MEMORIE DI SCIENZE GEOLOGICHE
già *Memorie degli Istituti di Geologia e Mineralogia dell'Università di Padova*

Allegato al Vol. XLIII, pagg. 27-40, 2 figg.
Padova, maggio 1992

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COMPILATION OF UPPER TRIASSIC AND JURASSIC CALCAREOUS NANNOFOSSIL RANGES

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Key words: Upper Triassic - Jurassic, Calcareous nannofossils, Ranges compilation.

ABSTRACT

After the critical review of the literature dealing with prae-Jurassic and Jurassic calcareous nannofossils, a compilation of ranges of most taxa was performed.

All data were filed in a Macintosh database. The distibution of 318 taxa was plotted against the chronostratigraphy provided by the original works.

This compilation is conceived as a database for biostratigraphers and a framework for future research addressed to improve the nannofossil biostratigraphic resolution for the Jurassic and to highlight the diversification and evolution of calcareous nannofloras during such a crucial time interval.

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This work was supported by M.P.I. 40% to S. MONECHI (Univ. Firenze).

RIASSUNTO

A seguito di una revisione critica della letteratura riguardante i Nannofossili calcarei giurassici e pregiurassici, è stata compilata una sintesi delle distribuzioni della maggior parte dei taxa.

Tutti i dati sono stati immessi in una banca-dati Macintosh. La distribuzione di 318 taxa è stata plottata in base alla cronostratigrafia riportata nei lavori originali.

Questa compilazione potrà essere utilizzata da biostratigrafi e costituire uno schema di partenza per ricerche future indirizzate a migliorare la risoluzione biostratigrafica del Giurassico e a chiarire l'evoluzione delle nannoflore durante questo cruciale intervallo di tempo.

INTRODUCTION

In the last few years particular efforts were made to improve the nannobiostratigraphy of the Jurassic. In fact this interval is a crucial time in nannofossil evolution.

Some 130 papers dealing with prae-Jurassic and Jurassic calcareous nannofossils have been published so far. For an updated bibliography see ERBA (1988).

A few zonations were proposed for various areas (STRADNER, 1963; AMEZIEUX, 1972; BARNARD & HAY, 1974; THIERSTEIN, 1976; HAMILTON, 1982; HAQ, 1983; PERCH-NIELSEN, 1985; BOWN, 1987a; BOWN & COOPER, 1989; BRALOWER *et al.*, 1989), and the biostratigraphic resolution attained for the Jurassic is quite good. Herein we present a range compilation conceived for biostratigraphers.

THE DATABASE

A compilation of ranges of most prae-Jurassic and Jurassic taxa was performed. All data were filed into a Macintosh database.

Symbol	Authors	Time interval considered
LLLL	Allemann et al., 1975	Tithonian p.p.-Berriasian
aaaaa	Amezieux,1972-Aquitaine	Toarcian-Tithonian
AAAA	Amezieux,1972-Paris	Toarcian-Tithonian
••••	Baldi-Beke, 1965	Tithonian p.p.-Berriasian
••••	Barnard & Hay,1974	Toarcian-Tithonian
BBBB	Bown et al., 1988	Hettangian-Berriasian
////	Bown, 1987a Portugal	Norian-Toarcian
%%%	Bown, 1987a Wales	Norian-Toarcian
ooooo	Bown,1987b	Rhaetian-Toarcian
bbbb	Bralower et al., 1989	Kimmeridgian-Berriasian
mmm	Bronnimann, 1955	Tithonian p.p.-Berriasian
pppp	Cepek, 1978	Kimmeridgian p.p.-Berriasian
HHHH	Channell et al., 1987	Kimmeridgian-Berriasian
$$$$	Cita & Pasquarè, 1959	Tithonian p.p.-Berriasian
§§§§	Cooper, 1984	Kimmeridgian-Berriasian
>>>>>	Cooper, 1987	Tithonian
CCCC	Crux,1984	Sinemurian-Aalenian p.p.
XXXX	Crux, 1987a	Sinemurian p.p.-Aalenian p.p.
ccccc	Crux,1987b	Rhaetian-Toarcian
DDDD	Dockerill, 1987	Toarcian-Kimmeridgian
EEEE	Erba & Quadrio, 1987	Tithonian p.p.-Berriasian
GGGG	Grun & Allemann, 1975	Tithonian p.p.-Berriasian
OOOO	Grun & Zweili,1980	Callovian-Oxfordian
▪▪▪	Hamilton, 1977	Sinemurian-Toarcian
▪▪▪	Hamilton, 1978	Callovian p.p.-Oxfordian p.p.
▪▪▪	Hamilton, 1979	Sinemurian p.p.-Bathonian p.p.
≤≤≤	Hamilton,1982	Rhaetian-Tithonian
----	Jafar,1983	Norian-Rhaetian
≈≈≈	Lezaud,1967	Callovian p.p.-Kimmeridgian p.p.
sssss	Lord et al., 1987	Tithonian
¬¬¬¬	Medd, 1971	Bathonian-Kimmeridgian
¬¬¬¬	Medd, 1979	Callovian p.p.-Kimmeridgian
¬¬¬¬	Medd, 1982	Bajocian-Tithonian
≠≠≠	Moshkovitz, 1979	Hettangian-Toarcian + Oxfordian
-+-+	Moshkovitz & Ehrlich,1976	Bajocian-Oxfordian
MMM	Moshkovitz & Ehrlich, 1981	Callovian-Berriasian
NNN	Noel, 1957	Pliensbachian-Tithonian
KKK	Perch-Nielsen, 1979	Tithonian-Berriasian
ggggg	Perch-Nielsen, 1985	Rhaetian-Berriasian
++++	Posch & Stradner,1987	Rhaetian
PPPP	Prins, 1969	Rhaetian-Pliensbachian
FFF	Proto Decima, 1974	Oxfordian-Berriasian
@@@	Rood & Barnard,1972	Toarcian + Bathonian-Kimmeridgian
RRRR	Roth, 1978	Kimmeridgian-Berriasian
rrrrr	Roth, 1983	Callovian-Berriasian
ddd	Schmidt, 1978	Tithonian-Berriasian
SSSS	Stradner, 1963	Hettangian-Berriasian
Δ-Δ-	Thierstein, 1971	Tithonian p.p.-Berriasian
Δ-Δ-	Thierstein, 1973	Tithonian p.p.-Berriasian
TTTT	Thierstein, 1975	Tithonian-Berriasian
ΔΔΔ	Thierstein, 1976	Hettangian-Berriasian
tttt	Trejo, 1960	Tithonian p.p.-Berriasian
###	Wiegand, 1984	Sinemurian p.p.-Berriasian
xxxx	Wilcoxon, 1972a	Oxfordian-Berriasian
xxxx	Wilcoxon, 1972b	Oxfordian-Berriasian
ww	Wind, 1978	Oxfordian-Berriasian
w-w-	Wise & Wind, 1976	Oxfordian p.p.-Kimmeridgian p.p.
~~	Worsley, 1971	Kimmeridgian p.p.-Berriasian
'''''	Young et al.,1986	Sinemurian-Toarcian

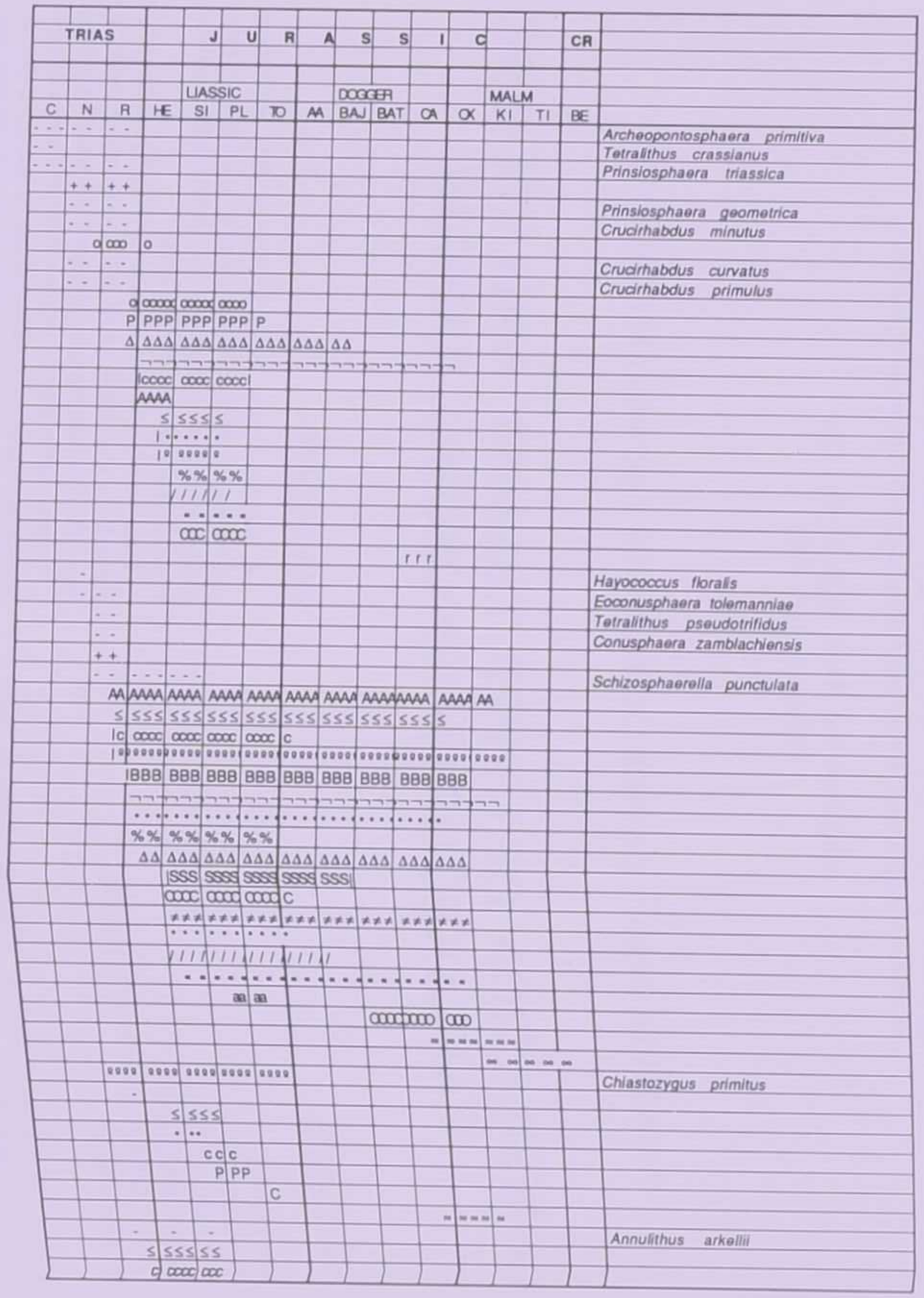


FIG. 1 - Ranges of Upper Triassic - Jurassic calcareous nannofossils plotted against chronostratigraphy reported in the original works herein listed. The symbol "I" indicates that first occurrence and /or the last occurrence are considered as biohorizons.

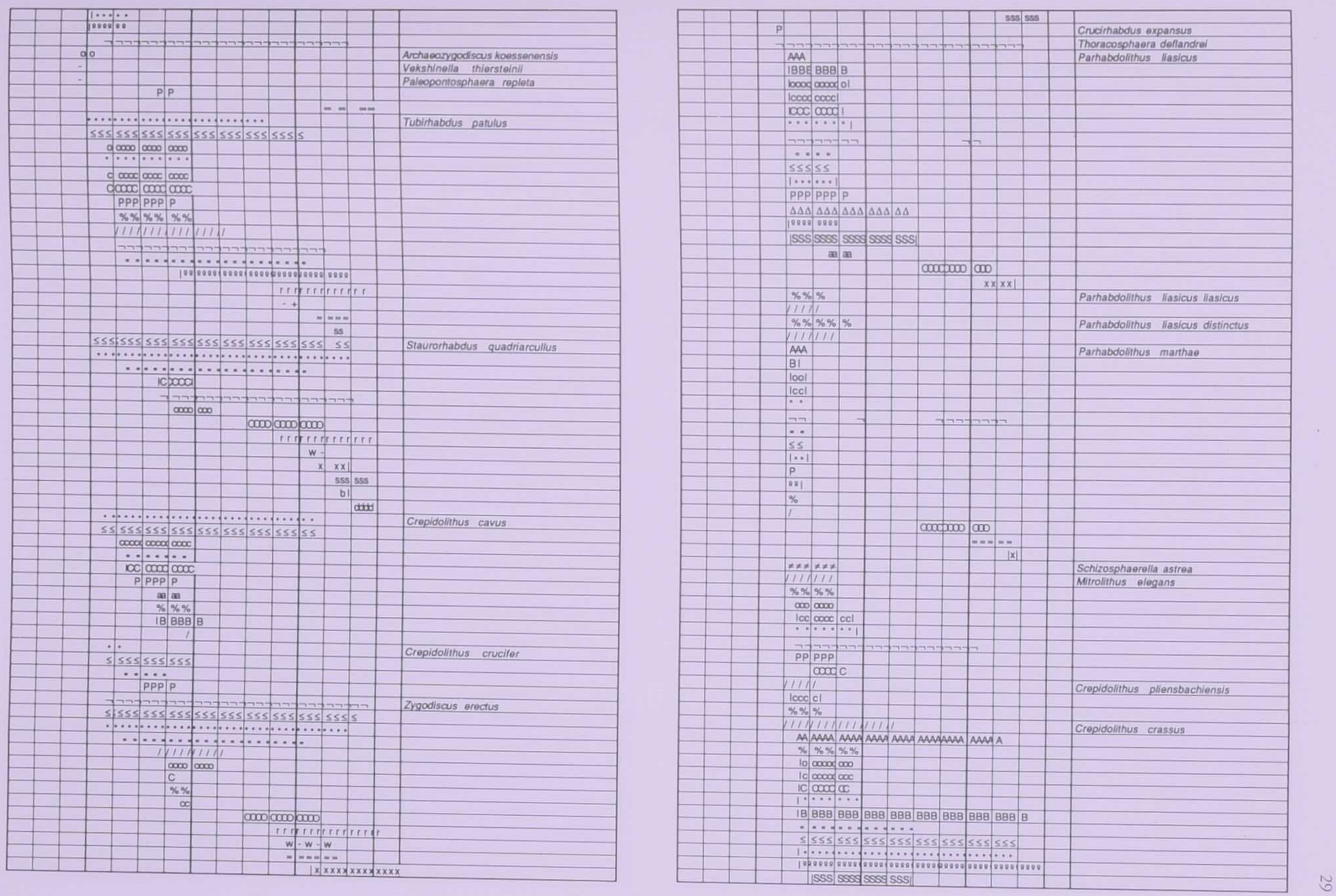


FIG. 1 - (*continued*).

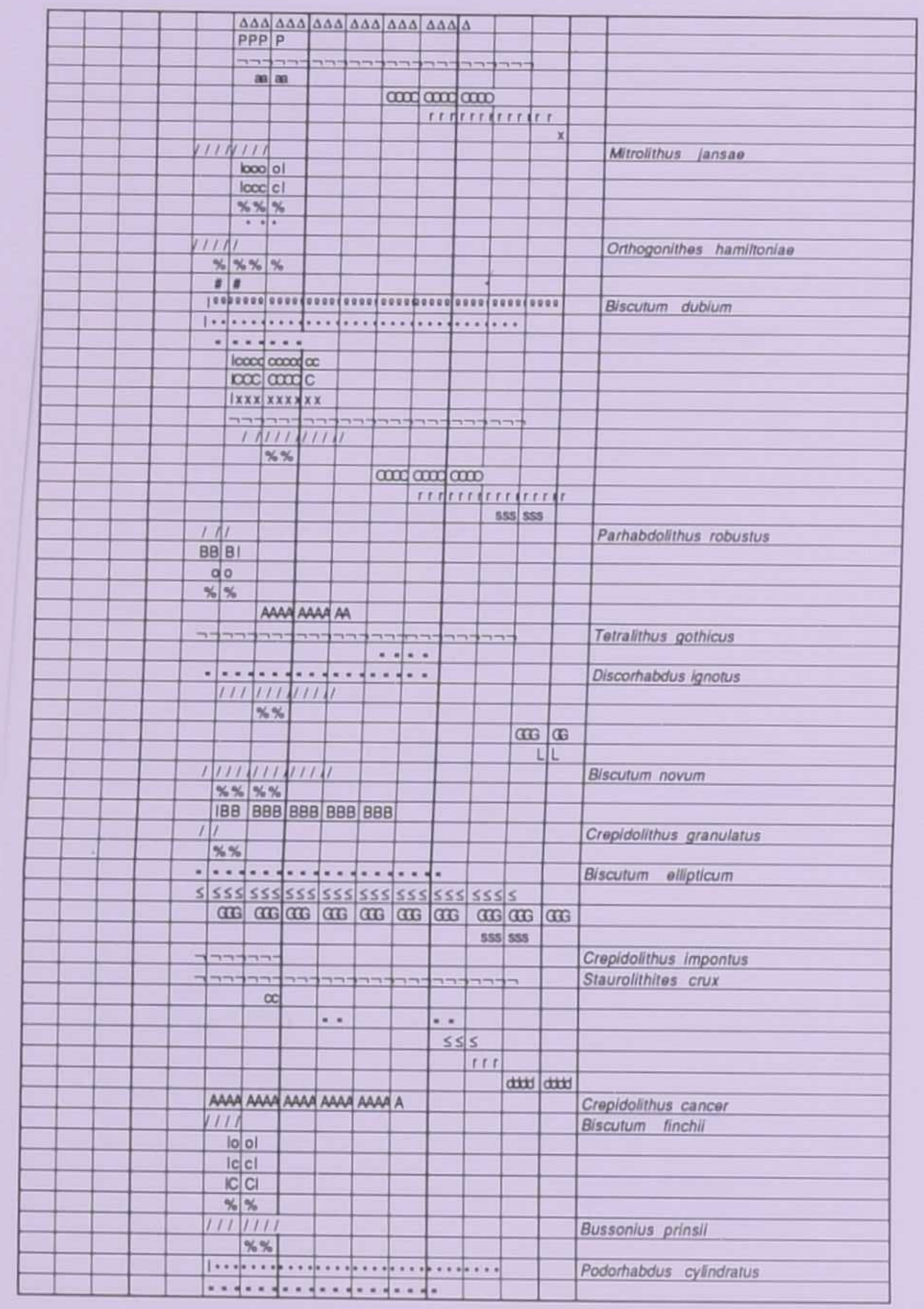
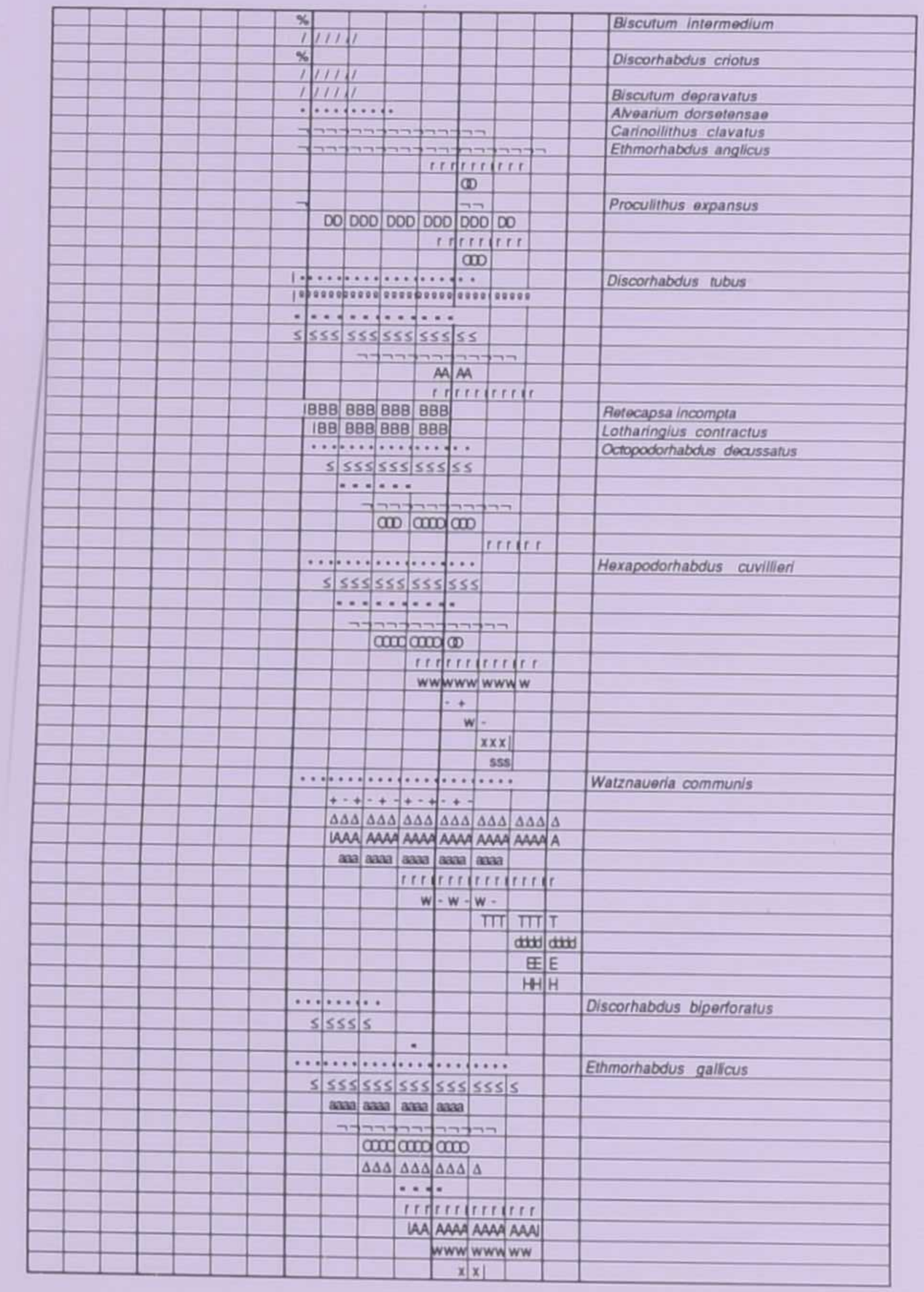


FIG. 1 - (*continued*).

Parhabdolithus elongatus
Coccolithus opacus
Bidiscorhabdus ocellatus
Parhabdolithus zwellii
Bucculinus
Fusellinus
Fribillinus
Biscutum grandis
Mitrolithus lenticularis
Sollasites lowell
Podorhabdus atavus
Biscutum erismatum
Lotharingius hauffii
Lotharingius crucicentralis
Sollasites pristinus
Lotharingius primitivus
Lotharingius sigillatus
Mitrolithus irregularis
Paleopontosphaera incospiqua
Striatococcus grandiculus
Striatococcus opacus
Lucidiella intermedia
Lucidiella perforata
Striatomarginis speciosus
Paleopontosphaera binodosa
Calyculus cribrum
Diazomatholithus lehmanii
Rhombolithion duodecostatum
Stradnerlithus humilis
Proculithus fistulatus
Staurorhabdus magnus
Stradnerlithus sattinii
Biscutum constans
Discorhabdus superbus
Stradnerlithus comptus
Vaucherauvillius implicatus
Calyculus absolutus
Calyculus derivatus
Calyculus hommerilllii
Calyculus magnus
Calyculus serral
Rectilius productus
Stradnerlithus langii
Discorhabdus patulus
Discorhabdus striatus
Striatomarginis primitivus

FIG. 1 - (*continued*).



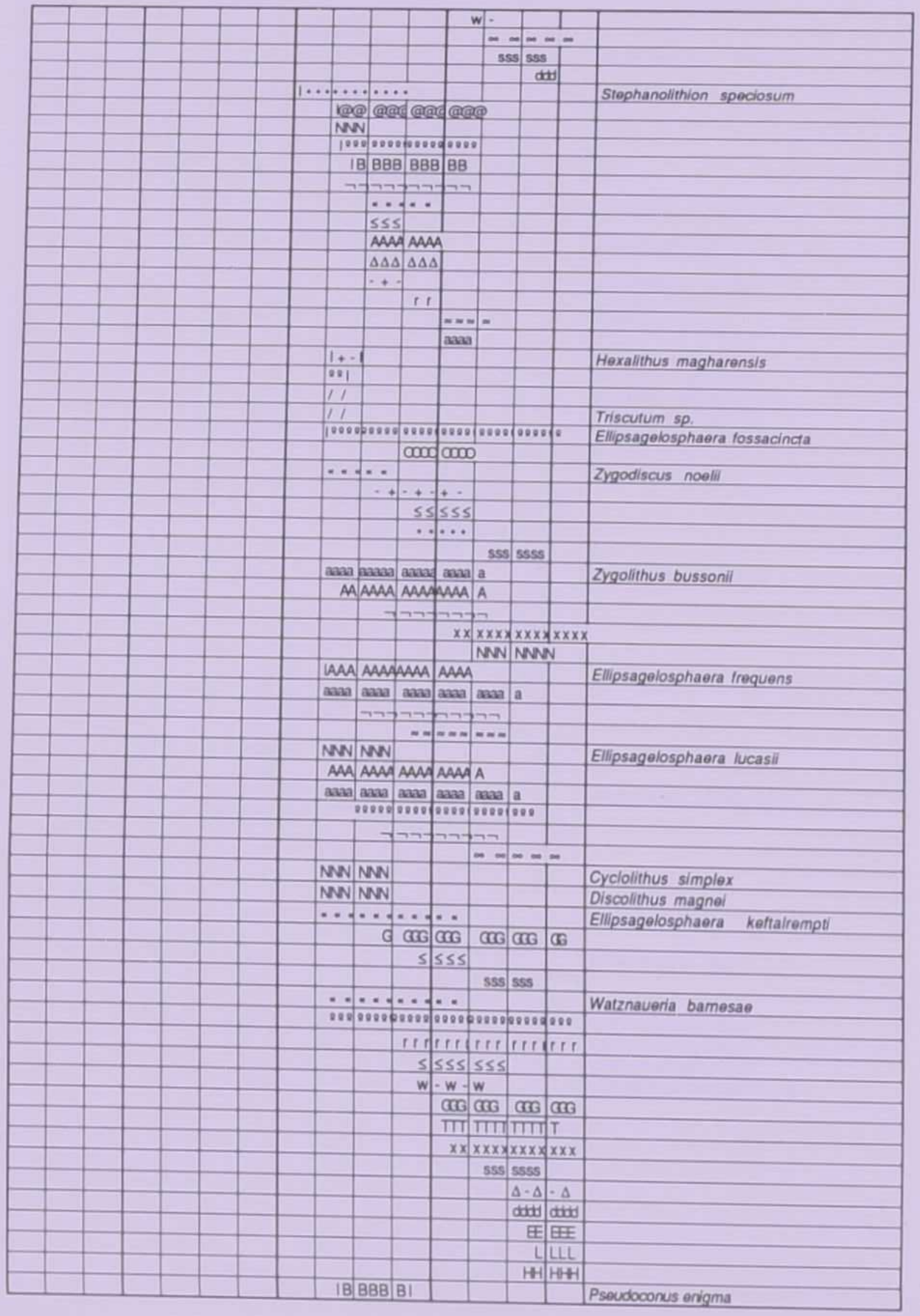
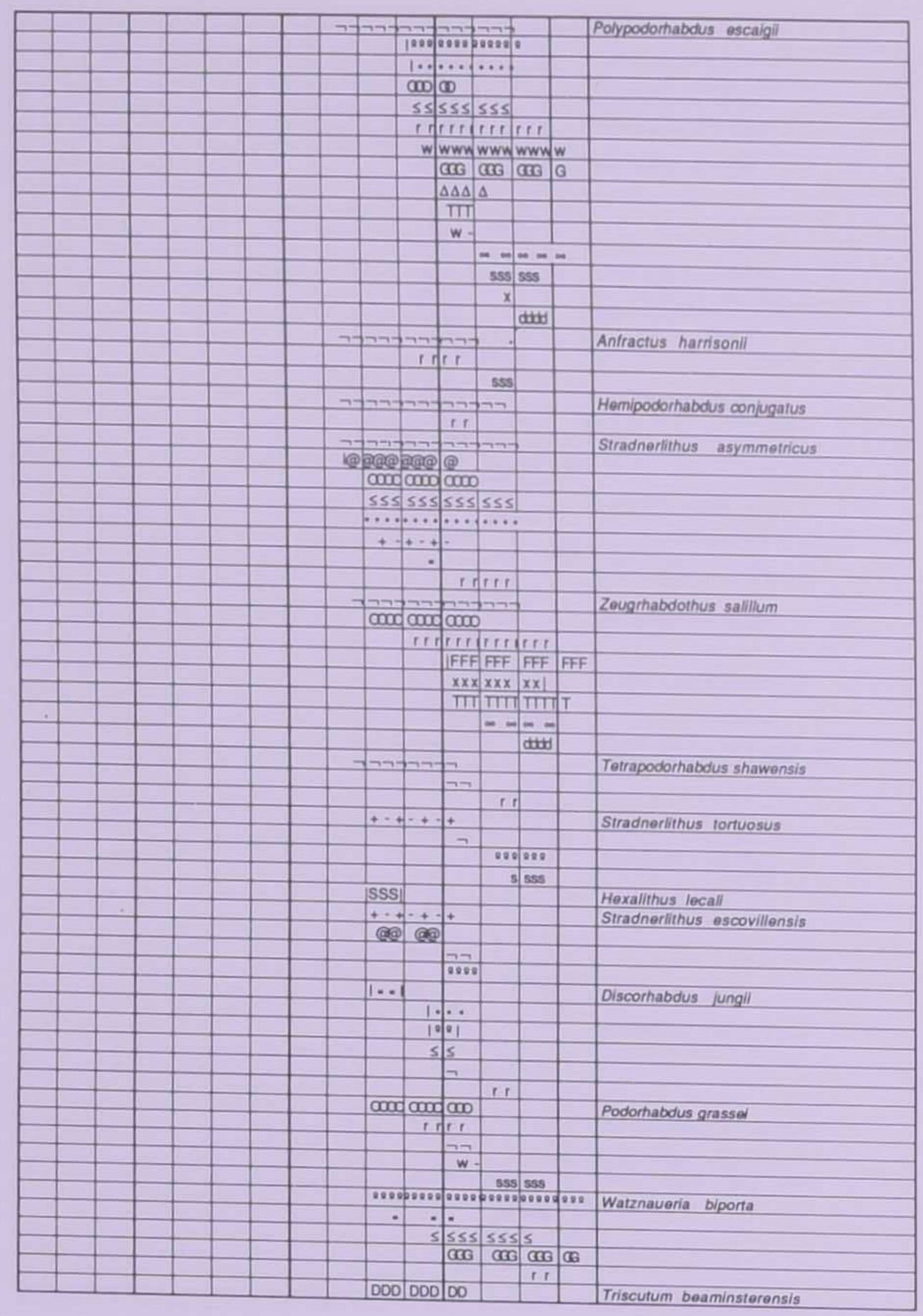


FIG. 1 - (*continued*).



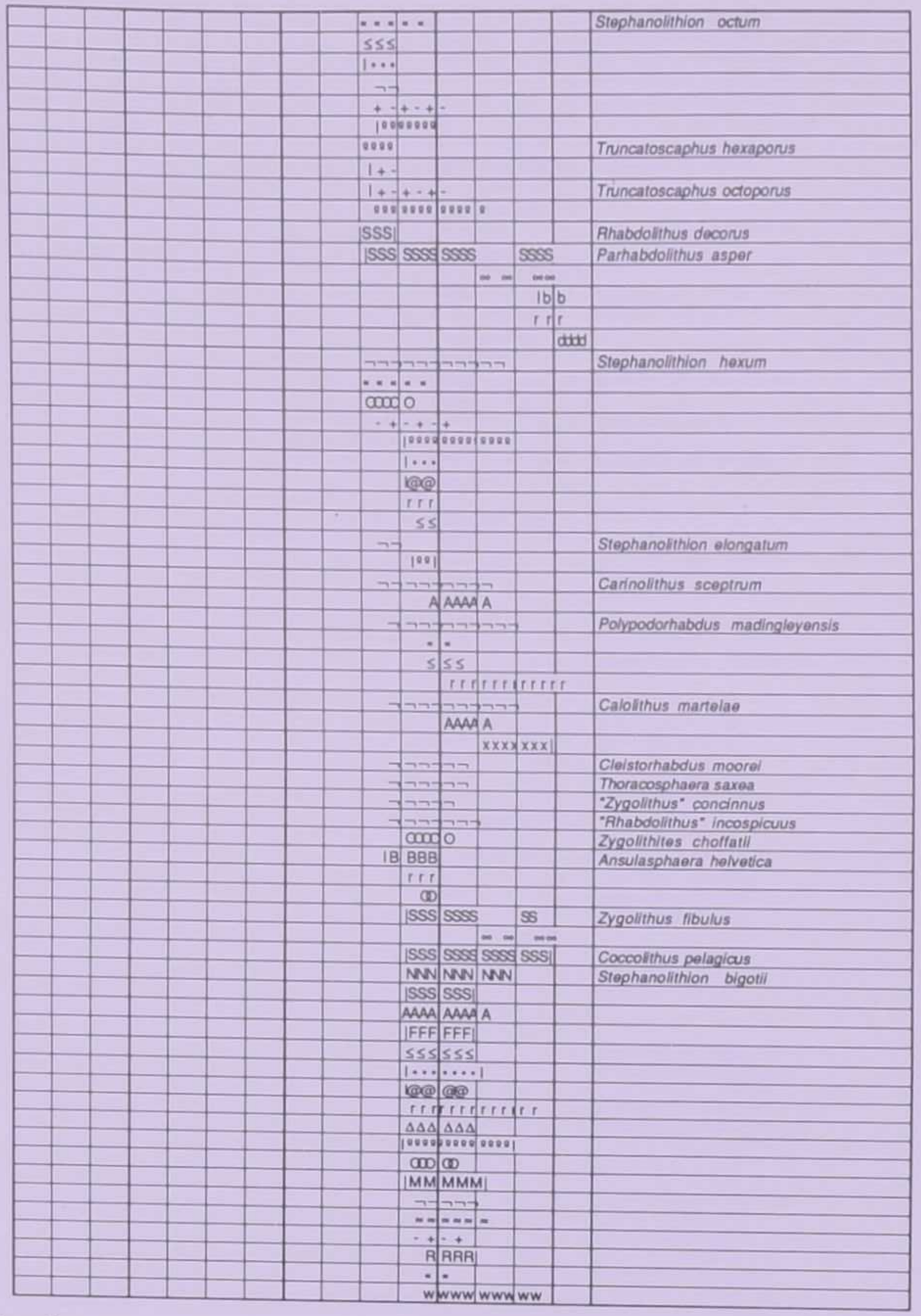
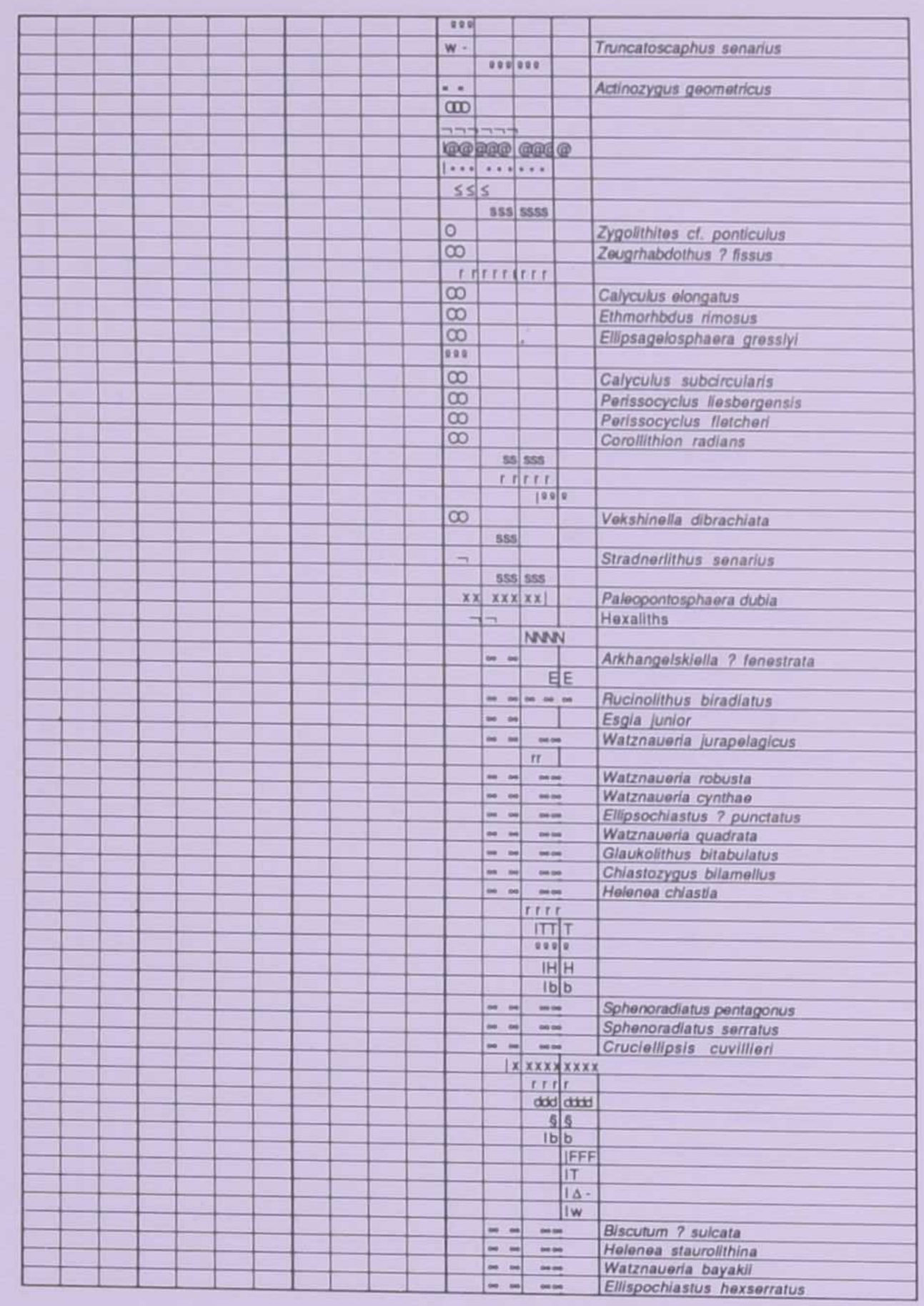


FIG. 1 - (*continued*).

Stephanolithion bigotii bigotii
Discorhabdus longicornis
Ellipsagelosphaera reinhardtii
Thurmannolithion clatratum
Podorhabdus rahla
Actinosphaera deflandrei
Stephanolithion bigotii maximum
Stradnerlithus callomonii
Stradnerlithus octocostatus
Stradnerlithus rotatus
Diadorhombus horrellii
Loxolithus armilla
Cyclagelosphaera tubulata
Ellipsagelosphaera strigosa
Axopodorhabdus depravatus
Ellipsagelosphaera ovata
Watznaueria manivitae
Crepidolithus perforatus
Corollithion fragilis

Ellipsagelosphaera plena
Proculithus charlottei
Truncatoscaphus delftensis
Stradnerlithus octoradiatus
Discorhabdus exilithus
Chiastozygus asymmetricus
Anfractus variabilis
Millbrookia virgata
Neococcolithes dubius
Rhabdolithus annulatus
Rhabdolithus septrum
Vekshinella stradneri
Stradnerlithus minutus
Dekapodorhabdus typicus
Diadorhombus scutulatus
Parhabdolithus pseudobelgicus
Polypodorhabdus beckii
Sollasites bipolaris
Sollasites horticus
Stephanolithion maximum
Stephanolithion carinatum
Stradnerlithus bifurcatus
Stradnerlithus pauciramosus
Stradnerlithus rhombicus
Diadozygus dorsetense
Octopodorhabdus oculisminutis
Polypodorhabdus harrisonii
Ahmuerella ? retiformis
Stradnerlithus sexiramatus
Sollasites concentricus
Diadorhombus minutus

FIG. 1 - (*continued*).



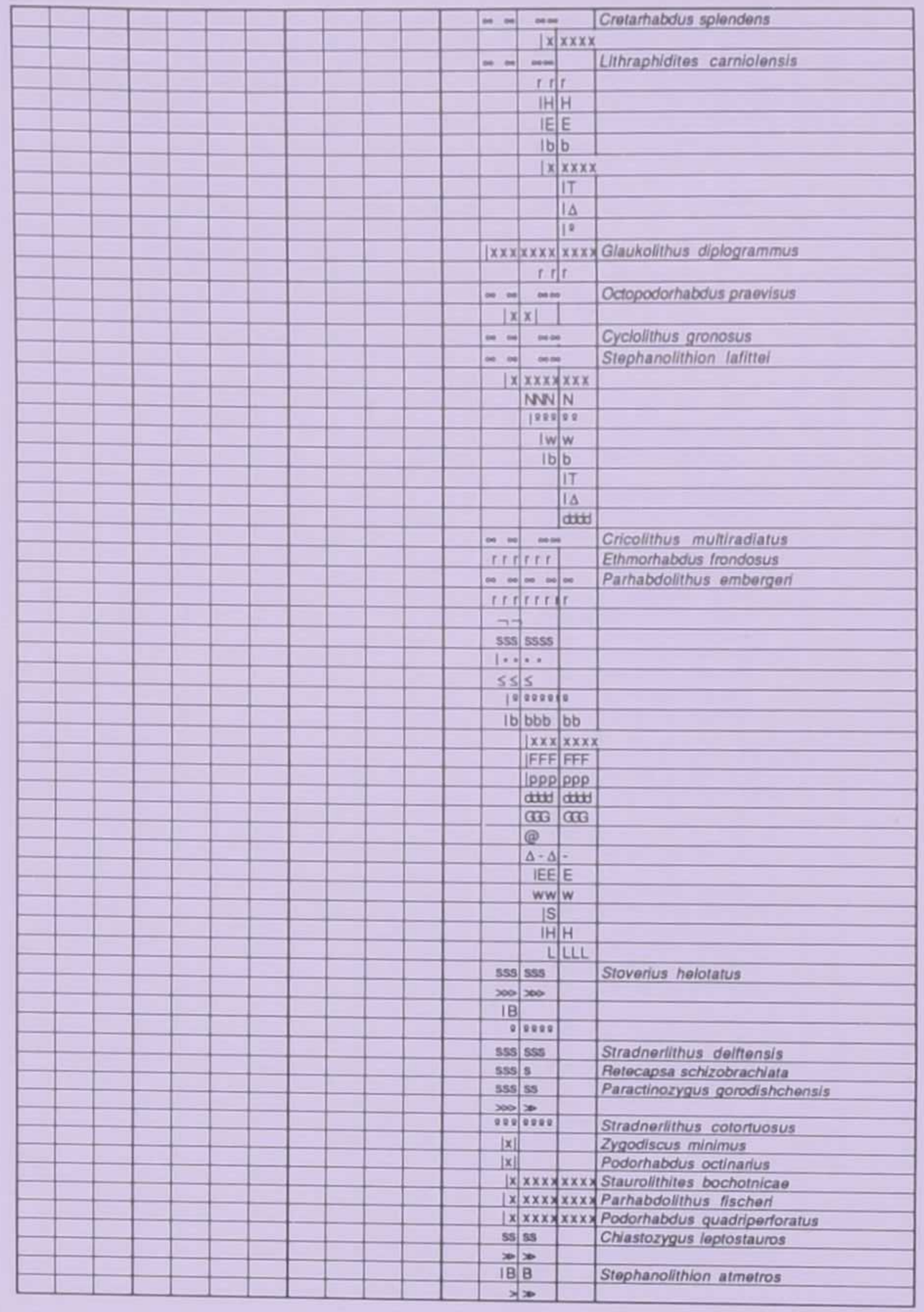


FIG. 1 - (*continued*).

r r r	*Nannoconus dolomiticus*
IHH H	
IEE E	
I$$ $	
I°° °	
IK K	
s sss	*Cretarhabdus conicus*
d dddd	
I r r r r	*Nannoconus cf. colomii (small)*
Ib bbb b	*Microstaurus quadratus*
Ib bbI	*Faviconus multicolumnatus*
Ib bbbb b	*Conusphaera mexicana minor*
I r r r r r	*Conusphaera mexicana*
G GGG GGG	
IMMM MM	
ITTT T	
IΔΔΔ Δ	
IΔ-Δ -	
I°°°° °	
Iwww w	
§§§§ §	
IRRR R	
dddd dddd	
HH H	
EE E	
L LLL	
I xxx I	*Rucinolithus hayii*
Ibbb bb	*Conusphaera mexicana mexicana*
Ixxx xxxx	*NANNOCONIDS*
∞∞	*Schizosphaerella oblongata*
∞∞	*Mitosia infinitae*
∞∞	*Cricolithus cyclus*
∞∞	*Podorhabdus dietzmannii*
IL LLL	
∞∞	*Braarudosphaera hoschulzii*
Δ - Δ	
§ §	
I°	
I°	
IH	
IE	
NNN	*Tremalithus rotundus*
NNNN	*Nannoconus colomii*
GGG GGG	
r r r	
I • •	
I - Δ	
IE E	
I° °	
I • • -	
I MM	
I dddd	
IΔ	
IT	
Ipp	
I r r r	*Polycostella beckmannii*
IFFF F I	
dddd d	
IΔΔ	
Ib I	
ITT TI	
HH	
EE EI	
Iw wI	

I° °I	
°°°°°	*Truncatoscaphus intermedius*
ITTT T	*Cretarhabdus surirellus*
Ib b	
§§§ §	*Hexalithus noelae*
Ib bI	
r r	
H	
TTT TT	*Cretaturbella rothii*
IFFF FFF	
Ix I	*Eiffellithus gorkae*
Ix I	*Watznaueria prolonga*
It I	*Nannoconus broennimannii*
I° °	
IT	
IK	
r r r	*Zygodiscus cf. elegans*
I x xxxx	*Watznaueria actinosa*
I x xxxx	*Vagalapilla imbricata*
I x xxxx	*Podorhabdus gorkae*
I x xxxx	*Discoaster? atlanticus*
Ib I	*Polycostella senaria*
IT TT	
E E	*Nannoconus sp.*
w w	
° °	
Ib I	*Umbria granulosa minor*
Ib bbI	*Umbria gr. granulosa*
IE E	*Braarudosphaera regularis*
I° °	
Ib b	*Vagalapilla compacta*
Ib b	*Speetonia colligata*
Ib b	*Markalius ellipticus*
I x xxxx	*Braarudosphaera discula*
bI	*Nannoconus compressus*
I° °	*Nannoconus quadratus*
Ib b	*Nannoconus winterei*
I° °	*Nannoconus globulus*
I • • - •	
It tttt	
Ib b	*Nannoconus globulus minor*
E E	*Discorhabdus rotatorius*
T T	
Ib b	*Nannoconus infans*
∞ ∞	*Nannoconus steinmannii*
IS	
IH H	
IE E	
I° °	
It tttt	
• - •	
I KK	
§ §	
mm	
Ib	
Ib b	*Manivitella pemmatoidea*
d dddd	
IL LLL	*Cruciplacolithus pinnatus*
I x I	*Prediscosphaera cretacea*
Ib	*Nannoconus steinmannii minor*
Ib	*Nannoconus kamptneri minor*
I°	*Biscutum salebrosum*
I°	*Micrantholithus obtusus*
dddd	*Markalius circumradiatus*

FIG. 1 - (*continued*).

Only papers dealing with biostratigraphy were considered, whereas monographies focused on extremely short time intervals and/or peculiar facies, and taxonomic papers were not taken into account (Erba, 1988).

A total of 56 works regarding different areas and various time intervals were filed. The Upper Triassic is considered in six works. Five papers report species ranges from the entire Jurassic; Liassic is treated in 16 papers, Dogger in 18, Malm in 19. Moreover the Jurassic/Cretaceous boundary is considered in 23 papers.

The nannofossil distribution was plotted against the chronostratigraphy provided by the original works. An attempt was made to file ranges versus ammonite biostratigraphy. However, not all the papers provide such a calibration of nannobiohorizons to ammonite zones, and significative discrepancies occur among ammonite biostratigraphies established in different paleogeographic areas. For these reasons, we decided to omit ammonite zones and to plot the nannofossil ranges against stages according to the original calibrations.

Ranges of 318 taxa are herein reported. When possible, we grouped synonims under one species name. If descriptions and/or illustrations were missing or not sufficient, different species names were maintained.

It must be pointed out that, despite the large number of taxonomic papers, limited agreement exists about the classification, expecially at ranks higher than the specific level. Confusion was generated by the proliferation of new names in many cases due to different techniques, to preservation, and to very restrictive taxonomic concepts overlooking the intraspecific variability.

Fig. 1 illustrates taxa ranges. They are plotted in stratigraphical order, from the Upper Triassic to the Jurassic/Cretaceous boundary.

For every taxon, ranges given by different authors are reported from the oldest to the youngest. Some discrepancies are only apparent due to the time interval considered in the original work.

DISCUSSION AND CONCLUSIONS

This compilation summarizes the stratigraphic ranges of most Upper Triassic and Jurassic calcareous nannofossils. It is evident that the distribution of only few taxa is established and that further detailed investigations are required in order to precise the ranges of several species, including numerous markers. It's not clear if discrepancies in ranges can be attributed to different

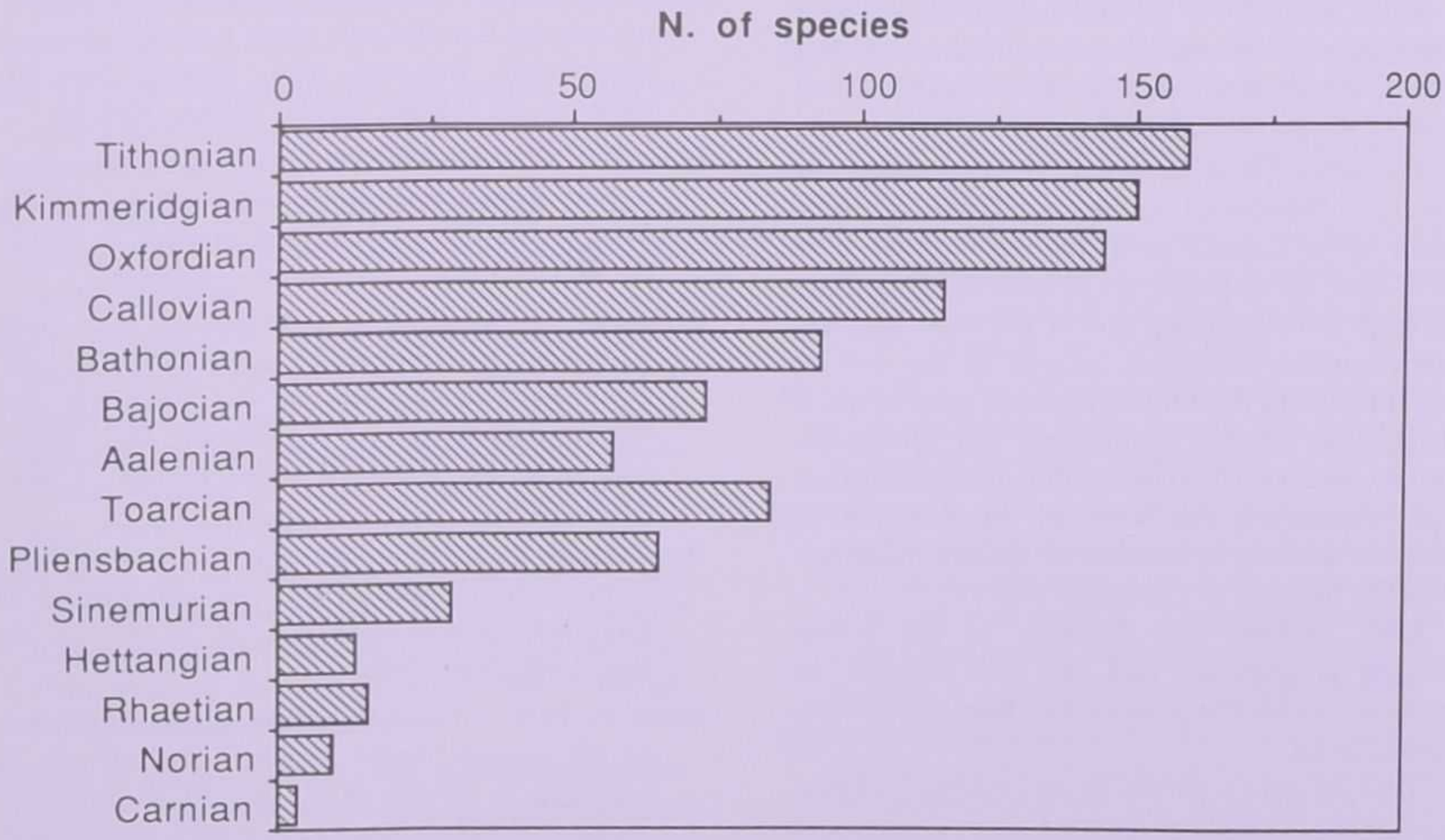


Fig. 2 - Species diversity of calcareous nannofloras during the Carnian to Tithonian time interval.

paleogeographic areas. In fact most papers deal with middle and high latitude localities whereas low latitudes were considered in a few papers.

Ten taxa are restricted to the Upper Triassic, whereas seven others first occur in the Upper Triassic but are present also in the Jurassic. During the Jurassic 296 first occurences are recorded. In general, the sequence of first occurrences and extinctions seems to have a higher resolution in the Lower Jurassic. In the Dogger a minor number of events are recognized, whereas a strong increase in the biostratigraphic resolution is recorded in the Upper Jurassic.

A precise quantification of FO and LO was however prevented by the discrepancies already pointed out.

At present a working group of I.N.A. (International Nannoplankton Association) is trying to coordinate research on Jurassic nannofossils. The group already met once in April 1990 (London) and summarized the latest information obtained for sections from England, Portugal, Switzerland, France, Italy, and Morocco (Erba, 1990). New data on taxonomy and evolution strongly improved also the biostratigraphy. The sequence of nannofossil events, calibrated with ammonite biozones, yields a high resolution zonation. However, some discrepancies still exist because: (a) ammonite zones are not yet uncontroversially calibrated between high and low latitudes; (b) nannofossils show differences due to preservation and paleoprovincialism.

While waiting for further improvements and publication of the results of the Jurassic working group, the present compilation is meant as the state of the art of published data.

The nannofloral diversity is represented in Figure 2. Number of species is plotted for every stage in the Carnian to Tithonian interval. It is clear that nannofossils progressively diversified through time becoming one of the most important calcareous planktonic groups by the end of the Jurassic. In the Middle Jurassic, once again, a decrease in diversity is recorded. The species diversity reached a maximum during the Toarcian and subsequently fell down in the Aalenian. A constant increase in number of species characterized the Bajocian to Tithonian interval.

Most probably the decrease in the Lower Dogger is apparent and not real because, in general, the Middle Jurassic has been quite overlooked so far.

This database is meant as an updated compilation of the available ranges of Upper Triassic and Jurassic calcareous nannofossils. It is conceived as a tool for biostratigraphers and it could also be considered as a framework for future research addressed to improve the biostratigraphic resolution and to understand the evolution of calcareous nannofloras during such a crucial time interval.

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