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Deposits of Foraminiferal Tests in the Tokyo Bay, Japan

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Abstract

Results are given of a quantitative study of the Foraminifera of Tokyo Bay in an attempt to decipher the ecologic conditions which determine the assemblage of the area. Two foraminiferal populations are noticed. The first is characteristic of the southern and more saline waters and the second is found in the northern brackish area.

Introduction

This investigation was undertaken as a series of studies for preliminary to the paleoecology of the smaller Foraminifera. Fossil foraminiferal assemblages are composed of fossil remains representing animals which were living where they occur, as well as those which lived elsewhere but remains of which were later transported and deposited in their present position. Those which remained intact and withstood dislocation with the passing of geologic time make up fossil assemblages. Therefore, in order to establish the relationship between fossil assemblages and environmental conditions surrounding their deposition, it is necessary to take into consideration, besides the living Foraminifera, on tests of dead Foraminifera deposited with them. I regard this treatment not as an ecologic study but rather as a thanatologic approach. It was with the above concept in mind that this investigation was carried out.

The Tokyo Bay is one of larger indentations along Pacific coast of Honshû. Oceanographic observations on this bay had been carried out several times by The Central Fisheries Experimental Station (Chûô Suisan Shikenjo) during years from 1947 to 1949.

Masaho MARUHASHI reported on the foraminiferal fauna of this bay in 1948 (1), but her collections were limited to the innermost part of the Bay. Tadashige HABE also investigated deposits of molluscan shells in 1950 (2) and concluded that *Theora lubrica* GOULD and *Raeta yokohamensis* PILSBRY, which are indicator animals of strong enbayment, were thicker in the north-east. I support this opinion from foraminiferal analysis.

The materials used for this work were collected by the Central Fisheries Experimental Station in June, 1948 for the purpose of basic study for productivities of the Tokyo Bay. Here, I express my gratitudes to all the people who gave

me valuable helps and particular thanks are due to Mr. T. HABE and Prof. J. MAKIYAMA for their kind suggestions throughout the study.

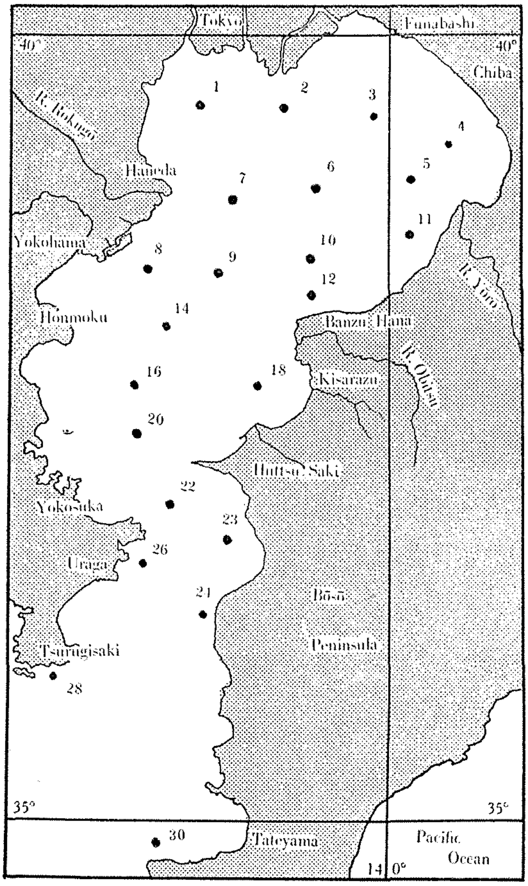

Fig. 1. Index map of Tokyo Bay

Method of study

Bottom samples were taken from 22 stations. Ekman-Lenz's Bottom Sampler was employed. Fractions of sediment examined were carefully taken out from surface layer of bottom samples. Approximately 20 grams of each of dried samples was screened with a 200–mesh standard sieve. Foraminiferal tests in the residue were sorted and classified. The total number of tests thus counted was divided by twenty (orginal weight of sediment used) to give the total number of species of Foraminifera in one gram dry weight of sediment in which fractions coarser than 0.074 mm. Foraminiferal number (3, 4) of all species from each sample is listed in table 2.

Distribution of foraminiferal tests

1. Number of Species: There are in all 126 species, among which 2 species are pelagic Foraminifera. The rest is benthonic Foraminifera including 23 species of arenaceous forms, 25 species of imperforate calcareous forms and 76 species of perforate Foraminifera.

The distribution of the number of benthonic species shows nearly the same tendency as those of other bays in Japan (5, 6, 7); that is, the greatest number being at stations at the mouth of the bay, southern area from the line between Futtsu and Honmoku (the Uraga Channel). While those located in the interior of the bay show counts which diminish in direct proportion to their relative distance from the Uraga Channel. Thus the smallest count distributes at stations on the north-east (stations nos. 2, 4, 5, and 10).

2. Number of Foraminifera: The total number of individuals obtained

Table 1

Station No.	Depth (m.)	Deposits	Mud Temp. (C)	Cl $^0/_{00}$ (Bottom)
1	6.0	fs	18.9	15.86
2	9.5	m	18.9	16.94
3	13.5	m	18.6	17.95
4	14.0	m	18.8	17.96
5	18.0	m	18.2	17.97
6	21.5	m	15.9	18.14
7	20.0	m	15.9	18.25
8	20.0	m	16.0	18.23
9	30.0	m	15.6	18.31
10	22.0	m	17.2	18.20
11	16.0	fs	18.6	18.21
12	16.0	fs	18.0	18.13
14	33.0	m	15.0	18.36
16	18.0	cs, sh	17.0	18.46
18	13.0	fs	17.7	18.30
20	37.0	fs	—	18.58
22	52.0	cs, sh	—	18.79
23	10.0	cs, sh	—	18.51
24	18.0	cs, sh	—	18.85
26	23.0	fs	—	18.90
28	53.0	fs	—	19.29
30	70.0	fs	—	19.11

(These observations were made together with bottom sampling during June, 17–18, 1948. Numerical values of Cl $^0/_{00}$ are the average value during from May, 1947 to Sept., 1949. m: mud, cs: coarse sand, fs: fine sand, sh: shell frangments.)

from 22 stations is 12,940. The greatest number is found at the Uraga Channel (stations nos. 26, 28 and 30) and small foraminiferal numbers at the north-east near Chiba. Generally the number of benthonic foraminifera increases toward open sea area, and the large majority of these tests are abraded by currents and mixed with shell fragments and bryozoan remains. These facts indicate that the assemblage on the Uraga Channel is autoecious allochthonous type. On the contrary, tests collected from inner part of the bay, northern area from Futtsu-Honmoku line, are perfect in shape and there is no evidence of violent transportation by currents. Small foraminiferal numbers as well as small numbers of species must be attributed to low salinities of the bay (see table 1), since the "over-whelming majority of Foraminifera are adapted to normal salinity" (8).

3. Distribution of Species: Large pelagic foraminiferal numbers are limited to the area where bay water and open-sea water overlap. Dominant or characteristic species found largely at the Uraga Channel are Miliolidae, *Cassidulina* gen., *Cibicides* gen., *Eponides* gen., *Textularia concia* d'ORBIGNY, *T. abbreviata* D'ORBIGNY and *Amphistegina radiata* (TERQUEM). Those species are representatives of shallow water fauna of Pacific coast since Pliocene. The composition of assemblages in the inner region of various bays is almost similar regardless of their location either on the Pacific coast or the Japan Sea side. Among these species, *Trochammina globigeriniformis* (PARKER and JONES) and *Rotalia beccarii* (LINNAEUS) are good indicators of strong embayment character (5, 6, 7). *Trochammina globigeriniformis* comprises over 80% of the population in the northeastern area near Chiba. Another contrasting features of species collected from the inner region of the bay are the tendency to become small forms. *Textularia parvula* CUSHMAN, *Proteonina difflugiformis* (BRADY), *Elphidium fabum* (FICHTEL and MOLL), *Nonionella miocenum stella* CUSHMAN and MOYER and *Nonion manpukujiensis* OTUKA are remarkably small and have transparent thin wall compared with the same species collected from the Uraga Channel and Pliocene beds of Bôsô. Small forms can not be considered as younger forms because they have full character of adults, therefore, they must be dwarfs which have been adapted to brackish water.

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Table 2 Distribution of Foraminifera in surface sediment from Tokyo Bay

Foraminifera \ Station No.	1	2	3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	23	24	26	28	30
Proteonina difflugiformis (BRADY)	—	—	—	—	—	—	—	—	0.4	—	—	0.1	0.9	3.5	1.8	0.1	—	—	—	0.2	—	—
Reophax nodulosa BRADY	—	—	0.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
cf. *pilulifer* BRADY	—	—	—	—	—	—	—	—	0.3	—	—	—	—	—	—	—	—	—	—	—	—	—
curtus CUSHMAN	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—	—	—	—	—
bilocularis FLINT	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—
excentricus CUSHMAN	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	0.1
Glomospira goldialis (JONES and PARKER)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—	—	—
Ammobaculites americanus CUSHMAN	0.1	—	0.1	—	—	0.1	—	—	0.2	0.1	0.2	0.6	—	0.4	0.4	—	—	—	—	—	—	—
cf. *pseudospirale* (WILLIAMSON)	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—	—	—	—	—	—	—	—
Textularia parvula CUSHMAN	—	0.3	0.1	—	—	—	—	5.5	3.2	—	—	—	0.1	0.1	—	0.1	2.5	—	—	—	—	—
gramen D'ORBIGNY	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—	—	5.0	—	0.5	0.8	0.3	2.4
foliacea HERON-ALLEN and EARLAND	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—	—	0.5	0.8	0.5	—
hauerii D'ORBIGNY	—	—	—	—	—	—	—	—	—	—	—	—	—	0.2	0.5	—	—	—	0.3	0.9	0.1	0.3
conica D'ORBIGNY	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.3	0.1	0.4	0.1	1.4
abbreviata D'ORBIGNY	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.7	—	0.3	1.2	0.2	2.3
sagittula DEFRANCE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	0.2	1.1	0.1	3.5
Gaudryina cf. *robusta* CUSHMAN	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	0.1	—	0.2	0.6	0.2	3.1
ogasaensis ASANO	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.2
Heterillina guespellensis SCHLUMBERGER	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—	—	—	—	0.1
Massilina inaequalis CUSHMAN	0.1	—	0.1	0.1	—	—	0.1	—	—	—	—	—	—	—	0.4	—	—	—	—	—	0.2	—
alveoliniformis MILLET	—	—	—	—	—	—	—	—	—	—	—	—	—	0.2	—	—	—	—	—	—	0.1	—
secans (D'ORBIGNY)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—

Table 2 (cont.)

	1	2	3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	23	24	26	28	30
Spiroloculina planissima (LAMARCK)	—	—	—	—	—	—	—	—	0.1	—	—	—	—	0.1	0.2	0.1	—	—	—	—	—	—
depressa D'ORBIGNY	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—	—	—	0.1	—	0.2
canaliculata D'ORBIGNY	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—	—	0.9	0.6	0.8
communis incisa CUSHMAN	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.2	—	—	0.2	0.1	0.6
Triloculina laevigata D'ORBIGNY	—	—	0.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—
circularis BORNEMANN	—	—	—	—	—	—	—	0.1	—	—	—	—	—	—	0.1	—	—	—	0.2	0.4	0.5	4.0
trigonula (LAMARCK)	—	—	—	—	—	—	—	0.1	—	—	0.2	—	—	0.4	0.1	1.0	—	1.0	0.5	2.6	1.0	3.4
tricarinata D'ORBIGNY	—	—	—	—	—	—	—	—	—	—	—	—	0.2	1.5	0.7	—	—	—	—	0.4	0.2	1.4
oblonga (MONTAGU)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—	—	0.1	0.1	0.1
cf. *planciana* D'ORBIGNY	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.6
Quinqueloculina seminulum (LINNAEUS)	0.2	—	0.1	—	—	—	—	0.3	0.3	0.1	—	0.1	0.4	2.6	0.6	1.0	0.2	0.1	0.3	5.4	0.3	2.9
vulgaris D'ORBIGNY	2.5	—	0.1	0.1	—	—	—	0.1	0.2	—	—	—	0.6	1.4	1.0	0.6	1.0	0.1	0.4	2.3	—	3.9
lamarckiana D'ORBIGNY	—	—	—	—	—	—	—	—	0.1	—	—	0.1	1.0	4.5	0.8	0.5	—	—	—	0.2	0.6	0.8
cf. *contorta* D'ORBIGNY	—	—	—	—	—	—	—	—	—	—	—	—	0.1	0.2	0.2	—	—	—	—	0.9	0.1	0.3
agglutinans CUSHMAN	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	0.2	—	—	0.3	0.3	0.1	—	0.1
curta CUSHMAN	—	—	—	—	—	—	—	—	—	—	—	—	—	0.4	0.6	—	0.4	0.2	0.3	0.5	0.1	1.0
parkerii (BRADY)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—
polygona D'ORBIGNY	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.3	0.1	—
cf. *venusta* KARRER	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.0
Pyrgo denticulata (BRADY)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.4	0.2	0.3
natukawa MATUI and NAKAGAWA	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.4	0.1	0.3
Trochammina globigeriniformis (PARKER and JONES)	5.9	6.4	27.8	1.5	2.4	6.1	14.0	3.3	0.1	0.3	0.1	5.0	2.5	2.7	2.4	2.4	0.4	0.2	0.1	0.5	—	—
inflata (MONTAGU)	—	—	0.2	—	—	0.1	0.9	0.6	2.4	—	—	—	0.1	0.3	0.4	0.1	0.5	0.1	0.4	0.1	—	0.1

nana (BRADY)	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—	—	—	0.1	0.1	—	—	—
Nouria polymorphinoides HERON-ALLEN and EARLAND	—	—	—	—	—	—	—	—	1.0	—	—	—	—	0.1	0.1	0.1	—	—	—	0.3	0.1	—
tenuis HADA	—	—	—	—	—	—	—	—	0.2	—	—	—	—	1.0	—	—	—	—	—	0.2	—	0.3
Robulus calcar (LINNAEUS)	—	—	—	—	—	—	—	—	0.1	—	0.1	—	0.1	0.1	0.1	—	0.1	—	—	—	0.2	—
cf. *iotus* (CUSHMAN)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	0.1	—
Lagenonodosaria scalaris sagamiensis ASANO	—	—	—	—	—	—	—	—	—	—	—	—	0.2	0.1	0.2	—	—	—	—	2.1	0.1	0.6
Marginulina nakamurai (ASANO)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1
Lagena striata strumosa REUSS	—	—	—	0.1	—	—	—	0.1	2.5	—	0.1	0.1	0.4	—	0.4	—	—	—	—	0.3	0.1	—
semistriata WILLIAMSON	—	—	—	—	—	0.1	—	—	0.1	—	—	—	0.1	—	—	0.1	—	—	—	0.2	0.1	—
acuticosta REUSS	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	0.1	—	—	—	0.1	0.3	0.3
hexagona (WILLIAMSON)	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—	0.1	—	0.1	0.1	—
sulcata (WALKER and JACOB)	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—	—	—	—	—	—
hispida CUSHMAN	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—
Nodosaria vertebralis (BATSCH)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	0.1	—
Dentalina emaciata REUSS	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	0.1	—
Sigmoidella kagaensis CUSHMAN and OZAWA	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	0.1	0.1	—	—	—
Guttulina kishinoui CUSHMAN and OZAWA	0.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1
Elphidium advenum CUSHMAN	1.2	—	—	—	—	—	—	0.1	—	—	0.2	—	1.7	3.7	2.0	4.7	0.6	0.6	0.2	3.0	—	0.1
fabum (FICHTEL and MOLL)	2.6	0.1	0.2	0.1	—	0.1	—	0.2	0.3	—	—	—	0.1	4.8	0.4	2.5	0.1	0.2	—	0.1	0.2	—
macellum (FICHTEL and MOLL)	0.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
crispum (LINNAEUS)	—	—	—	—	—	—	—	—	—	—	0.2	—	—	0.1	4.0	—	0.1	0.2	1.4	4.7	2.6	5.6
jenseni (CUSHMAN)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.2	2.2	—	0.2	—	1.1	0.1	0.1
craticulatum (FICHTEL and MOLL)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	0.3	—	—	—

Table 2 (cont.)

	1	2	3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	23	24	26	28	30
Nonion manpukujiensis OTUKA	0.1	—	—	—	—	0.1	—	—	7.9	0.1	—	0.3	1.9	2.0	1.2	1.7	0.3	—	—	0.5	0.2	0.1
pacificum (CUSHMAN)	—	—	—	—	—	0.1	—	—	—	—	—	—	0.1	—	—	—	—	0.1	—	0.1	—	0.2
japonicum ASANO	—	—	—	—	—	—	—	—	—	—	—	—	0.7	0.8	0.4	0.5	—	—	—	0.6	0.1	—
boueanum (D'ORBIGNY)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—	—	—	—
Nonionella japonica ASANO	0.1	—	—	—	—	—	—	0.1	—	—	—	—	—	—	—	0.1	—	—	—	0.2	0.1	—
miocenica stella CUSHMAN and MOYER	0.1	0.3	0.8	0.1	—	0.3	4.4	3.5	16.7	0.2	0.2	0.5	14.0	5.7	1.5	1.0	0.2	0.1	—	—	—	0.1
tredeca (ASANO)	—	—	—	—	—	—	—	0.1	—	—	—	—	—	0.1	—	—	0.1	0.1	—	—	—	0.2
Astrononion stelligerum (D'ORBIGNY)	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—	—	—	—	0.1	—
Bolivina striatula CUSHMAN	0.1	—	—	—	—	—	—	—	—	—	—	—	0.1	0.1	0.1	—	—	—	—	—	—	—
robusta BRADY	—	—	—	0.1	—	—	—	—	—	—	0.2	—	0.2	0.2	—	0.4	—	—	0.1	0.5	0.5	0.2
subangularis ogasaensis ASANO	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—	—	—	—	—	—	0.2	—	—
spinescens CUSHMAN	—	—	—	—	—	—	—	—	—	—	—	—	1.0	—	—	—	—	—	—	—	—	0.1
seminuda CUSHMAN	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.4	—	—	0.2	0.1	—	—
Entosolenia lucida WILLIAMSON	0.2	0.4	0.1	0.1	0.1	0.2	1.6	0.7	2.3	0.1	0.1	0.2	1.1	0.1	—	—	0.1	—	0.2	—	—	—
globosa (BORNEMANN)	—	—	—	—	—	—	—	—	—	—	—	—	—	0.2	0.1	0.1	—	—	—	—	—	0.2
Virgulinella sp.	—	0.1	0.4	—	0.1	0.4	0.2	0.5	—	—	—	0.1	—	—	—	—	—	0.1	—	—	—	—
Bulimina marginata D'ORBIGNY	—	—	0.1	—	—	—	0.1	0.1	0.1	—	—	—	—	0.5	—	0.1	—	—	—	0.2	—	0.1
Siphogenerina raphana (PARKER and JONES)	—	—	—	—	—	—	—	—	—	—	—	—	0.1	1.8	—	1.5	0.2	—	—	2.8	1.6	0.8
Chrysalidinella dimorpha (BRADY)	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	0.2	—	—	—	—	—	0.2
Uvigerina tenuistriata REUSS	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—	—	—	0.8	0.4	0.1
cf. *falinosa* HANTKEN	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1
Loxostomum karrerianum (BRADY)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.2	0.1

Rotalia beccarii (LINNAEUS)	2.5	0.1	0.4	—	—	—	—	0.1	—	—	0.1	0.1	1.1	2.5	0.1	4.8	—	—	0.1	0.5	0.6	0.6
japonica HADA	0.4	0.1	0.2	—	0.1	—	—	0.2	0.4	0.1	—	0.4	7.8	4.7	8.0	0.6	0.2	0.1	0.1	—	—	—
nipponica ASANO	0.4	—	—	—	—	—	—	0.2	0.1	0.1	—	0.1	—	—	—	—	—	—	—	—	—	—
papillosa BRADY	—	—	—	—	—	—	—	—	—	—	—	0.1	0.3	1.8	15.4	0.3	—	0.2	0.1	—	0.8	—
Cancris auriculus (FICHTEL and MOLL)	—	—	—	—	—	—	—	—	0.1	—	—	—	—	1.9	0.1	0.5	0.3	0.2	—	2.9	0.4	0.2
Baggina phillippinensis (CUSHMAN)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.4	—	—	—	—	—
Eponides haidingeri (D'ORBIGNY)	—	—	0.1	—	—	—	—	—	—	—	0.2	0.1	—	—	—	—	0.9	0.1	0.4	0.1	0.1	0.8
repandus (FICHTEL and MOLL)	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	0.7	0.5	2.6	1.9	2.0	3.7
Gyroidina soldanii D'ORBIGNY	—	—	0.1	—	—	—	—	—	—	—	—	—	—	0.1	—	—	0.3	0.1	—	1.5	1.3	1.9
Epistomella sp.	—	—	—	—	—	0.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.0
Siphoninoides echinatus (BRADY)	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—	—	—	0.9	2.2	1.0
Patellina corrugata WILLIAMSON	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	0.1	0.1
Discorbis orbicularis (TERQUEM)	—	—	—	—	—	—	0.1	—	—	—	0.1	—	—	—	—	—	0.2	0.1	—	—	—	—
bertheloti (D'ORBIGNY)	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—	—	—	—	—	—	—	—	0.8
mira CUSHMAN	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—	—	—	—	0.9	—	—	—	—
opercularis (D'ORBIGNY)	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—	—	—	—	—	0.1	—	—	0.2
globularis (D'ORBIGNY)	—	—	—	—	—	—	—	—	—	—	—	—	—	0.4	0.2	0.1	—	—	0.1	—	—	0.2
vilardeboanus (D'ORBIGNY)	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	0.1	0.6	—	0.3	0.7	0.3	0.5
Amphistegina radiata (TERQUEM)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.7	—	—	0.4	0.1	0.1
Cymbaloporetta squamosa (BRADY)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.2	0.1
Cassidulina subglobosa BRADY	—	—	0.1	—	—	—	—	—	—	—	0.3	—	—	1.5	—	0.5	0.3	0.2	—	3.6	6.4	2.6
orientale CUSHMAN	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—	—	—	0.1	—	—	—	—	—
pacifica CUSHMAN	—	—	—	—	—	—	—	—	—	—	—	—	0.1	0.1	—	0.1	—	—	—	0.4	1.3	—
Pullenia quinqueloba (REUSS)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	0.1	0.1	0.3

Table 2 (cont.)

	1	2	3	4	5	6	7	8	9	10	11	12	14	16	18	20	22	23	24	26	28	30
Sphaeroidina dehiscens PARKER and JONES	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.2	—	—	—	0.1
bulloides (D'ORBIGNY)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	0.1	0.1
Cibicides refulgens (MONTFORT)	—	—	0.1	—	—	—	—	—	—	—	0.3	0 2	0.1	0.3	0.3	0.4	0.2	0.2	0.4	2.6	2.5	10.5
lobatulus (WALKER and JACOB)	—	—	—	—	—	—	—	—	—	—	0.1	—	—	0.2	—	0.3	0.8	0.2	0.8	1.4	1.8	4.0
pseudoungerianus (CUSHMAN)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.2	0.9	0.4	0.3	0.9	0.6	1.7
Planulina wuellerstorfi (SCHAWAGER)	—	—	—	—	—	—	0.1	—	—	—	0.5	0.1	—	1.4	0.1	1.5	1.9	0.2	0.6	5.2	4.1	3.4
Anomalina grosserugosa (GÜMBEL)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1
Rectocibicides sp.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	0.1	—	—
Dyocibicides sp.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	0.1
Acerbulina cf. *inhaerens* (SCHULTZE)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.2	—	0.3
Gypsina cf. *vesicularis* PARKER and JONES	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.2	—	—	—	0.1	—	0.1	—
Globigerina bulloides D'ORBIGNY	—	0.1	—	—	—	0.1	0.2	0.1	0.5	—	0.6	—	2.0	1.3	0.4	1.3	0.1	1.1	0.9	10.0	23 5	36.6
Globorotalia crassa (D'ORBIGNY)	—	—	—	—	0.1	—	—	—	—	—	—	—	—	—	—	—	—	0.1	0.1	—	—	2.9
Total Foraminiferal Number	16.9	7.6	31.1	2.1	2.8	7.9	21.7	25.9	39.6	1.1	4.3	6.5	38.2	57.4	46.4	32.3	21.7	9.5	14.4	75.3	55.8	120.2
Benthonic Foraminiferal Number	16.9	7.8	31.1	2.1	2.7	7.8	21.5	28.8	39.1	1.1	3.7	6.5	36.2	56.1	46.0	31.0	21.6	8.3	13.4	65.3	32.3	80.7
Pelagic Foraminiferal Number	—	0.1	—	—	0.1	0.1	0.2	0.1	0.5	—	0.6	—	2.0	1.3	0.4	1.3	0.1	1.2	1.0	10.0	23.5	39.5
Number of Species	17	9	19	7	4	12	10	19	24	8	23	20	30	57	43	38	38	38	40	47	66	75