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NOTES ON DREDGING IN THE GREAT BITTER LAKE OF THE SUEZ CANAL

by

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INTRODUCTION

In the summer of 1950, the present writer spent a three weeks' holiday dredging in the Great Bitter Lake. Plans to collect specimens in that area for the Rijksmuseum van Natuurlijke Historie at Leiden had, unfortunately, to be drawn up somewhat hurriedly, but at least the most essential equipment was complete by the beginning of the writer's stay at Fayed, on the western shore of the Lake. Between August 18th and September 5th, the Great Bitter Lake was explored as well as possible under the circumstances.

The investigation discussed below was, as is fully realised, of a limited character; it consisted almost exclusively of operations for collecting marine organisms, though on a fairly large scale. However, it was considered preferable to do the work with the means available rather than let this chance slip for want of ideal circumstances, the more so because no extensive exploration of the bottom fauna of the Bitter Lake had ever been carried out in the past. The discovery of a few distinct plant zones in the Lake will, it is hoped, add to the ecological interest of the collections made.

To Mr. J. Doorn, of the Anglo-Egyptian Oilfields Ltd., the writer owes many thanks for the able manufacture of a most serviceable marine dredge. The Compagnie Universelle du Canal Maritime de Suez kindly made available a detailed hydrographic map of the Great Bitter Lake. The writer is also much indebted to Miss Dr. J. Th. Koster, Rijksherbarium, Leiden, for the identification of the collected plants.

BRIEF COMMENTS ON THE ISTHMUS OF SUEZ

The excavation of the Suez Canal has added much interest to the manifold problem of the extent of intermingling between marine faunal provinces, now, as in the past. The Canal is unique in that it offers free communication, be it of a limited character, across an area which has acted in the geologic past as a faunal barrier between two widely different faunal provinces. Due to M. Blanckenhorn's and L. R. Cox's investigations [1]) in particular, it is well established that the Gulf of Suez in Miocene times was in open connection with the Mediterranean, while no direct connection can have existed between the Gulf and the Indian Ocean. In late Miocene time, the Isthmus of Suez emerged from the sea. In the Pliocene, a new connection was established between the Indian Ocean and the Red Sea, the Gulf of Suez extending over the Isthmus as far as Ismailia but no connection being re-established [2]) with the Mediterranean until the excavation of the Suez Canal was completed. As the result of the University of Cambridge Expedition to the Suez Canal (which did not explore the bottom fauna of the Great Bitter Lake), the general effects of the artificial sea connection upon the faunal picture are probably largely understood. The present investigation offers a more detailed examination, notably of the benthos, of a part of the area covered by the Cambridge Expedition. The discovery of two faunas (see below), one seemingly older than the other, may be expected to add some new points to the study of the development of the Isthmian marine fauna.

EQUIPMENT AND TECHNIQUE

The equipment used for the reconnaissance discussed here, consisted of a small Dutch surf-boat fitted out with a 2 B.H.P. outboard motor and a single marine dredge with upturned cutting edges and wire mesh (size: 4 mm sq.), which is apparently of almost allround value for work under the circumstances peculiar to the Bitter Lake. The type of vessel may be considered ideal for the kind of work carried out. When fully equipped, the boat was given a speed of eight knots. This speed was, of course, not

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1) Of Cox's papers, I quote here: Notes on the Post-Miocene Ostreidae and Pectinidae of the Red Sea Region, with remarks on the geological significance of their distribution; Proc. Mal. Soc. London, vol. XVIII, parts IV & V, pp. 165-209; 1929.

2) The writer has had the opportunity recently to verify Cox's conclusions by means of an examination of Miocene and Plio-Pleistocene fossils, mainly mollusca, from the Gulf of Suez Region in the collection of the Anglo-Egyptian Oilfields, Ltd. The results obtained from a much larger number of species than available to Cox at the time, fully confirm the latter's carefully drawn conclusions.

adequate for navigation in the main shipping lane, crowded as it was with considerably faster vessels for the best part of each day. Consequently, only a few samples were taken in the area of the main shipping lane.

Of each station (see fig. 1), the position was determined by intersections derived from compass bearings both on prominent points ashore and buoys. Although it was not always easy to obtain correct readings due to the wave effects, and though the soundings — carried out with the lead — were not corrected for the slight tidal effects, the locations were found to tally quite well with the map and soundings as recorded by the Suez Canal Company. Near the northern entrance of the Canal, however, considerable changes in the bottom configuration appeared to have taken place since 1925 [1]). Consequently, this part of the map was left blank here (fig. 1).

Dredging was done as much as possible as contour-dredging, usually between 50-150 m each way in the area of each station. Because of limited means of storage, the most bulky material dredged, i.e., plants and sediments, was removed after taking brief notes on its nature. Certain Holothuroidea and fishes were left out as well (see below). This procedure could be followed since the different, quite uniformly composed plant zones were discovered on reconnaissance trips at the very beginning of the survey, so that on later trips notes were made on the presence or absence of the commonest elements and the necessary reduction in the size of the catches achieved.

Most of the material collected was preserved in spirits, but part of the samples suitable for it were kept aside for drying. No water samples were taken, neither data on water temperatures assembled. The water temperature was, however, noticed to be at least as high as in the top layers in the Gulf of Suez.

The extent of the plant zones was ascertained by means of a great number of quick hauls with the dredge. Since, however, the storage space did not permit keeping all material that was thus sampled, and since this material invariably proved to be virtually the same as that collected at adjacent stations, it was usually discarded.

No difficulties in dredging were encountered, since there are apparently no rocky parts or coral growths whatsoever in the whole Lake, the sediments being mainly sands and clays.

Dredging in the Little Bitter Lake was omitted. It may, however, be recommended as an object for future dredgings since according to local

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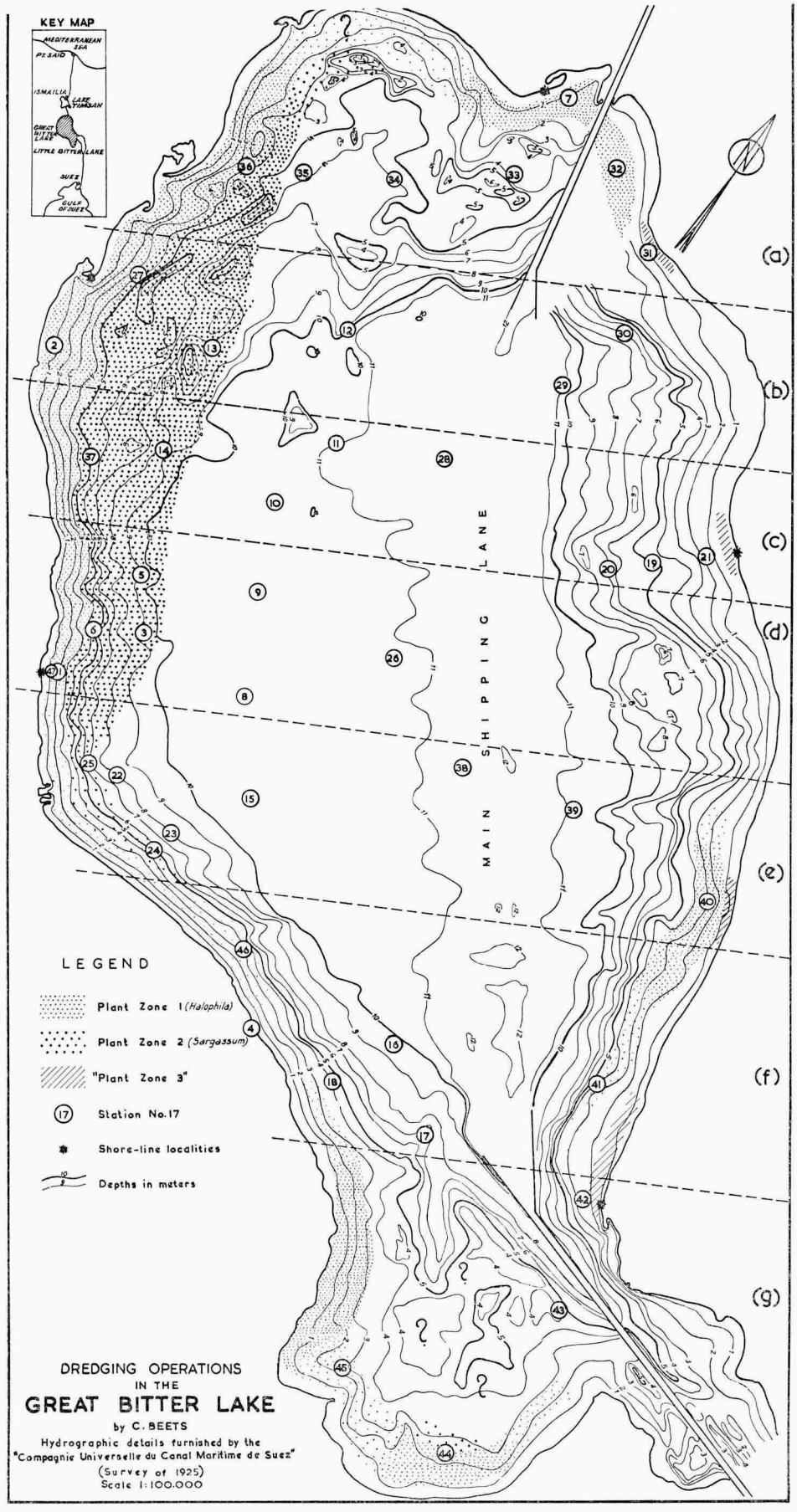
1) A new map is under preparation, according to information supplied by the Suez Canal Company.


KEY MAP
MEDITERRANEAN SEA
PT. SAID
ISMAILIA
LAKE TIMSAH
GREAT BITTER LAKE
LITTLE BITTER LAKE
SUEZ
GULF OF SUEZ
MAIN SHIPPING LANE
(a)
(b)
(c)
(d)
(e)
(f)
(g)
LEGEND
Plant Zone 1 (Halophila)
Plant Zone 2 (Sargassum)
"Plant Zone 3"
Station No. 17
Shore-line localities
Depths in meters
DREDGING OPERATIONS
IN THE
GREAT BITTER LAKE
by C. BEETS
Hydrographic details furnished by the
"Compagnie Universelle du Canal Maritime de Suez"
(Survey of 1925)
Scale 1:100.000

fishermen the conditions prevailing in the Little Bitter Lake seem to be different from those in the Great Lake. Fish apparently abound in the clearer waters of the Little Lake, even sharks — entering the Canal from the South — being sighted there quite often, but never in the Great Lake where fishing is much poorer. To a certain extent, this may be due to the presence of three porpoises which for many years seem to have made the Great Lake their permanent abode. These porpoises followed the writer's tiny vessel faithfully on most of its trips, though slipping away from time to time to the bows of more impressive ships.

COMMENTS ON THE PRELIMINARY RESULTS

The Great Bitter Lake is characterised by steeper western than eastern slopes and an almost flat bottom, and by the presence of distinct marine plant zones which occupy especially the western and southeastern portions of the Lake. It would seem that there is a connection between this distribution and the prevailing northerly winds. Also, the deposits along the western and southern shores of the Lake have a comparatively high clay content, the waters there being much stirred and muddy, especially during afternoon hours.

Plant Zone 1 occupies the shallower portions of the submarine slopes. It is particularly well developed along the western to northern shores of the Lake, though rarely reaching the shore-line. Its exact nature could not be settled in the northwesternmost corner of the Lake due to lack of time, but I assume that it may be as well developed there as along the western coast of the Lake. This zone vanishes rapidly in the northeastern corner of the Lake, and slowly so in the Southwest. Here, after an interruption, follows another well-developed part and again one in the extreme Southeast, separated from the one before by a stretch with poor vegetation. Finally, a not very well developed equivalent of this zone occurs in the eastern part of the Lake.

Zone 1 is almost exclusively composed of *Halophila stipulacea* (Forsk.) Aschers., though occasionally other plants may be observed as well, for instance, Algae filling gaps between the main components and forming flat lichen-like patches, or Algae which are strikingly reminiscent of reindeer-moss. On shoals, but also in other places whenever the water is clear, Zone 1 may be observed forming submarine gardens. The garden-like appearance of the zone is particularly noticeable near Station 36 [a] [1]), 2 [b] and 27 [b] and also to the North of Station 45 [g]. This picture is, however,

1) Compare the first paragraph of the chapter: List of Stations.

somewhat blurred by the presence of swarms of peculiar Holothuroidea [1]), all seemingly of one species, which cluster around the plants. Apart from these, the eye is struck by the presence of gastropods such as Muricidae and Fusinidae, bivalve shells (for instance, mussels), starfishes, prawns, juvenile squids, and sea-horses (*Hippocampus*). In the little embayment to the West of Station 27 [b], in quiet water, a large number of small Cerithiidae was found. It may be added that the sea bottom between Zone 1 and the shore-line is characterised by the patchy occurrence of sea-grass.

It may be due to the presence of a rich vegetation that evidently merely a limited proportion of the fauna contained in the deposits of Zone 1, was brought up by the dredge. At least, the fauna collected along the shore in a few places, invariably proved to contain a number of species not dredged, apart from a few non-marine elements which evidently have been transported into the Lake by fresh water. It was noticed in various places that the water contained in the sediment underneath the plant cover is somewhat fouled, although neither the vegetation nor the fauna seem to suffer appreciably from this condition.

The lower boundary of Zone 1 is on the whole unexpectedly sharp. In a few places only did I obtain a strong impression of the presence of a truly intermediate zone with a mixed vegetation of plant types 1 and 2, notably in the area between Stations 27 [b] and 36 [a] and near station 44 [g].

Plant Zone 2, the deepest, reaches downward to a maximum depth of about 10 metres and is almost exclusively developed on the western submarine slopes. Its presence in the extreme Southeast of the Lake was ascertained, but lack of time did not permit completion of the work in that area, nor in the extreme northwestern corner of the Lake, hence the question-marks in fig. 1.

The zone is composed almost exclusively of *Sargassum*. Its fauna is rich, in places with a notable content of echinoids as opposed to the fauna of Zone 1. Again, the presence of a rich vegetation may have prevented the dredge from collecting as much of the burrowing fauna as would be necessary for obtaining a true picture of the entire fauna. Holothuroidea of the same kind as abound in Zone 1, are well represented again in Zone 2.

As to "Plant Zone 3", it may be remarked that on odd places along the western shores of the Lake, and much more noticeably so along its eastern shores, patches of sea-weeds occur which give a vague impression of forming a zone. There are at least three different kinds of weeds which,

1) *Synapta*, judging from figures in various publications.

unfortunately, could not be sampled well. One Alga, which was also noticed in Zone 1, is *Dictyota dichotoma* (Huds.) Lamour.

Near Station 31 [a], close to the shore in water 10-50 cm deep, occur sea-weeds in abundance on mussel clusters which together form hemispherical bodies on the sea bottom. *Dictyota dichotoma* forms a minority here, whereas it is in the majority near Stations 40 [e] and 42 [g]. The "Zone" seems to occur in clear water not exceeding 2.50 m depth. Its presence was also noticed near Station 21 [c], and it may actually occur along the greater part of the eastern shore of the Lake.

The greater part of the bottom of the Great Bitter Lake, however, does not show any vegetation at all, nor was much live fauna collected in it, save, for instance, at Stations 12 [b], 17 [f], 20 [c], 23 [e] and 34 [a]. In some places the Holothuroidea which were found to be normally restricted to Plant Zones 1 and 2, seem to have been carried downwards by currents out of their favourite environment, while the presence of other live organisms, for instance starfishes, cannot be readily explained unless we assume the proximity of vegetation with accompanying fauna. In other words, the observations on the extent of Plant Zone 2 may not be detailed enough, small patches of this zone possibly having been missed by the dredge, in particular in the area between Stations 12[b] and 34 [a].

Hermit-crabs appeared to descend into water of 6-7 m depth on the eastern submarine slopes of the Lake.

It appears that the bottom samples taken from depths exceeding about 9 metres contain a fauna which is different from the fauna collected in shallower parts of the Lake. The former is characterised by the presence of well preserved large Cardiums of semi-fossilized appearance. As the deepest parts of the Lake appeared to be quite uniformly fouled, it may perhaps be assumed that the dead fauna contained in their sediment represent the relics of the first settlers of a new fauna invading the Great Bitter Lake after its re-connection with the open sea due to the excavation of the Suez Canal, but not living for long owing to subsequent fouling of the water. It will be of particular interest to settle the character of this fauna, whether Mediterranean or Erythraean. The fouling of a bottom layer of water in the Lake may be due to a combination of stagnancy and the exhaust products of mechanically driven ships.

On the other hand, one should bear in mind the possibility that this fauna may represent the relic of a Plio-Pleistocene Erythraean fauna which perished due to the separation of the Lake from the Gulf of Suez.

LIST OF STATIONS

N.B. In order to facilitate checking of the relative positions of the various localities on the accompanying map (fig. 1), a simple grid was added to it, the various areas being indicated alphabetically from North to South: a-g. Below, as in the previous chapter, these alphabetical symbols for rough location are added between brackets after the station numbers.

Station 1 [d]. Depth 1-2.70 m, bottom muddy/sandy though fairly firm, thickly covered with *Halophila stipulacea* (Forsk.) Aschers. (Plant type 1), also yielding some *Sargassum* prob. *crispum* (Forsk.) Ag. and *Spirulina subsalsa* Oerst. Fauna rich. Several *Synapta* present.

Station 2 [b]. A shoal, 0.30-1 m deep, composed of somewhat muddy and sandy gravel deposits thickly covered with *Halophila*. Starfishes lying widely apart, mollusca denser, *Synapta* abundant.

Station 3 [d]. Depth 9.20-10 m, sediment on the whole muddy but containing a good deal of coarse sand and gravel, covered thickly by *Sargassum*. Fauna consisting of small elements.

Station 4 [f]. A shoal in a small embayment, 0.20-0.75 m deep, with patches of sea-grass and mussels, the sediment as in Station 2. Here and there boulders occur, beset with small sea anemones.

Station 5 [d]. Depth 9 m, vegetation and sediment as in Station 3.

Station 6 [d]. Depth 5-5.50 m, vegetation and sediment as in Stations 3 and 5.

Station 7 [a]. Depth 0.50-1.50 m., sediment as in Station 2, well covered with *Halophila stipulacea*. Also present: *Falkenbergia rufolanosa* (Harv.) Schmitz. The catch was rather small, which may be due in part to the position near the Suez Canal entrance, where the water was found to be somewhat fouled. In the whole small embayment around station 7, below the bottom surface, occur deposits containing dead shells etc., which when brought to the surface produce a strong smell of H_2S.

Station 8 [d]. Depth 10.40 m, sediment mainly clayey, with a small amount of fine sand. No vegetation of any kind present.

Station 9 [d]. Depth 10.60 m, sediment as in Station 8. No vegetation.

Station 10 [c]. Depth 10.40 m, sediment and lack of vegetation as in Stations 8 and 9.

Station 11 [c]. Depth 11 m, sediment more clayey than in Stations 8-10. No vegetation present.

Station 12 [b]. Depth round about 10 m. Sediment as in Stations 8-10, but so firm that the catch was small. The presence of live starfishes and *Synapta* is something exceptional in this largely lifeless area.

Station 13 [b]. Depth about 7 m, sediment finely to rather coarsely sandy, with a thick cover of *Sargassum*.

Station 14 [c]. Depth 8.50 m, sediment, vegetation, and fauna in general as in Stations 3, 5, and 13. The only plant collected appeared to be *Sargassum* prob. *crispum*.

Station 15 [e]. Depth 10.40 m, sediment consisting of sandy clay, no vegetation.

Station 16 [f]. Depth 9.80 m, sediment as in Station 15, no vegetation.

Station 17 [f]. Depth 7.10 m, sediment about equally sandy and clayey, no vegetation, but live material present (as in Station 12).

Station 18 [f]. Depth 4.60 m, sediment consisting of sandy clay, no vegetation.

Station 19 [c]. Depth 5-5.50 m, sediment consisting of sand with some small gravel, no vegetation.

Station 20 [c]. Depth 6.80-7.20 m, sediment and lack of vegetation as in Station 19.

Station 21 [c]. Depth 1.50-3 m; sediment: slightly clayey sand, no vegetation. The fauna dredged is poorer than the material collected along the shore nearby.

Station 22 [e] Depth about 8 m. Sediment: clay admixed with fine sand and rusty sheet iron fragments. (The station is near the end of a jetty.) No vegetation present.

Station 23 [e]. Depth about 8 m. Sandy clay as in Station 22, no vegetation. Live *Synapta* present.

Station 24 [e]. Depth 5.80 m, sediment as in Stations 22 and 23. Rare specimens of *Sargassum* prob. *crispum* and some *Synapta* present.

Station 25 [e]. Depth 7 m. Sediment: sandy clay. Vegetation thin (*Sargassum*).

Station 26 [d]. Depth 10.80 m. Sediment: sandy clay. No vegetation.

Station 27 [b]. Depth 4.20 m. Sediment: muddy sand. The vegetation is mixed (Plant types 1 and 2). Fauna rich: *Synapta* and sea-horses numerous but not kept for the collection. Miss Koster identified: *Halophila stipulacea, Sargassum* prob. *crispum,* and *Jania rubens* (L.) Lamour.

Station 28 [c]. Depth 11.20 m. Sediment: somewhat sandy clay. No vegetation.

Station 29]b]. Depth 11 m. Sediment mainly sandy, with some clay. No vegetation.

Station 30 [b]. Depth 6.90 m. Sediment: mainly sand and gravel, little clay. No vegetation.

Station 31 [a]. Depth 1.40-1.80 m. Sediment: mainly sand, little gravel.

No vegetation. Fauna: many shrimps caught (not kept). Several *Synapta* present.

Station 32 [a]. Depth 2.60 m. Sandy/muddy sediment. Vegetation not very rich (*Halophila stipulacea*). *Synapta* abounding (not kept), and several sea-horses present (not kept).

Station 33 [a]. Depth 3.85 m. Sediment: sand with a little gravel and clay. No vegetation.

Station 34 [a]. Depth 6.20 m. Sediment: sandy clay. No vegetation, but *Synapta* present.

Station 35 [a]. Depth 5.60 m. Sediment: sandy clay. No vegetation.

Station 36 [a]. Depth 4 m. Sediment: sandy clay. Rich vegetation (Plant types 1 and 2 mixed) and rich fauna (*Synapta* and sea-horses not kept).

Station 37 [c]. Depth 5.10 m. Sediment: sandy clay. Rich vegetation of *Sargassum* prob. *crispum*.

Station 38 [e]. Depth 11.30 m. Sediment: clay with little fine sand. No vegetation.

Station 39 [e]. Depth 10.80 m. Sediment and lack of vegetation as in Station 38, but there is more live fauna.

Station 40 [e]. Depth 3.10 m. Sandy sediment. Vegetation quite rich (*Halophila stipulacea*). Several *Synapta* present (not kept).

Station 41 [f]. Depth 4.70 m. Sediment: mainly sand, little clay. Vegetation poor (*Halophila*). Some *Synapta* present (not kept).

Station 42 [g]. Depth 2.50 m. Sediment: sand. Some vegetation but none of Plant types 1 or 2. Several shrimps and sea-horses (not kept).

Station 43 [g]. Depth 4.30 m. Sediment: sandy clay. Poor fauna. No vegetation.

Station 44 [g]. Depth 2.80 m. Sediment: muddy gritty sand. Rich vegetation of mixed kind: Plant types 1 and 2.

Station 45 [g]. Depth 2.65 m. Sediment: clayey sand. Vegetation poor (Plant type 1).

Station 46 [f]. Depth 3.80 m. Sediment: muddy sand. Vegetation poor (Plant type 1).

Station 47 [a]. This is an area about 50 m wide between Station 1 and the shore, 0.35-1 m deep, characterised by the presence of Muricidae and Fusinidae and patchy occurrences of mussels and sea-grass.