creek algae (Ling and Tyler (to be published)).



1 Croasdale & Scott (1976)
2 Scott & Prescott (1958)
3 Bailey (1893, 1895, 1898)
4 Borge (1896, 1911)
5 Krieger (1937, 1939)
6 Krieger & Gerloff (1962)
7 McLeod (1975)
8 Möbius (1892, 1894)
9 Schmidle (1896)
10 May (1970, 1972, 1973, 1978)
11 Norstedt (1888)
12 Playfair (1907, 1908, 1910,1912, 1914, 1915a,b, 1916a,b, 1917, 1918, 1919, 1921, 1923)
13 Raciborski (1892)
14 Skinner (1980)
15 Thomasson (1973)
16 Hardy (1905, 1906)
17 Tyler (1970)
18 Viyakornvilas (1974)
19 West (1905, 1909)
20 Prescott & Scott (1952)
21 Harrop (1896)
22 Thomasson & Tyler (1971)
23 Wood et al. (1959)
24 Foged (1978)
25 Hustedt (1955)
26 Wood (1961)
27 Strom (1921)
28 Powling (1970)
29 Brady (1979)
30 De Toni & Forti (1923)
31 Berg (1953)
32 Thomas (1979)
33 Thomas & Gould (1981)

Fig. 1 Australian freshwater algal reports and locations of sampling (Encircled numbers indicate reports that include diatoms)

1.2 Historical Perspective

There have been few diatom investigations in Australia (Foged 1978), and this lack is particularly evident in the few reports on the freshwater flora. Figure 1 provides further illustration that the distribution of collectors and their collections has been heavily biased towards the southeastern portion of Australia. While non-diatomaceous algae have received some attention previously, the environmental studies in the Alligator Rivers Region of the Northern Territory have provided the first opportunity for Australia's tropical diatom flora to be investigated thoroughly since Foged's (1978) brief trip up the east coast of Queensland in 1966. These studies have been carried out both on behalf of the Australian Government (through the Office of the Supervising Scientist for the Alligator Rivers Region) by the author and on behalf of the uranium mining company, Pancontinental Mining Limited, by H.T. Brady under a contract to Macquarie University. Brady's (1979) report to Pancontinental covered some diatoms of a few sites between Darwin and the Alligator Rivers Region as well as sites in the Magela Creek area adjacent to the proposed Jabiluka mine site.

1.3 The Study Area

1.3.1 General topography of the Alligator Rivers Region

The area referred to as the 'Alligator Rivers Region' is confined to the land making up the space from the western catchment of the West Alligator River to the west catchment of the East Alligator River with the addition of the catchment of the Cooper Creek on the east side of the East Alligator River. The Cooper Creek will not be considered here.

The Region is bounded to the south (and to some extent the east) by an extensive sandstone plateau contiguous with the Arnhem plateau, and to the north by the Van Diemen Gulf (Fig. 2).

Fox et al. (1977) sensibly divided the Region into four broad topographic areas, the plateau, lowlands, flood plains and tidal flats. The plateau consists of a sandstone formation which presumably covered most of the Region at some earlier time. However, it has retreated both south and east due to erosion, leaving behind various outliers; the whole plateau is scored with deep gorges and contains impressive waterfalls and permanent waterholes or billabongs. The lowlands are formed of the basement rock (containing major uranium orebodies) which once underlay the plateau and which is now largely covered by the erosional products of the plateau, mostly sandy loams. The flood plains appear to have been formed under an estuarine depositional environment (Fox et al. 1977) which was probably similar to the tidal flat environments existing at present.

The presence of economic uranium orebodies near to the main floodways of the Magela and Nourlangie Creeks (Figs 3, 4) has meant that these two have received the major share of scientific inquiry. Both creeks rise in the plateau region and are formed ultimately from a wide variety of tributaries both on the plateau and in the lowlands. In the plateau country the dry

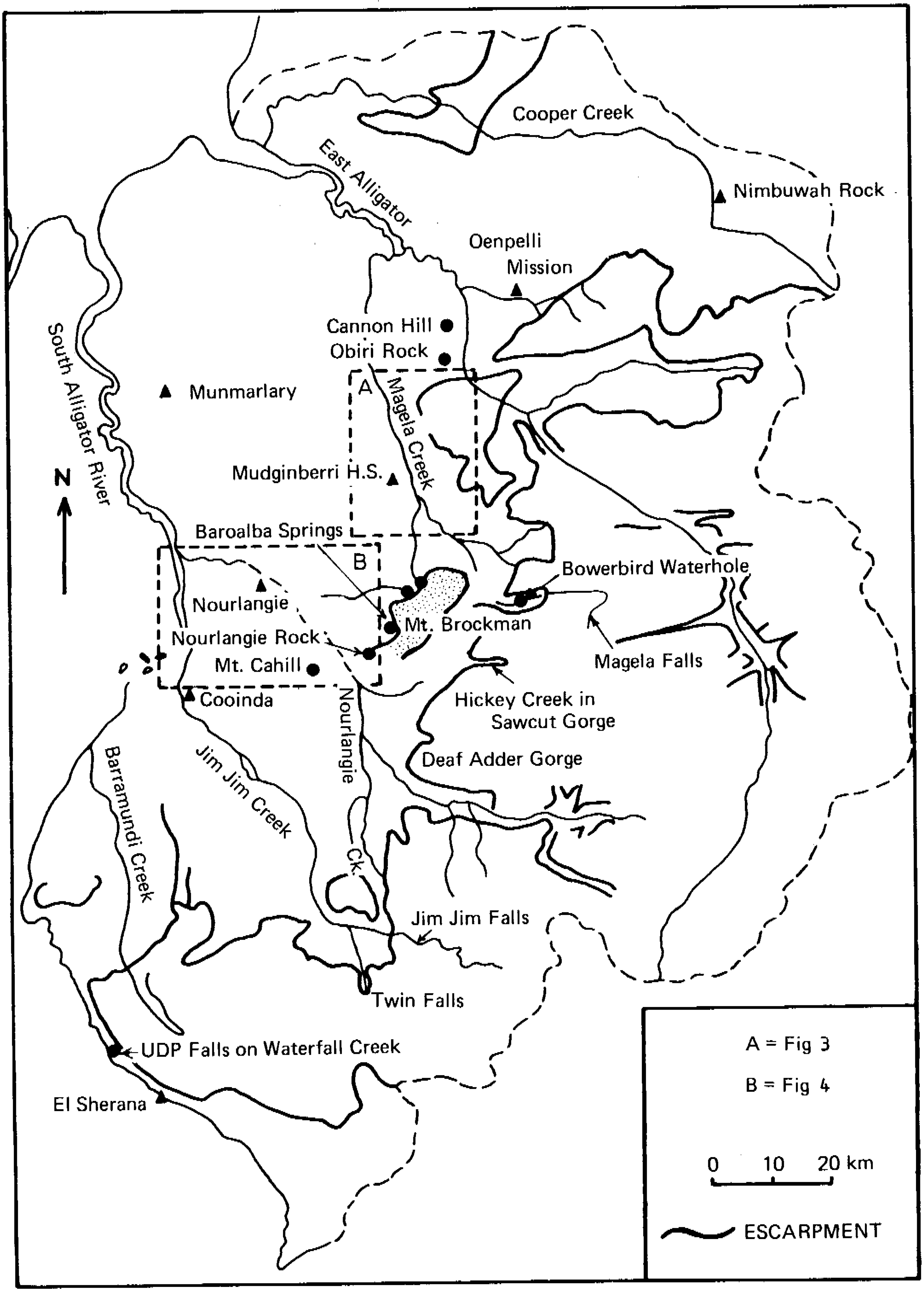


Fig. 2 Study areas in the Alligator Rivers Region

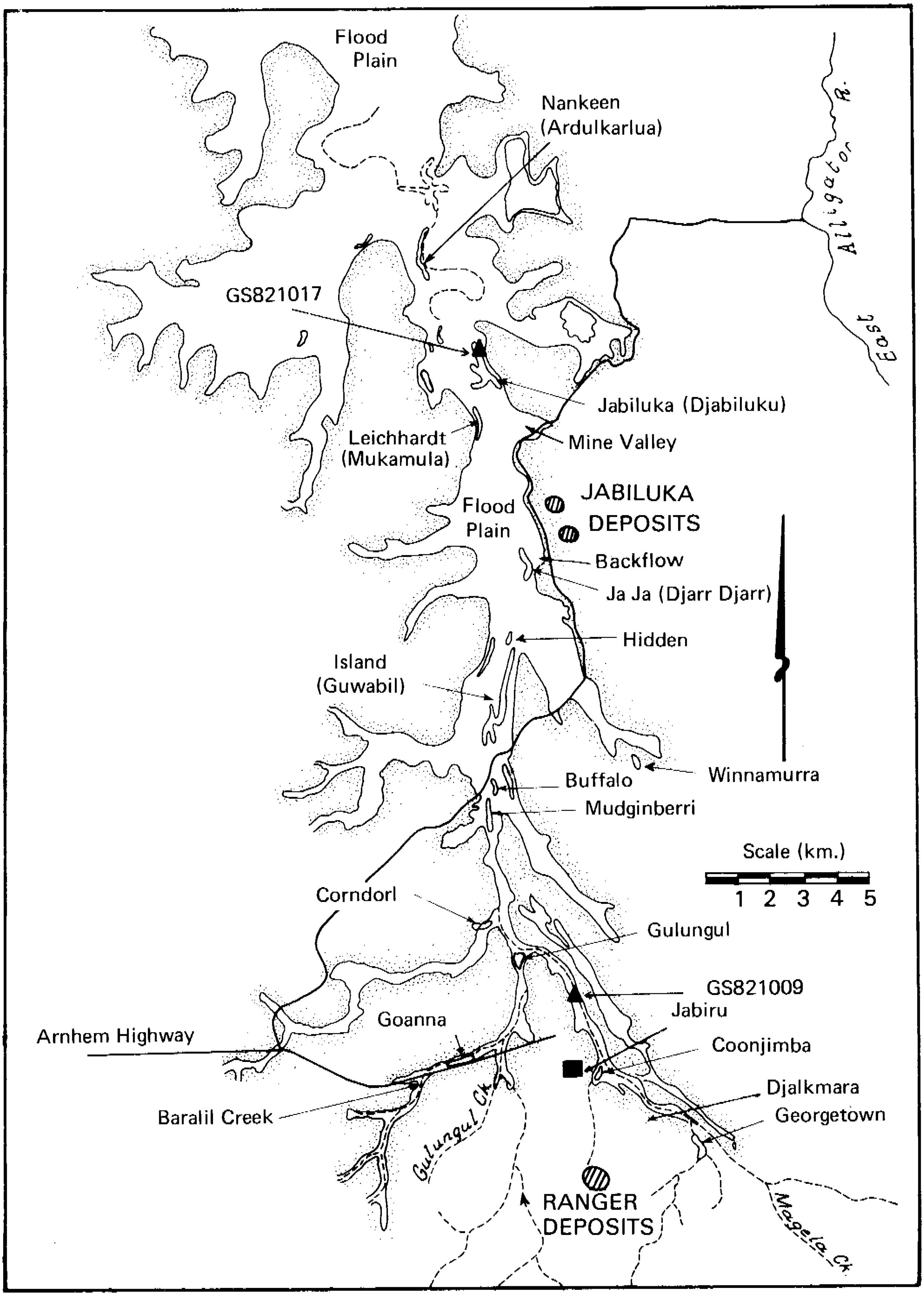


Fig. 3 Magela Creek system

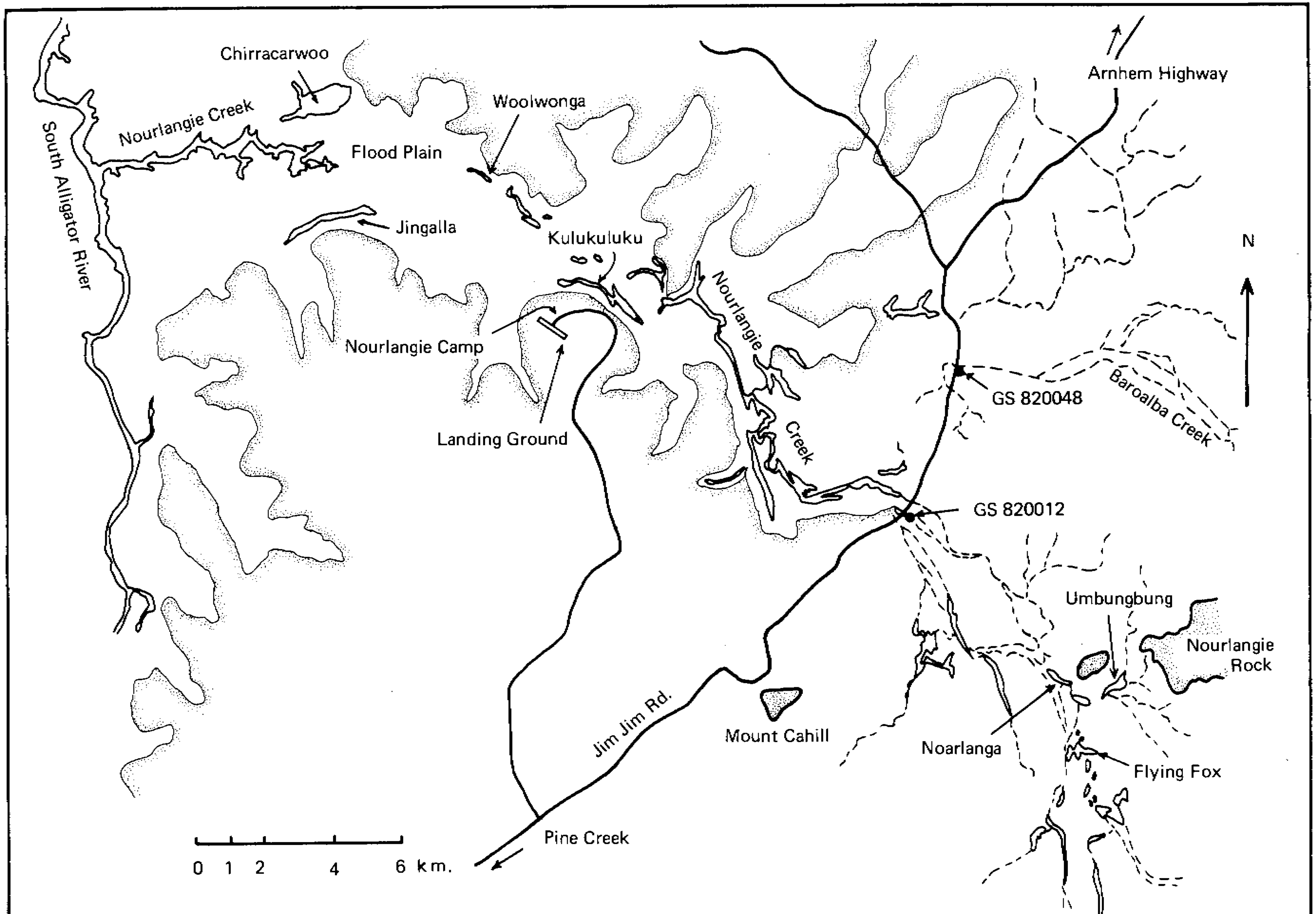


Fig. 4 Nourlangie Creek system

season finds the creeks represented by long narrow billabongs formed in the main channel of the creek. Down in the lowlands, three different types of billabong are formed (Walker and Tyler (to be published)). First are the main channel ones such as Island Billabong, which are relatively deep and narrow. The second group is formed at the confluence of the lowland tributaries and the main channel by the dams that result from water backflowing up the tributaries at times of peak flow (e.g. Coonjimba and Gulungul Billabongs) and these tend to be broad and shallow. Finally there are the billabongs left in the scoured depressions on the flood plain (e.g. Jabiluka).

Water flows in the creeks on a seasonal basis, starting with the beginning of the monsoonal wet season in November/December and ceasing within one to two months of the end of the wet season in about May. In the intervening months of drought, the flow ways are reduced to a series of billabongs, some of which are fed by groundwater while others may nearly evaporate to dryness over the dry season. The billabongs are therefore the only sources of permanent water and provide a focus for the continued survival of aquatic and terrestrial animals, many of which rely on aquatic food chains for their existence. It was both logical and convenient to set up permanent collection sites on various key billabongs, with other collections being made as and when it was possible to do so. These other collections were made either in the stream channels (e.g. at road crossings), in ephemeral pools on the plains, or up in the plateau country in the waterfall splashpools. The splashpools were taken as the effective headwaters of the lowland creeks, owing to the inaccessibility of the plateau sections of the creeks.

1.3.2 The sites sampled

The sites in the Magela Creek catchment which were used to provide the samples upon which this atlas was based are listed in Table 1. Sites outside the Magela Creek catchment included in a study of the distribution of taxa included billabongs on Nourlangie Creek (Table 2), sites associated with the lower East Alligator River including the Magela Outflow (Table 3) and mostly single sample sets from diverse sites across tropical Australia (Table 4). Of particular interest were the samples from the East Finniss River and Rum Jungle area where water is still heavily polluted by uranium mine tailings. The depauperate flora observed in those samples provided an ominous warning as to the likely effect of a major tailings spillage into the Alligator Rivers Region (see Section 4).

Among the sites not included in this report are two which were amply covered by Brady (1979), Ja Ja (Djarr Djarr) and Mine Valley Billabongs. These were omitted because of criticism that government contract workers were duplicating the work of the mining company surveys. The wisdom of these omissions is questioned in light of the comments offered on the Brady (1979) study in Section 3.2.

Furthermore, the few samples from the Magela Outflow and elsewhere on the lower East Alligator River were included, not as an attempt to characterise the estuarine flora (which was outside the scope of this study) but to better characterise the flora from the floodplain billabongs suspected of estuarine affinities.

TABLE 1 COLLECTING SITES AND COLLECTIONS FROM THE MAGELA CREEK

Site	Sample No.	Date	Sample No.	Date
Magela Falls Pool	927-931	280979		
Lat. 12°47'12"S				
Long. 133°6'7"E				
Radon Springs	570-574	080279		
Lat. 12°45'19"S	621	080279		
Long. 132°54'37"E	890-894	070979		
Bowerbird Billabong	509	071178	932-935	021079
Lat. 12°46'43"S	578	130279	1000-1003	281179
Long. 133°2'50"E	856-859	110879		
Coonjimba Billabong	468,469	130578	650-653	220479
Lat. 12°39'44"S	483	310478	667	290479
Long. 132°54'16"E	496,497	290978	699-701	020579
	520	110179	798-801	060879
	524,567	311278	809,810	220679
	553	059279	942-945	031079
	588	220379	1121,1122	080280
	608	300878	1225	051079
Gulungul Billabong	446,447	070778	1084	161079
Lat. 12°37'50"S	498-500	290978	1095	191179
Long. 132°53'1"E	523,547,562	110179	1147	141179
	556-559	020279	1152,1153	201179
	569	070279	1173	101279
	644	210479	1181	070180
	675-677	010579	1213	070379
	675-677	010579	1216-1218	040579
	722,723	010679	1236-1239	202080
	793,794	050879	1251,1252	280280
	830	300779	1266	210380
	842-845	080879	1292,1293	160480
	939,941	031079	1308	081279
	1006	061279		
Corndorl Billabong	462-464	110778	595	080379
Lat. 12°37'26"S	472,473	150578	885-889	230879
Long. 132°52'18"E	491	020878	923-926	270979
	511,550	090179	1131	140280
	552	020279	1186	080180
	579	140279	1132,1133	140280
	590	280379	1215,1230	070579
First Magela Crossing				
Lat. 12°34'59"S	452,453	070778	632-634	210479
Long. 132°52'30"E	536	200179	716	310579
& 2nd Magela Crossing				
Lat. 12°34'27"S	592,593,612	050279	1126,1127,1130	260280
Long. 132°52'43"E	614-620	050279	1284	260280

Table 1 (ctd)

Site	Sample No.	Date	Sample No.	Date
Island Billabong (Guwabil)[a]	438,441	080478	991-993	201179
Lat. 12°33'28"S	450,451	070778	1020-1022	161279
Long. 132°52'50"E	501,502	290978	1080	150979
	516,517	050179	1082	151079
	528	171178	1087	131179
	531,538	190179	1096	191179
	575,576	030179	1128,1129	090280
	626-631	210479	1141	131179
	664-666,668	290479	1154,1155	201179
	669-671	010579	1162	231179
	782-790	050879	175	201279
	807,808	210679	1177	040180
	822,823	060779	1182,1183,1186	070180
	834-841	070879	1226	081079
	912,913	190979	1264,1265	130380
	918-922	250979	1286,1287	090480
	984	041079		
Hades Flats Lat. 12°33'22"S Long. 132°54'6"E	622-625	210479		
Jabiluka Billabong (Djabiluku)[a]	434	060478	1016-1018	161279
Lat. 12°27'57"S	488,489	200778	1074-1076	090879
Long. 132°52'28"E	507,508	290978	1086	161079
	515	080179	1089	131179
	532	200179	1097	191179
	568	080179	1105	261179
	582	200179	1145	131179
	584,585	130379	1149	141179
	603	260878	1159	201179
	654-658	270479	1163	261179
	739-741	040679	1192	080180
	776,778,779	050879	1210	200380
	826,827	110779	1244,1245	220280
	876-879	200879	1255	060380
	914-917	250979	1279,1280	020480
Leichhardt Billabong (Mukamula)[a]	435	060578	833	010879
Lat. 12°28'45"S	454-457	080778	906-911	140979
Long. 132°52'20"E	487	190778	976-978, 980-982	041079
	505,506	290978	1071	100779
	512	181278	1073	010879
	513,514	170179	1090,1091	131179
	534	241178	1098	191179
	543	170179	1112	080180
	545	181278	1143,1144	131179
	548	181278	1158	201179

Table 1 (ctd)

Site	Sample No.	Date	Sample No.	Date
Leichhardt Billabong (ctd)	600	300878	1160	211179
	662,663	270479	1189-1191	080180
	703-706	290579	1242,1243	220280
	764,769	040879	1278	010480
	824,825	100779		
Nankeen Billabong (Ardulkarlua)[a]	458-460	080778	1113,194	140180
Lat. 12°25'45"S	586	130379	1148	141179
Long. 132°51'43"E	564	271178	1246,1247	220280
	602,607	260878	1257,1258	060380
	971-975	041079	1282,1282	020480

[a] Brackets enclose proposed names for billabongs to replace common names used throughout this report.

TABLE 2 COLLECTING SITES AND COLLECTIONS FROM THE NOURLANGIE CREEK CATCHMENT

Site	Sample No.	Date	Sample No.	Date
Deaf Adder Gorge	596,597	270878		
Lat. 13°6'37"S				
Long. 132°56'5"E				
Long Harrys (Nourlanga)[a]	708-710	300479	1167,1168	111279
Lat. 12°52'10"S	804	020679	1268	230380
Long. 132°47'8"E	092-905	120979		
Umbungung Billabong	712-715	300579	863	020679
Lat. 12°51'58"S	820,821	310779	898-901	120979
Long. 132°47'40"E	831,832	310779	1072	310779
Baroalba Springs	1004,1005	011279		
Lat. 12°49'40"S				
Long. 132°52'43"E				
Jingalla Billabong	1166	291179	1232	120280
Lat. 12°44'10"S	1195	160180	1269,1270	230380
Long. 132°35'13"E				

[a] Brackets enclose proposed name for billabong to replace the common name used throughout this report.

TABLE 3 COLLECTING SITES AND COLLECTIONS FROM THE LOWER EAST ALLIGATOR RIVER CATCHMENT

Site	Sample No.	Date	Sample No.	Date
Cahills Crossing Lat. 12°25'41"S Long. 132°57'52"E	688-690	020579		
Red Lily Billabong at Cannon Hill Lat. 12°21'44S Long. 132°58'8"E	960-965 1171 1239,1240	151179 131279 200280	1271-1273 1297,1298	280380 220480
Magela Outflow Lat. 12°15'53"S Long. 132°52'5"E	895-897	110979		

Similarly, the samples from outside the Region are intended, not to provide an adequate appraisal of the local diatom floras, but to give an indication of the likely distribution of the taxa considered here.

TABLE 4 COLLECTION SITES AND COLLECTIONS OUTSIDE THE MAIN STUDY REGION

Site	Latitude	Longitude	Sample No.	Date
Jim Jim Falls	13°16'34"	132°50'12"E	868-875	190879
Twin Falls	13°19'21"S	132°46'51"E	968,969	181179
Mary River	13°22'46"S	131°57'40"E	864-867	050879
East Finniss River	12°59'32"S	130°59'55"E	1007-1009 1014,1015 1296	121279 121279 190480
Rum Jungle	ca. 12°59'32"S	131°00'33"E	1010-1013 1294,1295	121279 190480
Lake Argyle, W.A.	16°34'54"S	128°44'51"E	1045-1050, 1053	191279
Lake Moondarra, Qld	20°34'50"S	139°34'20"E	946-950 957-959	091179 101179

1.4 The Sampling Program

Limnological studies in the Magela Creek catchment, which commenced in early 1978, were directed towards gaining an understanding of the basic physico-chemical characteristics of the system. As such, algal collections were infrequent and seldom as thorough as required by a competent phycologist. With the expansion of the study to include a baseline study of non-diatomaceous algae, algal collections, mainly plankton tows with a 25 µm net were made more systematically (approximately once a month) at the more commonly visited sites (see Walker and Tyler 1983).

In early 1979 the study was expanded to include waterholes on the Nourlangie Creek. At the same time the author was employed to study the diatoms and, in addition to phytoplankton sampling, instigated periphyton sampling and the placement of artificial substrates in an attempt to sample the broadest range of habitats possible, given the resources and time available. This was also intended to contribute to an understanding of the seasonal characteristics of the algal flora within the Alligator Rivers Region.

Periods of intensive sampling, ranging outside the regular sampling sites and dates, were consequent upon visits to the Region by either Dr. Ling or the author. On these occasions, any interesting habitats were sampled for algae to ensure as broad a coverage as possible of the entire Region. In addition, adventitious samples were gained from inaccessible places like Magela Falls and Baroalba Springs by personnel involved in other sampling programs. A special effort was made to obtain samples from outside the Region to add a pan-tropical perspective. As a result, samples from as far east as Lake Moondarra in central Queensland and as far west as Lake Argyle in northeastern Western Australia are included in this report.

2 BACKGROUND INFORMATION AND METHODOLOGY

2.1 Sampling Methods

The sampling followed a three-pronged strategy based primarily upon the use a 25 µm mesh plankton net. In addition, when macrophytes were available, the associated periphyton was sampled by carefully collecting small pieces of the various macrophyte species. This was difficult because the periphyton was loosely aggregated around the macrophyte leaves and stems, rather than being attached to the plant surface as is common in the more temperate regions.

Lastly, in a variation of the 'diatometer' method (see Patrick et al. 1954), narrow strips of flexible plastic were attached to the ropes of permanent buoys. This method had the advantage of providing information on colonising rates as well as allowing the collection of benthic forms on a permanent basis, unlike the strictly seasonal basis of the periphyton collections. Even using this method was fraught with some frustration in the occasional loss of buoys owing to crocodile, flood or human intervention. All samples were preserved initially in 5-10% Lugols Iodine (I_2-KI) but from 1979 on they were usually preserved in 4% formaldehyde solution.

2.2 Sample Preparation

2.2.1 Preparation of samples for light microscopy

Past and present investigations have left us with a system of diatom taxonomy based almost entirely on the morphology and ultrastructure of the siliceous component of the diatom cell wall (the frustule).

Early light microscopists found that the frustule could be best observed if it had all its organic components cleared out first and was then mounted in a medium of high refractive index.

Various methods have been used to oxidise the cell contents including boiling in concentrated sulphuric and nitric acids (Hendey 1964), hydrogen peroxide and potassium dichromate (van der Werff 1953), and burning in a muffle furnace (Zoto et al. 1973). All these methods have disadvantages, namely the amount of time required for each sample, the violence of the reaction, and the destruction or distortion of the frustules. The method described by Crawford (1971) is perhaps the most generally useful and requires warming the material in concentrated nitric acid for 12 hours in a water bath set at 60°C. This method, which was used here, has the following advantages.

(a) It is non-explosive and the test tubes can be left unattended overnight in a fume hood to allow the removal of the nitrogen dioxide which evolves.

(b) A large number of samples can be cleared in the one operation.

(c) There is a minimum number of steps involved and, more importantly, there is no need for pretreatment with hydrochloric acid and hence no danger of toxic and carcinogenic chemicals being formed from the combination of formaldehyde and HCl.

(d) The clearing action is sufficiently gentle to provide electron-microscope quality frustules, many of which remain intact.

After clearing, diatomaceous material must be stored in high grade ethanol. This implies that the cleared material has had the soluble chemicals removed by repeated dilution, using distilled water, settling of the diatoms and removal of the supernatant. This ethanol suspension can then be used for either light microscopy or scanning electron microscopy. For transmission electron microscopy the distilled water suspension must be used.

To prepare permanent slides for light microscopy, a hot plate set at 70°C is required together with clean glass slides and cover-glasses (No. 1 thickness) and an appropriate high refractive index mounting medium such as Canada Balsam, Naphrax or Hyrax.

Some of the diatom suspension is pipetted on to a cover-glass which has been preheated on the hotplate. The cover-glass and suspension are then left on the hotplate for the alcohol to evaporate off. At the same time the slide, clearly marked for identification, is preheated by being placed upside down on the edge of the hotplate. When the cover-glass is completely dry, a small drop of the mounting medium is placed on the middle of it and the slide is then placed over the mountant and lowered so that the mountant helps pick up the cover-glass. At this stage the slide plus cover-glass can be turned over. The cover-glass is then gently pressed down on the slide to express any excess mounting medium. Once it has been allowed to cool, the slide is ready for use in the light microscope.

2.2.2 Preparation of samples for electron microscopy

The initial preparation is the same as for light microscopy, with the production of an alcoholic suspension of cleared frustules. This suspension can be placed directly on to a scanning electron microscope stub and is best left to evaporate under a slight vacuum in a desiccator. After this, the stub can be carbon- and gold-coated in the usual way.

2.3 Key to the Diatom Genera of the Region

1. Cells centric in valve view, rarely pseudozygomorphic, with concentric, radial or irregular, never pennate structure. Axial area absent. Valve outline circular, polygonal or elliptical, rarely lanceolate or irregular. 2.

1. Cells truly zygomorphic, structure almost always pennate, rarely irregular. Axial area, with or without raphe, present. Valve outline generally linear to lanceolate, sometimes arcuate or sigmoid. 5.

    2. Cells mostly discoid or short cylindical, rarely extended in the pervalvar direction. Valve outline circular. Cells in most taxa without valve elevations or setae. 3.

    2. Cells elongate-cylindrical, greatly extended in the pervalvar direction owing to numerous girdle bands. Valves bilateral with an indentation on one side and a spine-like tubule on the other side, sometimes supported by an elevation of the valve, which fits into the indentation of the adjacent valve. RHIZOSOLENIA

    2. Cells of similar dimension in both the apical and pervalvar directions, rarely extended more in the pervalvar direction. Valve outline mostly elliptical, rarely circular. Cells bipolar owing to presence of short spines. Cells solitary. ATTHEYA

3. Cells lenticular, spherical or cylindrical, typically combined to form long chains. Valve wall usually thick. MELOSIRA

3. Cells lenticular or briefly cylindrical, girdle not conspicuously developed. Most are solitary, in rare instances forming brief chains. 4.

    4. Valve face with radially ribbed margin and distinct, variously structured (smooth or ornamented), often undulate centre. CYCLOTELLA

    4. Valve face areolate, not differentiated with a radially ribbed margin. COSCINODISCUS

5. Cells without raphes. 6.

5. Cells with at least one valve having a raphe. 9.

6. Cells with conspicuous girdle septa, successive girdle bands having one pole containing a septum, formed alternately. TABELLARIA

6. Cells without septa. 7.

7. Cells forming flat, stellate colonies; valves with a narrow median axial area. ASTERIONELLA

7. Cells not forming such colonies. 8.

8. Cells solitary or at most, with three cells joined together at both poles. SYNEDRA

8. Cells forming band-like colonies. FRAGILARIA

9. Raphe brief, formed near the poles on each valve, apical axis bowed. EUNOTIA

9. At least one valve of each cell with a fully developed raphe. 10.

10. One valve of each cell with a fully developed raphe, the other valve with an unpunctured axial area. 11.

10. Both valves with a developed raphe. 13.

11. Cells usually bent or reflexed around the transapical axis, solitary or forming foliose or band-like colonies. Valve view mostly linear to lanceolate, rarely elliptical. ACHNANTHES

11. Cells usually bent around the apical axis, solitary, with the raphic-valve adjacent to the substrate, never forming stalks and chains. Valve view mostly elliptical. 12.

12. Cells with a conspicuous inner framework of thick silicate ribs. CAMPYLONEIS

12. Cells without such a framework. COCCONEIS

13. Raphe set into the valve surface with the valve wall often thickened on either side of the raphe fissure, not a 'canal raphe system'. 14.

13. Raphe a 'canal raphe system' supported by transapical fibulae, often transapically displaced toward the valve surface or margin. Sometimes on a keel or extension of the valve surface or margin. Sometimes formed around the entire margin of each valve. 25.

14. Apical axis or transapical axis or both heteropolar. 15.

14. Both the apical and transapical axis isopolar. 17.

15. Apical axis heteropolar in girdle view. GOMPHONEMA

15. Apical axis isopolar, transapical axis heteropolar. 16.

16. Apical axis slightly bowed nearly straight. CYMBELLA

16. Apical axis prominently bowed, raphe formed near ventral margin. AMPHORA

17. Cells with marginal septa on which septal chambers are formed ('partectal ring' - Ross et al. 1979). MASTOGLOIA

17. Cells without such septa. 18.

18. Apical axis sigmoid, raphe fissures veering away from the midline at the central node. Puncta arranged to give the impression of two sets of lines crossing at right angles, one set of which is parallel to the apical axis. GYROSIGMA

18. Apical axis is not sigmoid. 19.

19. Raphe flanked by lateral tubes proceeding from the central nodule to each pole and opening externally via a line of distinct puncta or areolae formed parallel to and near the raphe (the 'longitudinal canal' - Ross et al. 1979). DIPLONEIS

19. Valves without such tubes. 20.

20. Each raphe slit veers away from the other and the mid-line at the central node, and bifurcates at the poles. NEIDIUM

20. Raphe not so structured. 21.

21. Raphe enclosed between two ribs (axial costae - Ross et al. 1979), valves as a rule lanceolate with very fine structure or linear to rectangular, central nodule slightly extended. FRUSTULIA

21. Raphe not enclosed between two ribs. 22.

22. Valve wall with transapical chambers on the inside (alveoli - Ross et al. 1979) separated by rib-costae. PINNULARIA

22. Valve wall punctate or transversely striate, transapical lines without obvious chambers. 23.

23. Central area unpunctured and thickened, developed to the valve margin (a 'stauros' - Ross et al. 1979). STAURONEIS

23. Central area mostly limited to the centre of the valve. 24.

24. Transapical rows of puncta crossed by several longitudinal hyaline areas. Apical axis sometimes slightly heteropolar. ANOMOEONEIS

24. Valves not so structured. NAVICULA

25. Valves with the raphe formed in the valve face or displaced towards one margin. 26.

25. Valves with the raphe formed around the entire margin on both sides of the cell. 30.

26. Valves bowed about the pervalvar axis or with transapical septa. 27.

26. Valves linear, sigmoid or ovate to almost circular, raphe often on or near the valve margin. 28.

27. Valves bowed with the raphe formed mostly towards the ventral margin but more or less recurved towards the dorsal margin at the centre. EPITHEMIA

27. Valves bowed with the raphe formed on or near the dorsal margin and slightly recurved towards the ventral margin. RHOPALODIA

28. Cells fusiform with tapering ends, repeatedly twisted around the apical axis. CYLINDROTHECA

28. Cells not obviously twisted about the axis. 29.

29. Valves with one side slightly constricted or geniculate near the centre or straight, both raphes formed on the same side of the cell. If one margin constricted then both raphes formed on the unconstricted margin. HANTZSCHIA

29. Valves not so formed, raphes formed on or towards the diagonally opposite margins of the cell or in the valve. NITZSCHIA

30. Cells saddle-shaped, apical axis of each valve parallel to the transapical axis of the other valve. CAMPYLODISCUS

30. The apical axis of each valve in the same line. 31.

31. Cells linear, narrow and sigmoid. STENOPTEROBIA

31. Cells cuneate, ovate to almost circular in valve view with nearly flat valve surfaces. SURIRELLA

3 SYSTEMATIC SECTION

3.1 Introductory Remarks

This section is set out first with the genera in alphabetical order and then the taxa within each genus in alphabetical order. This is intended to complement the plates which have been arranged as far as possible in taxonomic groupings. Each taxon starts with the name followed by the author(s) of the name. On the next line is the reference to the plate on which the taxon is illustrated in this report. If the taxon is new to science, then the description in English follows. New taxa have not been described in Latin nor have they been assigned a name as this is being done elsewhere so that the valid description can be published in a journal which fulfills the requirements of the International Code of Botanical Nomenclature (see Stafleu 1978). Where the taxon has been previously described, a listing of the author(s) and the most readily available references giving a description are entered. These are followed by a listing of any important synonyms, their authors, and reference to any useful descriptions of the taxon based upon the synonym. Finally, any comments pertaining to the taxon or its distribution are appended. For further listings of synonyms, Van Landingham (1967-1979) should be consulted as that index has been relied upon except where otherwise stated in the text. The terminology and layout of descriptions follow that recommended by the working group on diatom terminology (Anonymous 1975; Ross et al. 1979).

3.2 The Taxa Observed

3.2.1 ACHNANTHES Bory

3.2.1.1 Achnanthes affinis Grunow in Cleve and Grunow 1880

Plate 3/13,14: Magela Falls pool, 28 September 1978, #930

Cleve and Grunow 1880, p. 20

Van Heurck 1896, p. 280, Fig. 8/329; Hustedt 1930b, p. 199,201, Fig. 282; Cleve-Euler 1953, p. 39, Fig. 562; Hustedt 1959a, p. 381-382, Fig. 826; Patrick and Reimer 1966, p. 254-255, pl. 16/11,12 (as var. *affinis*); Foged 1978, p. 22

Foged (1978) described this taxon as cosmopolitan but it has been found in this study only in the near escarpment areas such as Magela Falls, Deaf Adder Falls and Jim Jim Falls.

3.2.1.2 Achnanthes exigua var. *heterovalva* Krasske 1923

Plate 3/17,18: Rum Jungle, 12 December 1979, #1011

Krasske 1923, p. 193, Fig. 9a,b

Hustedt 1930b, p. 202, Fig. 288 (as var. *heterovalvata*); Hustedt 1942, p. 40; Cleve-Euler 1953, p. 35, Fig. 544e-k; Hustedt 1959a, p. 387, Fig. 832c-f; Patrick and Reimer 1966, p. 258, pl. 16/25,26; Foged 1971, p. 271, pl. 8/15-18

This taxon seems to be broadly distributed from the cooler areas of Europe and North America to the tropics of southeast Asia and now Australia. In this study it was found in samples from Rum Jungle on the Finniss River, the Mary River and Umbungbung Billabong on the Nourlangie Creek.

3.2.1.3 Achnanthes linearis (W. Smith 1855) Grunow *in* Cleve and Grunow 1880

Plate 3/11,12: 15/7: Magela Falls pool, 28 September 1979, #929

Cleve and Grunow 1880, p. 23

Hustedt 1930b, p. 198, Fig. 276; Hustedt 1942, p. 36; Hustedt 1959a, p. 378, Fig. 821a,b; Patrick and Reimer 1966, p. 251-252, pl. 16/3,4 (as var. *linearis*); Foged 1971, p. 272; Foged 1978, p. 27; Foged 1979, p. 23. *Achnanthidium lineare* W. Smith 1855, p. 8, pl. 1/9

Regarding both this and the next taxon *(A. minutissima)* as well as *A. microcephala,* Van Landingham (1967, p. 52) has suggested that the differentiation of the three taxa is very difficult owing to their small size and the inadequacy of their original descriptions. Hence there has been confusion in the literature as to the delineation of the taxonomic boundaries. The specimens observed in this study have been sufficiently distinctive for there to have been little difficulty in differentiating the taxa at high magnifications. The main features are the larger size of this taxon and its two broad interstriae rather than the single interstria of the raphic valve central region of *A. minutissima.*

Foged (1978) considered this taxon to be cosmopolitan and it has been found in this study from Lake Argyle in the west to Lake Moondarra in the east. In the study region it seems to occur mainly in the upland sites near the scarp and has been observed in samples from Magela Falls, Bowerbird and Gulungul Billabongs on the Magela Creek, and Jim Jim and Twin Falls on the Jim Jim Creek.

3.2.1.4 Achnanthes minutissima Kuetzing 1833

Plate 3/10: Bowerbird Billabong, 11 August 1979, #857

Kuetzing 1833, Algae Exsiccatae, Dec. 8, No. 75; Kuetzing 1833, p. 578, Fig. 54

Van Heurck 1896, p. 282, pl. 8/334; Hustedt 1930b, p. 198, Fig. 272; Hustedt 1942, p. 46; Hustedt 1959a, p. 376, Fig. 820a-c; Patrick and Reimer 1966, p. 253-254, pl. 16/9,10 (as var. *minutissima*); Foged 1971, p. 273; Foged 1978, p. 28; Foged 1979, p. 23; Brady 1979, p. 12, pl. 1/1,2

Foged (1978) considered this taxon to be cosmopolitan and later (Foged 1979) added that it would be most likely to occur in slightly alkaline waters. In this study it has been found only in the slightly acid waters of Rum Jungle and Bowerbird Billabong. Brady (1979) observed this taxon in samples from the Elizabeth River and went on to quote Schoeman (1973) that it is most likely to be found in well-aerated water of pH 6.7 to 8.4. See Section 3.2.1.3 for comments on identification.

3.2.1.5 Achnanthes sp. 1

Plate 3/15,16: Magela Falls pool, 28 September 1979, #930

Valves lanceolate, length 14-45 µm and width 5-13 µm.
Striae 22-25/10 µm, varying from parallel at centre to slightly radiate towards the poles.

Rapheless valve: Axial area approximately 1 µm wide, straight, formed between poles along the centre line, often with a narrow longitudinal ridge along the centre line of the area.

Raphic valve: Axial area straight, varying from approximately 1 µm wide at the poles and inflating into a central area 4 µm wide and 7 µm long. The central area is rhomboid but with a horseshoe-shaped area on one side. The raphe is straight, formed in the central line of the axial area, and with a 2 µm gap at the central nodule.

As with *A. pseudolanceolata* Manguin in 1962 (*non* Hustedt 1952) and *A. lanceolata* (Brébisson 1849) Grunow 1880, *Achnanthes* sp. 1 differs from *A. hungarica* (Grunow 1863) Grunow 1880 in having the horseshoe-shaped area on the raphic instead of the rapheless valve. In addition, *A. hungarica* has a lower strial density (16-22/10 µm rather than 22-25/10 µm) and *Achnanthes* sp. 1 does not have a narrow stauros on either valve.

Initially observed in samples from the splashpool at the base of Magela Falls, this taxon has since been found in Bowerbird, Gulungul and Nankeen Billabongs and in samples from the Magela Creek and Rum Jungle on the Finniss River.

3.2.2 AMPHORA Ehrenberg

3.2.2.1 Amphora argus Pantocsek 1889

Plate 5/1: Gulungul Billabong, 29 September 1978, #499

Pantocsek 1889, pl. 22/329

Van Landingham (1967, p. 196) considered that this taxon is near to *A. ovalis* Kuetzing 1833. However the apparent lack of striae on the ventral side of the axial area and the nearly straight raphe fissures suggest that this is a valid taxon, although closely related to *A. ovalis*.

Has been observed, but rarely, in samples from Gulungul Billabong.

3.2.2.2 Amphora towutensis Hustedt 1942

Plate 5/2: Mary River, 5 August 1979, #864

Hustedt 1942, p. 96, Fig. 178-179

Krammer (1980) considered that the closely related and more common *A. libyca* Ehrenberg 1840 had a sufficiently wide range of morphology to encompass *A. towutensis*. However, the two taxa are easily distinguished by the presence of a raphe ledge formed dorsally from the raphe fissure in *A. towutensis* and on both sides of the raphe fissure in *A. libyca,* a feature to which Krammer (1980) attaches some taxonomic importance.

In this study this taxon has been found only from samples collected in the upper reaches of the Mary River.

3.2.3 ANOMOEONEIS Pfitzer

3.2.3.1 Anomoeoneis exilis var. *gomphonemacea* (Grunow *in* Van Heurck 1880) Cleve 1895

Plate 5/3: Bowerbird Billabong, 11 August 1979, #857

Cleve 1895, p. 8

Navicula gomphonemacea Grunow *in* Van Heurck 1880, pl. 12/13

Van Landingham (1967, p. 286) considered that this taxon is probably just a synonym of *A. exilis,* but the consistency of the heteropolar (gomphonemoid) structure of the valve, and the lack of any valves in the samples which did fit the *A. exilis* description, has supported the use of this variety here. This taxon is spread through the Magela Creek and Nourlangie Creek samples, occurring at Bowerbird, Island, Jabiluka, Leichhardt and Nankeen Billabongs on the Magela, and in Umbungbung Billabong on the Nourlangie.

3.2.3.2 Anomoeoneis exilis var. *lanceolata* Mayer 1919

Plate 5/4: Second Magela Crossing, 21 April 1979, #634

Mayer 1919, p. 202, pl. 7/12-14

Hustedt 1930b, p. 264; Hustedt 1942, p. 48 (as *A. exilis* f. *lanceolata*); Hustedt 1959a, p. 752, Fig. 1114d; Foged 1971, p. 276; Foged 1976, p. 11; Foged 1978, p. 35 (as *A. exilis* f. *lanceolata*); Foged 1979, p. 27, pl. 23/13,14.*Frustulia jajaensis* Brady 1979, p. 33, pl. 4/4,5 *(nomen nudum)*

This taxon was not very common but was observed in samples from Island and Leichhardt Billabongs on the Magela Creek, and in Long Harrys Billabong on the Nourlangie Creek. Foged (1978) considered this to be cosmopolitan in its distribution and later (Foged 1979) decided that it was most likely to occur in slightly alkaline waters. However, both Brady (1979) and the information gained in this study suggest that this taxon is found in predominantly acidic environments, and the environmental requirements may have less to do with pH than Foged considered.

The major differences between this and the previously mentioned variety include the generally larger size and the very extended central nodule of var. *gomphonemacea*.

3.2.3.3 Anomoeoneis serians var. *acuta* Hustedt 1937

Plate 5/5; 15/5: Gulungul Billabong, 1 June 1979, #722

Hustedt 1937, p. 218, pl. 15/23,24

Hustedt 1959a, p. 747, Fig. 112c,d; Prowse 1962, p. 39, pl. 11/b,c; Patrick and Reimer 1966, p. 378-379, pl. 33/2; Foged 1976, p. 11, pl. 10/1,2; Foged 1979, p. 27, pl. 23/8-10

Foged (1979) characterised this taxon as a cosmopolitan form preferring slightly acid freshwaters. As indicated above, this is more likely to be a tropical form, having been found in the southeast Asian region in addition to the record from Florida by Patrick and Reimer (1966).

In the Magela Creek system the taxon has been found in both Bowerbird and Island Billabongs and billabongs between the two, including Coonjimba and Gulungul.

3.2.3.4 Anomoeoneis serians var. *brachysira* (Brébisson ex Kuetzing 1849) Cleve *in* Cleve and Möller 1882

Plate 5/6-9; 15/4: Magela Falls pool, 28 September 1979 #930; Bowerbird Billabong, 11 August 1979, #857

Cleve and Moller 1882, No. 324

Hustedt 1930b, p. 264, Fig. 427; Hustedt 1942, p. 48; Hustedt 1959a, p. 748, Fig. 1112e-h; Patrick and Reimer 1966, p. 379-380, pl. 33/7-11; Foged 1978, p. 35, pl. 25/12; Foged 1979, p. 27, pl. 23/5-7,11

Navicula aponina var. *brachysira* Brébisson ex Kuetzing 1849, p. 69;

Anomoeoneis brachysira (Brébisson ex Kuetzing) Cleve 1895, p. 7; Prowse 1962, p. 38, pl. 11/j

Foged (1978) characterised this taxon as being a cosmopolitan form of acid freshwaters and this has been borne out by its distribution as a common taxon in the waters of the Magela Creek and surrounding areas.

3.2.3.5 Anomoeoneis sphaerophora (Kuetzing 1833-1836; Kuetzing 1844) Pfitzer 1871

Plate 5/10: Lake Argyle, 19 December 1979, #1053

Pfitzer 1871, p. 77, pl. 3/10

Hustedt 1930b, p. 262, Fig. 422; Hustedt 1942, p. 47;

Hustedt 1959a, p. 740, Fig. 1108a; Crosby and Wood 1949, p. 28-29, pl. 6/86; Foged 1976, p. 12; Foged 1978, p. 35, pl. 26/8; Foged 1979, p. 28, pl. 23/3,4.
Navicula sphaerophora Kuetzing 1833-1836, Decade No. 84; Kuetzing 1844, p. 95, pl. 4/17

Patrick and Reimer (1966, p. 374-375) attribute the first record to Ehrenberg (1843, p. 419, pl. 3(4)/3) and make no mention of the Kuetzing (1833-1836) exsiccata slide.

Crosby and Wood (1959), Patrick and Reimer (1966) and Foged (1978, 1979) all characterised this taxon as halophilous with a preference for hard, relatively alkaline waters. In this study it was only found in Lake Argyle.

3.2.4 ASTERIONELLA Hassall

3.2.4.1 *Asterionella zasuminensis* (Cabejszekowna 1937) Lundh-Almestrand 1954

Plate 2/17,18: Bowerbird Billabong, 7 Novembr 1978, #509; Island Billabong, 21 April 1979, #630

Lundh-Almestrand 1954, p. 179, Fig. 1b-e,2,3
Fragilaria zasuminensis Cabejszekowna 1937, p. 423

Eunotia zasuminensis (Cabejszekowna) Korner 1970, p. 664-667, Fig. 64-68, 140-146

Eunotia ossa Brady 1979, p. 30, pl. 7/10-12 *(nomen nudum)*

The lack of information to be gained from the study of the margin of most diatoms in the transmission electron microscope may well be the reason why Korner (1970) transferred this taxon from *Asterionella* to *Eunotia*. It does not fit well into either genus and the characteristics which should delineate it are variable. It is placed in *Asterionella* here, more to draw attention to it, than any conviction that it belongs in that genus. Some valves do have a labiate process at each end, others only at one end. Some valves have a rudimentary raphe similar to those found in *Eunotia* but lacking the valve development at the central area end of the internal fissure. Other valves either have no raphe at all, or at most, what appears to be an elongated labiate process set vertically in the wall of the valve margin. With the presence of spines all around the valve margin, there is also an affinity to the *Desmogonium* group of *Eunotia* (see comments Section 3.2.13.9) but the occasional presence of a labiate process at both poles makes such an identification difficult.

All these characteristics indicate a form intermediate between *Asterionella* and *Eunotia* which could almost be considered to be ancestral to *Eunotia*.

This taxon has been found as a common planktonic form in almost every billabong on the Magela Creek system, with permanent populations apparently maintained in Bowerbird Billabong. Also found in samples from the Nourlangie system and Deaf Adder Creek. Korner (1970) indicated that this taxon has been found in various places from Scandinavia to tropical Africa.

3.2.5 CAMPYLODISCUS Ehrenberg

3.2.5.1 Campylodiscus pervulsus Jurilj 1948

Plate 12/3: Magela Outflow, 11 September 1979, #896

Jurilj 1948, p. 195, Fig. 17

Van Landingham (1968, p. 661) considered that this taxon is a synonym of *C. noricus* var. *hibernicus* (Ehrenberg) Grunow but that taxon does not compare well with Jurilj's illustration.

In this investigation *C. pervulsus* was found in samples from the East Alligator River and is presumably a brackish water form.

3.2.6 COCCONEIS Ehrenberg

3.2.6.1 Cocconeis placentula Ehrenberg 1838

Plate 3/19-21: Lake Argyle, 19 December 1979, #1053

Ehrenberg 1838, p. 194

Schmidt et al. 1874-1959, pl. 192/38-44,46,47; 193/1-4; Van Heurck 1896, p. 288, pl. 8/341; Hustedt 1930b, p. 189, Fig. 260; Hustedt 1942, p. 42; Hustedt 1959a, p. 347, Fig. 802a,b; Patrick and Reimer 1966, p. 240-241, pl. 15/7 (as var. *placentula*); Foged 1971, p. 278, Foged 1976, p. 15; Foged 1978, p. 42, pl. 13/7,8; Foged 1979, p. 34, pl. 12/9,10; *Cocconeis placentula* var. *lineata* (Ehrenberg) Cleve 1895 *sensu* Brady 1979, p. 12, pl. 1/3,4

Foged (1978,1979) characterised this taxon as being a cosmopolitan form from alkaline freshwaters. In the Magela Creek system the author has found it in Gulungul, Corndorl and Nankeen Billabongs in this study, and from Lakes Argyle and Moondarra as well as many sites in southern Australia.

3.2.6.2 Cocconeis scutellum Ehrenberg 1838

Plate 3/22: Red Lily Billabong, 28 March 1980, #1273

Ehrenberg 1838, p. 194, pl. 14/8

Schmidt et al. 1874-1959, pl. 190/17-21; Van Heurck 1896, p. 286-287, Fig. 65, pl. 8/338; Hustedt 1930b, p. 191, Fig. 267; Hustedt 1942, p. 32; Crosby and Wood 1959, p. 13-14, pl. 3/39b (*non* pl. 3/39a); Hustedt 1959a, p. 337, Fig. 790; Hendey 1964, p. 180, pl. 27/8; Foged 1978, p. 42, pl. 13/4; 14/10; Foged 1979, p. 34, pl. 13/2,6

Foged (1978, 1979) characterised this taxon as polyhalobous and cosmopolitan and this has been found to be substantially correct in Australian populations. However, in this study, the distribution of the taxon has been limited to just a few sites, namely Island, Nankeen and Red Lily Billabongs.

3.2.7 COSCINODISCUS Ehrenberg *emend.* Rattray

3.2.7.1 Coscinodiscus asteromphalus Ehrenberg 1844

Plate 1/3,4: Magela Outflow, 11 September 1979, #895, #896

Ehrenberg 1844, p. 77

Schmidt et al. 1874-1959, pl. 63/12; 113/23; Hustedt 1930a, p. 452, Fig. 250; Hendey 1964, p. 78, pl. 24/2 *C. argus* Ehrenberg *sensu* Crosby and Wood 1959, p. 43-44, pl. 9/134,135

This is generally a brackish water form and was found in the East Alligator River as well as Red Lily Billabong.

3.2.7.2 Coscinodiscus lineatus Ehrenberg 1838

Plate 1/1,2: Magela Outflow, 11 September 1979, #895, #896

Ehrenberg 1838, p. 129

Schmidt et al. 1874-1959, pl. 59/26-29; Van Heurck 1896, p. 532, pl. 23/665; Hustedt 1930a, p. 392, Fig. 204; ?Crosby and Wood 1958, p. 497, pl. 31/15; ?Wood et al. 1959, pl. 213, pl. 15/10a,b; Prowse 1962, p.9, pl. 1/k,n; Hendey 1964, p. 76; Foged 1978, p. 43

Foged (1978) characterised this taxon as cosmopolitan and polyhalobous and this was to some extent borne out in this study by its presence in the East Alligator River and Leichhardt Billabong samples taken at the end of the dry season.

3.2.8 CYCLOTELLA Kuetzing

3.2.8.1 Cyclotella meneghiniana Kuetzing 1844

Plate 2/1-2: Magela Falls pool, 28 September 1979, #929; Jingalla, 29 November 1979, #1101

Kuetzing 1844, p. 50, pl. 30/68

Schmidt et al. 1874-1959, pl. 181/91; 222/25-31; Van Heurck 1896, p. 447, pl. 22/656; Hustedt 1930a, p. 341, Fig. 174; Hustedt 1930b, p. 100, Fig. 67; Hustedt 1942, p. 16-17; Prowse 1962, p. 7, pl. 1/e; 2/h; Foged 1971, p. 279, pl. 6/11; Foged 1978, p. 44, pl. 2/1-3; Foged 1979, p. 35, pl. 3/6

Two forms of this taxon are recognisable in the northern Australian samples, one having a sculptured appearance to its central area and the other having an apparently smooth central area. As has been found elsewhere (Professor F.E. Round, pers. comm.) the forms with the smooth area tend to be found in flowing water and the others mainly in the billabongs.

In keeping with Foged's (1978, 1979) characterisation of the taxon as a cosmopolitan form of slightly alkaline and brackish waters, most sites where it has been found in this study have been in the lower reaches of the waterway (Leichhardt and Red Lily Billabongs in the Magela Creek area and Jingalla Billabong on the Nourlangie Creek). However it was also found in samples from the splashpool of the Magela Falls, which is neither alkaline nor saline.

3.2.8.2 Cyclotella stelligera (Cleve and Grunow *in* Cleve 1881) Van Heurck 1882

Plate 2/3: Mary River, 5 August 1979, #867

Van Heurck 1882, pl. 94/22-26

Schmidt et al. 1874-1959, pl. 222/48,49; Hustedt 1930a, p. 339, Fig. 172; Hustedt 1930b, p. 100, Fig. 65; Hustedt 1942, p. 15; Foged 1976, p. 15; Foged 1978, p. 45, pl. 2/11; Foged 1979, p. 36, pl. 3/8,9,11,13,16; Brady 1979, p. 13, pl. 1/6; ?*non* Wood et al. 1959, p. 212, pl. 15/4 (illustration not adequate to verify identification). *C. meneghiniana* var. *stelligera* Cleve and Grunow *in* Cleve 1881, p. 22, pl. 5/63c

Foged (1978) characterised this taxon as cosmopolitan, but in this study it was found only in samples from the Mary River.

3.2.8.3 Cyclotella stylorum Brightwell 1860

Plate 2/4: Magela Outflow, 11 September 1979, #895

Brightwell 1860, p. 96, pl. 6/16

Schmidt et al. 1874-1959, pl. 223/6-8; Hustedt 1930a, p. 348, Fig. 179; Foged 1978, p. 45, pl. 2/12. *C. meneghiniana* Kuetzing 1844 *sensu* Crosby and Wood 1959, p. 44, pl. 9/137; *C. striata* (Kuetzing 1844) Grunow *in* Cleve and Grunow 1880 *sensu* Brady 1979, p. 13, pl. 1/7

Foged (1978) characterised this taxon as being polyhalobous as well as cosmopolitan but it was found in this study to prefer the more saline conditions towards the lower reaches of the Magela Creek (Island, Jabiluka and Leichhardt Billabongs) as well as the estuarine reaches of the East Alligator River.

3.2.8.4 Cyclotella woltereckii Hustedt 1942

Plate 2/5: Mary River, 5 August 1979, #867

Hustedt 1942, p. 16, Fig. 11-13

This is the first record of this taxon since Hustedt (1942) described it from Indonesia. It was found in one sample from the Mary River.

3.2.9 CYLINDROTHECA Rabenhorst *emend.* Reimann and Lewin

3.2.9.1 Cylindrotheca closterium (Ehrenberg 1839) Reimann and Lewin 1964

Plate 11/7: Jingalla Billabong, 29 November 1979, #1101

Reimann and Lewin 1964, p. 289, pl. 124/1-4; 125/1-4

Ceratoneis closterium Ehrenberg 1839b, p. 157

Nitzschia closterium (Ehrenberg 1839) Wm. Smith 1853, p. 42, pl. 15/120; Hustedt 1924 in Schmidt et al. 1874-1959, pl. 352/5; Hustedt 1930b, p. 424, Fig. 822; Hustedt 1942, p. 142; Hendey 1964, p. 283, pl. 21/8; Prowse 1962, p. 65, pl. 20/n

This taxon is commonly associated with slightly eutrophic conditions and was found in Jingalla Billabong samples from towards the end of the dry season when the water quality is at its lowest and when the water is most saline.

3.2.10 CYMBELLA Argardh

3.2.10.1 Cymbella affinis Kuetzing 1844

Plate 5/15; 15/8: Lake Argyle, 19 December 1979, #1053

Kuetzing 1844 p. 80, pl. 6/15

Schmidt et al. 1874-1959, pl. 9/29; 71/28,29; Van Heurck 1896, p. 144, pl. 1/31; Hustedt 1930b, p. 362, Fig. 671; Hustedt 1931 *in* Schmidt et al. 1874-1959, pl. 376/17-20; Hustedt 1942, p. 108; Cleve-Euler 1955, p. 158, Fig. 1242; Foged 1971, p. 279; Foged 1976, p. 16; Foged 1978, p. 46; Foged 1979, p. 37; ?Crosby and Wood 1959, p. 36, pl. 7/110; Brady 1979, p. 15, pl. 1/11

Cymbella cymbiformis Agardh 1830 *sensu* Brady 1979, p. 16, pl. 1/8-10

This taxon as represented in the northern Australian samples is sufficiently polymorphic to cover the ranges of *C. affinis* as well as *C. cistula* (Hemprich in Hemprich and Ehrenberg 1828) Kirchner 1878 and *C. sumatrensis* Hustedt 1938. While the Lake Argyle samples contain frustules identifiable as *C. sumatrensis* (J. John, pers. comm.) material from Lakes Argyle and Moondarra in addition to that from Island, Jabiluka and Red Lily Billabongs yielded forms intergrading between the three taxa.

3.2.10.2 Cymbella aspera (Ehrenberg 1839) Cleve 1894

Plate 8/5,6: Mary River, 5 August 1979, #864

Cleve 1894, p. 195

Hustedt 1930b, p. 365, Fig. 680; Hustedt 1931 *in* Schmidt et al. 1874-1959, pl. 375/1; Hustedt 1942, p. 110; Hanna 1932, p. 377; Foged 1971, p. 279; Patrick and Reimer 1975, p. 53-54, pl. 10/2 (as var. *aspera*); Foged 1978, p. 46, pl. 38/8;

Foged 1979, p. 37, pl. 35/14; Brady 1979, p. 15, pl. 2/1 (as *Cymbella No. 2) non C. aspera* p. 14, pl. 1/12

Cocconema asperum Ehrenberg 1839a, p. 30

Frustulia gastroides Kuetzing 1833, p. 15, Fig. 9

Cymbella gastroides (Kuetzing 1833) Kuetzing 1844, p. 79, pl. 6/4b
Schmidt et al. 1874-1959, p. 9/1,2; 72/12-14; Van Heurck 1896, p. 146, pl. 1/35

The wise use of the name *C. aspera* provides good grounds for following both Hanna (1932, p. 377) and Van Landingham (1969, p. 1159) in retaining it rather than using the earlier described *C. gastroides*.

Foged (1979) characterised this taxon as both cosmopolitan and alkaliphilic. It was found in samples from the Mary River in this study and in the Elizabeth River by Brady (1979) but not in other sites in the Region which would have seemed conducive to its growth.

3.2.10.3 Cymbella claasseniae Cholnoky 1958

Plate 5/17; 15/9: Magela Falls pool, 28 September 1979, #929

Cholnoky 1958a, p. 106, pl. 1/17-21

This is the first record of this taxon outside of Africa. In this study it was found to be common in samples from various sites from Magela, Jim Jim and Twin Falls in the scarp country, through to Bowerbird and Gulungul Billabongs on the upper plains.

3.2.10.4 Cymbella hustedtii Krasske 1923

Plate 5/16: Mary River, 5 August 1979, #864

Krasske 1923, p. 204, Fig. 11

Hustedt 1930b, p. 363, Fig. 674; Cleve-Euler 1955, p. 152, Fig. 1228; Foged 1971, p. 280; Patrick and Reimer 1975, p. 2-28, pl. 4/2a-3b (as var. *hustedtii*); Foged 1976, p. 16; Foged 1978, p. 47; Foged 1979, p. 38-39

Foged (1978, 1979) characterised this taxon as being associated with alkaline waters but it has been observed here in the slightly acid waters of Jim Jim Falls and Bowerbird Billabong as well as in the samples from the Mary River.

3.2.10.5 Cymbella minuta Hilse *ex* Rabenhorst 1862

Plate 5/12: Nankeen Billabong, 4 October 1979, #975

Rabenhorst 1862, Decades 63-64, No. 635 according to Patrick and Reimer 1975, pp. 47-48, pl. 8/1-4b (as var. *minuta*)

Cymbella ventricosa Agardh 1830, p. 9.

Schmidt et al. 1874-1959, pl. 9/32; 72/11; Hustedt 1930b, p. 359, Fig. 661; Hustedt 1942, p. 107; Prowse 1962, p. 60, pl. 17/s,t; Gandhi 1970, p. 761; Foged 1971, p. 283, pl. 4/6; Foged 1976, p. 16, pl. 17/11; Foged 1978, p. 50, pl. 37/6-8; Foged 1979, p. 42, pl. 34/11,12; Brady 1979, p. 17, pl. 2/3

Patrick and Reimer (1975, p. 48) pointed out that what was generally accepted as *C. ventricosa* arose out of Kuetzing's (1844) interpretation of what constituted the taxon and not Agardh's (1830) taxon which is probably a *Rhopalodia* (Patrick and Reimer 1975). Thus Kuetzing's name is a later homonym and has been replaced by the next earliest name, that of Hilse as used here. However, there is probably a good case for a *nomen conservandum* on the Kuetzing name and its interpretation, owing to the widespread and long term use of *C. ventricosa* in the literature.

In keeping with its cosmopolitan nature (Foged 1978, 1979) this taxon was found in almost every sampling site at some time or other, often dominating some of the periphytic assemblages.

3.2.10.6 Cymbella spicula Hustedt 1937

Plate 5/13,14: Gulungul Billabong, 21 April 1979, #644

Hustedt 1937, p. 422, pl. 25/14

Hustedt 1942, p. 107; Foged 1976, p. 18, pl. 18/1-4

This taxon was also reported by Foged (1978, p. 49, pl. 39/1,2) but the valves illustrated appear to be more closely related to *Gomphonema intricatum* than to a *Cymbella* species.

Previously this taxon has only been reported from the southeast Asian region (Java, Bali, Sumatra and Thailand) and was not common in the samples investigated in this study. The previous descriptions also have not indicated the tendency towards heterovalvae noted here, with one valve being more densely striate than the other. Both types of valves occurred in samples from Gulungul, Umbungbung and Mary River Billabongs with several frustules remaining intact, providing proof of the relationship between the two forms.

3.2.10.7 Cymbella subturgida Hustedt 1931

Plate 5/11: Jim Jim Falls, 19 August 1979, #871

Hustedt 1931 *in* Schmidt et al. 1874-1959, pl. 374/4

Foged 1978, p. 49

This taxon was originally reported from South America, but Foged reported its presence in Queensland. In this study the taxon was found mostly in upland sites such as Jim Jim and Magela Falls, Bowerbird and Coonjimba Billabongs, but it was also observed in samples from Jabiluka Billabong on the flood plain.

3.2.11 DIPLONEIS Ehrenberg

3.2.11.1 Diploneis ovalis (Hilse *in* Rabenhorst 1861) Cleve 1891

Plate 6/2: Jingalla Billabong, 29 November 1979, #1101

Cleve 1891, p. 44, pl. 2/13

Hustedt 1930b, p. 249, Fig. 390; Hustedt 1942, p. 46; Hustedt 1959a, p. 671-673, Fig. 1065a-e; Prowse 1962, p. 35, pl. 9/h; Foged 1971, p. 283; Foged 1978, p. 52, pl. 25/4; Foged 1979, p. 45, pl. 21/8

Pinnularia ovalis Hilse *in* Rabenhorst 1861, Alg. Eur. No. 1025

This taxon shows a remarkable array of characteristics which straddle two other previously described taxa. The structure of the striae fits the pattern exhibited by *Diploneis parma* Cleve 1891 with the striae changing from a single row to a double row of puncta at about one-third of the distance from the axial area to the margin. As such, this taxon, as represented in samples from Jingalla Billabong, appears to stand between *D. ovalis* and *D. parma* in a morphological series which derives from *D. oblongella* (Naegela *ex* Kuetzing 1849) Ross 1947 (considered to be a variety of *D. ovalis* by Van Landingham 1969, p. 1381), *D. ovalis, D. parma* and *D. subovalis* Cleve 1894 which has a double row of puncta per stria from the axial area to the margin. Given this range of intergrading morphology, the Northern Territory taxon has been assigned to the taxon to which it is most similar.

3.2.11.2 Diploneis subadvena Hustedt 1959

Plate 6/1: Magela Outflow, 11 September 1979, #895

Hustedt 1959a, p. 633-634, Fig. 1042

The size range of the specimens observed in samples from the East Alligator River overlap with the 26-50 μm range described by Hustedt (1959a), but vary down to lengths of 20 μm.

3.2.12 EPITHEMIA Brebisson *in* Brebisson and Godey

3.2.12.1 Epithemia adnata var. *saxonica* (Kuetzing 1844) Patrick *in* Patrick and Reimer 1975

Plate 11/2: Lake Moondarra, 10 November 1979, #958

Patrick and Reimer 1975, p. 182, pl. 24/9
Epithemia saxonica Kuetzing 1844, p. 35, 1. 5/15

Epithemia zebra var. *saxonica* (Kuetzing 1844) Grunow 1862, p. 328, pl. 6/6; Fricke 1904 *in* Schmidt et al. 1874-1959, pl. 252/3-14; Hustedt 1930b, p. 385, Fig. 730; Cleve-Euler 1952, p. 37, Fig. 1409i,k; Foged 1971, p. 284; Foged 1978, p. 55, pl. 42/3,4; Foged 1979, p. 44, pl. 38/3,8

Epithemia sp. aff. *adnata* var. *proboscidea* (Kuetzing) Patrick 1966 *sensu* Brady 1979, p. 18, pl. 4/1,2

Foged (1978) described this taxon as a cosmopolitan form of alkaline waters, but it has only been observed from two sites in northern Australia, Lake Moondarra near Mount Isa in this study and Howard Springs near Darwin by Brady (1979).

3.2.12.2 Epithemia cistula (Ehrenberg 1854) Ralfs *in* Pritchard 1861

Plate 11/1: Magela Falls pool, 28 September 1979, #927

Pritchard 1861, p. 762
Hustedt 1942, p. 125; Foged 1971, p. 283, pl. 17/19-21;
Foged 1976, p. 19, pl. 19/19

Eunotia cistula Ehrenberg 1854, pl. 10/2, Fig. 18
Epithemia No. 2 Brady 1979, p. 18, pl. 4/3

So far this taxon has been found only in the southeast Asian region. It occurred here only in samples from the escarpment region of the Magela Creek, from Magela Falls and Bowerbird Billabong.

3.2.13 EUNOTIA Ehrenberg

3.2.13.1 Eunotia aequalis Hustedt 1913

Plate 2/22: Gulungul Billabong, 8 December 1979, #1308

Hustedt 1913 *in* Schmidt et al. 1874-1959, pl. 294/16-21

This taxon appears to be an obligate periphyte, occurring only in periphyton samples from billabongs which have some macrophyte cover through the year. In this study it occurred in samples from Gulungul, Nankeen and Long Harrys Billabongs.

3.2.13.2 Eunotia ambigua Carter 1966

Plate 2/20: Magela Falls pool, 28 September 1979, #930

Carter 1966, p. 450, pl. 2/11-15,20

Previously described from Tristan de Cunha by Carter (1966) the specimens observed in samples from Magela Falls cover only one of the forms recognised by Carter as being part of the morphological range of the type.

3.2.13.3 Eunotia astricleveae A. Berg *ex* Cleve-Euler 1948

Plate 3/3: Gulungul Billabong, 8 December 1979, #1308

Cleve-Euler 1948, p. 15, Fig. 13a,b

Eunotia lunaris (Ehrenberg 1831) Grunow *in* Van Heurck 1896 *sensu* Brady 1979, p. 27, pl. 2/15,16

A comparison between Plates 3/3 and 3/4 indicates the considerable differences between *E. astricleveae* and *E. lunaris* in terms of gross morphology and regularity of striation.

A common taxon in the Magela Creek, it has been observed in samples from every billabong from Bowerbird to Nankeen and Red Lily near the East Alligator River. In addition, it was observed in samples from Umbungbung Billabong on the Nourlangie Creek.

3.2.13.4 *Eunotia bicapitata* Grunow *in* Van Heurck 1881

Plate 8/2: Jabiluka Billabong, 27 April 1979, #654

Van Heurck 1881, pl. 35/11

Considered by Van Landingham (1969, p. 1494) to be a synonym of *Eunotia flexuosa* (Brébisson *ex* Kuetzing 1849) Kuetzing 1846 and could possibly be considered as a variety of *E. flexuosa*.

This form was observed in samples from all the billabongs visited on the Magela Creek from Bowerbird to Nankeen, and all the sites on the Nourlangie Creek. In addition, it was found in one sample from Lake Argyle.

3.2.13.5 *Eunotia bigibba* Kuetzing 1849

Plate 3/6: Hades Flat, 21 April 1979, #625

Kuetzing 1849, p. 6

Hustedt 1913 *in* Schmidt et al. 1874-1959, pl. 290/9-16,19; Hustedt 1930b, p. 175, Fig. 214; Hustedt 1959a, p. 282, Fig. 747a,b; Foged 1978, p. 56; Foged 1979, p. 47, pl. 9/13

Eunotia diodon Ehrenberg 1837 *sensu* Brady 1979, p. 22, pl. 2/13

This form differs from *E. camelus* (see Plate 3/5) in having more truncated poles and a relatively straight ventral margin, and from *E. diodon* in having truncated poles and more inflated and acute dorsal swellings.

While *E. camelus* was far the more common form in samples from the Magela Creek, *E. bigibba* did conform to Foged's (1978, 1979) characterisation as an acid-water form and was found in samples from Bowerbird Billabong and in a sample from Hades Flat.

3.2.13.6 *Eunotia camelus* Ehrenberg 1841

Plate 3/5: Gulungul Billabong, 1 June 1979, #722

Ehrenberg 1841, p. 125, pl. 2/1, Fig. 1

Hustedt 1911, 1913 *in* Schmidt et al. 1874-1959, pl. 273/8,9; 274/19-21; 289/5-8; Hustedt 1942, p. 28-29; Prowse 1962, p. 17, pl. 5/y,z; Foged 1976, p. 20, pl. 4/1-4; Foged 1978, p. 56, pl. 10/9,10; Foged 1979, p. 47, pl. 11/8

E. diodon Ehrenberg 1837 *sensu* Brady 1979, p. 22, pl. 2/14 (*non* 13)

E. diodon var. *inflata* Brady 1979, p. 21, pl. 2/7,8 *(nomen nudum)*

This is a morphologically plastic and very common taxon in the Magela Creek and Nourlangie Creek samples. There is almost every variation between this form with two dorsal swellings and *E. trigibba, E. camelus* var. *ventricosa,* and forms of *E. pectinalis* var. *undulata* f. *fossilis* with up to seven dorsal swellings. The most common transition seems to be between *E. camelus,* found in various sites throughout southeast Asia, and *E. camelus* var. *ventricosa* reported from India by Gandhi (1957).

Found in all the billabongs between Coonjimba and Nankeen on the Magela Creek, all those sampled from the Nourlangie Creek and from the Mary River.

3.2.13.7 Eunotia camelus var. *denticulata* (Brébisson *in* Kuetzing 1849) Grunow 1865.

Plate 4/4: Corndorl Billabong, 23 August 1979, #888

Grunow 1865, p. 4, pl. 1/6d

Hustedt 1911 *in* Schmidt et al. 1874-1959, pl. 274/22-31

Himantidium denticulatum Brébisson *in* Kuetzing 1849, p. 10

Van Landingham (1969, p. 1498) considered this to be a synonym of the type but it survives in the field as a separate morph and deserves to be treated as such by the varietal designation.

In the Magela Creek samples, this form is restricted to the backflow billabongs of Coonjimba, Gulungul and Corndorl but has been observed once in a sample from the First Magela Crossing of the Oenpelli road. On the Nourlangie Creek it was found in samples from Long Harrys and Umbungbung Billabongs.

3.2.13.8 Eunotia camelus var. *ventricosa* Gandhi 1957

Plate 3/8: Hades Flat, 21 April 1979, #623

Gandhi 1957, p. 50, pl. 13/15

Eunotia camelus Ehrenberg 1841 *sensu* Brady 1979 p. 23, pl. 2/18 (*non* pl. 2/19,20)

As mentioned above, this taxon seems to intergrade with *E. camelus* in the samples from the Alligator Rivers Region and has an identical distribution. Together the two forms are the most common *Eunotia* taxa in the Region, mostly as periphytes but occasionally as major components of the plankton as well.

3.2.13.9 Eunotia didyma Grunow *in* Möller 1881

Plate 4/14: Mary River, 5 August 1979, #864

Moller 1881, 1.2.1.

Hustedt 1913 *in* Schmidt et al. 1874-1959, pl. 285/19-22 (as f. *genuina*); Hustedt 1942, p. 31; Foged 1971, p. 284, pl. 7/13,14 (as f. *genuina*); Foged 1978, p. 56

This is one of several taxa which will be mentioned here that conform to the criteria used by Patrick and Reimer (1966, p. 221) to differentiate the genus *Desmogonium* Ehrenberg 1848 from *Eunotia*. The principal characteristics are the presence of a rimoportule at each pole of the valve, the presence of small spines at the margin on both sides of the valve and possibly the growth pattern in the formation of zig-zag colonies (Patrick and Reimer 1966). This sort of differentiation is attractive, as *Desmogonium* is characterised by Patrick and Reimer (1966) as a tropical genus containing forms that live predominantly in acid freshwaters. However, as not enough is known of the range of taxa that might have to be transferred from *Eunotia*, it is more convenient to leave them all together pending a detailed analysis based on scanning electron microscopy as well as light microscopy of all the *Eunotia* taxa.

Foged (1978) characterised this taxon as tropical in its distribution and confined to acid waters. So far in this study it was found only in samples from the Mary River.

3.2.13.10 Eunotia didyma var. *maxima* Hustedt 1913

Plate 4/16: Jim Jim Falls pool, 19 August 1979, #868

Hustedt 1913 *in* Schmidt et al. 1874-1959, pl. 285/17

Found only in samples from Jim Jim Falls.

3.2.13.11 Eunotia didyma var. *maxima* f. 1

Plate 4/15: Jim Jim Falls pool, 19 August 1979, #868

Valves similar to *E. didyma* var. *maxima* but the whole shorter and more inflated with less acute poles (50° vs 42°) and reduced length to breadth ratio (2.37 vs 3.7). Valves range from 76-110 μm long and 38-44 μm long and 38-44 μm wide.

Initially observed in a sample from the slightly acidic, freshwater splash-pool at the base of 'im Jim Falls and not found in any other samples from outside the pool area since.

3.2.13.12 Eunotia didyma var. *media* Hustedt 1913

Plate 4/13· Mary River, 5 August 1979, #866

Hustedt 1913 *in* Schmidt et al. 1874-1959, pl. 285/11

Hustedt 1942, p. 31 (as f. *media*)

Eunotia formica Ehrenberg 1841 *sensu* Brady 1979, p. 24, pl. 3/2

This form differs from *E. formica* by being generally more robust, with broader and more pronounced poles.

This is a relatively rare taxon, which was found only in samples from Jabiluka Billabong and the Mary River. Brady (1979) found a more elongate form in the Elizabeth River.

3.2.13.13 *Eunotia flexuosa* (Brébisson ex Kuetzing 1849) Kuetzing 1849

Plate 8/1: Bowerbird Billabong, 28 November 1979, #1003

Kuetzing 1849, p. 6

Van Heurck 1896, p. 34, pl. 9/374; Hustedt 1913 *in* Schmidt et al. 1874-1959, pl. 291/9-14; Hustedt 1930b, p. 186, Fig. 258; Hustedt 1942, p. 31; Hustedt 1959a, p. 312, Fig. 778; Prowse 1962, p. 18, pl. 6/b,c; Patrick and Reimer 1966, p. 187-188, pl. 10/1 (as var. *flexuosa*); Foged 1971, p. 285; Foged 1978,p. 57, pl. 12/1; Foged 1979, p. 47; ?Brady 1979, p. 29.

? *Synedra flexuosa* Brébisson *ex* Kuetzing 1849

Foged (1979) characterised this taxon as a cosmopolitan form found in acidic waters. In the Magela Creek it was found in samples from Bowerbird, Coonjimba, Gulungul and Island Billabongs. It was also found in samples from Jim Jim Falls and from Umbungbung Billabong.

3.2.13.14 *Eunotia hebridica* var. *bergii* Gandhi 1959

Plate 4/1: Jabiluka Billabong, 20 January 1979, #582

Gandhi 1959, p. 101, pl. 1/21

Without giving any reason, Van Landingham (1969, p. 1529) considered that this taxon is a synonym of *E. flexuosa*. There does not seem to be any obvious similarity between any of the *E. flexuosa* varieties and this taxon and so Gandhi's (1959) designation has been retained here.

Cells of this taxon commonly occurred in samples from all billabongs between Coonjimba and Nankeen Billabongs on the Magela Creek. On the Nourlangie Creek it was also found in samples from Jingalla and Umbungbung Billabongs.

3.2.13.15 *Eunotia lunaris* (Ehrenberg 1831) Grunow *in* Van Heurck 1881

Plate 3/4: Bowerbird Billabong, 11 August 1979, #857

Van Heurck 1881, pl. 35/3,4

Van Heurck 1896, p. 303, pl. 9/384; Hustedt 1930b, p. 183, Fig. 249;

Hustedt 1942, p. 31; Hustedt 1959a, p. 302, Fig. 769; Prowse 1962, p. 19, pl. 5/f; Foged 1971, p. 285; Foged 1976, p. 21; Foged 1978, p. 58; Foged 1979, p. 48, pl. 9/1,6; *non* Brady 1979, p. 27, pl. 2/15,16

Synedra lunaris Ehrenberg 1831, p. 87

Eunotia curvata (Kuetzing 1934) Lagerstedt 1884 p. 61; Patrick and Reimer 1966, p. 189-190, pl. 10/4 (as var. *curvata*)

Eunotia alpina (Naegeli) Hustedt 1913 *(sic) sensu* Brady 1979, p. 28, pl. 3/10,11

Patrick and Reimer (1966, p. 189) give no reason for their preference for the later synonym of this taxon.

In keeping with Foged's (1978, 1979) characterisation of this taxon as cosmopolitan, it has been observed in samples from almost every site on the Magela Creek, from Jingalla and Long Harrys Billabong on the Nourlangie Creek, and from Jim Jim Falls and the Mary River.

3.2.13.16 *Eunotia monodon* Ehrenberg 1841

Plate 3/2: Gulungul Billabong, 7 July 1978, #446

Ehrenberg 1841, pl. 2/5 Fig. 7; 3/3 Fig. 3

Hustedt 1911, 1913 *in* Schmidt et al. 1874-1959, pl. 271/13,14; 287/1; Hustedt 1930b, p. 185, Fig. 254; Hustedt 1933 *in* Schmidt et al. 1874-1959, pl. 381/1; Hustedt 1942, p. 30; Hustedt 1959a, p. 305, Fig. 772a,b; Patrick and Reimer 1966, p. 198, pl. 11/6 (as var. *monodon*); Foged 1971, p. 285; Foged 1976, p. 21; Foged 1979, p. 48, pl. 9/10

Eunotia praerupta Ehrenberg 1841 *sensu* Brady 1979, p. 25, pl. 2/23; 3/7

Foged (1979) characterised this taxon as being a cosmopolitan form of acid freshwaters. Every billabong from Coonjimba to Red Lily yielded at least one sample in which it was present and frequently common. Also found in samples from Long Harrys and Umbungbung Billabongs on the Nourlangie Creek. Misshapen forms were relatively frequent, usually with one half of the valve diminished in size and often bent towards the ventral side near the middle of the valve.

3.2.13.17 *Eunotia monodon* var. *scandica* (Cleve-Euler 1953) Thomas comb. nov.

Plate 4/6: Second Magela Crossing, 21 April 1979, #634

Eunotia major var. *scandica* Cleve-Euler 1953, p. 119, Fig. 456a-c,f,g

Van Landingham (1969, p. 1546) considered *E. major* var. *scandica* Cleve-Euler 1953 to be a synonym of *E. monodon* Ehrenberg 1841. The author, while agreeing with Van Landingham regarding the relationship of this taxon to

Eunotia monodon, believes the more capitate and extended poles of var. *scandica* require the maintenance of its varietal status and hence new combination as shown.

This is a common form in the Magela Creek system being found from Bowerbird Billabongs through to Nankeen Billabong. Also found in samples from Long Harrys and Umbungbung Billabongs on the Nourlangie Creek.

3.2.13.18 *Eunotia monodon* var. *tropica* (Hustedt 1927) Hustedt 1933

Plate 4/5: Umbungbung Billabong, 12 September 1979, #901

Hustedt 1933 *in* Schmidt et al. 1874-1959, pl. 381/3-8

Hustedt 1942, p. 30; Foged 1971, p. 286

Eunotia tropica Hustedt 1927, p. 159, pl. 5/1

Foged (1971) described this taxon as being of southeast Asian and South American distribution. This again emphasises the close floristic ties between the northern part of the Northern Territory, including the Alligator Rivers Region, and the southeast Asian region as a whole.

In this study the taxon was found only in the Gulungul, Corndorl and Island Billabongs of Magela Creek and in Jingalla and Long Harrys on the Nourlangie Creek.

3.2.13.19 *Eunotia parallela* Ehrenberg 1841

Plate 8/4: Red Lily Billabong, 20 January 1979, #539

Ehrenberg 1841, p. 414

Hustedt 1911 *in* Schmidt et al. 1874-1959, pl. 271/16; Hustedt 1930b, p. 183, Fig. 247; Hustedt 1959a, p. 302, Fig. 768; Patrick and Reimer 1966, p. 193, pl. 10/12 (as var. *parallela*); Foged 1976, p. 21, pl. 4/15; Foged 1979, p. 49

Foged (1979) characterised this taxon as a cosmopolitan form of acidic freshwaters. In this study it was only found in billabongs of the Magela Creek, from Coonjimba to Nankeen, and in Red Lily Billabong.

3.2.13.20 *Eunotia pectinalis* (? O.F. Müller 1788; Dillwyn 1809) Rabenhorst 1864

Plate 3/1: Gulungul Billabong, 1 June 1979, #722

Rabenhorst 1864, p. 73

Van Heurck 1896, p. 300, pl. 9/370,371; Hustedt 1931 *in* Schmidt et al. 1874-1959, pl. 271/10,11,15; Hustedt 1930b, p. 180, Fig. 237; Hustedt 1942, p. 29; Hustedt 1959a, p. 296, Fig. 763a,k;

Prowse 1962, p. 21, pl. 5/b; Patrick and Reimer 1966, p. 204-205, pl. 12/8,10 (as var. *pectinalis*); Foged 971, p. 286; Foged 1976, p. 21; Foged 1978, p. 59, pl. 12/10; Foged 1979, p. 49, pl. 9/15; 11/5

Conferva pectinalis Dillwyn 1809, pl. 24

Eunotia pectinalis var. *minor* (Kuetzing 1844); Rabenhorst 1864 *sensu* Brady 1979, p. 20, pl. 3/8,9

Eunotia sp. aff. *tenella* (Grunow *in* Van Heurck 1881) Hustedt 1913 *in* Schmidt et al. 1874-1959, pl. 287/20-25 *sensu* Brady 1979, p. 19, pl. 2/10

Patrick and Reimer (1966) suggested that O.F. Müller may have been the original author of the name which would otherwise be attributed to Dillwyn. In the material studied here, the specimens covered the whole range from a small *E. pectinalis* var. *minor* through to a large *E. pectinalis* and this was used as the basis for rejecting the separate status of the variety as used by Brady (1979).

As with many species of this genus, Foged (1978, 1979) characterised this taxon as a cosmopolitan form of acidic freshwaters. In this study it was mainly found as a periphyton form in samples from every site on the Magela Creek except Magela Falls. Outside this area it was observed in samples from Long Harrys and Umbungbung Billabongs on the Nourlangie Creek, and from Lake Argyle and the Mary River.

3.2.13.21 *Eunotia pectinalis* var. *undulata* (Ralfs 1843) Rabenhorst 1864

Plate 4/3: Corndorl Billabong, 11 July 1978, #464

Rabenhorst 1864, p. 74

Van Heurck 1896, p. 301, pl. 9/373; Hustedt 1911, 1913 *in* Schmidt et al. 1874-1959, pl. 271/26-28; 289/26-34; Hustedt 1930b, p. 182, Fig. 240; Hustedt 1942, p. 29; Cleve-Euler 1953, p. 86, Fig. 409r; Hustedt 1959a, p. 298, Fig. 763; Patrick and Reimer 1966, p. 206, pl. 12/11; Foged 1971, p. 286, pl. 8,9 (as f. *undulata*); Foged 1978, p. 59, pl. 10/8; Foged 1979, p. 50, pl. 12/2; *non* Crosby and Wood 1959, p. 12, pl. 3/33a. *Fragilaria pectinalis* f. *undulata* Ralfs 1843, p. 108, pl. 2/3d

Foged (1978, 1979) characterised this form as a cosmopolitan form of acid freshwaters and this is borne out in the Magela Creek samples, the taxon being found from Coonjimba through to Nankeen Billabongs and in densities only slightly less than the nominate variety. Outside the Magela the taxon was only found in samples from Jingalla and Umbungbung Billabongs on the Nourlangie Creek.

3.2.13.22 *Eunotia pectinalis* var. *undulata* f. *fossilis* Manguin 1949

Plate 3/9: Nankeen Billabong, 8 July 1978, #460

Manguin 1949, p. 97, pl. 2/37
Eunotia camelus Ehrenberg 1841 *sensu* Brady 1979, p. 23, pl. 2/91,20

While Manguin's (1949) type material needs to be investigated in relation to this form, it does seem that Brady (1979) was near the mark in placing it in the *E. camelus* group, with which it would seem to be more closely related. (See also comments on *E. camelus* above.)

This was a very common form in the Magela Creek system, occurring in every billabong from Bowerbird to Nankeen and also in the Long Harrys and Umbungbung Billabongs on the Nourlangie Creek.

3.2.13.23 *Eunotia pseudoindica* var. *gracilis* (Frenguelli 1933) comb. nov.?

Plate 4/7: Jim Jim Falls pool, 19 August 1979, #868

? Frenguelli 1941, p. 307

Eunotia indica var. *gracilis* Frenguelli 1933, p. 454, pl. 9/16,17

E. maior var. *bidens* (Gregory) Rabenhorst 1864 *sensu* Brady 1979, p. 23, pl. 2/21 (a synonym of *E. monodon* var. *bidens* (Gregory) Hustedt)

Frenguelli (1933, p. 453-454, pl. 9/11-17) described an *Eunotia indica (non* Grunow 1865) with two varieties (var. *bigibba* and var. *gracilis*). Later, Frenguelli (1941, p. 30) renamed the type *E. pseudoindica* without making it clear as to the new status of the previously named varieties.

This taxon was found in all sites on the Magela Creek except Magela Falls, and also in Radon Springs, Deaf Adder and Jim Jim Falls as well as all sites on the Nourlangie Creek.

3.2.13.24 *Eunotia pseudopectinalis* Hustedt 1924

Plate 8/3: Radon Springs, 8 February 1979, #573

Hustedt 1924, p. 547, pl. 18/1

Cleve-Euler 1953, p. 93, Fig. 410; Hustedt 1959a, pl. 314, Fig. 779

This taxon was never common in a sample and seems to be confined to Magela Creek and Radon Springs. It was found in the billabongs of the upper reaches from Bowerbird to Island.

3.2.13.25 *Eunotia rabenhorstiana* var. *elongatum* (Patrick 1940) Brady 1979

Plate 4/12; 15/1-3: Leichhardt Billabong, 8 July 1978, #455

Brady 1979, p. 29, pl. 3/3-5

Desmogonium rabenhorstianum var. *elongatum* Patrick 1940, p. 3, Fig. 1-3; Patrick and Reimer 1966, p. 221-222, pl. 14/15

Contrary to Van Landingham (1969, p. 1281) and Brady (1979, p. 29) this form does belong to the *Desmogonium* group as indicated in plate 15/1-3, by the presence of a rimoportule at each pole of the valve, and marginal spines. However for the reasons advanced above in the consideration of *Eunotia didyma* the taxon has been retained in the genus *Eunotia* until a better appraisal of the two genera can be made.

This taxon was common in some samples from various billabongs in the Region, being recorded in samples from Gulungul, Island, Jabiluka, Leichhardt and Nankeen on the Magela Creek, from Jingalla and Long Harrys Billabongs on the Nourlangie Creek and from Jim Jim Falls. Brady (1979) also collected it from the Darwin and Elizabeth Rivers.

3.2.13.26 *Eunotia rabenhorstii* var. *africana* f. *triodon* Hustedt 1949

Plate 2/19: Bowerbird Billabong, 7 November 1978, #509

Hustedt 1949, p. 69, pl. 2/10

Originally found by Hustedt (1949) in the Albert National Park in what was the Belgian Congo, this was a common planktonic form often associated with *Asterionella zasuminensis*. It is characterised by the slightly rhomboid girdle view, and greater to lesser degrees of capitation of the poles in valve view.

It was found in Bowerbird, Island, Jabiluka, Leichhardt, Nankeen and Red Lily Billabongs on the Magela Creek and in Long Harrys on the Nourlangie Creek.

3.2.13.27 *Eunotia sudetica* var. *australis* Cleve-Euler 1948

Plate 2/24: Radon Springs, 7 September 1979, #893

Cleve-Euler 1948, p. 13, pl. 1/10

? *Eunotia sudetica* var. *hamuranaensis* Foged 1979, p. 51, pl. 10/9.

Without a comparative study of the two sets of type material it is impossible to be certain that Foged's (1979) variety from New Zealand is the same as that described by Cleve-Euler (1948). However, the published information indicates that this is so.

In this study the taxon was found in the upper reaches of the Magela Creek at Bowerbird, Coonjimba, Gulungul and Island Billabongs, in Radon Springs, in Umbungbung Billabong on the Nourlangie Creek, and the area around Rum Jungle.

3.2.13.28 Eunotia triconfusa Van Landingham 1969

Plate 2/23: Bowerbird Billabong, 11 August 1979, #857

Van Landingham 1969, p. 1492

Eunotia attenuata Manguin *in* Allorge and Manguin 1941, p. 174, Fig. 444

This taxon was renamed by Van Landingham (1969) owing to the earlier naming of *E. attenuata* Cleve-Euler 1934.

This was not a common taxon in samples frdom Magela Creek and was not observed in samples from outside the area. It was found in Radon Springs, Bowerbird, Gulungul and Nankeen Billabongs and is therefore probably distributed throughout the system, but in very low numbers.

3.2.13.29 Eunotia trigibba Hustedt 1913

Plate 3/7: Gulungul Billabong, 1 June 1979, #722

Hustedt 1913 *in* Schmidt et al. 1874-1959, pl. 286/16-18

Foged 1978, p. 61, pl. 10/11,12; Foged 1979, p. 52

Eunotia subgibba Gandhi 1966, p. 129, Fig. 35; Foged 1978, p. 61, pl. 10/7; Brady 1979, p. 22, pl. 2/17

The form, observed in Magela Creek samples, covered the range in morphology between *E. trigibba* and *E. subgibba* as well as being potentially part of the *E. camelus* series (see above). Thus Gandhi's (1966) form is here treated as a synonym, until further taxonomic revision of this group can be undertaken.

As with *E. camelus* this taxon was found throughout the Magela Creek in samples from Magela Falls to Nankeen Billabong, in samples from Long Harrys and Umbungbung Billabongs on the Nourlangie Creek.

3.2.13.30 Eunotia trinacria var. *undulata* Hustedt 1930

Plate 2/21; 15/6: Island Billabong, 21 April 1979, #630

Hustedt 1930b, p. 176, Fig. 222

Hustedt 1933 *in* Schmidt et al. 1874-1959, pl. 382/78-83; Cleve-Euler 1953, p. 103, Fig. 433d,e; Hustedt 1959a, p. 285, Fig. 750d-i; Patrick and Reimer 1966, p. 217-218, pl. 14/5

This taxon should perhaps be considered as a form of var. *undulata* as it is much more slender than the type illustrated by Patrick and Reimer (1966, pl. 14/5).

Found only in the Magela Creek in this study, it was relatively widely distributed in that area from Bowerbird to Nankeen Billabongs.

3.2.13.31 *Eunotia zygodon* Ehrenberg 1841

Plate 4/8: Rum Jungle, 12 December 1979, #1011

Ehrenberg 1841, p. 415, pl. 2/1, Fig. 6

Hustedt 1913 *in* Schmidt et al. 1874-1959, pl. 289/16-18; Patrick and Reimer 1966, p. 199, pl. 11/8 (as var. *zygodon*)

There is very little to distinguish this taxon from *E. pseudoindica* var. *gracilis* (Frenguelli 1933) except the more extended poles and less acute dorsal swellings of the latter, and the Frenguelli name may have to be added to the synonymy of this taxon.

An uncommon form in samples from Magela Falls, Radon Springs and Bowerbird Billabong, it was also found in samples from Rum Jungle.

3.2.13.32 *Eunotia zygodon* var. *depressa* Husteddt 1913

Plate 4/10: Bowerbird Billabong, 11 August 1979, #857

Hustedt 1913 *in* Schmidt et al. 1874-1959, pl. 287/5,13

This taxon is widely distributed in the Magela Creek but not common in any samples except one from Jim Jim Falls. It was found in samples from Bowerbird, Gulungul, Corndorl, Island, Jabiluka and Leichhardt Billabongs as well as Umbungbung Billabong on the Nourlangie Creek and Red Lily near the East Alligator River.

3.2.13.33 *Eunotia zygodon* var. *elongata* Hustedt 1913

Plate 4/9: Jim Jim Falls pool, 19 August 1979, #868

Hustedt 1913 *in* Schmidt et al. 1874-1959, pl. 187/14

This taxon differs from var. *depressa* and var. *emarginata* in having one pair of dorsal swellings with the maximum breadth skewed towards the centre and with elongate and uninflated poles on the valves.

It was found only in samples from Jim Jim Falls.

3.2.13.34 *Eunotia zygodon* var. *emarginata* Hustedt 1913

Plate 4/11: Jim Jim Falls pool, 19 August 1979, #868

Hustedt 1913 *in* Schmidt et al. 1874-1959, pl. 287/6

Eunotia sibirica Cleve *in* Cleve and Grunow 1880 *sensu* Brady 1979, p. 24, pl. 3/1

This taxon has very little resemblance to Cleve's species and was misidentified by Brady (1979). This variety differs from *E. depressa* in that the latter has a more skewed distribution of the dorsal swellings and more truncated poles.

Found only in Jim Jim Falls and a sample from Gulungul Billabong.

3.2.14 FRAGILARIA Lyngbye 1819

3.2.14.1 Fragilaria strangulata (Zanon 1939) Hustedt 1949

Plate 2/16: Radon Springs, 7 September 1979, #892

Hustedt 1949, p. 62, Fig. 19-28

Synedra strangulata Zanon 1938, p. 587, Fig. 14

Found only in the scarp sites in samples from Magela Falls, Radon Springs and Baroalba Springs. A planktonic form, previously only reported from the Congo (Zaire).

3.2.15 FRUSTULIA Agardh

3.2.15.1 Frustulia entrancensis Foged 1978

Plate 6/6: Radon Springs, 7 September 1979, #890

Foged 1978, p. 65, pl. 19/15,16

Described in samples from brackish water at Lakes Entrance in southeastern Victoria by Foged (1978) it presumably must have been washed there from freshwater if this, the only other record, is to be taken into account. The only site where it occurred was Radon Springs, a freshwater habitat.

3.2.15.2 Frustulia rhomboides (Ehrenberg 1841) De Toni 1891

Plate 6/3-5: Radon Springs, 7 September 1979, #892; Second Magela Crossing, 21 April 1979, #634

De Toni 1891, p. 277

Hustedt 1930 *in* Schmidt et al. 1874-1959, pl. 396/1,2; Hustedt 1930b, p. 220-221, Fig. 324; Hustedt 1942, p. 46; Cleve-Euler 1952, p. 7; Crosby and Wood 1959, p. 21, pl. 6/58A,B; Hustedt 1959a, p. 728, Fig. 1097a-g, 1098a; Prowse 1962, p. 28, pl. 8/a,b; Hendey 1964, p. 239; Patrick and Reimer 1966, p. 306, pl. 21/5 (as var. *rhomboides*); Foged 1978, p. 65; Foged 1979, p. 55; Brady 1979, p. 32, pl. 4/11.
Navicula rhomboides Ehrenberg 1841, p. 419, pl. 3/1, Fig. 15

This tube-dwelling form was widespread in the Magela Creek and has been observed in various parts of Australia (Crosby and Wood 1959; Foged 1978) as well as other parts of the world in acid freshwaters (Foged 1978). Found in all sites of the Magela Creek system except Magela Falls. On the Nourlangie Creek it was found in samples from Jingalla and Long Harrys Billabongs.

Also found in samples from Jim Jim Falls, Baroalba Springs, the East Finniss River and Lake Argyle.

3.2.16 GOMPHONEMA Agardh

3.2.16.1 Gomphonema gracile Ehrenberg 1838

Plate 6/8: Second Magela Crossing, 21 April 1979, #634

Ehrenberg 1838, p. 217, 18/3

Van Heurck 1896, p. 272, pl. 7/309; Fricke 1902 *in* Schmidt et al. 1874-1959, pl. 236/16; Hustedt 1930b, p. 376, Fig. 702; Hustedt 1942, p. 116; Cleve-Euler 1955, p. 185; Wood 1961, p. 692, pl. 54/162; Prowse 1962, p. 61, pl. 16/a,e; Gandhi 1970, p. 765-766, Fig. 35; Foged 1971, p. 289, pl. 16/10,12; Patrick and Reimer 1975, p. 131-132, pl. 17/1-3 (as var. *gracile*); Foged 1976, p. 25; Foged 1978, p. 69, pl. 39/7; 40/21,22; Foged 1979, p. 58, pl. 37/11; Brady 1979, p. 35, pl. 4/16

Foged (1978, 1978) characterised this taxon as a cosmopolitan form of alkaline waters. While it was certainly widespread, it was found in large numbers in the Magela system in both acid and alkaline waters. Found in samples from all sites from Magela Falls to the East Alligator River, with the exception of Radon Springs. Also found in samples from all sites in the Nourlangie Creek, the Mary River and Lake Argyle.

3.2.16.2 Gomphonema intricatum var. *vibrio* (Ehrenberg 1841) Cleve 1894

Plate 6/7: Magela Falls pool, 28 September 1979, #927

Cleve 1894, p. 182

Van Heurck 1896, p. 273, pl. 29/812; Hustedt 1930b, p. 376, Fig. 698, Cleve-Euler 1955, p. 187, Fig. 1283e,f; Foged 1971, p. 290, pl. 17/1; Patrick and Reimer 1975, p. 135, pl. 18/4; Foged 1978, p. 70, pl. 39/5

Gomphonema vibrio Ehrenberg 1841, p. 416, pl. 2/1, Fig. 40.

This taxon differs from *G. gracile* in being larger and having more regularly spaced striae.

This was not a common form in the Magela Creek samples and was not found in sites outside the Magela catchment in this study. It was found throughout the Magela Creek system from Magela Falls, Bowerbird and Gulungul Billabongs in the upper reaches and from Nankeen and Red Lily Billabongs in the lower regions.

3.2.16.3 Gomphonema parvulum (Kuetzing 1844) Kuetzing 1849

Plate 6/10-12: Nankeen Billabong, 8 July 1978, #460; Jabiluka Billabong, 29 September 1978, #508

Kuetzing 1849, p. 65

Van Heurck 1896, p. 272, pl. 7/306: Fricke 1902 *in* Schmidt et al. 1874-1959, pl. 234/2-15,18-19; Hustedt 1930b, p. 372, Fig. 713a; Hustedt 1942, p. 113; Cleve-Euler 1955, p. 177; ? Wood 1961, p. 693, pl. 54/164 (inadequate illustration); Prowse 1962, p. 61, pl. 16/c,d,g-i; Foged 1971, p. 291; Patrick and Reimer 1975, p. 122-123, pl. 17/7-12 (as var. *parvulum*); Foged 1976, p. 26, pl. 8/13; 9/17; Foged 1978, p. 71, pl. 40/12,15; Foged 1979, p. 59, pl. 37/7

Gomphonema parvulum var. *subelliptica* Cleve 1894 *sensu* Brady 1979, p. 37, pl. 4/15

This taxon varies from the other taxa described here by its small size, somewhat inflated valves and a tendency to capitate poles.

Sometimes dominant, this form was common in samples from the lower regions of Magela Creek from Gulungul through to Nankeen Billabongs and even in samples from the East Alligator River. Therefore it is probably more salt-tolerant than *G. gracile* with which it may be co-dominant in the middle regions. Also found in Jingalla Billabong on the Nourlangie Creek and in samples from Lake Moondarra.

3.2.16.4 Gomphonema subtile Ehrenberg 1841

Plate 6/9: Gulungul Billabong, 8 December 1979, #1308

Ehrenberg 1841, p. 416

Van Heurck 1896, p. 271, p. 29/811; Hustedt 1930b, p. 376, Fig. 709; Hustedt 1942, p. 119; Cleve-Euler 1955, p. 177, Fig. 1268a,b (as var. *typicum*); Prowse 1962, p. 61-62, pl. 16/b,j-l; Foged 1971, p. 292; Patrick and Reimer 1975, p. 117-118, pl. 16/1 (as var. *subtile*)

This form differs from the other taxa described here in its small size, slender shape and low strial density.

A rare taxon, it was found only in one sample from Gulungul Billabong and in one from the Second Magela Crossing of the Oenpelli Road.

3.2.17 GYROSIGMA Hassall *emend.* Cleve

3.2.17.1 Gyrosigma attenuatum (Kuetzing 1833) Rabenhorst 1853

Plate 8/7: Lake Moondarra, 10 November 1979, #959

Rabenhorst 1853, p. 47, pl. 5/2

Hustedt 1930b, p. 224, Fig. 330; Cleve-Euler 1952, p. 12; Prowse 1962, p. 29, pl. 10/c; Patrick and Reimer 1966, p. 319, pl. 24/1 (as var. *attenuatum*); Foged 1978, p. 73, pl. 21/3,4

Frustulia attenuata Kuetzing 1833, p. 555, pl. 14/35

Gyrosigma accuminatum (sic) (Kuetzing 1833) Rabenhorst 1853 *sensu* Brady 1979, p. 39, pl. 4/10.

G. attenuatum differs from *G. acuminatum* in that the raphe curves continuously to a point near the central nodule, whereas the latter taxon has a raphe that is straight for at least a quarter of the length of the cell on either side of the central nodule. As can be seen from both Brady's (1979, pl. 4/10) and the illustration presented here (pl. 8/7), *G. attenuatum* is the correct name for the Magela Creek taxon. Foged (1978) characterised this taxon as a cosmopolitan form of alkaline waters and this may explain its rarity in the usually acid waters in this region. Found in one sample from Red Lily Billabong and also Lake Moondarra. Brady (1979) reported this form from the Darwin and Elizabeth Rivers.

3.2.18 HANTZSCHIA Grunow

3.2.18.1 Hantzschia amphioxys (Ehrenberg 1841) Grunow *in* Cleve and Grunow 1880

Plate 11/6: Mary River, 5 August 1979, #867

Cleve and Grunow 1880, p. 103

Van Heurck 1896, p. 381, Fig. 123, pl. 15/483b; Hustedt 1921 *in* Schmidt et al. 1874-1959, pl. 329/11,12,15-20; Hustedt 1930b, p. 394, Fig. 747; Hustedt 1942, p. 127; Cleve-Euler 1952, p. 46; *non* Crosby and Wood 1959, p. 40, pl. 8/120 (= *H. virgata* ?); Foged 1971, p. 294, pl. 18/3; Foged 1976, p. 27; Foged 1978, p. 75; Foged 1979, p. 62; ? Brady 1979, p. 49, pl. 6/2 (as *Nitzschia* No. 2)

Foged (1978) characterised this taxon as cosmopolitan but it was found only in samples from Coonjimba Billabong and the Mary River.

3.2.18.2 Hantzschia amphioxys var. *gracilis* Hustedt 1921

Plate 13/1: Coonjimba Billabong, 6 August 1979, #800

Hustedt 1921 *in* Schmidt et al. 1874-1959, pl. 329/6-8

Cleve-Euler 1952, p. 52, Fig. 1421i

While this taxon was not common in any of the samples studied it was present in many of the samples from Coonjimba, Gulungul and Corndorl Billabongs and the First Magela Crossing and Hades Flat on the Oenpelli Road. In addition it occurred in samples from Long Harrys and Umbungbung Billabongs on the Nourlangie Creek and from Lake Argyle.

3.2.19 MASTOGLOIA Thwaites *in* W. Smith

3.2.19.1 Mastogloia elliptica var. *dansei* (Thwaites 1848) Cleve 1895

Plate 6/13-15: Lake Moondarra, 10 November 1979, #957

Cleve 1895, p. 152-153

Hustedt 1959a, p. 501, Fig. 927b; Hendey 1964, p. 238; Patrick and Reimer 1966, p. 300-301, pl. 20/20-23; Foged 1976, p. 29; Foged 1978, p. 78, pl. 17/12; Foged 1979, p. 64
Dickieia dansei Thwaites 1848, p. 171-172, pl. 12/K, Fig. 1-4

Foged (1978, 1979) characterised this taxon as a cosmopolitan form of alkaline, slightly saline waters and this was borne out by the presence of abundant cells in sites like Red Lily and Nankeen Billabongs where salinities were elevated for most of the dry season, and in sites like the shallow Gulungul and Corndorl Billabongs where salinities were elevated towards the end of the dry season. Also collected from Lakes Argyle and Moondarra late in the dry season.

3.2.20 MELOSIRA Agardh

The following taxa in this genus have been recently removed and placed in *Aulacosira* Thwaites by Simonsen (1979, p. 15-17). While there is a need to remove this group from the genus *Melosira* (see Thomas and Gould 1981) the features that Simonsen (1979) used to differentiate this group and place it in the Thalassiosiraceae are not stable, and hence not usable in making the distinction (Thomas and Gould 1981, pp. 30,33, Figs. 4/4,5; 5/1,2). The grouping with *Melosira* has been therefore retained here until a careful study of the groups can be completed.

3.2.20.1 Melosira distans (Ehrenberg 1836) Kuetzing 1844

Plate 2/6: Gulungul Billabong, 29 September 1978, #498

Kuetzing 1844, p. 54, pl. 2/12

Schmidt et al. 1874-1959, pl. 181/64,65,68; 182/4,5; Van Heurck 1896, p. 442, pl. 19/61b; Hustedt 1930a, p. 262, Fig. 110a-e; Hustedt 1930b, p. 92-93, Fig. 53; Cleve-Euler 1951, p. 20; *non* Wood et al. 1959, p. 211-212, pl. 15/3 (?= *M. moniliformis*); Foged 1971, p. 296; Foged 1976, p. 29; Foged 1978, p. 81, pl. 1/13; Foged 1979, p. 65, pl. 3/14

Gallionella distans Ehrenberg 1836, pl. 3/5

? *Melosira* sp. A Thomas and Gould 1981, p. 29-30, Fig. 3/1-4; 4/1-3

The small size of this taxon prevents detailed study being undertaken without the aid of an electron microscope and, since the only one available had poor resolution, the relationship between this taxon and the form reported by Thomas and Gould (1981) could not be verified.

Found mainly in the Magela catchment during this study, this taxon was not common in any of the samples but occurred occasionally in samples from Coonjimba, Gulungul, Island, Leichhardt, Nankeen and Red Lily Billabongs. Also found in a sample from Umbungbung Billabong on the Nourlangie Creek and from the Mary River.

3.2.20.2 Melosira granulata (Ehrenberg 1841) Ralfs *in* Pritchard 1861

Plate 2/7-11: Mary River, 5 August 1979, #867; Bowerbird Billabong, 7 November 1978, #509

Pritchard 1861, p. 820

Van Heurck 1896, p. 444, pl. 19/621; Hustedt 1930a, p. 248, Fig. 104; Hustedt 1930b, p. 87, Fig. 44; Hustedt 1942, p. 9; Cleve-Euler 1951, p. 24; ? Wood et al. 1959, p. 211, pl. 15/2 (illustration inadequate); Prowse 1962, p. 6, pl. 1/a,b; Foged 1971, p. 296, pl. 6/13; Foged 1976, p. 29, pl. 1/1,2; Foged 1978, p. 81, pl. 1/4,9; Foged 1979, p. 66, pl. 1/1-3,8,9; Thomas and Gould 1981, p. 30,33, Figs. 3/5-21; 4/4,5; 5/1-5; 6/1-4

Melosira aff. *granulata* Brady 1979, p. 40, pl. 5/2

Melosira aff. *islandica* Brady 1979, p. 40, pl. 5/3,4

Foged (1978, 1979) characterised this taxon as cosmopolitan and favouring alkaline waters. This last characteristic is not borne out by its distribution in the acidic waters of the tropical north of Australia where it is a common planktonic form, frequently dominating the planktonic assemblages througnout the Magela Creek from Magela Falls to the Magela outflow at the East Alligator River. Also present in samples from all sites on the Nourlangie Creek, Deaf Adder, Jim Jim Falls, the Mary River, the East Finniss River and Lake Argyle.

3.2.20.3 Melosira granulata var. *angustissima* Otto Müller 1899

Plate 2/12,13: Bowerbird Billabong, 11 August, 1979, #857

Muller 1899, p. 315, pl. 12/28

Hustedt 1930a, p. 250, Fig. 104d; Hustedt 1930b, p. 88, Fig. 45; Hustedt 1942, p. 10; Cleve-Euler 1951, p. 25, Fig. 15d,e; Foged 1971, p. 296; Foged 1976, p. 29, pl. 1/3,4; Foged 1978, p. 8, pl. 1/7; Foged 1979, p. 66, pl. 1/4,5

This variety differs from the type in consistently having a greater length to breadth ratio; however it is otherwise similarly structured. It was found in low numbers throughout the Magela Creek from Magela Falls to Leichhardt and Red Lily Billabongs, again contradicting Foged's (1978, 1979) characterisation of having a preference for alkaline waters.

3.2.20.4 Melosira granulata var. *muzzanensis* (Meister 1912) Hustedt 1930

Plate 2/14,15: Gulungul Billabong, 8 December 1979, #1308

Hustedt 1930b, p. 88, Fig. 47

? Thomas and Gould 1981, p. 30,33, Figs. 3/11-14,17-20; 5/3-5; 6/1 (as small-pored form of *Melosira granulata)*

Melosira muzzanensis Meister 1912 p. 41, pl. 1/10

This taxon differs from the type of the species in the small size of its areolae (pores) and their greater density.

This form was found only in the three backflow billabongs, Coonjimba, Gulungul and Corndorl, and in several samples from Leichhardt Billabong.

Rather than being planktonic it seems to live mostly in the periphyton assemblages.

3.2.21 NAVICULA Bory

3.2.21.1 Navicula acceptata Hustedt 1950

Plate 7/4: Bowerbird Billabong, 11 August 1979, #87

Hustedt 1950, p. 398, pl. 38/66,67; Hustedt 1966, p. 247-248, Fig. 1372

This taxon differs from *N. pseudislandica* which it superficially resembles in outline, by being more oval than lanceolate and in having a single stria on each side of the central nodule separated from the striae on either side by a wide interstria.

Where present, cells of this form were sometimes abundant in the samples from such widely separated sites as Bowerbird, Leichhardt and Red Lily Billabongs in the Magela catchment and from Long Harrys Billabong, Lake Argyle and the channels around Rum Jungle.

3.2.21.2 Navicula americana Ehrenberg 1841

Plate 7/26: Gulungul Billabong, 8 December 1979, #1308

Ehrenberg 1841, p. 417

Van Heurck 1896, p. 223, pl. 5/21; Hustedt 1914 *in* Schmidt et al. 1874-1959, pl. 312/7-17; Hustedt 1930b, p. 280, Fig. 464; Hustedt 1942, p. 64; Cleve-Euler 1953, p. 183; ? Crosby and Wood 1959, p. 17, pl. 4/48 (illustration inadequate); Hustedt 1966, p. 111, Fig. 1246; Patrick and Reimer 1966, p. 493-494, pl. 47/3 (as var. *americana*); Foged 1971, p. 297; Foged 1976, p. 30, pl. 10/18; Foged 1978, p. 84, pl. 28/6; Foged 1979, p. 68, pl. 24/7; Brady 1979, p. 41, pl. 5/11 (as *N. pupula* f. *rectangularis*)

This taxon differs from *N. pupula* var. *rectangularis* in having a broad and thickened axial area, nearly parallel striae towards the poles, and in lacking the 'bow tie' shaped fascia at the centre.

Foged (1978,1979) characterised this taxon as a cosmopolitan form of alkaline waters and this perhaps explains its limited distribution in the samples observed in this study. It was found only in the sediments of Gulungul Billabong on the Magela Creek, in Umbungbung Billabong on the Nourlangie Creek and from the Diversion Channel at Rum Jungle.

3.2.21.3 Navicula anglica var. *subsalsa* (Grunow 1860) Cleve 1895

Plate 7/18: Mary River, 5 August 1979, #866

Cleve 1895, p. 22

Hustedt 1930b, p. 303; Cleve-Euler 1953, p. 141, Fig. 790g-k; Patrick and Reimer 1966, p. 520-521, pl. 49/20

Navicula tumida var. *subsalsa* Grunow 1860, p. 537, pl. 4/43b,c

Navicula No. 5 Brady 1979, p. 43, pl. 5/7,8

The taxon was found in one sample from Bowerbird Billabong on Magela Creek.

3.2.21.4 *Navicula arvensis* Hustedt 1936

Plate 7/3: Nankeen Billabong, 8 July 1978, #459

Hustedt 1936 *in* Schmidt et al. 1874-1959, pl. 401/22-26; Hustedt 1942, p. 60; Hustedt 1966, p. 86, Fig. 1229; Patrick and Reimer 1966, p. 483, pl. 46/1,2

Patrick and Reimer (1966) characterised this taxon as being semitropical owing to its presence in some of the less tropical areas of North America. In this study it was only found in several samples from Nankeen Billabong on the Magela Creek.

3.2.21.5 *Navicula bremensis* Hustedt 1957

Plate 7/11: Second Magela Crossing, 21 April 1979, #634

Hustedt 1957, p. 284, Figs. 34,35; Hustedt 1966, p. 227, Fig. 1346

This taxon differs from *N. jungii* in having the valve slightly inflated in the central region and in not having a gap or fascia between the striae on either side of the central area.

Only found in one sample from the First Magela Crossing of the Oenpelli Road and in several samples from downstream in Island Billabong.

3.2.21.6 *Navicula diserta* Hustedt 1939

Plate 7/19: Magela Outflow, 11 September 1979, #895

Hustedt 1939, p. 627, Figs 78,79

This taxon was rarely observed and was found in samples from two separate sites, Twin Falls and the East Alligator River.

3.2.21.7 *Navicula disparata* Hustedt 1942

Plate 7/22,23: Red Lily Billabong, 20 February 1980, #1240

Hustedt 1942, p. 61-62, Fig. 109; Prowse 1962, p. 42, pl. 12/m

This is the first record outside of Malaysia of this distinctive colonial taxon. Apparently a planktonic form, it was found to be relatively abundant in samples from Magela Falls, Corndorl, Island and particularly Leichhardt, Nankeen and Red Lily Billabongs. Also collected from Long Harrys Billabong, Lake Argyle and sites around Rum Jungle.

3.2.21.8 Navicula dutoitana Cholnoky 1959

Plate 7/8: Bowerbird Billabong, 11 August 1979, #857

Cholnoky 1959, p. 37, pl. 5/198-201

This form is distinguished from the other *Navicula* taxa referred to here by its slender shape in valve view with the slightly restricted poles and relatively hyaline, fine structure of the valve surface.

This is the first record of this taxon outside the Cape Province, South Africa, and in this case it was found in one sample from Bowerbird Billabong on the Magela Creek.

3.2.21.9 Navicula geinitzi Bünte 1901

Plate 7/14: Rum Jungle, 12 December 1979, #1011

Bünte 1901, pp. 53,123, pl. 1

Van Landingham (1975, p. 2560) suggested that this taxon probably belongs in *Anomoeoneis* but there was insufficient information based upon light microscopy to allow a determination and this form was not recognised in samples studied using the scanning electron microscope to back up this suggestion.

It was found in samples from Island Billabong and the area around Rum Jungle.

3.2.21.10 Navicula gysingensis Foged 1952

Plate 7/1,2: Gulungul Billabong, 7 July 1978, #446

Foged 1952, p. 167, Fig. 7

Patrick and Reimer 1966, p. 483, pl. 46/3 (as var. *gysingensis*);
Foged 1976, p. 34

Navicula No. 8 Brady 1979, p. 45, pl. 15,16

Patrick and Reimer (1966) characterised this taxon as preferring acid, soft water. Little evidence for or against this interpretation can be gained owing to the few samples in which it was observed and the inherent difficulties posed by its small size and almost invisible structure. It was found in a few samples from Gulungul and Island Billabongs on the Magela Creek.

3.2.21.11 Navicula halophilioides Hustedt 1959

Plate 7/15: Leichhardt Billabong, 8 July 1978, #455

Hustedt 1959b, p. 402, Fig. 4-7; Hustedt 1966, p. 68, Fig. 1213

Navicula cuspidata (Kuetzing 1833) Kuetzing 1844 *sensu* Brady 1979, p. 41, pl. 5/6

This taxon differs from *N. cuspidata* (the rostrate form) in being less rostrate at the poles, in having no broadening of the axial area in the region of the central nodule, and in having no recurve on the raphe at the central nodule (*vide* Patrick and Reimer 1966, pl. 43/10).

It was found in samples from Leichhardt Billabong on the Magela Creek.

3.2.21.12 Navicula jungii Krasske 1938

Plate 7/9,10: Red Lily Billabong, 15 November 1979, #857

Krasske 1938, p. 528, pl. 11/13,14

Hustedt 1966, p. 146, Fig. 1228a

Found in the Magela Creek samples but not others, this taxon was most common in the lower floodplain billabongs Leichhardt, Nankeen and Red Lily, but was also observed in samples from Bowerbird and Island Billabongs.

3.2.21.13 Navicula mutica Kuetzing 1844

Plate 7/13: Radon Springs, 7 September 1979, #890

Kuetzing 1844, p. 93, pl. 3/32

Van Heurck 1896, p. 206, pl. 4/167; Hustedt 1930b, p. 274, Fig. 453a; Hustedt 1930 *in* Schmidt et al. 1874-1959, pl 370/23,24; Hustedt 1942, p. 52-53; Cleve-Euler 1953, p. 193; Hendey 1964, p. 190; Hustedt 1966, p. 583, Fig. 1592a-f; Patrick and Reimer 1966, p. 454, pl. 42/2; Foged 1971, p. 303, pl. 11/11; Foged 1976, p. 35, pl. 11/7-10; Foged 1978, p. 93, pl. 28/11; Foged 1979, p. 76, pl. 25/13; Brady 1979, p. 45, pl. 7/9 (as f. *cohnii*)

The structure of this form is between that of *N. mutica* and *N. mutica* var. *tropica* (Hustedt 1937, p. 233, pl. 17/6; later transferred to *Navicula terminata* Hustedt 1966, p. 589, Fig. 1594) because of the incursion of striae into the central area, as in *N. mutica*, but there was also a distinct stigma as in *N. terminata*. This should perhaps be considered to be either a variety of *N. terminata* or a stigmated form of *N. mutica*; it is more in line with the concept of *N. mutica* in the literature.

Found to be common in many of the samples in which it was observed, it was distributed throughout the Magela Creek system from Magela Falls through to Leichhardt Billabong, with the exception of Coonjimba, Corndorl and Jabiluka Billabongs. It was also found in samples from Long Harrys on the Nourlangie Creek and from Jim Jim Falls and the area around Rum Jungle.

3.2.21.14 Navicula nuda Pantocsek 1889

Plate 7/16: Coonjimba Billabong, 3 October 1979, #942

Pantocsek 1889, p. 51, pl. 6/108

Cleve-Euler 1952, p. 19, Fig. 1358

This taxon is similarly structured on the valve face to *N. halophila*, but differs in having pronounced rostrate, capitate poles.

It was found in samples from Coonjimba, Corndorl, Island and Leichhardt Billabongs on the Magela Creek, and in those from Umbungbung Billabong on the Nourlangie Creek and the Mary River, but was not common in samples from any of these sites.

3.2.21.15 *Navicula perrotettii* (Grunow 1867) Cleve 1894

Plate 8/9: Coonjimba Billabong, 3 October 1979, #943

Cleve 1894, p. 110, pl. 3/12

Schmidt et al. 1874-1959, pl. 211/33; Hustedt 1942, p. 51; Hustedt 1966, p. 56, Fig. 1205a,b,d,e; Foged 1971, p. 304, pl. 11/1; Foged 1976, p. 36, pl. 11/1; Foged 1978, p. 94, pl. 28/2,3; Foged 1979, p. 77-78

Craticula perrotettii Grunow 1867, p. 20, pl. 1/21

This taxon was found in one sample from Coonjimba Billabong and while this does not provide supporting evidence for Foged's (1978) characterisation of the taxon as cosmopolitan, it does support his contention that it is a tropical form.

3.2.21.16 *Navicula pseudislandica* nom. nov.

Plate 7/5,6: Magela Falls pool, 28 September 1979, #930

Navicula islandica Østrup 1918, p. 26, pl. 3/36 (*non* Grunow 1881)

The name was proposed to cover *N. islandica* Østrup 1918 which was invalidated by the prior name *N. islandica* Grunow *in* Cleve and Moller 1881, No. 262. This form seems very prone to malformation of the valves (e.g. Plate 7/6) where the structure of the raphe and the striae associated with it are not formed properly, being either distorted or partially incomplete. As this occurred mostly in samples from waterfall splashpools, the malformation is unlikely to be caused by heavy metal or other contamination and remains a mystery. For a comparison of this and *N. acceptata* see above.

It was found in Magela Falls and Jim Jim Falls but also, rarely, in samples from Leichhardt Billabong on the Magela Creek and from Long Harrys Billabong on the Nourlangie Creek.

3.2.21.17 *Navicula pseudosubtilissima* Manguin *in* Bourrelly and Manguin 1952

Plate 7/7: Jim Jim Falls Billabong, 19 August 1979, #870

Bourrelly and Manguin 1952, p. 64, pl. 3/71

This form differs from *N. dutoitana* in having radiating striae which leave a triangular interstria opposite the central nodule, and in being broader and less rostrate than the latter.

It was found predominantly in the upper regions of the Magela Creek, from Magela Falls to Coonjimba Billabong, but was also found in Jim Jim Falls and the area around Rum Jungle.

3.2.21.18 *Navicula pupula* Kuetzing 1844

Plate 7/24: Long Harrys Billabong, 12 September 1979, #904

Kuetzing 1844, p. 93, pl. 30/40
Cleve 1895, p. 131; Van Heurck 1896, p. 225, pl. 5/226; Hustedt 1930b, p. 281, Fig. 467a; Hustedt 1934 *in* Schmidt et al. 1874-1959, pl. 396/15-21; Cleve-Euler 1953, p. 186; Hustedt 1966, p. 120-121, Fig. 1254a-g; Patrick and Reimer 1966, p. 495-496, pl. 47/7; Foged 1971, p. 304; Foged 1976, p. 36, pl. 12/14; Foged 1978, p. 96, pl. 28/9; Foged 1979, p. 78, pl. 25/6,7; Brady 1979, p. 42, pl. 5/9

? *Navicula pupula* var. *convergens?* Brady 1979, p. 42, pl. 5/10 *(nomen nudum)*.

This was a common taxon in the Magela catchment being found in billabongs from Bowerbird through to Nankeen. A truly cosmopolitan taxon found in the temperate regions of Australia and elsewhere (Foged 1978), it was found also in Long Harrys and Umbungbung Billabongs on the Nourlangie Creek, in the Mary River and Lake Moondarra, and in one sample from the Rum Jungle Diversion Channel.

3.2.21.19 *Navicula pupula* var. *rectangularis* (Gregory 1854) Grunow *in* Cleve and Grunow 1880

Plate 7/25: Leichhardt Billabong, 8 July 1978, #455

Cleve and Grunow 1880, p. 45

Hustedt 1930b, p. 281, Fig. 467; Hustedt 1934 *in* Schmidt et al. 1874-1959, pl. 396/15,21,26,27,32,33; Hustedt 1942, p. 64; Cleve-Euler 1953, p. 187, Fig. 890d-f; Patrick and Reimer 1966, p. 497, pl. 47/12; *non* Brady 1979, p. 41, pl. 5/11.

Stauroneis rectangularis Gregory 1854, p. 99, pl. 4/17

Navicula pupula f. *rectangularis* (Gregory 1854) Hustedt 1966, p. 121, Fig. 1254n-q

Foged 1971, p. 304; Foged 1976, p. 37; Foged 1978, p. 97, pl. 28/15; Foged 1979, p. 79

Foged (1978, 1979) characterised this form as being cosmopolitan and while it tends to be found at sites where the typical variety has been found, it was generally less common and had a more restricted range than the latter in this study. It was found in samples from Coonjimba, Gulungul, Jabiluka and Leichhardt Billabongs in the Magela Creek catchment and in none of the other sites sampled.

3.2.21.20 Navicula radiosa Kuetzing 1844

Plate 7/21: Mary River, 5 August 1979, #867

Kuetzing 1844, p. 91, pl. 4/23

Schmidt et al. 1874-1959, pl. 47/50-52; Van Heurck 1896, p. 180, pl. 3/112; Hustedt 1930b, p. 299, Fig. 513; Hustedt 1934 *in* Schmidt et al. 1874-1959, pl. 395/5,6; Hustedt 1942, p. 69-70; Cleve-Euler 1953, p. 155, Fig. 816a-c (as f. *genuina*); Patrick and Reimer 1966, p. 509, pl. 48/15 (as var. *radiosa*); Foged 1971, p. 304, pl. 2/1; Foged 1976, p. 37, pl. 14/1-3; Foged 1978, p. 97, pl. 29/10,11; Foged 1979, p. 79, pl. 27/3; *non* Crosby and Wood 1959, p. 18, pl. 5/55; *non* Brady 1979, p. 44-45, pl. 5/14 (= *N. digitoradiata*).

Navicula peregrina (Ehrenberg 1841) Kuetzing 1844 *sensu* Crosby and Wood 1959, p. 16, pl. 4/45.

The two taxa represented here (*N. radiosa* and *N. viridula*) and the form illustrated by Brady as *N. radiosa (= N. digitoradiata)* (Brady 1979) show three different ways in which these taxa with radiate striae can overcome the problem of how to arrange the striae opposite the central area. In *N. radiosa*, the striae remain radiate with one or two striae being formed short and alternating with the longer striae so that the strial density at the margin is little changed. In *N. viridula* the striae also remain radiate opposite the central area, but do not alternate between short and long striae, with the result that the strial density decreases in the region opposite the central area. In *N. digitoradiata* the striae opposite the central area are formed at right angles to the raphe and so the shortest striae are on the outside of the group which may number between three and seven and fill the space left by the two nearest radiate striae.

N. radiosa was the commonest naviculoid form in the Magela Creek samples after *Frustulia rhomboides* and was found from Magela Falls to Nankeen and Red Lily Billabongs. In addition it was found in samples from Long Harrys and Umbungbung Billabongs on the Nourlangie Creek, Jim Jim and Twin Falls, the Mary River and Lakes Argyle and Moondarra.

3.2.21.21 Navicula rhynchocephala Kuetzing 1844

Plate 7/20: Radon Springs, 7 September 1979, #892

Kuetzing 1844, p. 152, pl. 30/35

Van Heurck 1896, p. 181, pl. 3/119; Hustedt 1930b, p. 296, Fig. 501; Hustedt 1942, p. 67; Cleve-Euler 1953, p. 157, Fig. 817a-g (as var. *genuina*); Prowse 1962, p. 47, pl. 11/d,q; Hendey 1964, p. 199; Patrick and Reimer 1966, p. 505, pl. 48/6 (as var. *rhynchocephala*): Foged 1971, p. 305, pl. 2/4, 11/20; Foged 1978, p. 98; Foged 1979, p. 80, pl. 29/1,2

Foged (1978, 1979) characterised this taxon as being a cosmopolitan form of alkaline waters, but in the samples studied here it was equally common in waters of a more acid than alkaline nature. For example, Bowerbird Billabong tended to have a year-round pH of about 6.2 and at the same time was well stocked with *N. rhynchocephala*. It was also found through most of the Magela Creek system including Radon Springs, and Coonjimba, Island, Jabiluka and Red Lily Billabongs. Outside this area it was less common but was observed in samples from Jim Jim Falls, the Mary River and Lake Argyle.

3.2.21.22 Navicula schwabei Krasske 1939

Plate 8/8: Mary River, 5 August 1979, #867

Krasske 1939, p. 388, pl. 12/1,2

Hustedt 1966, p. 777, Fig. 1750

This taxon differs from *N. perrotettii* in the radiate nature of its striae and the broad central area on either side of the central nodule.

This is the first time this taxon has been recorded outside southern Chile. Here it was found in Coonjimba and Gulungul Billabongs and in the First Magela Crossing of the Oenpelli Road and also in Long Harrys and Umbungbung Billabongs on the Nourlangie Creek and the Mary River samples.

3.2.21.23 Navicula viridula (Kuetzing 1833) Ehrenberg 1836

Plate 7/12: Rum Jungle, 12 December 1979, #1012

Ehrenberg 1836, p. 53

Van Heurck 1896, p. 179, pl. 3/115; Hustedt 1930b, p. 297, Fig. 503; Hustedt 1942, p. 72; ? *non* Crosby and Wood 1959, p. 16-17, pl. 3/47 (illustration and description unclear); Patrick and Reimer 1966, p. 506, pl. 48/9 (as var. *viridula*); Foged 1971, p. 308; Foged 1976, p. 38; Foged 1978, p. 100; Foged 1979, p. 82.

Frustulia viridula Kuetzing 1833, p. 23, pl. 13/12

For taxonomic comparisons see *N. radiosa* above.

Foged (1978, 1979) characterised this taxon as a cosmopolitan form of alkaline waters and this was borne out in this study by its presence in the slightly alkaline waters of Jabiluka and Red Lily Billabongs, and in samples from the East Finniss River, all from late in the dry season when conductivities are elevated.

3.2.21.24 Navicula yarrensis Grunow 1876

Plate 7/17: Jingalla Billabong, 29 November 1979, #1101

Grunow 1876 *in* Schmidt et al. 1874-1959, pl. 46/1-6

Cleve-Euler 1955, p. 3, Fig. 971; Crosby and Wood 1959, p. 17, pl. 4/50; Foged 1976, p. 38, pl. 12/10; 13/1-3; Foged 1978, p. 101, pl. 30/1-3.

This brackish water form was first described from the Yarra River in Victoria but has since been collected from temperate and tropical areas over most of the world. In this study it was found in samples from Jingalla Billabong on the Nourlangie Creek which is suspected of being slightly brackish owing to connection with the tidal waters of the lower South Alligator River.

3.2.22 NEIDIUM Pfitzer

3.2.22.1 Neidium bisulcatum (Lagerstedt 1873) Cleve 1894

Plate 7/28: Hades Flat, 21 April 1979, #625

Cleve 1894, p. 68

Hustedt 1930b, p. 242, Fig. 374; Cleve-Euler 1955, p. 109, Fig. 1155a,b (as var. *genuinum*); Patrick and Reimer 1966, p. 397, pl. 36/5 (as var. *bisulcatum*); Foged 1978, p 101; Foged 1979, p. 83.

Navicula bisulcata Lagerstedt 1873, p. 31, pl. 1/8

This taxon differs from *N. iridis* var. *amphigomphus* in having a valve outline with broadly rounded poles whereas the latter has restricted or cuneate poles.

Foged (1978, 1979) characterised this taxon as a cosmopolitan form of alkaline waters but it was also found in neutral and slightly acid waters from Coonjimba through to Jabiluka Billabong on the Magela Creek and in samples from Umbungbung Billabong on the Nourlangie Creek.

3.2.22.2 Neidium dilatatum (Ehrenberg 1841) Cleve 1894

Plate 8/10: Bowerbird Billabong, 2 October 1979, #935

Cleve 1894, p 70

Hustedt 1930b, p. 246, Fig. 385; Cleve-Euler 1955, p. 114, Fig. 1167a,b (as f. *typica*)

Navicula dilatata Ehrenberg 1841, p. 418

This large form was found infrequently in samples from Bowerbird, Leichhardt and Nankeen Billabongs and probably also lives in the billabongs between. Also collected from Deaf Adder and Jim Jim Falls.

3.2.22.3 Neidium iridis var. *amphigomphus* (Ehrenberg 1841) Tempére and Peragallo 1912

Plate 7/27: Hades Flat, 21 April 1979, #625

Tempére and Peragallo 1912, p. 312, No. 629

Hustedt 1930b, p. 245, Fig. 382; Patrick and Reimer 1966, p. 387-388, pl. 34/2; Foged 1978, p. 102; Foged 1979, p. 84

Navicula amphigomphus Ehrenberg 1841, p. 417, pl. 3/1, Fig. 8
Schmidt et al. 1874-1959, pl. 49/9

Neidium amphigomphus (Ehrenberg 1841) Pfitzer 1871, p. 39, Cleve-Euler 1955, p. 115, Fig. 1168a,b (as var. *genuina*); Crosby and Wood 1959, p. 21, pl. 5/61

For taxonomic comments see *N. bisulcatum* above.

Found in samples from all sites from Coonjimba to Nankeen Billabongs on the Magela Creek, Umbungbung Billabong on the Nourlangie Creek and the samples from the Mary River.

3.2.23 NITZSCHIA Hassall

3.2.23.1 Nitzschia congolensis Hustedt 1949

Plate 11/10: Island Billabong, 21 April 1979, #630

Hustedt 1949, p. 134, pl. 12/15,16

This taxon differs from *N. rostellata* in having a very slim, almost linear, valve with extended rostrate ends, not as inflated or as heavily silicified as in *N. rostellata*.

Originally discovered in the Congo River in Africa, this taxon was found, but rarely, in samples from Island, Jabiluka and Nankeen Billabongs on the Magela Creek.

3.2.23.2 Nitzschia cursoria (Donkin 1858) Grunow *in* Cleve and Grunow 1880

Plate 11/8: Fish gut contents, Nourlangie Creek, 15 September 1978, #1214

Cleve and Grunow 1880, p. 89

Van Heurck 1896, p. 394, pl. 33/879

Bacillaria cursoria Donkin 1858, p. 26, pl. 3/12

This taxon has a colony formation very similar to that of *Bacillaria paradoxa* and exhibits the same type of 'laminar flow' movement of one cell with respect to the cells on either side of it.

Found most commonly in samples from Leichhardt Billabong, this taxon was also found in a sample from Island Billabong and in a fish gut sample from Nourlangie Creek at the crossing of the Jim Jim Road.

3.2.23.3 Nitzschia delauneyi Manguin *in* Bourrelly and Manguin 1952

Plate 11/12: Jingalla Billabong, 29 November 1979, #1101

Bourrelly and Manguin 1952, p. 105, pl. 9/196

This taxon was the predominant one in the East Finniss River and Rum Jungle samples and was common in some samples from Jingalla Billabong on the Nourlangie Creek and the samples from the Mary River.

3.2.23.4 *Nitzschia habirshawii* Febiger *ex* H.L. Smith 1874-1879

Plate 13/2-4: Magela Outflow, 11 September 1979, #896

H.L. Smith 1874-1879, No. 346

Hendey 1964, p. 282

Nitzschia sigma var. *habirshawii* (Febiger *ex* Cleve and Möller 1881) Grunow *in* Van Heurck 1881, pl. 66/4

Cleve-Euler 1955, p. 75, Fig. 1470f

This rare but widespread taxon occurs in estuaries in various parts of Australia (Thomas, unpublished data) and was found in samples from the Magela outflow into the East Alligator River, where the salinity was approximately 29 ppt.

3.2.23.5 *Nitzschia lanceolata* W. Smith 1853

Plate 11/13: Nankeen Billabong, 4 October 1979, #975

W. Smith 1853, p. 40, pl. 14/118

Van Heurck 1896, p. 400, pl. 17/548; Cleve-Euler 1955, p. 84, Fig. 1491a-c (as var. *genuina*)

This taxon was found in samples from Corndorl and Nankeen Billabongs, as well as from the periphyton of Hades Flats, but was not common in any of the samples.

3.2.23.6 *Nitzschia littoralis* Grunow *in* Cleve and Grunow 1880

Plate 12/1: Jingalla Billabong, 29 November 1979, #1101

Cleve and Grunow 1880, p. 75

Hustedt 1921 *in* Schmidt et al. 1874-1959, pl. 334/22-24; Cleve-Euler 1955, p. 62, Fig. 1438ka,b,d,e (as var. *genuina*); Hendey 1964, p. 277

This taxon is similar to *N. tryblionella* var. *maxima* but is just over half its size and is not slightly constricted at the centre.

Found in one sample from Jingalla Billabong on the Nourlangie Creek.

3.2.23.7 *Nitzschia longissima* (Brébisson in Kuetzing 1849) Grunow 1862

Plate 11/9: Jingalla Billabong, 29 November 1979, #1101

Grunow 1862, p. 581

Van Heurck, 1896, p. 404; Cleve-Euler 1955, p. 92, Fig. 1508a,b (as var. *genuina*); Hendey 1964, p. 283

N. closterium (= *Cylindrotheca closterium* (Ehrenberg) Reimann and Lewin) *sensu* Foged 1976, p. 40, pl. 22/1; Foged 1978, p. 104, pl. 46/7; ? Foged 1979, p. 85

Found frequently in samples from Nankeen Billabong on the Magela Creek and also in a sample from Jingalla Billabong on the Nourlangie Creek.

3.2.23.8 *Nitzschia obtusa* var. *nana* Grunow *in* Van Heurck 1885

Plate 11/17: Jingalla Billabong, 29 November 1979, #1101

Van Heurck 1885, p. 180

Van Heurck 1896, p. 398, pl. 16/539; Hustedt 1922 *in* Schmidt et al. 1874-1959, pl. 347/22-24; Cleve-Euler 1955, p. 78, Fig. 1476i,k

This taxon differs from var. *scalpelliformis* in being about one-third the length and more finely structured.

As with most of the *Nitzschia* taxa observed in this study, this form was most common in the billabongs during the late dry season when near eutrophic conditions prevail, and this was particularly so for the Leichhardt, Nankeen and Jingalla Billabongs from which this was collected.

3.2.23.9 *Nitzschia obtusa* var. *scalpelliformis* Grunow *in* Cleve and Möller 1879

Plate 11/16: Jingalla Billabong, 29 November 1979, #1101

Cleve and Möller 1879, No. 204

Van Heurck 1896, p. 397, pl. 16/538; Hustedt 1921 *in* Schmidt et al. 1874-1959, pl. 336/22-24; Hustedt 1930b, p. 422, Fig. 817b; Cleve-Euler 1955, p. 78, Fig. 1476f-h; Prowse 1962, p. 68, pl. 19/o; 20/d; Gandhi 1970, p. 785, Fig. 99; Foged 1971; p. 312, pl. ?5/12; 18/4; Foged 1976, p. 42, pl. 22/10; Foged 1978, p. 108, pl. 46/2; Foged 1979, p. 88, pl. 43/8

Foged (1978,1979) characterised this form as euryhaline which is in keeping with its presence in floodplain billabongs such as Nankeen on the Magela Creek and Jingalla on the Nourlangie Creek, particularly towards the end of the dry season. Also found in Lake Moondarra at about the same time of the year.

3.2.23.10 *Nitzschia palea* (Kuetzing 1844) W. Smith 1856

Plate 11/15: Red Lily Billabong, 15 November 1979, #962

W. Smith 1856, p. 89

Van Heurck 1896, p. 401, pl. 17/554; Hustedt 1924 *in* Schmidt et al. 1874-1959, pl. 349/1-10; Hustedt 1930b, p. 416, Fig. 802; Hustedt 1942, p. 139; Cleve-Euler 1955, p. 90, Fig. 1504a (as var. *genuina*); Prowse 1962, p. 68, pl. 19k; Foged 1971, p. 312, pl. 5/8,10; Foged 1976, p. 42, pl. 20/11; Foged 1978, p. 108, pl. 45/11; 46/22; Foged 1979, p. 88-89, pl. 43/13; 44/7; Brady 1979, p. 48, pl. 6/3

Synedra palea Kuetzing 1844, p. 63, pl. 3/27

This was the most heavily silicified and most distinctly punctate form of this genus found in the tropical samples and as such differs from the more slender *N. subcapitellata* which it otherwise resembles.

This cosmopolitan form was common in samples from Rum Jungle and was frequent in samples from Coonjimba, Gulungul, Island, Leichhardt, Nankeen and Red Lily Billabongs towards the end of the dry season. It was also found in samples from Long Harrys Billabong on the Nourlangie Creek.

3.2.23.11 Nitzschia rostellata Hustedt 1922

Plate 11/11: Red Lily Billabong, 20 February 1980, #1239

Hustedt 1922 *in* Schmidt et al. 1874-1959, pl. 348/9

Described from Jamaica, this form was similar to *N. congolensis* but more rostellate and broader across the middle of the valve (see above).

It was found in samples from Magela Falls through to Nankeen and Red Lily Billabongs, but not from sites outside the Magela Creek/East Alligator River catchment.

3.2.23.12 Nitzschia subcapitellata Hustedt 1939

Plate 11/14: Red Lily Billabong, 15 November 1979, #962

Hustedt 1939, p. 633, Fig. 109

For comparison with *N. palea,* see above.

This taxon was wide-ranging, being found in the tropical samples from Bowerbird to Jabiluka and Red Lily Billabongs on the Magela Creek system, Jingalla and Umbungbung Billabongs on the Nourlangie Creek, and in the samples from the Mary River, Rum Jungle and Lake Argyle to the west.

3.2.23.13 Nitzschia tryblionella var. *maxima* Grunow *in* Cleve and Grunow 1880

Plate 12/2: Nankeen Billabong, 4 October 1979, #975

Cleve and Grunow 1880, p. 69

Hustedt 1921 *in* Schmidt et al. 1874-1959, pl. 332/21; Foged 1978, p. 111, pl. 43/2; Foged 1979, p. 90, pl. 41/8

Foged (1978, 1979) characterised this taxon as being a cosmopolitan form of alkaline brackish waters. This was borne out by its presence in samples from Nankeen and Jingalla Billabongs from late in the dry season when salinities were found to be elevated.

3.2.24 PINNULARIA Ehrenberg

3.2.24.1 Pinnularia acrosphaeria var. *turgidula* Grunow *ex* Cleve 1895

Plate 8/12: Gulungul Billabong, 8 December 1979, #1308

Cleve 1895, p. 86

Hustedt 1914 *in* Schmidt et al. 1874-1959, pl. 311/8,9; Hustedt 1942, p. 90; Cleve-Euler 1955, p. 25; Patrick and Reimer 1966, p. 624, pl. 60/4; Foged 1971, p. 315, pl. 13/10

This large and distinctive form was observed in samples from Gulungul Billabong and in no other, either inside the Magela Creek system or outside the area.

3.2.24.2 Pinnularia biceps Gregory 1856

Plate 10/3: Bowerbird Billabong, 28 November 1979, #1001

Gregory 1856, p. 8, pl. 1/28

Ross 1947, p. 201; Patrick and Reimer 1966, p. 599, pl. 55/14,15 (as var. *biceps*)

Pinnularia interrupta W. Smith 1853, p. 59, pl. 19/184; Hustedt 1930b, p. 317, Fig. 573; Cleve-Euler 1955, p. 63, Fig. 1089a,b (as var. *genuina*); Foged 1978, p. 115; Foged 1979, p. 95, pl. 33/7,9

Pinnularia braunii (Grunow *in* Van Heurck 1880) Cleve 1895 *sensu* Brady 1979, p. 52, pl. 6/13 (*non* 14)

This taxon differs from *P. braunii* and *P. braunii* var. *amphicephala* in having a relatively linear to slightly concave valve margin as against a linear to linear-lanceolate valve margin for var. *amphicephala* and a lanceolate valve for *P. braunii*. In addition, the striae, if a transverse fascia is formed, have one, or at most two, short striae forming each margin of the fascia, whereas the other two taxa form a fascia which is gradually derived from an expanding axial area and is therefore bordered by three or more shorter striae. The transition between the radiate and convergent striae in *P. biceps* is not as abrupt as observed in the other two taxa.

Gregory's (1856) later name is adopted here in agreement with Ross (1947) who felt that the earlier name of Smith (1853) was confusing.

The taxon was found in samples from Radon Springs and Bowerbird and Nankeen Billabongs, but was relatively rare in most samples and therefore may have a wider distribution in the Magela Creek catchment than these observations would imply.

3.2.24.3 Pinnularia bogotensis (Grunow 1876) Cleve 1895
Plate 9/6: Second Magela Crossing, 21 April 1979, #634

Cleve 1895, p. 83-84

Cleve-Euler 1955, p. 44, Fig. 1058a-c (as var. *genuina*);
Patrick and Reimer 1966, p. 610-611, pl. 57/7 (as var. *bogotensis*);
Foged 1971, p. 315; Foged 1976, p. 44, pl. 15/9

Navicula bogotensis (Grunow 1876 *in* Schmidt et al. 1874-1959, pl. 44/30-31

Foged (1971) characterised this taxon as being a tropical form from America and Asia but Patrick and Reimer (1966) also recorded it from the more temperate areas of the east coast of North America.

Not found outside the Magela Creek catchment in this study, it was frequently observed in samples from Bowerbird to Island Billabongs and from Hades Flats.

3.2.24.4 Pinnularia braunii var. *amphicephala* (Mayer 1917) Hustedt 1930

Plate 10/4,5: Gulungul Billabong, 1 June 1979, #722;
8 December 1979, #1308

Hustedt 1930b, p. 319, Fig. 578

Hustedt 1942, p. 81; Prowse 1962, p. 50, pl. 14/1, 15/e;
Patrick and Reimer 1966, p. 594-595, pl. 55/4; Foged 1971, p. 316, pl. 12/3; Foged 1976, p. 45, pl. 15/10,11; Foged 1978, p. 113, pl. 33/12,14; Foged 1979, p. 93.

Pinnularia amphicephala Mayer 1917, p. 136, pl. 2/15,16

For taxonomic comments see *P. biceps* above.

This taxon was common in samples from Coonjimba to Nankeen and Red Lily Billabongs in the Magela Creek system; it was found also in Long Harrys and Umbungbung Billabongs on the Nourlangie Creek, and in samples from Jim Jim Falls, the Mary River and Lake Argyle.

3.2.24.5 Pinnularia brevicostata f. *ventricosa* Hustedt 1942

Plate 9/2: Jabiluka Billabong, 27 April 1979, #656

Hustedt 1942, p. 89, Fig. 171

Foged 1978, p. 113, pl. 34/4

? Pinnularia gibba Ehrenberg 1841 *sensu* Crosby and Wood 1959, p. 22, pl. 5/67B *non* pl. 5/66 (= *P. gibba* var. *linearis*)

This taxon differs from the other non-fasciate taxa in having a very broad axial area which is nearly linear on one side and which bows towards the same margin as the raphe fissures at the centre of the valve on the other side. It has no defined central area.

A rare form in the samples where it was observed, it was found in diverse localities such as Red Lily Billabong on the East Alligator River, Umbungbung Billabong on the Nourlangie Creek, and Jim Jim Falls.

3.2.24.6 Pinnularia brevicostata var. *sumatrana* Hustedt 1934

Plate 8/11: Gulungul Billabong, 8 December 1979, #1308

Hustedt 1934 *in* Schmidt et al. 1874-1959, pl. 389/7-9

Hustedt 1942, p. 89-90; Foged 1971, p. 316, pl. 3/3,5; Foged 1978, p. 113; Foged 1979, p. 93, pl. 31/3.

This taxon differs from the type in being linear in outline rather than slightly lanceolate, and this feature also helps differentiate it from *P. gibba* var. *linearis* to which it may appear similar.

This form was rare in all samples in which it was observed, and of an apparently limited distribution from Coonjimba to Island Billabongs on the Magela Creek, and in samples from Umbungbung Billabong on the Nourlangie Creek.

3.2.24.7 Pinnularia gibba Ehrenberg 1841

Plate 9/7: Gulungul Billabong, 7 July 1978, #447

Ehrenberg 1841, p. 384, pl. 2/1, Fig. 24; 3/1, Fig. 4

Hustedt 1930b, p. 327, Fig. 600; Hustedt 1942, p. 88; Cleve-Euler 1955, p. 69, Fig. 1091a,b (as var. *genuina*); *non* Crosby and Wood 1959, p. 22-23, pl. 5/67 (= *P. gibba* var. *linearis*); Foged 1971, p. 317, pl. 3/1; Foged 1978, p. 114, pl. 33/6; Foged 1979, p. 94, pl. 31/4; 32/4; *non* Brady 1979, p. 50, pl. 6/6,7 (= *P. legumen*)

This taxon varies in structure from having no transverse fascia to having a broad fascia interrupting the striae opposite the central nodule. In outline it differs from both *P. gibba* var. *linearis* and *P. legumen,* which are similar to it, by having slightly inflated poles but with the margin almost concave between the poles and the centre, whereas the others have either convex to non-inflated poles or, if the poles are inflated at all, the valve is only restricted immediately behind the pole. Both forms of *P. gibba* differ from *P. legumen* in having broader and less dense striae and diamond-shaped rather than lanceolate central areas.

A rare form in all samples where it was observed, it was found in only three sites on the Magela Creek; Gulungul, Corndorl and Leichhardt Billabongs.

3.2.24.8 Pinnularia gibba var. *linearis* Hustedt 1930

Plate 9/5,8: Gulungul Billabong, 21 April 1979, #644

Hustedt 1930b, p. 327, Fig. 604

Foged 1978, p. 114-115; Foged 1979, p. 94-95, pl. 31/5

Pinnularia brevicostata Cleve 1891 *sensu* Crosby and Wood 1959, p. 22-23, pl. 5/66

Pinnularia abaujensis var. *linearis* (Hustedt 1930) Patrick *in* Patrick and Reimer, 1966, p. 613, pl. 58/3

Pinnularia microstauron var. *brebissoni* (Kuetzing) Mayer 1912 *sensu* Brady 1979, p. 53, pl. 6/9

Pinnularia hemiptera (Kuetzing) Rabenhorst 1853 *sensu* Brady 1979, p. 53, pl. 6/10

Patrick and Reimer (1966) give no reason why they considered that this variety should be assigned to *P. abaujensis* (Pantocsek 1889) Ross 1947 rather than to *P. gibba* Ehrenberg 1841 and there is no obvious reason why it should be transferred, as it has very little resemblance to the former.

For other taxonomic comments see *P. gibba* above.

A relatively common form, this taxon was found in all sites from Coonjimba to Nankeen Billabongs on the Magela Creek, in Long Harrys and Umbungbung Billabongs on the Nourlangie Creek, and in the Mary River.

3.2.24.9 Pinnularia intermedia (Lagerstedt 1873) Cleve 1895

Plate 9/11: Gulungul Billabong, 8 December 1979, #1308

Cleve 1895, p. 80

Hustedt 1914 *in* Schmidt et al. 1874-1959, pl. 313/28; Cleve-Euler 1955, p. 31, Fig. 1036a-g (as var. *genuina*); Patrick and Reimer 1966, p. 617, pl. 58/10 (as var. *intermedia*)

Navicula intermedia Lagerstedt 1873, p. 23, pl. 1/3

This taxon differs from *P. microstauron* in not having extended poles and in having transverse fascia which are bounded by four striae of nearly the same length as the rest of the striae on the valve, whereas *P. microstauron* tends to have several short striae forming the boundary of the fascia.
It was found in one sediment sample from Gulungul Billabong on the Magela Creek.

3.2.24.10 Pinnularia legumen Ehrenberg 1841

Plate 9/4: Jabiluka Billabong, 27 April 1979, #656

Ehrenberg 1841, pl. 4/1, Fig. 7

Hustedt 1930b, p, 322, Fig. 587; Hustedt 1934 *in* Schmidt et al. 1874-1959, pl. 392/8-10; Cleve-Euler 1955, p. 50, Fig. 1070a (as var. *genuina*); Prowse 1962, p. 51, pl. 8/e; Patrick and Reimer 1966, p. 608, pl. 57/2 (as var. *legumen*); Foged 1971, p. 318; Foged 1976, p. 46, pl. 16/6; Foged 1978, p. 116; Foged 1979, p. 96; *Pinnularia gibba* Ehrenberg 1841 *sensu* Brady 1979, p. 50, pl. 6/6,7

For taxonomic comments see *P. gibba* above. The taxon also differs from *Pinnularia luculenta* in the lanceolate outline of the central area, and the inflated rather than concave outline of the valve margin between the poles and the central region found in the latter.

A rare form, it was found in samples from Bowerbird, Gulungul and all sites between Island and Nankeen Billabongs on the Magela Creek, Red Lily Billabong beside the East Alligator River, and Jingalla Billabong on the Nourlangie Creek.

3.2.24.11 *Pinnularia luculenta* (A. Schmidt 1876) Cleve 1895

Plate 9/3: Hades Flats, 21 April 1979, #623

Cleve 1895, p. 82

Foged 1971, p. 318-319, pl. 14/10; Foged 1976, p. 46, pl. 16/4; Foged 1978, p. 116.

Navicula luculenta A. Schmidt 1876 *in* Schmidt et al. 1874-1959, pl. 43/12

For taxonomic comments see *P. legumen* above.

While characterising this taxon as a tropical form of Africa and Asia, Foged (1978) provided the first report of it from just outside the tropics in Queensland. This was a relatively common form in periphyton samples from Coonjimba through to Leichhardt Billabongs on the Magela Creek, and from Umbungbung Billabong on the Nourlangie Creek.

3.2.24.12 *Pinnularia major* (Kuetzing 1833) Rabenhorst 1853

Plate 8/13: Bowerbird Billabong, 2 October 1979, #935

Rabenhorst 1853, p. 42, pl. 6/5

Hustedt 1930b, p. 331, Fig. 614; Hustedt 1934 *in* Schmidt et al. 1874-1959, pl. 386/1,2; Hustedt 1942, p. 91; Cleve-Euler 1955, p. 70; Crosby and Wood 1959, p. 22, pl. 5/64; Patrick and Reimer 1966, p. 629, pl. 61/4 (as var. *major*); Foged 1976, p. 46; Foged 1978, p. 116

Frustulia major Kuetzing 1833, p. 547, pl. 14/25

This taxon is mainly distinguished by its large size (ca. 150-200 m). In a few samples, a rare valve of a heavily silicified giant form (ca 400 m) was observed, but was not seen intact.

It was found, though only rarely, in samples from Bowerbird through to Nankeen Billabongs on the Magela Creek and from Long Harrys and Umbungbung Billabongs on the Nourlangie Creek.

3.2.24.13 Pinnularia microstauron (Ehrenberg 1841) Cleve 1891

Plate 9/9,10: Gulungul Billabong, 1 June 1979 #722,

Nankeen Billabong, 8 July 1978 #459

Cleve 1891, p. 28

Hustedt 1930b, p. 320, Fig. 582; Hustedt 1942, p. 81; Cleve-Euler 1955, p. 55, Fig. 1073a-c (as var. *genuina*); Prowse 1962, p. 52, pl. 14/c,e; Patrick and Reimer 1966, p. 597-598, pl. 55/12 (as var. *microstauron*); Gandhi 1970, p. 787, Fig. 108; Foged 1971, p. 319, pl. 12/5-7; Foged 1976, p. 46, pl. 15/5,13,14; Foged 1978, p. 116; Foged 1979, p. 96, pl. 32/10,11

Pinnularia subcapitata Gregory 1856 *sensu* Brady 1979, p. 54, pl. 6/11

Pinnularia braunii (Grunow *in* Van Heurck 1880) Cleve 1895 *sensu* Brady 1979, p. 52, pl. 6/14 (*non* 13)

Stauroptera microstauron Ehrenberg 1841, pl. 1/4, Fig. 1

For taxonomic comments see *P. intermedia* above.

This was probably the most common taxon of the genus in Magela Creek samples and was found in all billabongs from Bowerbird to Nankeen and Red Lily. It was also found in samples from Umbungbung on the Nourlangie Creek, as well as in those from the area around Rum Jungle.

3.2.24.14 Pinnularia rangoonensis Grunow *ex* Cleve 1895

Plate 9/1; Bowerbird Billabong, 13 February 1979, #578

Cleve 1895, p. 96

Cleve-Euler 1955, p. 27, Fig. 1028a,b (as var. *genuina*)

This taxon is structured like an undersized *P. major,* but with a more lanceolate central area.

It was found in one sample of phytoplankton from Bowerbird Billabong on the Magela Creek at a time when high flowrates could have carried any cells in the plankton from a long distance upstream.

3.2.24.15 Pinnularia stauroptera (Grunow 1860) Rabenhorst 1864

Plate 10/1,2: Gulungul Billabong, 21 April 1979, #644;
Radon Springs, 7 September 1979, #893

Rabenhorst 1864, p. 222

Cleve-Euler 1955, p. 55, Fig. 1091a-c,x (as var. *genuina*);
? Crosby and Wood 1959, p. 23, pl. 5/69.

Navicula stauroptera Grunow 1860, p. 516, pl. 2/18

Pinnularia interrupta W. Smith 1853 *sensu* Brady 1979, p. 51, pl. 6/4,5

This taxon is structured similarly to *P. biceps* and *P. braunii* var. *amphicephala* in terms of distribution of striae and shape of the transverse fascia, but differs in being linear-lanceolate with inflated rather than capitate poles. The Magela Creek form seemed to vary more in width (as illustrated in plate 10/1,2) than in length.

This was a common form in the Magela Creek samples and was found from Bowerbird to Nankeen Billabongs, Radon Springs and Jim Jim Falls. It was also found in samples from Jingalla and Umbungbung Billabongs on the Nourlangie Creek.

3.2.25 RHIZOSOLENIA Ehrenberg *emend.* Brightwell

3.2.25.1 Rhizosolenia eriensis H.L. Smith 1872

Plate 1/5: Bowerbird Billabong, 7 November 1978, #509

H.L. Smith 1872, p. 44

Hustedt 1914 *in* Schmidt et al. 1874-1959, pl. 314/19-23;
Hustedt 1930a, p. 595, Fig. 341; Hustedt 1930b, p. 115, Fig. 92;
Cleve-Euler 1951, p. 91, Fig. 173a (as var. *genuina*);
Wood et al 1959, p. 219, pl. 17/42; Prowse 1962, p. 12, pl. 3/f;
Foged 1979, p. 102, pl. 6/1

While this can be characterised as cosmopolitan in its distribution (Foged 1979) it was not common in the plankton of any of the sites studied here. It ranged from Bowerbird and Island to Nankeen Billabongs on the Magela Creek, and in addition was found in one sample from the Mary River.

3.2.26 RHOPALODIA Otto Müller

3.2.26.1 Rhopalodia gibba (Ehrenberg 1830) Otto Müller 1895

Plate 11/5: Lake Moondarra, Qld, 10 November 1979, #958

Otto Müller 1895, p. 65, pl. 1/15-17

Van Heurck 1896, p. 298; Fricke 1905 *in* Schmidt et al. 1874-1959, pl. 253/1-13; Hustedt 1930b, p. 390, Fig. 740; Hustedt 1942, p. 126; Cleve-Euler 1955, p. 44, Fig. 1416,a,e; Crosby and Wood 1959, p. 35, pl. 7/108a,b; Foged 1971, p. 321, pl. 18/1; Patrick and Reimer 1975, p. 189-190, pl. 28/1 (as var. *gibba*); Foged 1976, p. 48; Foged 1978, p. 122, pl. 42/14; Foged 1979, p. 102-103, pl. 39/7

Navicula gibba Ehrenberg 1830, p. 64, 68

Foged (1978, 1979) characterised this as a cosmopolitan form of alkaline waters; it is also likely to prefer slightly elevated salinities. In this study it was found in samples from the late dry season in the area around Rum Jungle and in samples from Lakes Argyle and Moondarra.

3.2.26.2 *Rhopalodia gibba* var. *ventricosa* (Kuetzing 1844) H. and M. Peragallo 1900

Plate 11/3: Bowerbird Billabong, 13 February 1979, #578

H. and M. Peragallo 1897-1908, p. 302, pl. 77/3-5

Fricke 1905 *in* Schmidt et al. 1874-1959, pl. 253/14-17; Hustedt 1930b, p. 39, Fig. 74; Cleve-Euler 1955, p. 44, Fig. 1416c,d; Foged 1971, p. 321; Patrick and Reimer 1975, p. 190, pl. 28/3,4; Foged 1978, p. 122, pl. 42/12; Foged 1979, p. 103, pl. 39/8

Epithemia ventricosa Kuetzing 1844, p. 35, pl. 30/9a,b non *Rhopalodia ventricosa* (Kuetzing 1844) Otto Muller 1895 *sensu* Crosby and Wood 1959, p. 36, pl. 7/109a,b (? = *R. parallela)*

Foged (1979) characterised this taxon as being a cosmopolitan form of alkaline waters and this was largely borne out in its distribution on the Magela Creek, an occasional cell being observed in samples from the slightly acid environment of Bowerbird Billabong. It was more common in samples taken in the late dry season in Gulungul Billabong, and in those from around Rum Jungle where it was sometimes abundant.

3.2.26.3 *Rhopalodia gibberula* (Ehrenberg 1841) Otto Müller 1895

Plate 11/4: Lake Moondarra, Qld, 10 November 1979, #958

Otto Müller 1895, p. 58

Fricke 1905 *in* Schmidt et al. 1874-1959, pl. 254/12-21; Hustedt 1930b, p. 391, Fig. 742; Prowse 1962, p. 62, pl. 22/a; Patrick and Reimer 1975, p. 191-192, pl. 28/6 (as var. *gibberula*); *non* Foged 1976, p. 48, pl. 19/20 (= *R. gibba* var. *ventricosa*); ? Foged 1979, p. 103; Brady 1979, p. 54, pl. 7/8.

Eunotia gibberula Ehrenberg 1841, p. 414, pl. 3/4, Fig. 8

Rhopalodia musculus (Kuetzing 1844) Otto Müller 1899 *sensu* Foged 1978, p. 123, pl. 41/11,13.

Patrick and Reimer (1975) characterised this taxon as being a cosmopolitan form of chloride-dominated, though not necessarily saline, waters. It was therefore to be expected that it would not appear in samples from the sulphate-rich waters of the Magela Creek and environs, and that it was observed in samples from chloride-rich Lakes Argyle and Moondarra.

3.2.27 STAURONEIS Ehrenberg

3.2.27.1 Stauroneis anceps Ehrenberg 1841

Plate 10/6,9; Coonjimba Billabong, 29 September 1978, #496;
3 October 1979, #942

Ehrenberg 1841, p. 306, 422, pl. 2/1, Fig. 8

Van Heurck 1896, p. 160, pl. 1/55; Hustedt 1930b, p. 256, Fig. 405; Hustedt 1942, p. 50; Cleve-Euler 1953, p. 207, Fig. 943a,b (as var. *genuina*); Crosby and Wood 1959a, p. 28, pl. 6/83; Hustedt 1959a, p. 771, Fig. 1120a; Prowse 1962, p. 36, pl. 13/d;
Patrick and Reimer 1966, p. 361, pl. 30/1 (as var. *anceps*); Foged 1971, p. 322, pl. 10/11; Foged 1976, p. 48, pl. 9/13; Foged 1978, p. 123-124, pl. 25/5, 26/2; Foged 1979, p. 104, pl. 22/7,8; *non* Brady 1979, p. 55, pl. 7/2 (= *S. phoenicenteron*)

Stauroneis nobilis f. *alabamae* (Heiden 1903) Cleve-Euler 1953 *sensu* Brady 1979, p. 55, pl. 7/3

This taxon differs from the other representatives of the genus reported here in having extended, slightly concave margins in the polar regions, and irregular lines of puncta in the longitudinal direction.

It was found from Coonjimba to Jabiluka Billabongs on the Magela Creek and in samples from Umbungbung Billabong on the Nourlangie Creek.

3.2.27.2 Stauroneis anceps var. *birostris* (Ehrenberg 1841) Cleve 1894

Plate 10/10: Second Magela Crossing, 21 April 1979, #634

Cleve 1894, p. 147

Cleve-Euler 1953, p. 209, Fig. 943s

Stauroneis birostris Ehrenberg 1841, p. 422, pl. 2/3, Fig. 1

Stauroneis alabamae Heiden 1903 *in* Schmidt et al. 1874-1959, pl. 242/3

This taxon differs from the type in having an extended rhomboid to rhombo-lanceolate valve outline.

It was found in samples from Gulungul Billabong and from periphyton growing near the Second Magela Crossing of the Oenpelli road; also in samples from Long Harrys Billabong on the Nourlangie Creek.

3.2.27.3 Stauroneis phoenicenteron (Nitzsch 1817) Ehrenberg 1841

Plate 10/7: Island Billabong, 21 April 1979, #630

Ehrenberg 1841, p. 311, pl. 2/5, Fig. 1; 3/1, Fig. 17; 3/2, Fig. 3

Van Heurck 1896, p. 158, Fig. 30, pl. 1/50; Heiden 1903 *in* Schmidt et al. 1874-1959, pl. 241/16; Hustedt 1930b, p. 255, Fig. 404; Hustedt 1942, p. 49; Cleve-Euler 1953, p. 209, Fig. 944a (as var. *genuina*); ? *non* Crosby and Wood 1959, p. 28, pl. 6/84 (illustration unclear); Hustedt 1959, p. 766, Fig. 1118a; Patrick and Reimer 1966, p. 359, pl. 29/1,2; Foged 1971, p. 323, pl. 10/7; Foged 1976, p. 49; Foged 1978, p. 125, pl. 26/1; Foged 1979, p. 105, pl. 22/1,2; 23/1,2

Bacillaria phoenicenteron Nitzsch 1817, p. 92, pl. 4

Stauroneis anceps Ehrenberg 1841 *sensu* Brady 1979, p. 55, pl. 7/1

The major differences which quickly delineate this taxon from the other taxa described here are the broad stauros and the broad poles in valve view.

This was the most common *Stauroneis* taxon in this study, both in density per sample, and in range over the Magela Creek from Magela Falls to Nankeen Billabong. It was also observed in samples from Umbungbung Billabong on the Nourlangie Creek.

3.2.27.4 *Stauroneis phoenicenteron* var. *hattorii* Tsumura 1955

Plate 10/13: Hades Flats, 21 April 1979, #625

Tsumura 1955, p. 18, pl. 1/11; 6/1-5; 8/10; 9/2

This taxon differs from the type in the acute, cuneate poles and in the stauros which broadens towards the margins. In addition the punctae are distributed in regular longitudinal as well as lateral rows.

It was found in samples from Coonjimba Billabong and from Hades Flats on the Magela Creek, and from Long Harrys and Umbungbung Billabongs on the Nourlangie Creek.

3.2.27.5 *Stauroneis phoenicenteron* var. *nobilis* (Schumann 1867) Sabelina *in* Proschkina-Lavrenko 1950

Plate 10/11,12: Umbungbung Billabong, 31 July 1979, #832

Proschkina-Lavrenko 1950, p. 151

Stauroneis nobilia Schumann 1867, p. 59, pl. 2/60. Cleve-Euler 1953, p. 211, Fig. 947; Hustedt 1959, p. 778, Fig. 1125b; Patrick and Reimer 1966, p. 370, pl. 31/2 (as var. *nobilis*)

This taxon differs from the type in its extended and slightly capitate poles and slightly undulate margins.

It was found in samples from Coonjimba, Gulungul and Corndorl Billabongs, and from Hades Flats on the Magela Creek and also in Umbungbung Billabong on the Nourlangie Creek.

3.2.27.6 Stauroneis spicula Hickie 1874

Plate 10/8: Jingalla Billabong, 29 November 1979, #1101

Hickie 1874, p. 290

Van Heurck 1896, p. 160, pl. 1/58; Hustedt 1959, p. 830, Fig. 1173; Hendey 1977, p. 281-190, pl. 1; Foged 1978, p. 125, pl. 6/4,7;

Navicula spicula (Hickie 1874) Cleve 1894, p. 110; Patrick and Reimer 1966, p. 469, pl. 44/9 (as var. *spicula*)

Foged (1978) characterised this taxon as an euryhaline form, which is again indicative of the saline influence on Jingalla Billabong on the Nourlangie Creek, the one site from whence it was collected here.

3.2.28 STENOPTEROBIA Brébisson *in* litt. *ex* Habirshaw et al.

3.2.28.1 Stenopterobia intermedia (Lewis 1864) Van Heurck 1896

Plate 13/5: Bowerbird Billabong, 11 August 1979, #857

Van Heurck 1896, p. 374

Hustedt 1912 *in* Schmidt et al. 1874-1959, pl. 284/3-5, 7-12; Hustedt 1930b, p. 428, Fig. 830; Hustedt 1942, p. 143, 145; Wood 1961, p. 697, pl. 56/199; Prowse 1962, p. 72, pl. 21/a; Foged 1971, p. 323; Foged 1978, p. 126; Foged 1979, p. 105, pl. 44/3,4

Surirella intermedia Lewis 1864, p. 339, pl. 1/2

Stenopterobia intermedia f. *subacuta* Fricke *ex* Hustedt 1912 *in* Schmidt et al. 1874-1959, pl. 284/6; Brady 1979, p. 56, pl. 7/5

This form was seen to range in shape from that described as typical, to that illustrated by Hustedt (1912) for the subacute form; therefore the subacute form is being treated here as a synonym of the type.

The taxon was common in samples from all sites from Magela Falls through to Nankeen Billabong on the Magela Creek, supporting Foged's (1978, 1979) characterisation of it as being a cosmopolitan form of acidic freshwaters. Also found in samples from Long Harrys and Jingalla Billabongs on the Nourlangie Creek, Jim Jim Falls and the Mary River.

3.2.28.2 Stenopterobia intermedia var. *capitata* Fontell 1917

Plate 13/6: Bowerbird Billabong, 11 August 1979, #857

Fontell 1917, p. 46, pl. 2/46

This form differs from the type in having rhomboid, inflated poles.

Found in Magela Falls splashpool and as a common component of the Bowerbird Billabong phytoplankton and periphyton, it was also found in a sample from Long Harrys Billabong on the Nourlangie Creek. This is the first record of the taxon outside of northern Europe.

3.2.29 SURIRELLA Turpin

3.2.29.1 *Surirella arachnoidea* Wood 1963

Plate 12/5: Magela Outflow, 11 September 1979, #896

Wood 1963, p. 210, pl. 4/99

The first and only record of this taxon was from 'Indonesian waters' by Wood (1963) and its presence in the East Alligator River samples was indicative of the marine influence on the lower reaches of the river.

3.2.29.2 *Surirella biseriata* Brébisson *in* Brébisson and Godey 1835

Plate 13/8: Jim Jim Falls splashpool, 19 August 1979, #868

Brébisson and Godey 1835, p. 53, pl. 7

Schmidt 1875 *in* Schmidt et al. 1874-1959, pl. 22/13,14; Van Heurck 1896, p. 368, Fig. 120, pl. 12/575; Hustedt 1912 *in* Schmidt et al. 1874-1959, pl.. 283/2; Hustedt 1930b, p. 342, Fig. 831, 832; Hustedt 1942, p. 146; Cleve-Euler 1955, p. 105, Fig. 1528a (as var. *genuina*); Prowse 1962, p. 73, pl. 22/d; Foged 1971, p. 324; Foged 1978, p. 127, Foged 1979, p. 106

This was a common form in the escarpment sites such as Magela, Jim Jim and Twin Falls in addition to Bowerbird Billabong.

3.2.29.3 *Surirella biseriata* var. *constricta* (Ehrenberg 1838) Grunow *ex* Hustedt 1912

Plate 14/3: Magela Falls splashpool, 28 September 1979, #930

Hustedt 1912 *in* Schmidt et al. 1874-1959, pl. 283/1

Hustedt 1930b, p. 433, Fig. 835; Cleve-Euler 1955, p. 106, Fig. 1528n

Navicula constricta Ehrenberg 1838, p. 188, pl. 21/17

Van Landingham (1978, p. 3806) attributed the combination of this name to Hustedt (1911, p. 304, pl. 2/9) as well as to Grunow. However, Hustedt (1912, 1930b) continued to attribute the combination to Grunow.

This taxon differs from *S. linearis* var. *constricta* in being broader and shorter, but it differs mainly in having a narrow, almost non-existent central longitudinal line whereas *S. linearis* var. *constricta* has a broad central line.

The taxon was found in samples from Magela Falls and Radon Springs, and from Island Billabong and Hades Flats on the lower reaches of the Magela Creek.

3.2.29.4 *Surirella biseriata* var. *subparallela* Meister 1912

Plate 14/1-2: Second Magela Creek Crossing, 21 April 1979, #634

Meister 1912, p. 225

Cleve-Euler 1955, p. 107, Fig. 1528m

This differs from var. *constricta* in having a linear valve outline rather than a slightly concave margin, and in being generally at least 120 μm long.

A common escarpment form, it was found in samples from Jim Jim Falls, Radon Springs, Deaf Adder and Magela Falls and Bowerbird Billabong. It was found less frequently in samples from Coonjimba, Island, Jabiluka and Nankeen Billabongs on the Magela Creek.

3.2.29.5 *Surirella delicatissima* Lewis 1863

Plate 12/8: Bowerbird Billabong, 11 August 1979, #857

Lewis 1863, p. 343, pl. 3/4

Fricke 1906 *in* Schmidt et al. 1874-1959, pl. 266/3-5; Hustedt 1912 *in* Schmidt et al. 1874-1959, pl. 282/13,14; Hustedt 1930b, p. 436, Fig. 846, 847; Hustedt 1942, p. 156; Cleve-Euler 1955, p. 119, Fig. 1560; Foged 1971, p. 324; Foged 1976, p. 50, pl. 22/8; Foged 1978, p. 127-128, pl. 47/9; Foged 1979, p. 107, pl. 44/5

The fusiform outline of this form differentiates it from the other taxa described here.

Foged (1978, 1979) characterised this taxon as a 'halophobous' form and this was borne out by its frequent occurrence in the very low salinity waters of the upper regions of the Magela Creek, Magela Falls, Bowerbird through to Coonjimba Billabongs, from Radon Springs and Jim Jim Falls. It was also found in the samples from the early dry season in Island Billabong on the Magela Creek and from Long Harrys Billabong on the Nourlangie Creek.

3.2.29.6 *Surirella gemma* Ehrenberg 1839

Plate 12/4: Magela Outflow, 11 September 1979, #896

Ehrenberg 1839b, p. 156, pl. 4/5

Schmidt 1875 *in* Schmidt et al. 1874-1959, pl. 24/26,27; Van Heurck 1896, p 372, pl. 13/582; Cleve-Euler 1955, p. 117, Fig. 1555; Crosby and Wood 1959, p. 41, pl. 8/122; Hendey 1964, p. 288, pl. 40/5; 42/4; Foged 1978, p. 128, pl. 47/10

This cosmopolitan brackish water form (Foged 1978) was found in samples from the East Alligator River at the Magela Creek Outfall where the salinity was recorded as 29 ppt.

3.2.29.7 *Surirella linearis* var. *constricta* Grunow 1862

Plate 14/4: Radon Springs, 7 September 1979, #890

Grunow 1862, p. 455

Hustedt 1930b, p. 434, Fig. 839; Hustedt 1942, p. 150, Fig. 369-372; Cleve-Euler 1955, p. 109, Fig. 1535g,h; Foged 1971, p. 324; Foged 1976, p. 50; Foged 1978, p. 128; Foged 1979, p. 107

For taxonomic comments see *S. biseriata* var. *constricta* above.

It was found to predominate in waters of the upper regions near the escarpment such as Jim Jim Falls, Radon Springs and Magela Falls. It also occurred in samples from Corndorl and Jabiluka Billabongs.

3.2.29.8 *Surirella robusta* Ehrenberg 1840

Plate 12/6,77; 13/10,11: Nankeen Billabong, 4 October 1979, #975; Umbungbung Billabong, 28 June 1979, #821

Ehrenberg 1840, p. 215

Schmidt 1875 *in* Schmidt et al. 1874-1959, pl. 22/3; Van Heurck 1896, p. 371, pl. 12/577; Hustedt 1930b, p. 437, Fig. 850; Hustedt 1942, p. 172; Prowse 1962, p. 74, pl. 21/c; Foged 1971, p. 324; Foged 1976, p. 51, pl. 24/4; Foged 1978, p. 129; Foged 1979, p. 108

This taxon seems to prefer slightly alkaline water, since it is found from Coonjimba to Nankeen Billabongs on the Magela Creek, Long Harrys and Umbungbung Billabongs on the Nourlangie Creek, and in samples from the Mary River and Lake Moondarra.

3.2.29.9 *Surirella spiralis* Kuetzing 1844

Plate 13/9: Jim Jim Falls Billabong, 19 August 1979, #871

Kuetzing 1844, p. 60, pl. 3/64

Schmidt 1877 *in* Schmidt et al. 1874-1959, pl. 56/25,26; Hustedt 1930b, p.445, Fig. 870; Cleve-Euler 1955, p. 124, Fig. 1567; Prowse 1962, p. 75, pl. 23/1

This form was found most commonly in samples from Jim Jim Falls but was also observed, though rarely, in samples from Radon Springs, Bowerbird and Gulungul Billabongs.

3.2.29.10 *Surirella thienemanni* Hustedt 1935

Plate 13/7: Radon Springs, 8 February 1979, #572

Hustedt 1935, p. 179, pl. 3/18

Hustedt 1942, p. 149, Fig. 365, 366

This form differs from *S. linearis* var. *constricta* in being almost twice as long, more slender and more constricted in the middle regions.

A rare form, it was found in samples from Radon Springs, Baroalba Springs and from Island Billabong on the Magela Creek.

3.2.30 SYNEDRA Ehrenberg

3.2.30.1 Synedra ulna (Nitzsch 1817) Ehrenberg 1838

Plate 4/1: Nankeen Billabong, 4 October 1979, #971

Ehrenberg 1838, p. 211, pl. 17/1

Van Heurck 1896, p. 310, pl. 10/409; Hustedt 1914 *in* Schmidt et al. 1874-1959, pl. 301/1-26; 302/1; 303/16,17; Hustedt 1930b, p. 151, Fig. 158; Hustedt 1942, p. 25-26; Crosby and Wood 1959, p. 6, pl. 2/11; Hustedt 1959a, p. 195, Fig. 691Aa-c; Patrick and Reimer 1966, p. 148-149, pl. 7/1,2 (as var. *ulna*); Foged 1971, p. 325, pl. 7/3; Foged 1976, p. 52, pl. 2/7-12; Foged 1978, p. 132, pl. 8/11,12; Foged 1979, p. 111, pl. 8/12; 9/3; Brady 1979, p. 56, pl. 7/6,7.

Bacillaria ulna Nitzsch 1817, p. 99, pl. 5

This taxon had a patchy distribution in the samples from Gulungul, Island, Nankeen and Red Lily Billabongs, although sometimes appearing in abundant proportions. It was also found in a sample from the Magela Outflow, and samples from the Mary River, Lake Argyle and Lake Moondarra.

3.2.31 A Form of Unknown Affinity

Plate 14/5,6: Magela Outflow, 11 September 1979, #895

The form illustrated was found in two samples from the Magela Outflow and could be of either fresh or brackish affinity. At the smaller extent of its size range it was almost circular and structured in a manner similar to that described for *Cyclotella antiqua* W. Smith 1853. However, it appears to have a greater similarity to the araphic valve of a form of *Campyloneis* as yet undescribed, with the bilateral symmetry and radiate areolae. Professor F.E. Round suggested that it may be derived from a spore of some type, but it will require further investigation using electron microscopy to elucidate the affinities of this unusual form.

3.2.32 Taxa Represented by Insufficient Data to Allow Confirmation

3.2.32.1 Achnanthes longipes Agardh 1824

For illustration see Hustedt (1959a, p. 427-428, Fig. 878)

Represented by a valve fragment in one sample from the Rum Jungle area.

3.2.32.2 Attheya zachariasi Brun 1894

For illustration see Hustedt (1930a, 771, Fig. 450)

Represented by part of a valve slightly obscured by detritus in a sample from Jingalla Billabong on the Nourlangie Creek.

3.2.32.3 *Eunotia serra* var. *diadema* (Ehrenberg 1837) Patrick 1958

For illustration see Patrick and Reimer (1966, p. 201, pl. 12/3)

Represented by part of a valve found in one sample from Bowerbird Billabong on the Magela Creek.

3.2.32.4 *Gomphonema truncatum* var. *capitatum* (Ehrenberg 1838) *in* Patrick and Reimer 1975

For illustration see Patrick and Reimer (1975, p. 119-120, pl. 16/4)

Represented by part of a valve from one sample from Lake Moondarra.

3.2.32.5 *Navicula lyra* Ehrenberg 1841

For illustration see Patrick and Reimer (1966, p. 443, pl. 39/5,6)

Represented by part of a valve in one sample from Red Lily Billabong on the west side of the East Alligator River.

3.2.32.6 *Rhizosolenia loniseta* Zacharias 1893

For illustration see Hustedt (1930a, p. 594, Fig. 340)

Represented by one valve with seta intact in a sample from Magela Falls.

3.2.32.7 *Synedra rumpens* Kuetzing 1944

For illustration see Hustedt (1959a, p. 207, Fig. 697a,b)

Represented by several parts of cells, one of which contained part of the central area but the poles, which would have allowed definite identification, were missing. All valve pieces were contained in one sample from Cahills Crossing of the East Alligator River.

3.2.32.8 *Synedra tabulata* (Agardh 1832) Kuetzing 1844

For illustration see Hustedt (1959, p. 218, Fig. 710a-d)

Represented by part of a valve in one sample from Red Lily Billabong on the west side of the East Alligator River.

3.2.32.9 *Tabellaria flocculosa* (Roth 1797) Kuetzing 1844

For illustration see Hustedt (1959a, p. 28-30, Fig. 558)

Represented by one girdle band in each of two samples, one from Red Lily Billabong on the west side of the East Alligator River and one from Lake Moondarra.

PLATE 1

1,2	*Coscinodiscus lineatus* Ehrenberg
3,4	*C. asteromphalus* Ehrenberg
5	*Rhizosolenia eriensis* H.L. Smith

Scale 10 μm

PLATE 1

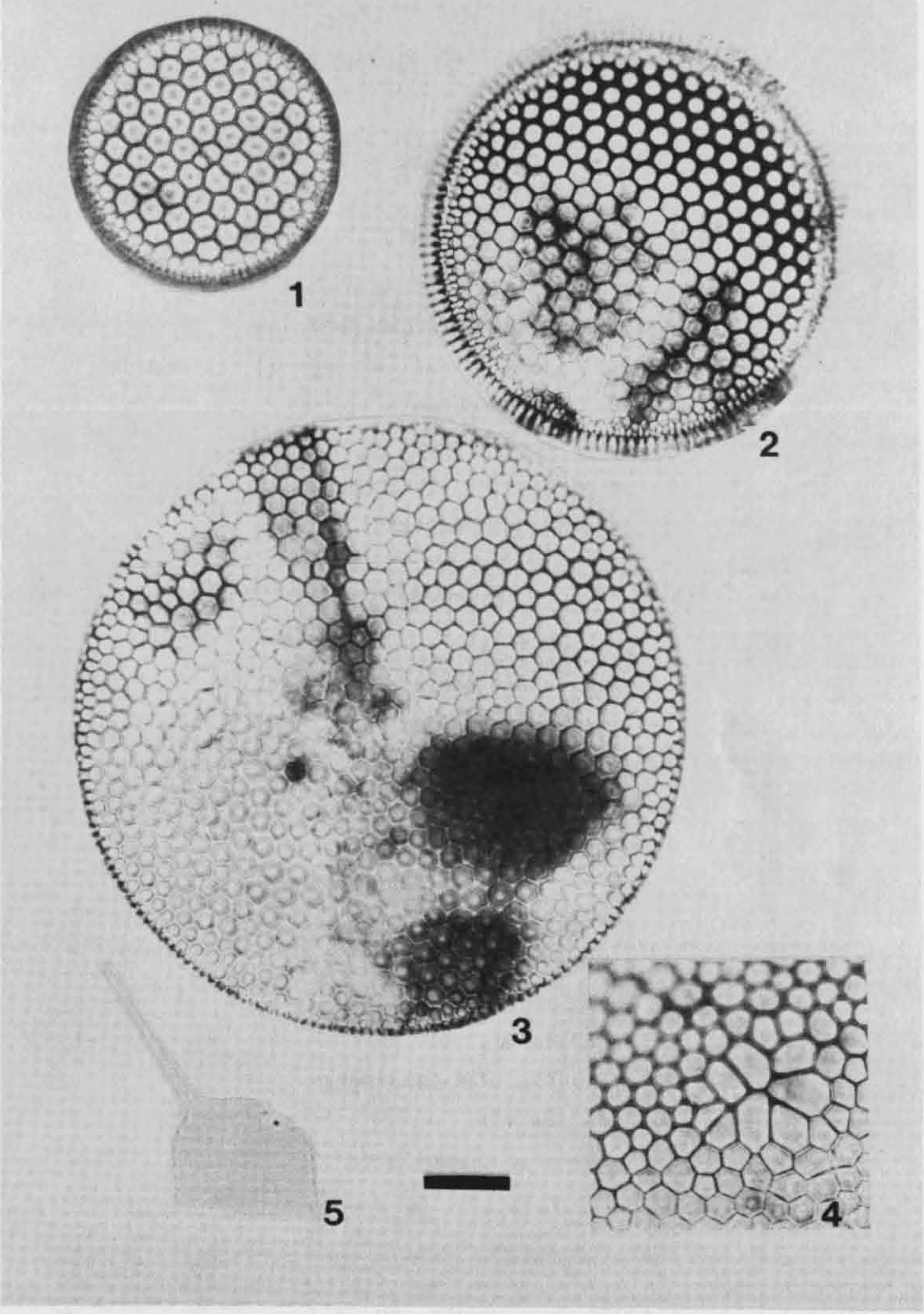


PLATE 2

1,2	*Cyclotella meneghiniana* Kuetzing
3	*C. stelligera* (Cleve and Grunow) Van Heurck
4	*C. stylorum* Brightwell
5	*C. woltereeki* Hustedt
6	*Melosira distans* (Ehrenberg) Kuetzing
7-11	*M. granulata* (Ehrenberg) Ralfs
12,13	*M. granulata* var. *angustissima* Otto Muller
14,15	*M. granulata* *muzzanensis* (Meister) Hustedt
16	*Fragilaria stangulata* (Zanon) Hustedt
17-18	*Asterionella zasuminensis* (Cabejszekowna) Lundh-Almestrand
19	*Eunotia rabenhorstii* var. *africana* f. *triodon* Hustedt
20	*E. ambigua* Carter
21	*E. trinacria* var. *undulata* Hustedt
22	*E. aequalis* Hustedt
23	*E. triconfusa* Van Landingham
24	*E. sudetica* var. *australis* Cleve-Euler

Scale 10 μm

PLATE 2

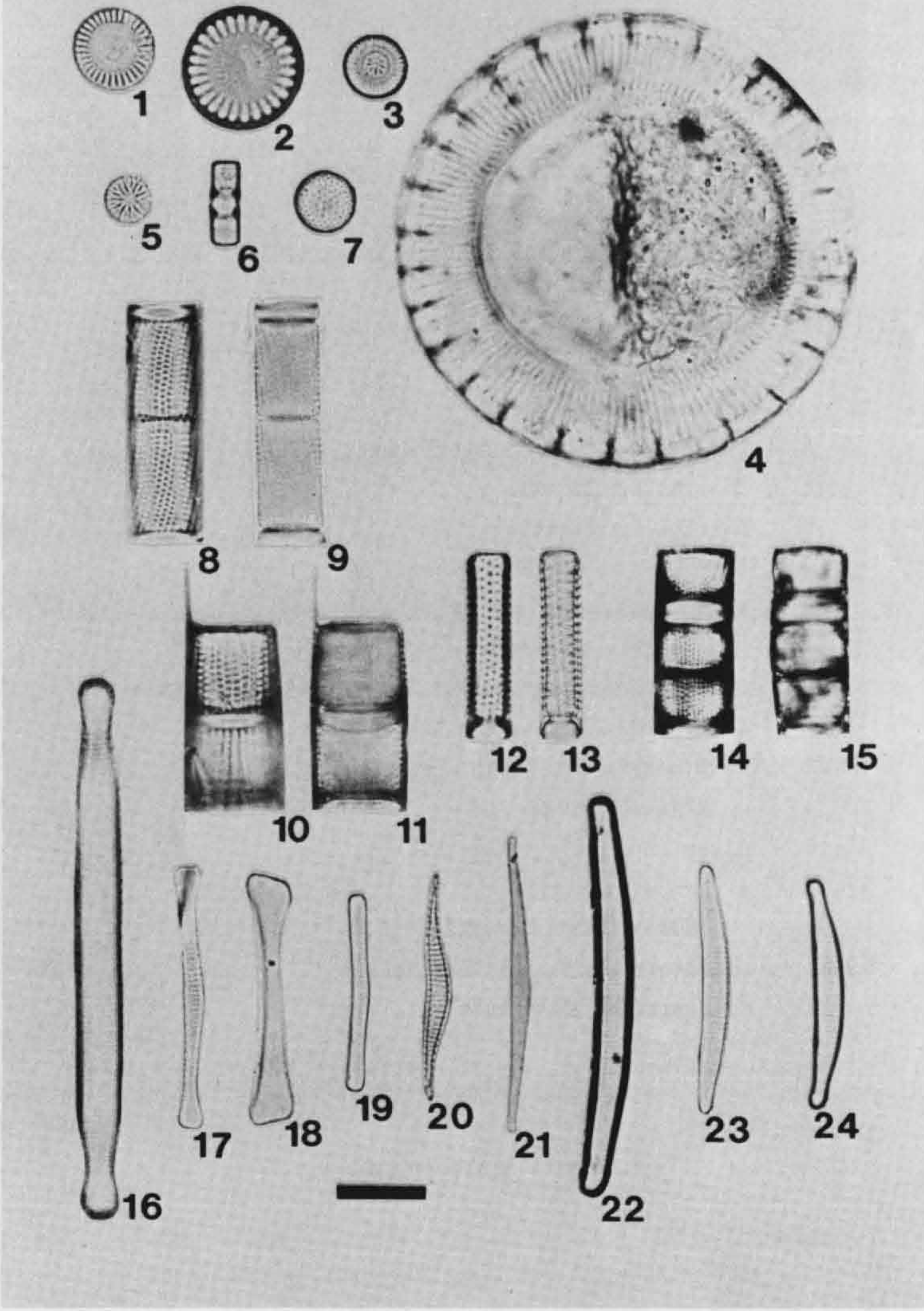


PLATE 3

1 *Eunotia pectinalis* (Dillwyn) Rabenhorst
2 *E. monodon* Ehrenberg
3 *E. astricleveae* Berg
4 *E. lunaris* (Ehrenberg) Grunow
5 *E. camelus* Ehrenberg
6 *E. bigibba* Kuetzing
7 *E. trigibba* Hustedt
8 *E. camelus* var.
ventricosa Gandhi
9 *E. pectinalis* var. *undulata* f. *fossilis* Manguin
10 *Achnanthes minutissima* Kuetzing
11,12 *A. linearis* (W. Smith) Grunow
13,14 *A. affinis* Grunow
15,16 *A.* sp. 1
17,18 *A. exigua* var.
heterovalva Krasske
19-21 *Cocconeis placentula* Ehrenberg
22 *C. scutellum* Ehrenberg

Scale 10 μm

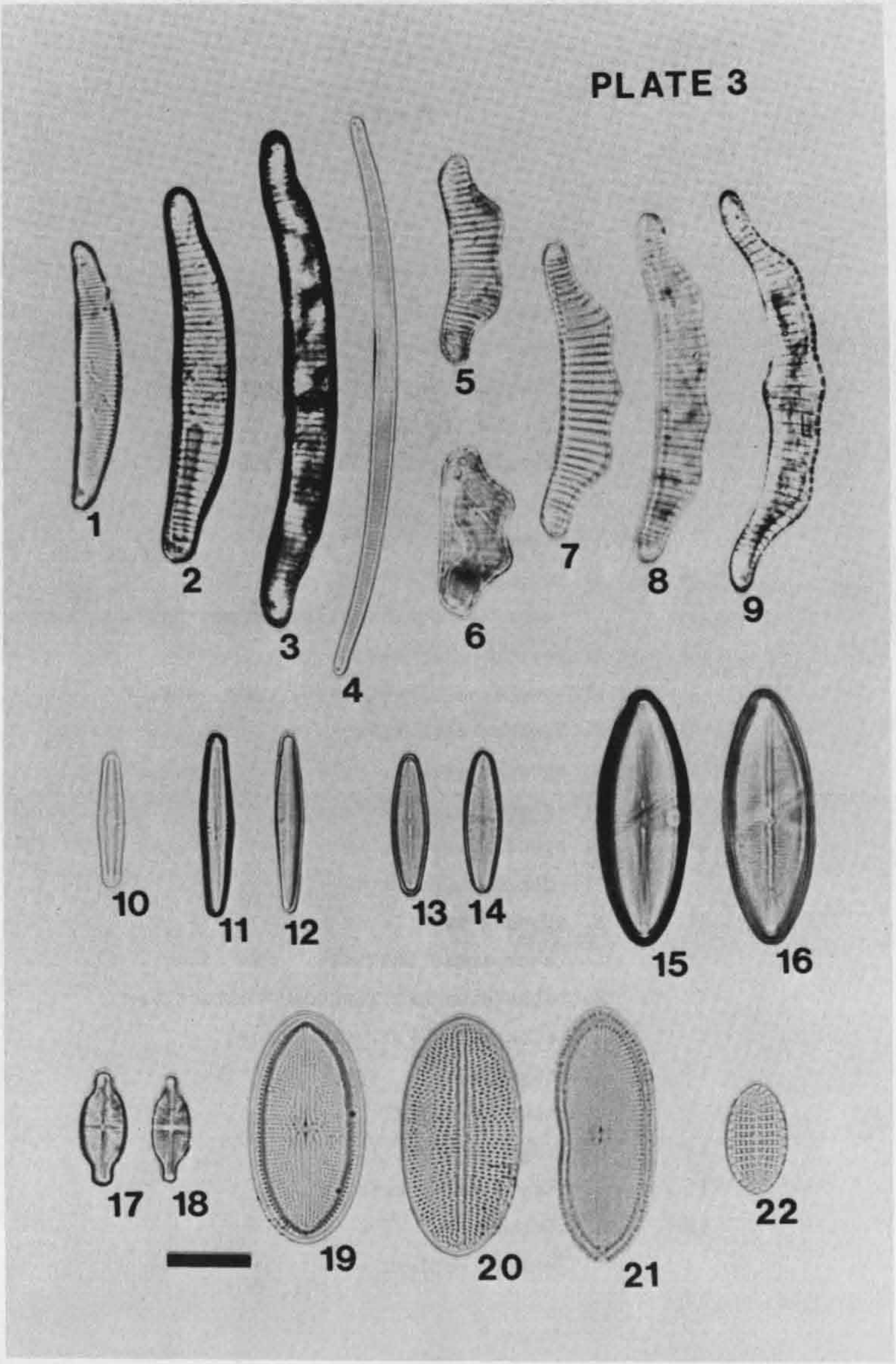


PLATE 3
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PLATE 4

1 *Synedra ulna* (Nitzsch) Ehrenberg
2 *Eunotia hebridica* var.
bergii Gandhi
3 *E. pectinalis* var.
undulata (Ralfs) Rabenhorst
4 *E. camelus* var.
denticulata (Brebisson) Grunow
5 *E. monodon* var.
tropica (Hustedt) Hustedt
6 *E. monodon* var.
scandica (Cleve-Euler) comb. nov.
7 *E. pseudoindica* var.
gracilis (Frenguelli) comb. nov. ?
8 *E. zygodon* Ehrenberg
9 *E. zygodon* var.
elongata Hustedt
10 *E. zygodon* var.
depressa Hustedt
11 *E. zygodon* var.
emarginata Hustedt
12 *E. rabenhorstiana* (Grunow) Hustedt var.
elongatum (Patrick) Brady
13 *E. didyma* var.
media Hustedt
14 *E. didyma* Grunow
15 *E. didyma* var. *maxima* f. 1
16 *E. didyma* var.
maxima Hustedt

Scale 20 μm

PLATE 4

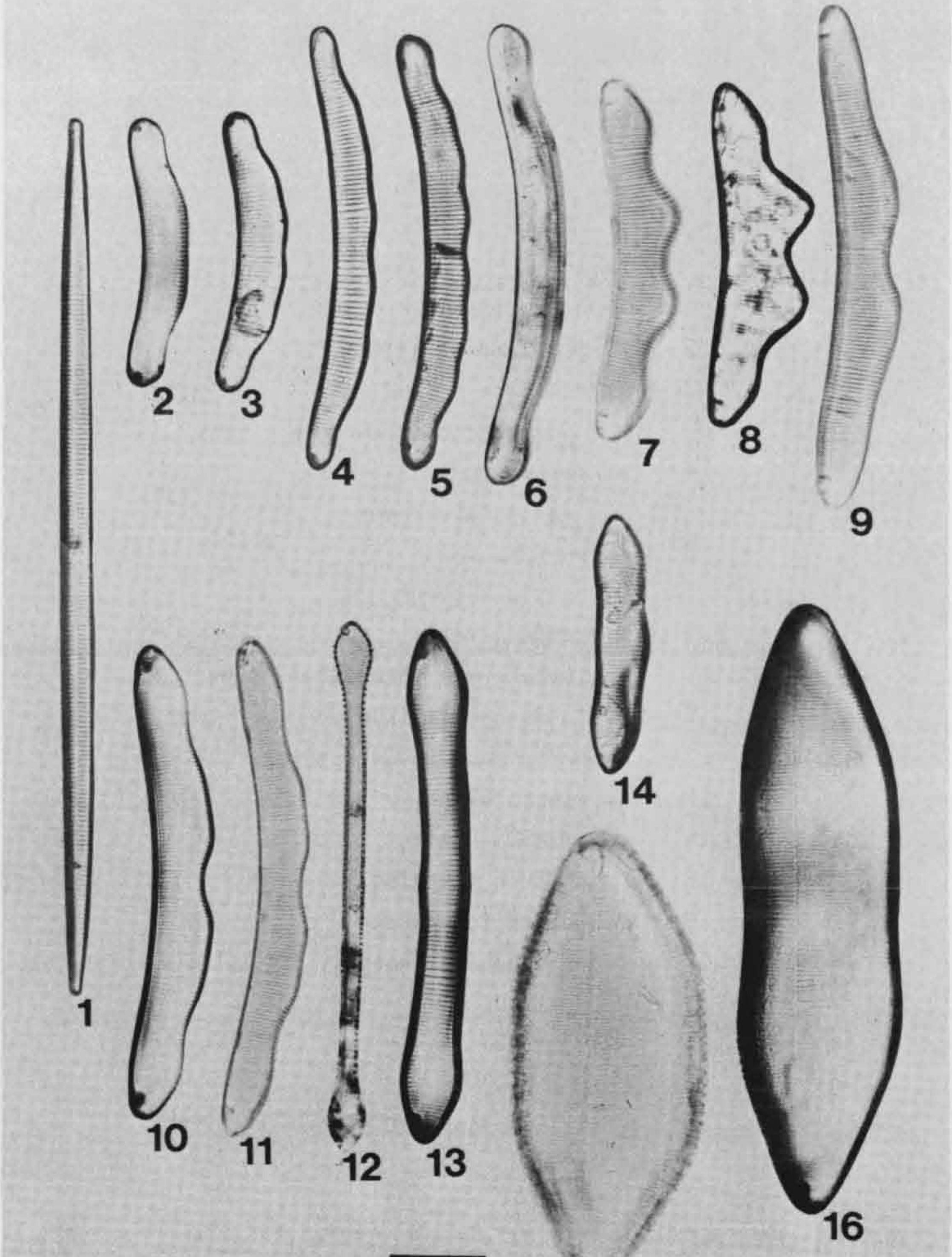

PLATE 5

1 *Amphora argus* Pantocsek
2 *A. towutensis* Hustedt
3 *Anomoeoneis exilis* var.
gomphonemacea (Grunow) Cleve
4 *A. exilis* var.
lanceolata Mayer
5 *A. serians* var.
acuta Hustedt
6-9 *A. serians* var.
brachysira (Brebisson) Cleve
10 *A. sphaerophora* (Kuetzing) Pfitzer
11 *Cymbella subturgida* Hustedt
12 *C. minuta* Hilse
13,14 *C. spicula* Hustedt
15 *C. affinis* Kuetzing
16 *C. hustedtii* Krasske
17 *C. claasseniae* Cholnoky

Scale 10 μm

PLATE 5

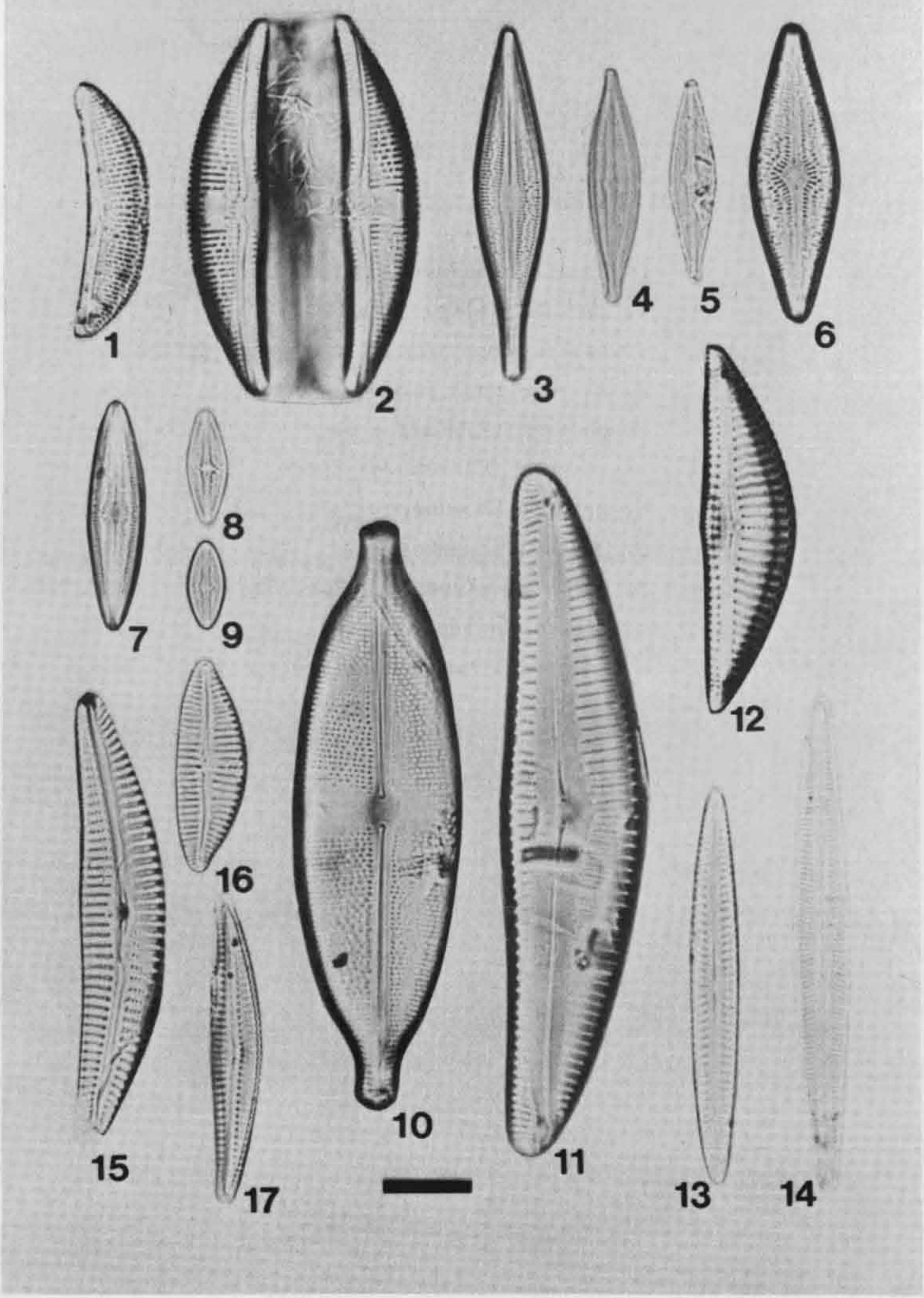

PLATE 6

1	*Diploneis subadvena* Hustedt
2	*D. ovalis* (Hilse) Cleve
3-5	*Frustulia rhomboides* (Ehrenberg) De Toni
6	*F. entrancensis* Foged
7	*Gomphonema intricatum* var. *vibrio* (Ehrenberg) Cleve
8	*G. gracile* Ehrenberg
9	*G. subtile* Ehrenberg
10-12	*G. parvulum* (Kuetzing) Kuetzing
13-15	*Mastogloia elliptica* var. *dansei* (Thwaites) Cleve

Scale 10 μm

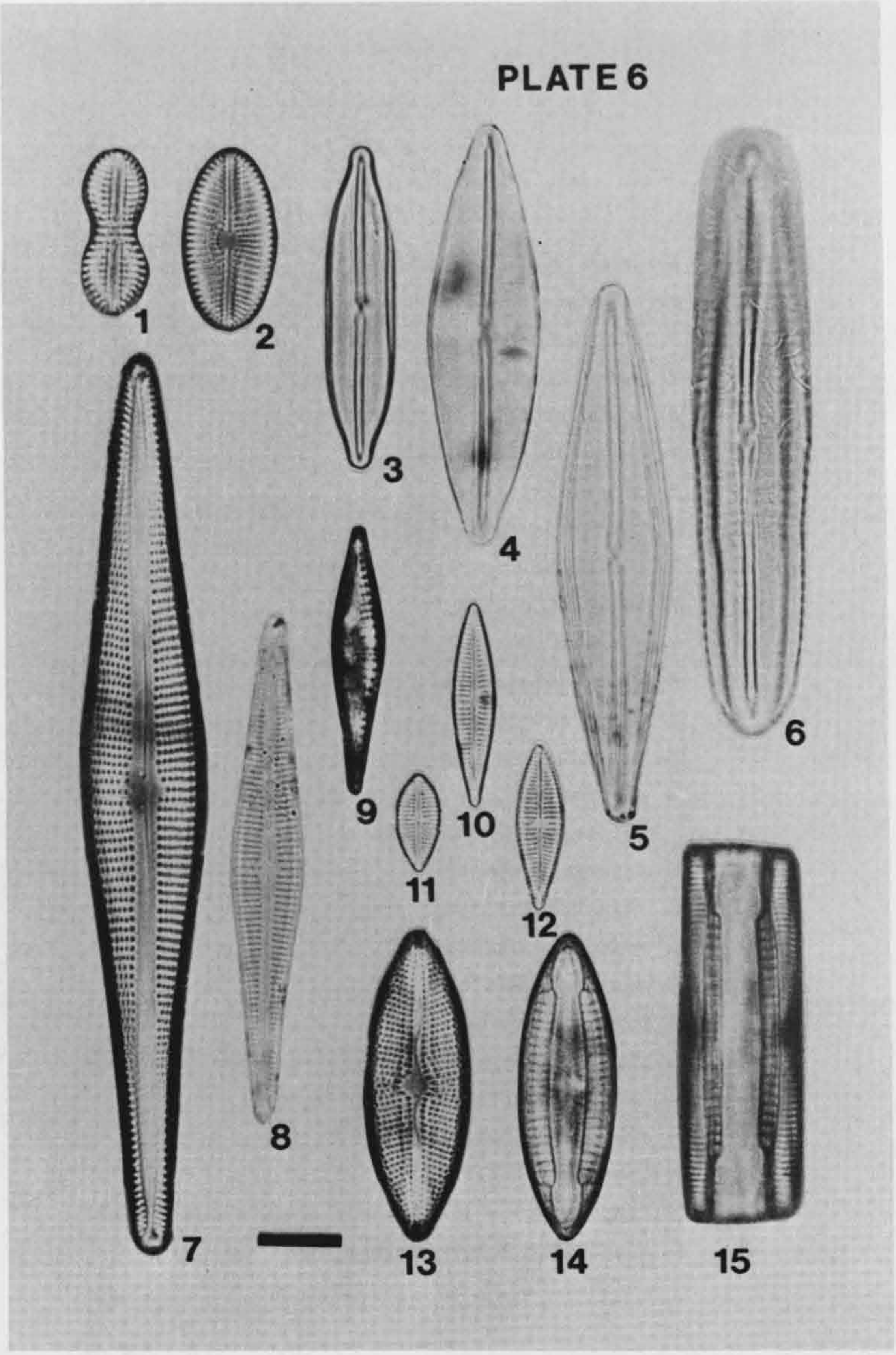
PLATE 6
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PLATE 7

1,2 *Navicula gysingensis* Foged
3 *N. arvensis* Hustedt
4 *N. acceptata* Hustedt
5,6 *N. pseudislandica* nom. nov. (6. Malformed valve)
7 *N. pseudosubtilissima* Manguin
8 *N. dutoitana* Cholnoky
9,10 *N. jungii* Krasske
11 *N. bremensis* Hustedt
12 *N. viridula* (Kuetzing) Ehrenberg
13 *N. mutica* Kuetzing
14 *N. geinitzi* Bünte
15 *N. halophilioides* Hustedt
16 *N. nuda* Pantocsek
17 *N. yarrensis* Grunow
18 *N. anglica* var. *subsalsa* (Grunow) Cleve
19 *N. diserta* Hustedt
20 *N. rhynchocephala* Keutzing
21 *N. radiosa* Keutzing
22,23 *N. disparata* Hustedt
24 *N. pupula* Kuetzing
25 *N. pupula* var. *rectangularis* (Gregory) Grunow
26 *N. americana* Ehrenberg
27 *Neidium iridis* var. *amphigomphus* (Ehrenberg) Tempére and Peragallo
28 *N. bisulcatum* (Lagerstedt) Cleve

Scale 10 μm

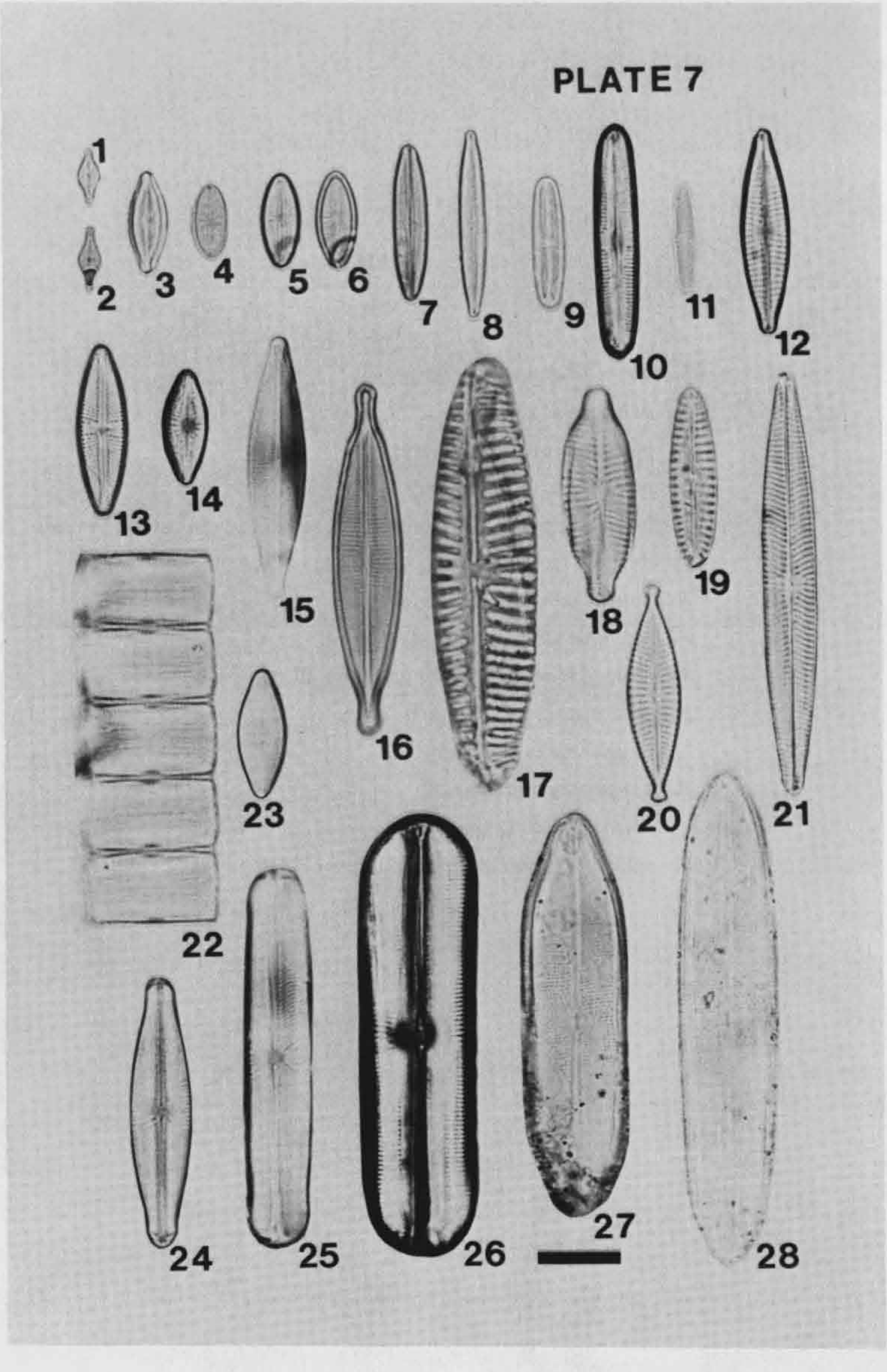
PLATE 7
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PLATE 8

1	*Eunotia flexuosa* Brébisson
2	*E. bicapitata* Grunow
3	*E. pseudopectinalis* Hustedt
4	*E. parallela* Ehrenberg
5,6	*Cymbella aspera* (Ehrenberg) Cleve (6. Internal view)
7	*Gyrosigma attenuatum* (Kuetzing) Rabenhorst
8	*Navicula schwabei* Krasske
9	*N. perrotettii* (Grunow) Cleve
10	*Neidium dilatatum* (Ehrenberg) Cleve
11	*Pinnularia brevicostata* var. *sumatrana* Hustedt
12	*P. acrosphaeria* var. *turgidula* Grunow
13	*P. major* (Kuetzing) Rabenhorst

Scale 20 μm

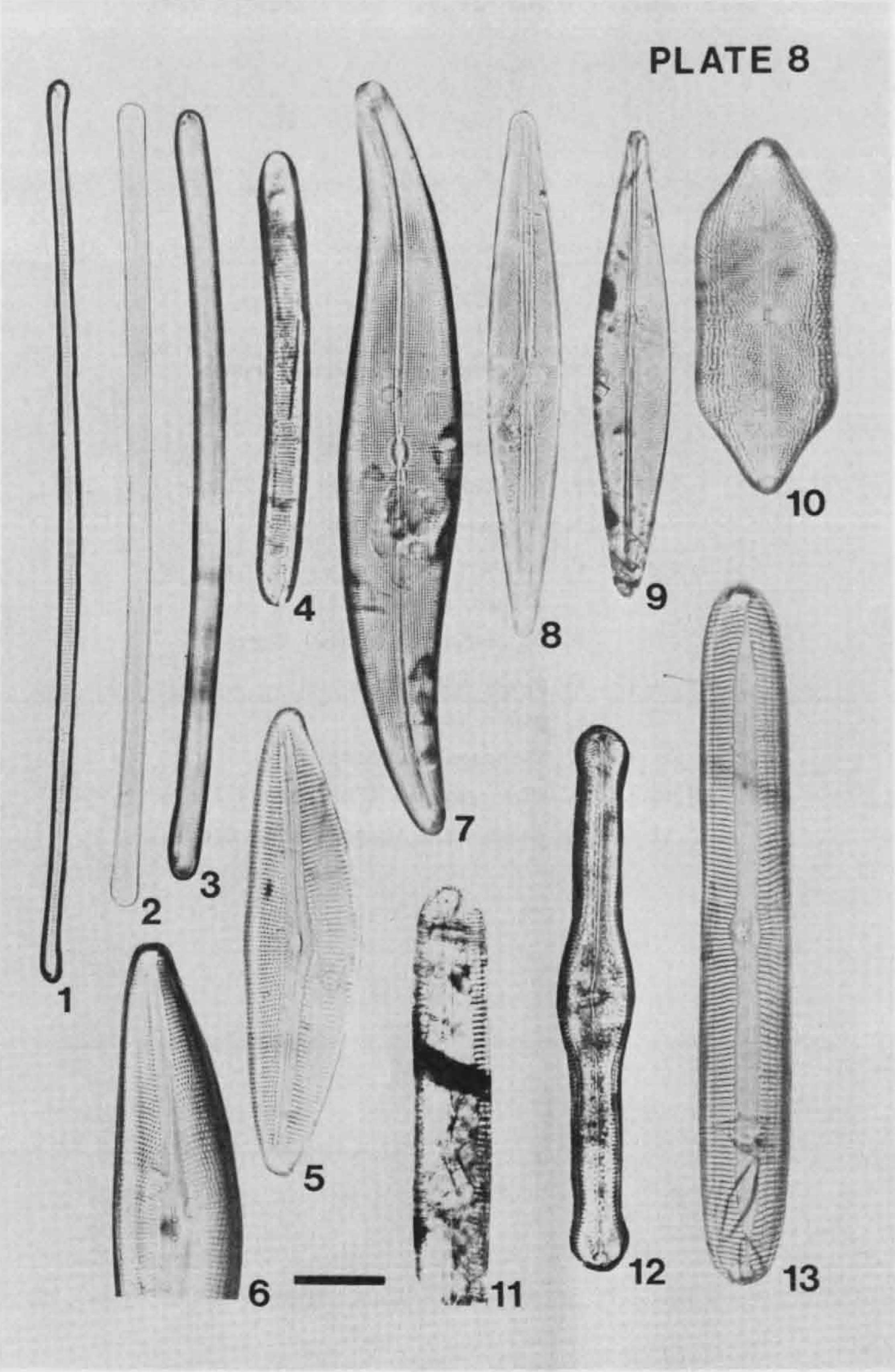
PLATE 8
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PLATE 9

1	*Pinnularia rangoonensis* Grunow
2	*P. brevicostata* f. *ventricosa* Hustedt
3	*P. luculenta* (A. Schmidt) Cleve
4	*P. legumen* Ehrenberg
5	*P. gibba* var. *linearis* Hustedt
6	*P. bogotensis* (Grunow) Cleve
7	*P. gibba* Ehrenberg
8	*P. gibba* var. *linearis* Hustedt
9,10	*P. microstauron* (Ehrenberg) Cleve
11	*P. intermedia* (Lagerstedt) Cleve

Scale 10 μm

PLATE 9

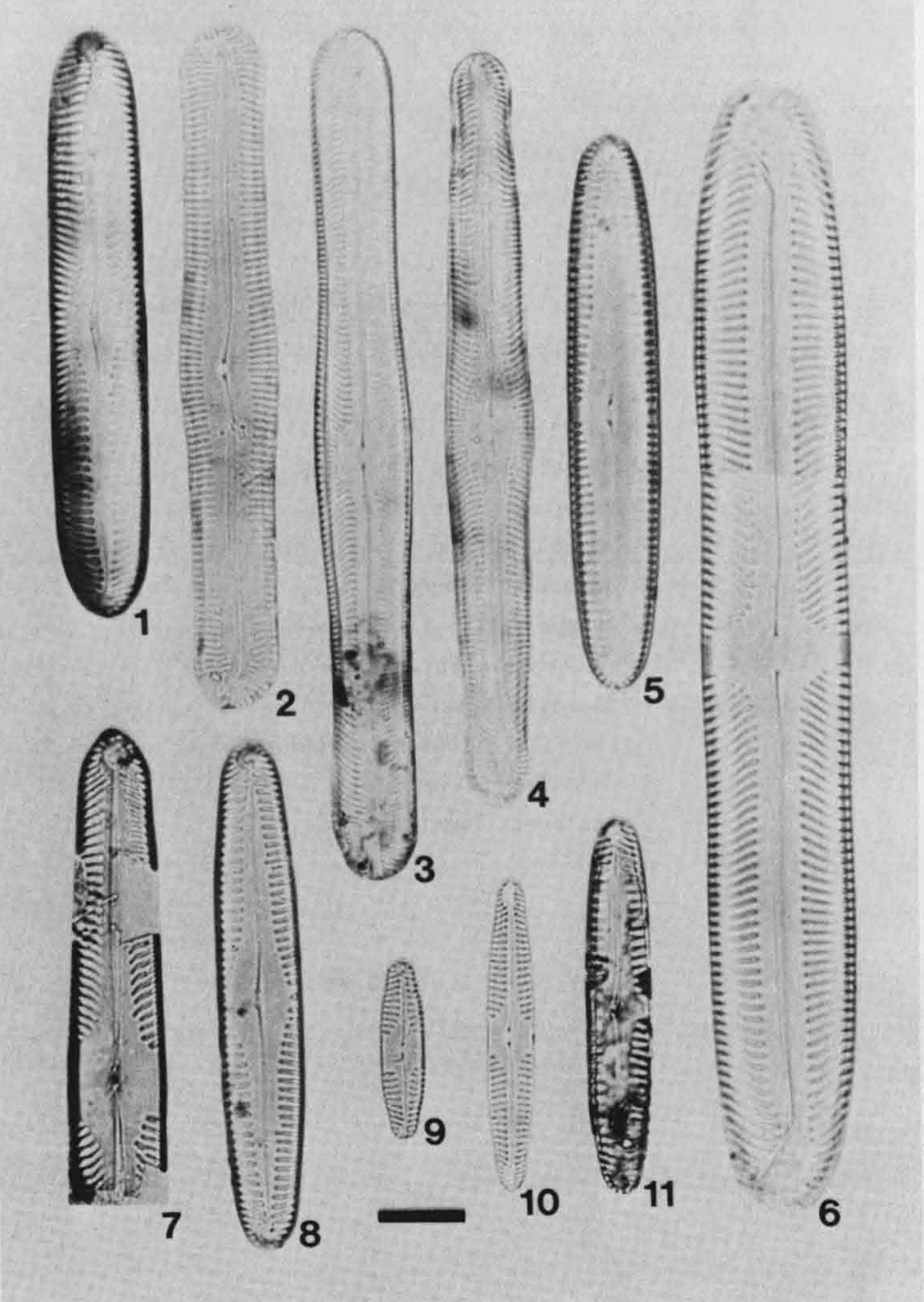

PLATE 10

1,2	*Pinnularia stauroptera* (Grunow) Rabenhorst
3	*P. biceps* Gregory
4,5	*P. braunii* var. *amphicephala* (Mayer) Hustedt
6	*Stauroneis anceps* Ehrenberg
7	*S. phoenicenteron* (Nitzsch) Ehrenberg
8	*S. spicula* Hickie
9	*S. anceps* Ehrenberg
10	*S. anceps* var. *birostris* (Ehrenberg) Cleve
11,12	*S. phoenicenteron* var. *nobilis* (Schumann) Sabelina
13	*S. phoenicenteron* var. *hattorii* Tsumura

Scale 10 μm

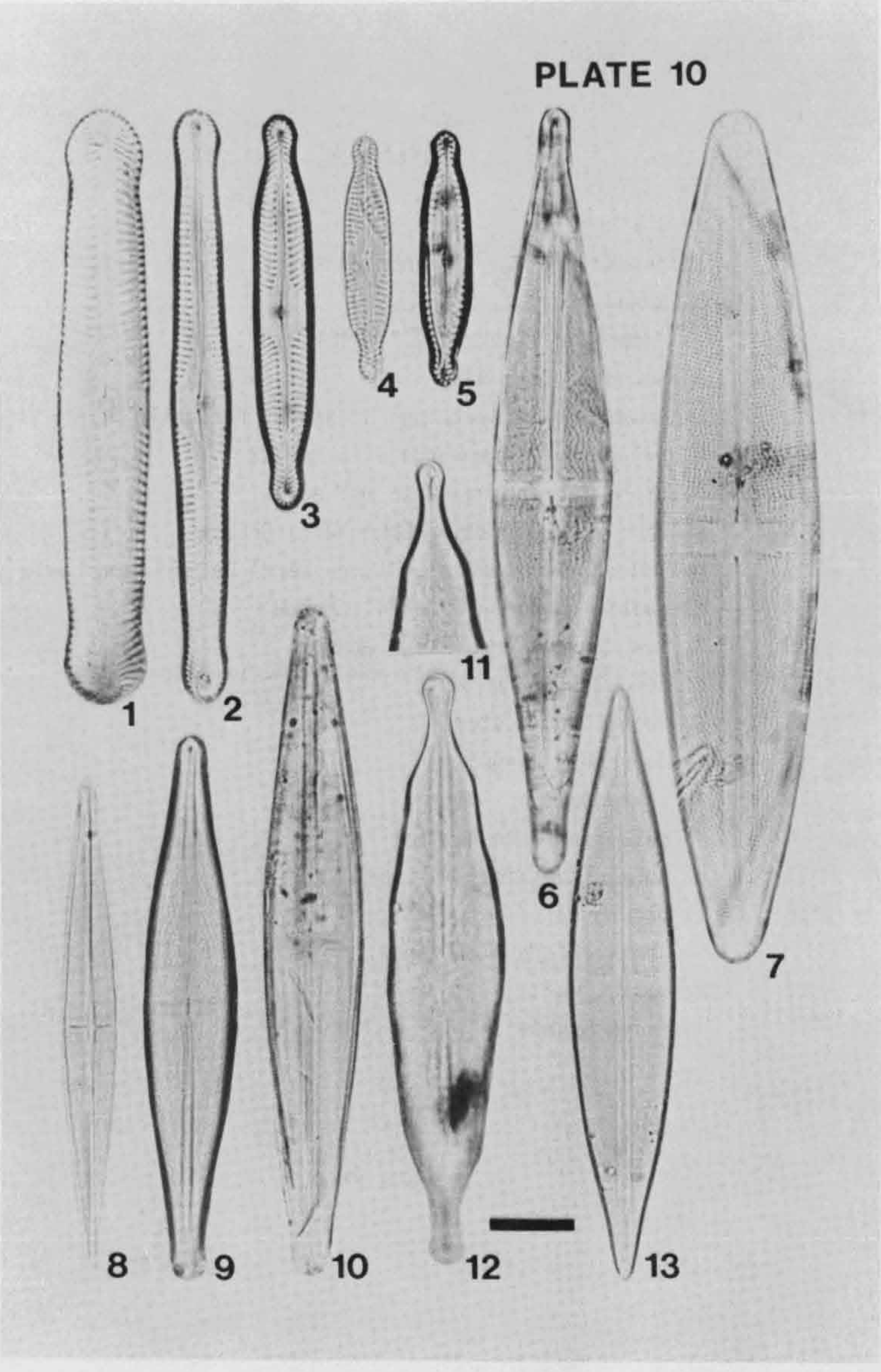
PLATE 10
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PLATE 11

1 *Epithemia cistula* (Ehrenberg) Ralfs

2 *E. adnata* var.
saxonica (Kuetzing) Patrick

3 *Rhopalodia gibba* var.
ventricosa (Kuetzing) H. and M. Peragallo

4 *R. gibberula* (Ehrenberg) Otto Muller

5 *R. gibba* (Ehrenberg) Otto Muller

6 *Hantzschia amphyioxys* (Ehrenberg) Grunow

7 *Cylindrotheca closterium* (Ehrenberg) Reimann and Lewin

8 *Nitzschia cursoria* (Donkin) Grunow

9 *N. longissima* (Brebisson) Grunow

10 *N. congolensis* Hustedt

11 *N. rostellata* Hustedt

12 *N. delauneyi* Manguin

13 *N. lanceolata* W. Smith

14 *N. subcapitellata* Hustedt

15 *N. palea* (Kuetzing) W. Smith

16 *N. obtusa* var.
scalpelliformis Grunow

17 *N. obtusa* var.
nana Grunow

Scale 10 μm

PLATE 11

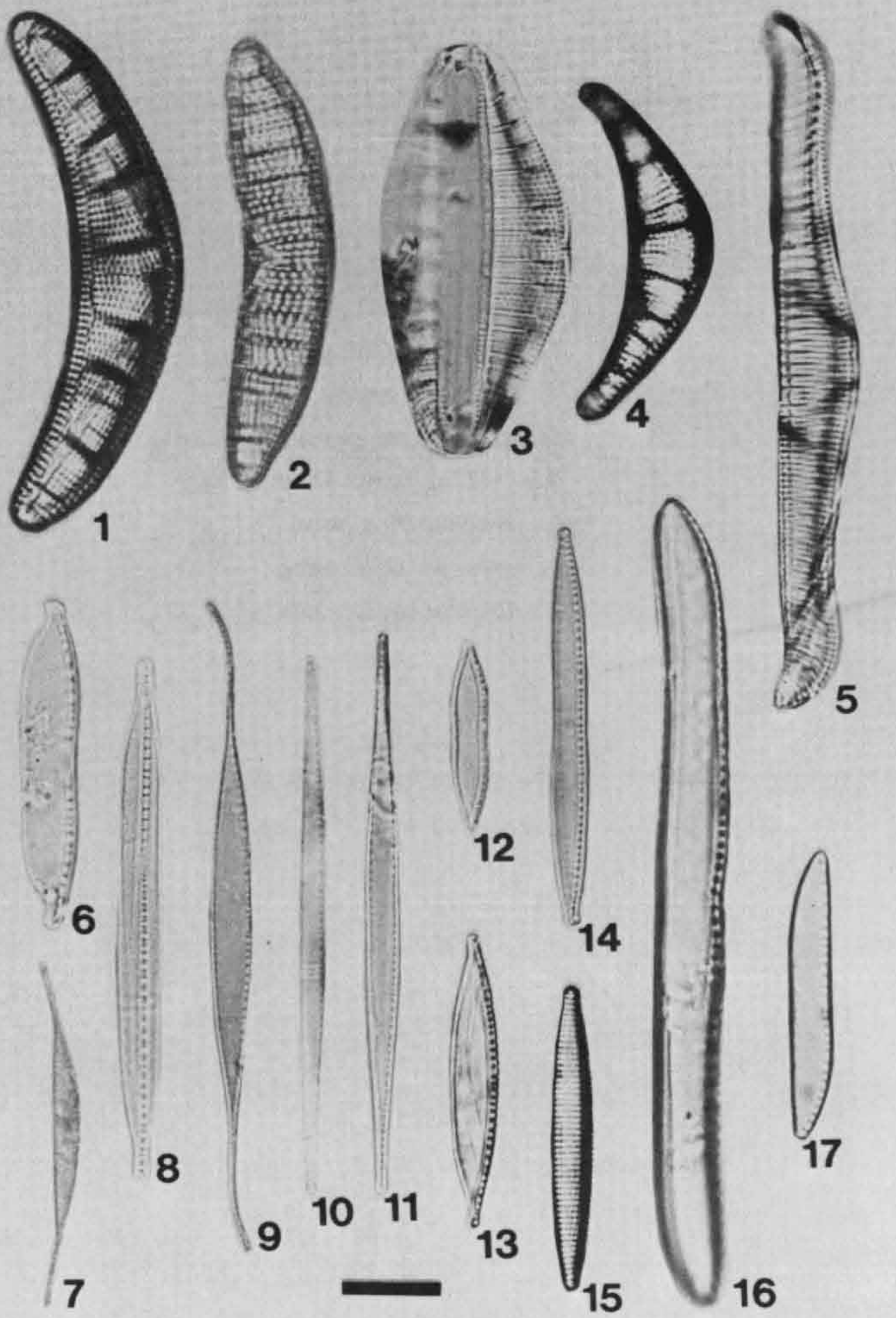

PLATE 12

1	*Nitzschia littoralis* Grunow
2	*N. tryblionella* var. *maxima* Grunow
3	*Campylodiscus pervulsus* Jurilj
4	*Surirella gemma* Ehrenberg
5	*S. arachnoidea* Wood
6,7	*S. robusta* Ehrenberg
8	*S. delicatissima* Lewis

Scale 10 μm (Figs 1,2,4-8)
Scale 50 μm (Fig. 3)

PLATE 12

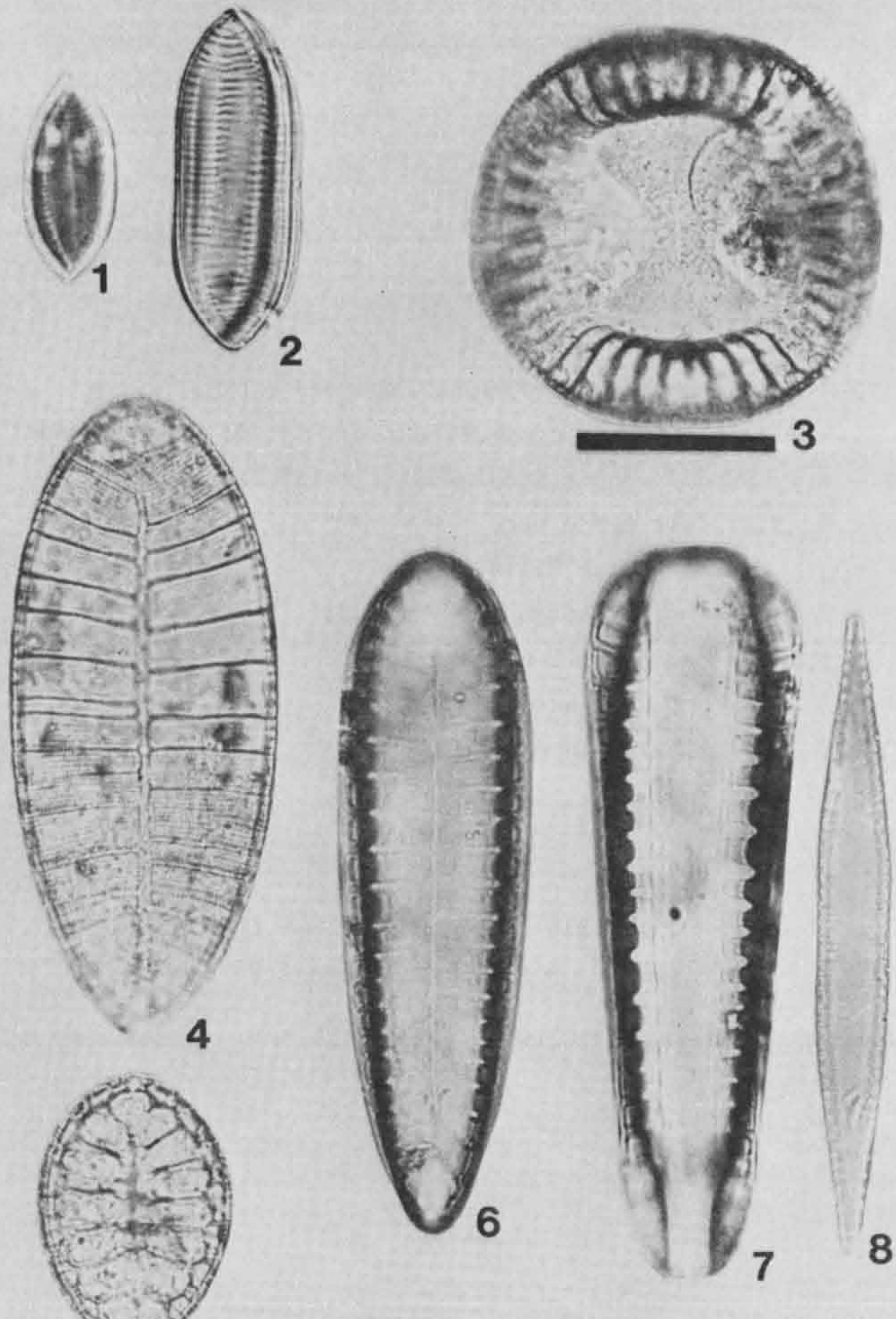

PLATE 13

1 *Hantzschia amphioxys* var.
gracilis Hustedt

2-4 *Nitzschia habirschawii* Febiger
(Fig. 3; central region; Fig. 4: polar region)

5 *Stenopterobia intermedia* (Lewis) Van Heurck

6 *S. intermedia* var.
capitata Fontell

7 *Surirella thienemanni* Hustedt

8 *S. biseriata* Brebisson

9 *S. spiralis* Kuetzing

10,11 *S. robusta* Ehrenberg

Scale 20 μm (Figs 1,3-8,10,11)
Scale 50 μm (Figs 2,9)

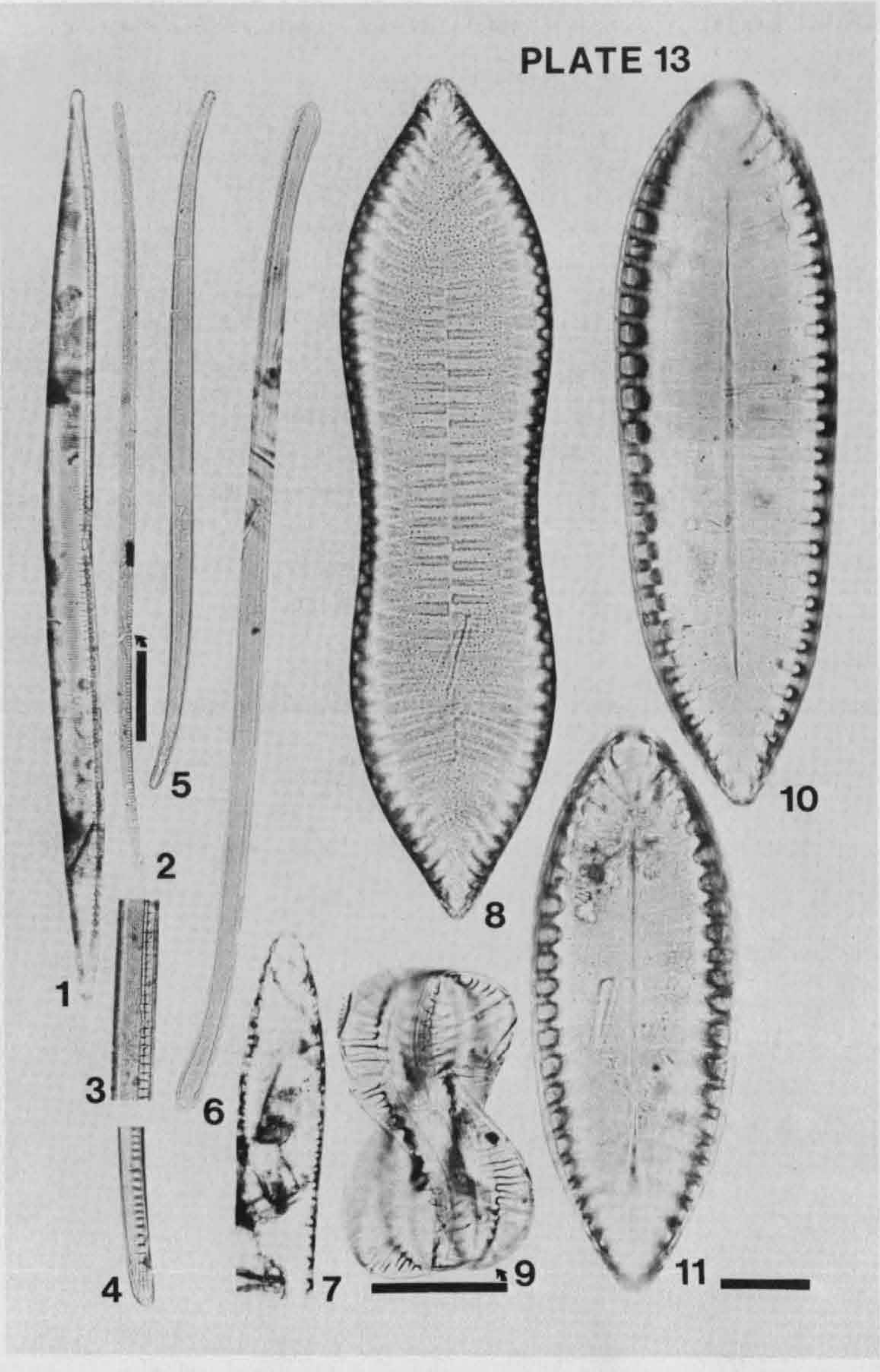
PLATE 13
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PLATE 14

1,2	*Surirella biseriata* var. *subparallela* Meister
3	*S. biseriata* var. *constricta* (Ehrenberg) Hustedt
4	*S. linearis* var. *constricta* Grunow
5,6	? *Campyloneis/Cyclotella* sp.

Scale 10 μm

PLATE 14

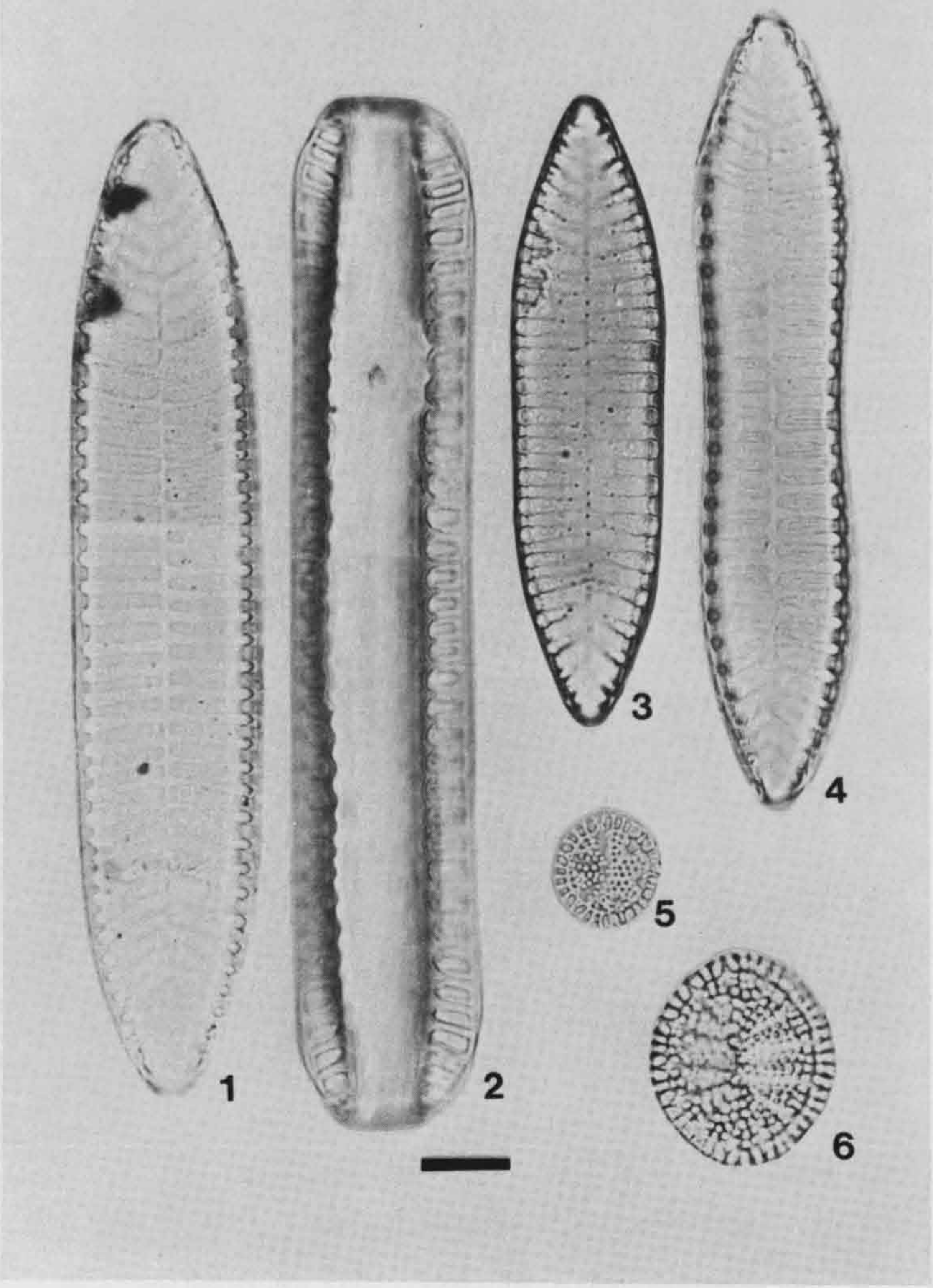


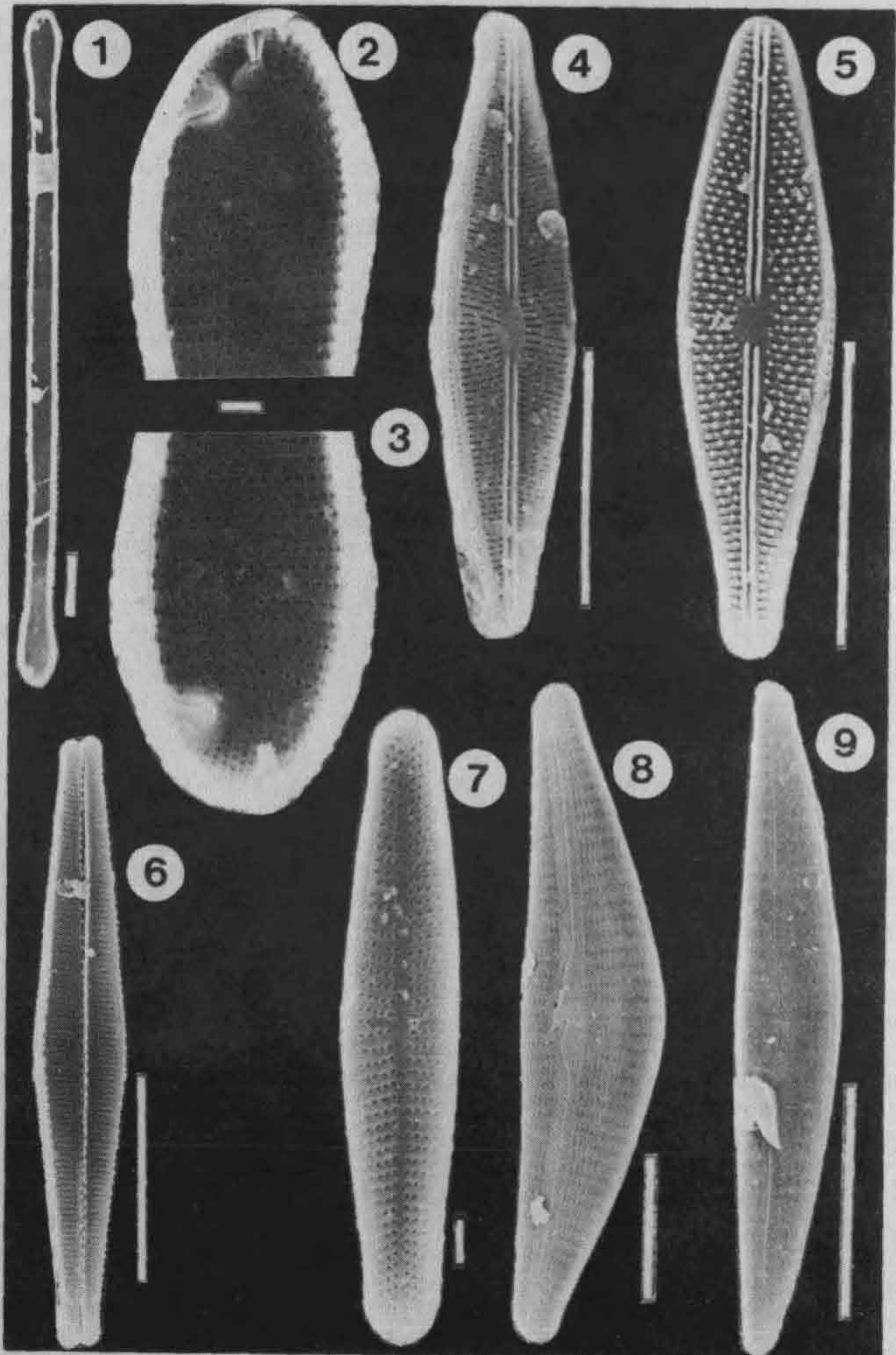
PLATE 15

Scanning electron micrographs

1-3 *Eunotia rabenhorstiana* (Grunow) Hustedt
4 *Anomoeoneis serians* var.
brachysira (Brebisson) Cleve
5 *A. serians* var.
acuta Hustedt
6 *Eunotia trinacria* var.
undulata Hustedt
7 *Achnanthes linearis* (W. Smith) Grunow
8 *Cymbella affinis* Kuetzing
9 *C. claasseniae* Cholnoky

Scale 10 μm (Figs 1,4-6,8,9)
Scale 1 μm (Figs 2,3,7)

PLATE 15



4 DISTRIBUTIONAL PATTERNS

4.1 Preliminary Remarks

The wide range in numbers of samples taken from various sites, particularly those from outside the Magela Creek system, makes any attempt at regional comparisons tenuous in the extreme. Similarly, many of the sampling sites were visited infrequently, either because they were off the normal sampling roster or because they were inaccessible for much of the year; this is as true for the samples from isolated places such as Magela Falls and Baroalba Springs, as for the extra-regional sites which could often only be reached for sampling by quite circuitous airline routes.

There are nevertheless some characteristics of the diatom flora of northern Australian freshwaters which can be elucidated from the observations made here. These include aspects of the diversity and distribution of the elements of the flora (see Section 4.5) as well as the likely usefulness of the flora as a tool for the monitoring of pollution in the waterways near the uranium mining and processing sites (see Section 5).

Finally this report is based on the examination of approximately one-third (477 samples) of the total number of samples collected during this study. Owing to the lack of time available for the processing of the newer samples prior to the preparation of the report, some of the samples from rarely visited sites are yet to be investigated. Some of the more recent samples have been quickly scanned but have yielded no information which would necessitate revision of what follows.

4.2 Distribution of Taxa

The distribution of taxa within the Magela Creek region is given in Appendix 1. It is seen that the taxa can be divided into four groups, one each for taxa mainly confined to the escarpment, the plains and the flood plains, and one group containing the majority of taxa for which no distinct distributional pattern is evident. A further aspect which is not brought out in these presence and absence scores is that of the marked temporal variation in water quality between the end of the wet season and the end of the dry season. The effect of this variation on the diatom flora seems to vary from minimal in the escarpment pools to maximal in the floodplain billabongs. Thus the flora appears to be composed of taxa which are prevalent in very dilute freshwaters, whether having preferences for chloride- or sulphate-dominated waters, and most of these taxa live continuously in the plateau waterholes, with the possibility of spreading to the lower reaches during the wet season. At the other end of the system are the taxa which are found predominantly in the higher conductivity waters that occur in the upper estuaries of the Alligator Rivers. These taxa are probably carried in backflow waters in the late flooding at the end of the wet season and survive in the floodplain waterholes. Here the waters rapidly increase in conductivity through the combined effects of evaporation and groundwater inflow. The majority of taxa can tolerate gradual changes in the environment and therefore can range throughout the system and survive in water of varying quality.

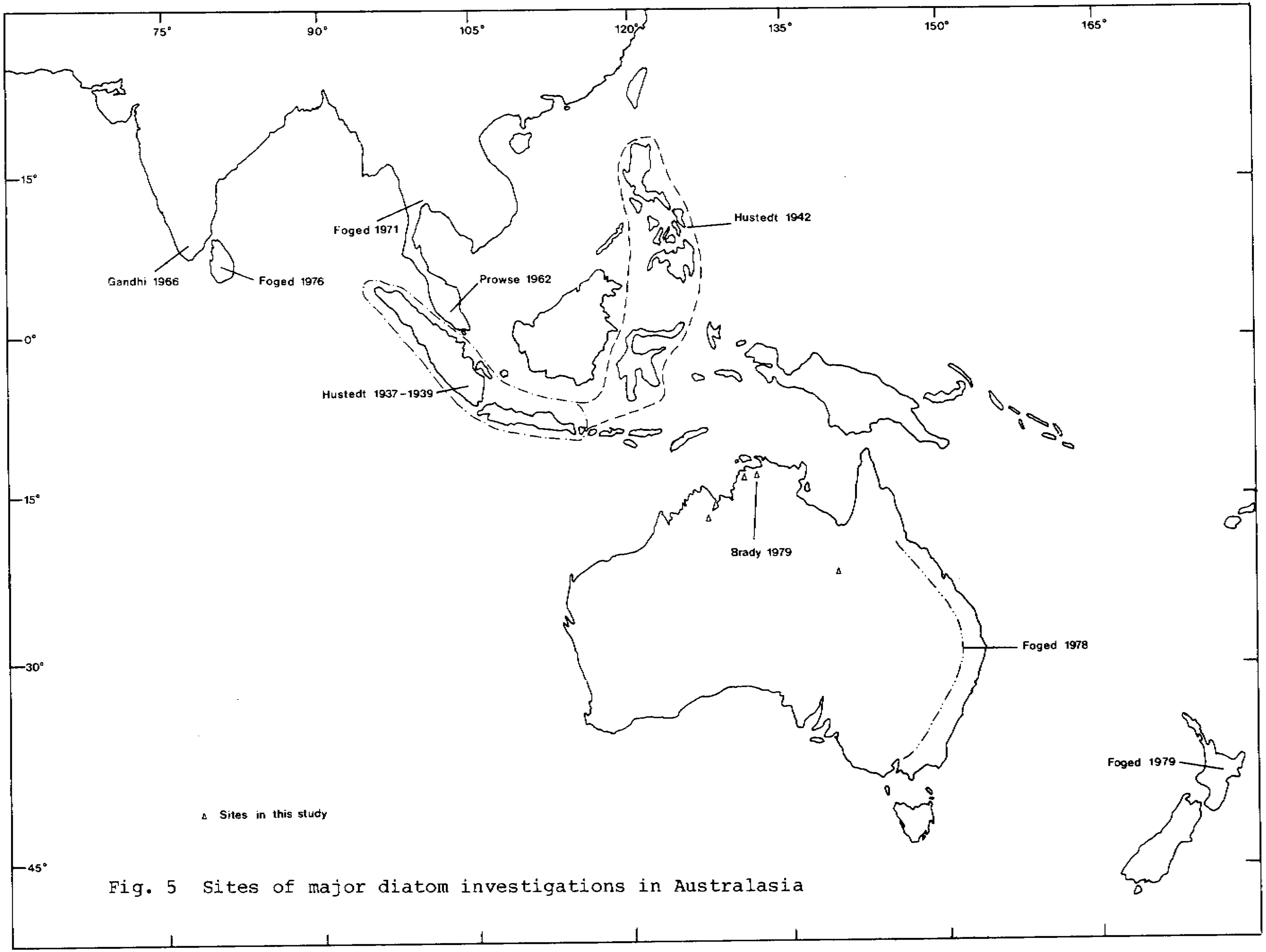


Fig. 5 Sites of major diatom investigations in Australasia

It is difficult to know how widespread the distribution of many of the taxa is, since many of them are poorly represented in the collections and are therefore sufficiently rare to give rise to the suspicion that their presence in widely separated localities could be anomalous. This problem is exemplified by the distribution of a taxon such as *Cyclotella meneghiniana* which was found in the Magela Falls samples and in Leichhardt and Red Lily Billabongs, but not in any of the samples from the intervening waterbodies. In spite of all the above comments there was no apparent trend in the form of marked variations in taxa diversity from one end of the Magela Creek to the other except for a slight tendency for the maximum number of taxa to occur in the backflow billabongs. This is not altogether unusual when it is considered that the majority of the samples also came from those billabongs, but does reflect the wide variety of both microhabitats and the environmental change experienced by their resident flora. This is backed up by the samples obtained from sites outside the Magela Creek (see Appendix 2) where fewer samples gave high species counts for the similarly situated billabongs such as Umbungbung and Long Harrys.

Of the extra-Magela Creek samples, the most significant are likely to be those from the East Finniss River and Rum Jungle area as these reflect the likely effects of broad-scale environmental stress on the diatom flora. Here the most significant change is not that from many taxa to just a few, for that effect is also seen in some of the other sample sites, but is more the change from a flora containing a variety of taxa from a variety of taxonomic groups to a flora which is largely dominated by a few species of the genus *Nitzschia*. This change can also be seen in the Magela Creek system at the end of the dry season when the water quality of most of the billabongs is at its poorest.

The sites such as Lakes Argyle and Moondarra appear to be chloride- rather than sulphate-dominated waters and, with the exception of some floodplain billabongs such as Red Lily and Jingalla, appear to have a high conductivity in comparison with the water of the Alligator Rivers Region. This is surprising as both these lakes are managed as water resources for human as well as for agricultural consumption.

On the international scale, the distribution of taxa fits in well with that of a Region lying within a tropical zone which, climatically, has much in common with southeast Asia. The majority of flora found in the Alligator Rivers Region have been described in the various floristic studies from India and Ceylon through to the Philippines (see Fig. 5). These studies are all referred to in Section 3.2. However, the flora has an affinity with the temperate Australian and New Zealand floras except that most of the taxa found in these temperate areas are the cosmopolitan forms which seem to have a worldwide distribution.

5 CONCLUSIONS

The diatom flora of the Alligator Rivers Region is a very rich one by temperate and tropical freshwater standards, probably because of the very diverse nature of the environment. Such an environment creates many problems for the ecologist who wishes to use the flora to obtain information concerning the effects of outside influences upon the sytems as these are likely to be masked to some extent by the inherent internal variation. Variation, which was amply demonstrated in the multiple samples taken in this study, is such that individual samples are of little value. Samples taken less than a metre apart, while mostly containing the same taxa, had quite different taxa dominating each sample. The unexpectedly high spatial heterogeneity in diversity of taxa could be a major problem in the development of a sound monitoring system based on diatoms. Further basic information on both seasonal and spatial dynamics is necessary to elucidate the problem.

The taxa present indicate that the water quality changes throughout the dry season, ranging from oligotrophic with very low conductivity through to relatively eutrophic with elevated conductivities. At each stage in this change, the taxa present are likely to react differently to environmental perturbations, either man-made or otherwise, and these possible reactions would require a careful program of field and laboratory investigations if they are to be used to help elucidate the changes, if any, in the aquatic system caused by environmental hazards. However, the samples from the Rum Jungle area indicate that the relatively high diversity in taxa does not imply that the system is stable, but rather that it is sensitive to influences other than those which it has evolved to deal with.

As for the taxa themselves, there are some major problems for the novice in the presence of a large number of taxa from taxonomically difficult genera such as *Eunotia, Navicula, Nitzschia* and *Pinnularia*, the taxonomy of which is in need of a thorough revision. It would require a full year's work in some of the American and European museums and Herbaria to check the validity of many of the identifications of the taxa presented here, as these have all had to be based upon written descriptions and illustrations.

The major problem arising from the taxonomic difficulties is the cost efficiency of spending many hours at a microscope determining the presence or absence of the taxa in each sample. On occasion, with a very rich sample, the examination can take the best part of a day for someone who is familiar with the material. What probably is needed is a search technique based on a relatively small number of the more common taxa which cover a range of environmental habitats and which can be taken as indicative of them. However, until the distributional patterns of the taxa can be correlated with the physico-chemical characteristics of the billabongs in which the samples were taken, the information presented here cannot be extended to form the basis for a monitoring scheme.

6 ACKNOWLEDGMENTS

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Finally, to my colleagues, Drs Tyler and Ling, and Mr Tim Walker, for samples, for discussion and for encouragement and support, I extend my warmest thanks.

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APPENDIX 1

Presence/Absence Scores for Diatoms of the Magela Creek and nearby Sites

	Magela Falls	Radon Springs	Bowerbird Billabong	Coonjimba Billabong	Gulungul Billabong	Corndorl Billabong	1&2 Magela Crossing	Island Billabong	Hades Flat	Jabiluka Billabong	Leichhardt Billabong	Nankeen Billabong	Red Lily Billabong	E. Alligator
Achnanthes affinis	+	-	-	-	-	-	-	-	-	-	-	-	-	-
A. exigua var. *heterovalva*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. sp. 1	+	+	+	-	-	-	-	-	-	-	-	+	-	-
A. linearis	+	-	+	-	+	-	-	-	-	-	-	-	-	-
A. minutissima	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Amphora argus	-	-	-	-	+	-	-	-	-	-	-	-	-	-
A. towutensis	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anomoeoneis exilis var. *gomphonemacea*	-	-	+	-	-	-	+	+	-	+	+	+	-	-
A. exilis var. *lanceolata*	-	-	-	-	-	-	+	+	-	-	+	-	-	-
A. serians var. *acuta*	-	-	+	+	+	-	-	+	-	-	-	-	-	-
A. serians var. *brachysira*	+	-	+	-	+	+	+	-	-	+	+	-	+	-
A. sphaerophora	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Asterionella zasuminensis	+	+	+	+	+	+	+	+	-	+	+	+	+	+
Campylodiscus pervulsus	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Cocconeis placentula	-	-	-	-	+	+	+	-	-	-	-	+	-	-
C. scutellum	-	-	-	-	-	-	+	+	-	-	-	+	+	-
Coscinodiscus asteromphalus	-	-	-	-	-	-	-	-	-	-	-	-	+	+
C. lineatus	-	-	-	-	-	-	-	-	-	-	+	-	-	+
Cyclotella meneghiniana	+	-	-	-	-	-	-	-	-	-	+	-	+	-
C. stelligera	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C. stylorum	-	-	-	-	-	-	-	+	-	+	+	-	-	+
C. woltereckii	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cylindrotheca closterium	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cymbella affinis	-	-	-	-	-	-	+	+	-	+	-	-	+	-
C. aspera	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C. claasseniae	+	-	+	-	+	-	-	-	-	-	-	-	-	-
C. hustedtii	-	-	+	-	-	-	-	-	-	-	-	-	-	-
C. minuta	+	-	+	+	+	+	+	+	-	+	+	+	+	+
C. spicula	-	-	-	-	+	-	-	-	-	-	-	-	-	-
C. subturgida	+	-	+	+	-	-	-	-	-	+	-	-	-	-
Diploneis ovalis	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D. subadvena	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Epithemia adnata var. *saxonica*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E. cistula	+	-	+	-	-	-	-	-	-	-	-	-	-	-
Eunotia aequalis	-	-	-	-	+	-	+	-	-	-	-	+	-	-
E. ambigua	+	-	-	-	-	-	-	-	-	-	-	-	-	-
E. astricleveae	-	-	+	+	+	+	+	+	-	+	+	+	+	-
E. bicapitata	-	-	+	+	+	+	+	+	-	+	+	+	+	-

Appendix 1 (ctd)

	Magela Falls	Radon Springs	Bowerbird Billabong	Coonjimba Billabong	Gulungul Billabong	Corndorl Billabong	1&2 Magela Crossing	Island Billabong	Hades Flat	Jabiluka Billabong	Leichhardt Billabong	Nankeen Billabong	Red Lily Billabong	E. Alligator
E. bigibba	–	–	+	–	–	–	–	–	+	–	–	–	–	–
E. camelus	–	–	–	+	+	+	+	+	+	+	+	+	+	–
E. camelus var. *denticulata*	–	–	–	+	+	+	+	–	–	–	–	–	–	–
E. camelus var. *ventricosa*	–	–	–	+	+	+	+	+	+	–	+	+	+	–
E. didyma	–	–	–	–	–	–	–	–	–	–	–	–	–	–
E. didyma var. *maxima*	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Eunotia didyma var. *maxima* f. 1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
E. didyma var. *media*	–	–	–	–	–	–	–	–	–	+	–	–	–	–
E. flexuosa	–	–	+	+	+	–	+	+	–	–	–	–	–	–
E. hebridica var. *bergii*	–	–	–	+	+	+	+	+	+	+	+	+	–	–
E. lunaris	+	–	+	+	+	+	+	+	+	+	+	+	+	–
E. monodon	–	–	–	+	+	+	–	+	–	+	+	+	+	–
E. monodon var. *scandica*	–	–	+	+	+	+	+	+	+	–	+	+	–	–
E. monodon var. *tropica*	–	–	–	–	+	+	–	+	–	–	–	–	–	–
E. parallela	–	–	–	+	+	+	+	+	–	+	+	+	+	–
E. pectinalis	–	+	+	+	+	+	+	+	+	+	+	+	+	–
E. pectinalis var. *undulata*	–	–	–	+	+	+	+	–	–	+	+	+	–	–
E. pectinalis var. *undulata* f. *fossilis*	–	–	+	+	+	+	+	+	+	+	+	+	–	–
E. pseudoindica var. *gracilis*	–	+	+	+	+	+	+	+	+	+	+	+	+	–
E. pseudopectinalis	–	+	+	–	+	+	–	+	–	–	–	–	–	–
E. rabenhorstiana var. *elongatum*	–	–	–	–	+	–	–	+	–	+	+	+	–	–
E. rabenhorstii var. *africana* f. *triodon*	–	–	+	–	–	–	–	+	–	+	+	+	+	–
E. sudetica var. *australis*	–	+	+	+	+	–	–	+	–	–	–	–	–	–
E. triconfusa	–	+	+	–	+	–	–	–	–	–	–	+	–	–
E. trigibba	+	–	+	+	+	+	+	+	+	+	+	+	–	–
E. trinacria f. *undulata*	–	–	+	+	+	–	–	+	–	+	+	+	–	–
E. zygodon	+	+	+	–	–	–	–	–	–	–	–	–	–	–
E. zygodon var. *depressa*	–	–	+	–	+	+	–	+	–	+	+	–	+	–
E. zygodon var. *elongata*	–	–	–	–	–	–	–	–	–	–	–	–	–	–
E. zydodon var. *emarginata*	–	–	–	–	+	–	–	–	–	–	–	–	–	–
Fragilaria strangulata	+	+	–	–	–	–	–	–	–	–	–	–	–	–
Frustulia entrancensis	–	+	–	–	–	–	–	–	–	–	–	–	–	–
F. rhomboides	–	+	+	+	+	+	+	+	+	+	+	+	+	–
Gomphonema gracile	+	–	+	+	+	+	+	+	+	+	+	+	+	+
G. intricatum var. *vibrio*	+	–	+	–	+	–	–	–	–	–	–	+	+	–
G. parvulum	–	–	–	–	+	+	–	+	–	+	+	+	+	+
G. subtile	–	–	–	–	+	–	+	–	–	–	–	–	–	–
Gyrosigma attenuatum	–	–	–	–	–	–	–	–	–	–	–	–	+	–
Hantzschia amphioxys	–	–	–	+	–	–	–	–	–	–	–	–	–	–

Appendix 1 (ctd)

	Magela Falls	Radon Springs	Bowerbird Billabong	Coonjimba Billabong	Gulungul Billabong	Corndorl Billabong	1&2 Magela Crossing	Island Billabong	Hades Flat	Jabiluka Billabong	Leichhardt Billabong	Nankeen Billabong	Red Lily Billabong	E. Alligator
H. amphioxys var. *gracilis*	–	–	–	+	+	+	+	–	+	–	–	–	–	–
Mastogloia elliptica var. *dansei*	–	–	–	–	+	+	–	–	–	–	–	+	+	–
Melosira distans	–	–	–	+	+	–	+	+	–	–	+	+	+	–
M. granulata	+	–	+	+	+	+	+	+	–	+	+	+	+	+
M. granulata var. *angustissima*	+	–	+	–	–	–	+	–	–	+	+	–	+	–
M. granulata var. *muzzanensis*	–	–	–	+	+	+	–	–	–	–	+	–	–	–
Navicula acceptata	–	–	+	–	–	–	–	–	–	–	+	–	+	–
N. americana	–	–	–	–	+	–	–	–	–	–	–	–	–	–
Navicula anglica var. *subsalsa*	–	–	+	–	–	–	–	–	–	–	–	–	–	–
N. arvensis	–	–	–	–	–	–	–	–	–	–	–	+	–	–
N. bremensis	–	–	–	–	–	–	+	+	–	–	–	–	–	–
N. diserta	–	–	–	–	–	–	–	–	–	–	–	–	–	+
N. disparata	+	–	–	–	–	+	–	+	–	–	+	+	+	–
N. dutoitana	–	–	+	–	–	–	–	–	–	–	–	–	–	–
N. geinitzi	–	–	–	–	–	–	–	+	–	–	–	–	–	–
N. gysingensis	–	–	–	–	+	–	–	+	–	–	–	–	–	–
N. halophilioides	–	–	–	–	–	–	–	–	–	–	+	–	–	–
N. jungii	–	–	+	–	–	–	–	+	–	–	+	+	+	–
N. mutica	+	+	+	–	+	–	–	+	–	–	+	–	–	–
N. nuda	–	–	–	+	–	+	–	+	–	–	+	–	–	–
N. perrotettii	–	–	–	+	–	–	–	–	–	–	–	–	–	–
N. pseudislandica	+	–	–	–	–	–	–	–	–	–	+	–	–	–
N. pseudosubtilissima	+	+	+	+	–	–	–	–	–	–	–	–	–	–
N. pupula	–	–	+	+	+	+	+	+	–	+	+	+	–	+
N. pupula var. *rectangularis*	–	–	–	+	+	–	–	–	–	+	+	–	–	–
N. radiosa	+	–	+	+	+	+	+	+	+	+	+	+	+	–
N. rhynchocephala	–	+	+	+	–	–	+	+	–	+	–	–	+	–
N. schwabei	–	–	–	+	+	–	+	–	–	–	–	–	–	–
N. viridula	–	–	–	–	–	–	–	–	–	+	–	–	+	–
N. yarrensis	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Neidium bisulcatum	–	–	–	+	+	+	–	–	+	+	–	–	–	–
N. dilatatum	–	–	+	–	–	–	–	–	–	–	+	+	–	–
N. iridis var. *amphigomphus*	–	–	–	+	+	+	+	+	+	+	+	+	–	–
Nitzschia congolensis	–	–	–	–	–	–	–	+	–	+	–	+	–	–
N. cursoria	–	–	–	–	–	–	–	+	–	–	+	–	–	–
N. delauneyi	–	–	–	–	–	–	–	–	–	–	–	–	–	–
N. habirshawii	–	–	–	–	–	–	–	–	–	–	–	–	–	+
N. lanceolata	–	–	–	–	–	+	–	–	+	–	–	+	–	–
N. littoralis	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Appendix 1 (ctd)

	Magela Falls	Radon Springs	Bowerbird Billabong	Coonjimba Billabong	Gulungul Billabong	Corndorl Billabong	1&2 Magela Crossing	Island Billabong	Hades Flat	Jabiluka Billabong	Leichhardt Billabong	Nankeen Billabong	Red Lily Billabong	E. Alligator
N. longissima	-	-	-	-	-	-	-	-	-	-	-	+	-	-
N. obtusa var. *nana*	-	-	-	-	-	-	-	-	-	-	+	+	-	-
N. obtusa var. *scalpelliformis*	-	-	-	-	-	-	-	-	-	-	-	+	-	-
N. palea	-	-	-	+	+	-	-	+	-	-	+	+	+	-
N. rostellata	+	-	-	+	+	+	+	+	-	+	+	+	+	-
N. subcapitellata	-	-	+	+	+	+	+	+	-	+	-	-	+	-
N. tryblionella var. *maxima*	-	-	-	-	-	-	-	-	-	-	-	+	-	-
Pinnularia acrosphaeria var. *turgidula*	-	-	-	-	+	-	-	-	-	-	-	-	-	-
P. biceps	-	+	+	-	-	-	-	-	-	-	-	+	-	-
P. bogotensis	-	-	+	+	-	+	+	+	+	-	-	-	-	-
P. braunii var. *amphicephala*	-	-	-	+	+	+	+	+	-	+	+	+	+	-
P. brevicostata var. *ventricosa*	-	-	-	-	-	-	-	-	-	-	-	-	-	+
P. brevicostata var. *sumatrana*	-	-	-	+	+	-	-	+	-	-	-	-	-	-
Pinnularia gibba	-	-	-	-	+	+	-	-	-	-	+	-	-	-
P. gibba var. *linearis*	-	-	-	+	+	+	+	-	+	+	+	+	-	-
P. intermedia	-	-	-	-	+	-	-	-	-	-	-	-	-	-
P. legumen	-	-	+	-	+	-	-	+	+	+	+	+	+	-
P. luculenta	-	-	-	+	+	-	+	+	+	+	+	-	-	-
P. major	-	-	+	+	+	+	-	+	-	+	+	+	-	-
P. microstauron	-	-	+	+	+	+	-	+	+	+	+	+	+	-
P. rangoonensis	-	-	+	-	-	-	-	-	-	-	-	-	-	-
P. stauroptera	-	+	+	+	+	+	+	+	+	+	+	+	-	-
Rhizosolenia eriensis	-	-	+	-	-	-	-	+	-	-	-	+	-	-
Rhopalodia gibba	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R. gibba var. *ventricosa*	-	-	+	-	+	-	+	-	-	-	-	-	-	-
R. gibberula	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stauroneis anceps	-	-	-	+	+	+	+	-	+	+	-	-	-	-
S. anceps var. *birostris*	-	-	-	-	+	-	+	-	-	-	-	-	-	-
S. phoenicenteron	+	-	-	+	+	+	+	+	+	-	+	+	-	-
S. phoenicenteron var. *hattorii*	-	-	-	+	-	-	-	-	+	-	-	-	-	-
S. phoenicenteron var. *nobilis*	-	-	-	+	+	+	-	-	+	-	-	-	-	-
S. spicula	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenopterobia intermedia	+	-	+	+	+	+	+	+	+	+	+	+	-	-
S. intermedia var. *capitata*	+	-	+	-	-	-	-	-	-	-	-	-	-	-
Surirella arachnoidea	-	-	-	-	-	-	-	-	-	-	-	-	-	+
S. biseriata	+	-	+	-	-	-	-	-	-	-	-	-	-	-
S. biseriata var. *constricta*	+	+	-	-	-	-	-	+	+	-	-	-	-	-
S. biseriata var. *subparallela*	+	+	+	+	-	-	+	+	-	+	-	+	-	-
S. delicatissima	+	+	+	+	-	-	+	+	-	-	-	-	-	-

Appendix 1 (ctd)

	Magela Falls	Radon Springs	Bowerbird Billabong	Coonjimba Billabong	Gulungul Billabong	Corndorl Billabong	1&2 Magela Crossing	Island Billabong	Hades Flat	Jabiluka Billabong	Leichhardt Billabong	Nankeen Billabong	Red Lily Billabong	E. Alligator
S. gemma	-	-	-	-	-	-	-	-	-	-	-	-	-	+
S. linearis var. *constricta*	+	+	-	-	-	+	+	-	-	+	-	-	-	-
S. robusta	-	-	-	+	+	+	-	-	-	+	+	+	-	-
S. spiralis	-	+	+	-	+	-	-	-	-	-	-	-	-	-
S. thienemanni	-	+	-	-	-	-	-	+	-	-	-	-	-	-
Synedra ulna	-	-	-	-	+	-	-	+	-	-	-	+	+	+
? *Campyloneis*	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Total Taxa	34	22	60	59	75	52	52	66	29	51	60	60	41	17
Total Samples	5	11	14	33	50	27	21	81	4	54	59	21	14	6

APPENDIX 2

Presence/Absence Scores for Diatoms of Sites other than Magela Creek

	Baroalba Springs	Jim Jim Falls	Twin Falls	Deaf Adder	Umbungbung B.	Long Harrys B.	Jingalla B.	Mary River	E. Finniss River	Rum Jungle	L. Moondarra	L. Argyle
Achnanthes affinis	-	+	-	+	-	-	-	-	-	-	-	-
A. exigua var. *heterovalva*	-	-	-	-	+	-	-	+	-	+	-	-
A. sp. 1	-	-	-	-	-	-	-	-	-	+	-	-
A. linearis	-	+	+	-	-	-	-	+	-	-	+	+
A. minutissima	-	-	-	-	-	-	-	-	-	+	-	-
Amphora argus	-	-	-	-	-	-	-	-	-	-	-	-
A. towutensis	-	-	-	-	-	-	-	+	-	-	-	-
Anomoeoneis exilis var. *gomphonemacea*	-	-	-	-	+	-	-	-	-	-	-	-
A. exilis var. *lanceolata*	-	-	-	-	-	+	-	-	-	-	-	-
A. serians var. *acuta*	-	-	-	-	-	-	-	-	-	-	-	-
A. serians var. *brachysira*	-	+	+	-	-	-	-	-	-	-	-	+
A. sphaerophora	-	-	-	-	-	-	-	-	-	-	-	+
Asterionella zasuminensis	-	-	-	+	+	+	+	-	-	-	-	-
Camylodiscus pervulsus	-	-	-	-	-	-	-	-	-	-	-	-
Cocconeis placentula	-	-	-	-	-	-	+	-	-	-	+	+
C. scutellum	-	-	-	-	-	-	-	-	-	-	-	-
Coscinodiscus asteromphalus	-	-	-	-	-	-	-	-	-	-	-	-
C. lineatus	-	-	-	-	-	-	-	-	-	-	-	-
Cyclotella meneghiniana	-	-	-	-	-	-	+	+	-	-	-	-
C. stelligera	-	-	-	-	-	-	-	+	-	-	-	-
C. stylorum	-	-	-	-	-	-	-	-	-	-	-	-
C. woltereckí	-	-	-	-	-	-	-	+	-	-	-	-
Cylindrotheca closterium	-	-	-	-	-	-	+	-	-	-	-	-
Cymbella affinis	-	-	-	-	-	+	-	-	-	-	+	+
C. aspera	-	-	-	-	-	-	-	+	-	-	-	-
C. claasseniae	-	+	+	-	-	-	-	+	-	-	-	-
C. hustedtii	-	+	-	-	-	-	-	+	-	-	-	-
C. minuta	-	+	-	-	+	+	+	+	-	+	+	+
C. spicula	-	-	-	-	+	-	-	+	-	-	-	-
C. subturgida	-	+	-	-	-	-	-	-	-	-	-	-
Diploneis ovalis	-	-	-	-	-	-	+	-	-	-	-	-
D. subadvena	-	-	-	-	-	-	-	-	-		-	-
Epithemia adnata var. *saxonica*	-	-	-	-	-	-	-	-	-	-	+	-
E. cistula	-	-	-	-	-	-	-	-	-	-	-	-
Eunotia aequalis	-	-	-	-	-	+	-	-	-	-	-	-
E. ambigua	-	-	-	-	-	-	-	-	-	-	-	-
E. astricleveae	-	-	-	-	+	-	-	-	-	-	-	-

	Baroalba Springs	Jim Jim Falls	Twin Falls	Deaf Adder	Umbungbung B.	Long Harrys B.	Jingalla B.	Mary River	E. Finniss River	Rum Jungle	L. Moondarra	L. Argyle
E. bicapitata	+	-	-	-	+	+	+	-	-	-	-	+
E. bigibba	-	-	-	-	-	-	-	-	-	-	-	-
E. camelus	-	-	-	-	+	+	+	+	-	-	-	-
E. camelus var. *denticulata*	-	-	-	-	+	+	-	-	-	-	-	-
E. camelus var. *ventricosa*				-	.	.	.	.	-	-	-	-
E. didyma	-	-	-	-	-	-	-	+	-	-	-	-
E. didyma var. *maxima*	-	+	-	-	-	-	-	-	-	-	-	-
Eunotia didyma var. *maxima* f. 1	-	+	-	-	-	-	-	-	-	-	-	-
E. didyma var. *media*	-	-	-	-	-	-	-	+	-	-	-	-
E. flexuosa	-	+	-	-	+	-	-	-	-	-	-	-
E. hebridica var. *bergii*	-	-	-	-	+	-	+	-	-	-	-	-
E. lunaris	-	+	-	-	-	+	+	+	-	-	-	-
E. monodon	-	-	-	-	+	+	-	-	-	-	-	-
E. monodon var. *scandica*	-	-	-	-	+	+	-	-	-	-	-	-
E. monodon var. *tropica*	-	-	-	-	-	+	+	-	-	-	-	-
E. parallela	-	-	-	-	-	-	-	-	-	-	-	-
E. pectinalis	-	-	-	-	+	+	-	+	-	-	-	-
E. pectinalis var. *undulata*	-	-	-	-	+	-	+	-	-	-	-	-
E. pectinalis var. *undulata* f. *fossilis*	-	-	-	-	+	+	-	-	-	-	-	-
E. pseudoindica var. *gracilis*	-	+	-	+	+	+	+	-	-	-	-	-
E. pseudopectinalis	-	-	-	-	-	-	-	-	-	-	-	-
E. rabenhorstiana var. *elongatum*	-	+	-	-	-	+	+	-	-	-	-	-
E. rabenhorstii var. *africana* f. *triodon*	-	-	-	-	-	+	-	-	-	-	-	-
E. sudetica var. *australis*	-	-	-	-	+	-	-	-	-	+	-	-
E. triconfusa	-	-	-	-	-	-	-	-	-	-	-	-
E. trigibba	-	-	-	-	+	+	-	-	-	-	-	-
E. trinacria f. *undulata*	-	-	-	-	-	-	-	-	-	-	-	-
E. zygodon	-	-	-	-	-	-	-	-	-	+	-	-
E. zygodon var. *depressa*	-	+	-	-	+	-	-	-	-	-	-	-
E. zygodon var. *elongata*	-	+	-	-	-	-	-	-	-	-	-	-
E. zygodon var. *emarginata*	-	+	-	-	-	-	-	-	-	-	-	-
Fragilaria strangulata	+	-	-	-	-	-	-	-	-	-	-	-
Frustulia entrancensis	-	-	-	-	-	-	-	-	-	-	-	-
F. rhomboides	+	+	-	-	-	+	+	-	+	+	-	+
Gomphonema gracile	-	-	-	-	+	+	+	+	-	-	-	+
G. intricatum var. *vibrio*	-	-	-	-	-	-	-	-	-	-	-	-
G. parvulum	-	-	-	-	-	-	+	-	-	-	+	-
G. subtile	-	-	-	-	-	-	-	-	-	-	-	-

Appendix 2 (ctd)

	Baroalba Springs	Jim Jim Falls	Twin Falls	Deaf Adder	Umbungbung B.	Long Harrys B.	Jingalla B.	Mary River	E. Finniss River	Rum Jungle	L. Moondarra	L. Argyle
Gyrosigma attenuatum	-	-	-	-	-	-	-	-	-	-	+	-
Hantzschia amphioxys	-	-	-	-	-	-	-	+	-	+	-	-
H. amphioxys var. *gracilis*	-	-	-	-	+	+	-	-	-	-	-	+
Mastogloia elliptica var. *dansei*	-	-	-	-	-	-	-	-	-	-	+	+
Melosira distans	-	-	-	-	+	-	-	+	-	-	-	-
M. granulata	-	+	-	+	+	+	+	+	+	-	-	+
M. granulata var. *angustissima*	-	-	-	-	-	-	-	+	-	-	-	+
M. granulata var. *muzzanensis*	-	-	-	-	-	-	-	-	-	-	-	-
Navicula acceptata	-	-	-	-	-	+	-	-	-	+	-	+
N. americana	-	-	-	-	+	-	-	-	-	+	-	-
Navicula anglica f. *subsalsa*	-	-	-	-	-	-	-	-	-	-	-	-
N. arvensis	-	-	-	-	-	-	-	-	-	-	-	-
N. bremensis	-	-	-	-	-	-	-	-	-	-	-	-
N. diserta	-	-	+	-	-	-	-	-	-	-	-	-
N. disparata	-	-	-	-	-	+	-	-	-	+	-	+
N. dutoitana	-	-	-	-	-	-	-	-	-	-	-	-
N. geinitzi	-	-	-	-	-	-	-	-	-	+	-	-
N. gysingensis	-	-	-	-	-	-	-	-	-	-	-	-
N. halophilioides	-	-	-	-	-	-	-	-	-	-	-	-
N. jungii	-	-	-	-	-	-	-	-	-	-	-	-
N. mutica	-	+	-	-	-	+	-	-	-	+	-	-
N. nuda	-	-	-	-	+	-	-	+	-	-	-	-
N. perrotettii	-	-	-	-	-	-	-	-	-	-	-	-
N. pseudislandica	-	+	-	-	-	+	-	-	-	-	-	-
N. pseudosubtilissima	-	+	-	-	-	-	-	-	-	+	-	-
N. pupula	-	-	-	-	+	+	-	+	-	+	+	-
N. pupula var. *rectangularis*	-	-	-	-	-	-	-	-	-	-	-	-
N. radiosa	-	+	+	-	+	+	-	+	-	-	+	+
N. rhynchocephala	-	+	-	-	-	-	-	+	-	-	-	+
N. schwabei	-	-	-	-	+	+	-	+	-	-	-	-
N. viridula	-	-	-	-	-	-	-	-	+	-	-	-
N. yarrensis	-	-	-	-	-	-	+	-	-	-	-	-
Neidium bisulcatum	-	-	-	-	+	-	-	-	-	-	-	-
N. dilatatum	-	+	-	+	-	-	-	-	-	-	-	-
N. iridis var. *amphigomphus*	-	-	-	-	+	-	-	+	-	-	-	-
Nitzschia congolensis	-	-	-	-	-	-	-	-	-	-	-	-
N. cursoria	-	-	-	-	-	-	-	-	-	-	-	-
N. delauneyi	-	-	-	-	-	-	+	+	+	+	-	-
N. habirshawii	-	-	-	-	-	-	-	-	-	-	-	-
N. lanceolata	-	-	-	-	-	-	-	-	-	-	-	-

	Baroalba Springs	Jim Jim Falls	Twin Falls	Deaf Adder	Umbungbung B.	Long Harrys B.	Jingalla B.	Mary River	E. Finniss River	Rum Jungle	L. Moondarra	L. Argyle
N. littoralis	-	-	-	-	-	-	+	-	-	-	-	-
N. longissima	-	-	-	-	-	-	+	-	-	-	-	-
N. obtusa var. *nana*	-	-	-	-	-	-	+	-	-	-	-	-
N. obtusa var. *scalpelliformis*	-	-	-	-	-	-	+	-	-	-	+	-
N. palea	-	-	-	-	-	+	-	-	-	+	-	-
N. rostellata	-	-	-	-	-	-	-	-	-	-	-	-
N. subcapitellata	-	-	-	-	+	-	+	+	-	+	-	+
N. tryblionella var. *maxima*	-	-	-	-	-	-	+	-	-	-	-	-
Pinnularia acrosphaeria var. *turgidula*	-	-	-	-	-	-	-	-	-	-	-	-
P. biceps	-	-	-	-	-	-	-	-	-	-	-	-
P. bogotensis	-	-	-	-	-	-	-	-	-	-	-	-
P. braunii var. *amphicephala*	-	+	-	-	+	+	-	+	-	-	-	+
P. *brevicostata* var. *ventricosa*	-	+	-	-	+	-	-	-	-	-	-	-
P. brevicostata var. *sumatrana*	-	-	-	-	+	-	-	-	-	-	-	-
Pinnularia gibba	-	-	-	-	-	-	-	-	-	-	-	-
P. gibba var. *linearis*	-	-	-	-	+	+	-	+	-	-	-	-
P. intermedia	-	-	-	-	-	-	-	-	-	-	-	-
P. legumen	-	-	-	-	-	-	+	-	-	-	-	-
P. luculenta	-	-	-	-	+	-	-	-	-	-	-	-
P. major	-	-	-	-	+	+	-	-	-	-	-	-
P. microstauron	-	-	-	-	+	-	-	-	-	+	-	-
P. rangoonensis												
P. stauroptera	-	+	-	-	+	-	+	-	-	-	-	-
Rhizosolenia eriensis	-	-	-	-	-	-	-	+	-	-	-	-
Rhopalodia gibba	-	-	-	-	-	-	-	-	-	+	+	+
R. gibba var. *ventricosa*	-	-	-	-	-	-	-	-	-	+	-	-
R. gibberula	-	-	-	-	-	-	-	-	-	+	+	+
Stauroneis anceps	-	-	-	-	+	-	-	-	-	-	-	-
S. anceps var. *birostris*	-	-	-	-	-	+	-	-	-	-	-	-
S. phoenicenteron	-	-	-	-	+	-	-	-	-	-	-	-
S. phoenicenteron var. *hattorii*	-	-	-	-	+	+	-	-	-	-	-	-
S. phoenicenteron var. *nobilis*	-	-	-	-	+	-	-	-	-	-	-	-
S. spicula	-	-	-	-	-	-	+	-	-	-	-	-
Stenopterobia intermedia	-	+	-	-	-	+	+	+	-	-	-	-
S. intermedia var. *capitata*	-	-	-	-	-	+	-	-	-	-	-	-
Surirella arachnoidea	-	-	-	-	-	-	-	-	-	-	-	-
S. biseriata	-	+	+	-	-	-	-	-	-	-	-	-
S. biseriata var. *constricta*	-	-	-	-	-	-	-	-	-	-	-	-
S. biseriata var. *subparallela*	-	+	-	+	-	-	-	-	-	-	-	-

Appendix 2 (ctd)

	Baroalba Springs	Jim Jim Falls	Twin Falls	Deaf Adder	Umbungbung B.	Long Harrys B.	Jingalla B.	Mary River	E. Finniss River	Rum Jungle	L. Moondarra	L. Argyle
S. delicatissima	-	+	-	-	-	+	-	-	-	-	-	-
S. gemma	-	-	-	-	-	-	-	-	-	-	-	-
S. linearis var. *constricta*	-	+	-	-	-	-	-	-	-	-	-	-
S. robusta	-	-	-	-	+	+	-	+	-	-	+	-
S. spiralis	-	+	-	-	-	-	-	-	-	-	-	-
S. thienemanni	+	-	-	-	-	-	-	-	-	-	-	-
Synedra ulna	-	-	-	-	-	-	-	+	-	-	+	+
? Campyloneis												
Total Taxa	4	31	6	6	46	39	25	30	4	20	15	22
Total Samples	2	8	2	2	16	11	5	4	6	6	8	7

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TM2	Transport of trace metals in the Magela Creek system, Northern Territory. II. Trace Metals in the Magela Creek billabongs at the end of the 1978 dry season. December 1981 (23 pp)	Davies, S.H.R., Hart, B.T.
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