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# ECOLOGY OF DISTRIBUTION OF THE SAND-DWELLING MYSID *GASTROSACCUS SANCTUS* (VAN BENEDEN, 1861) <sup>1)</sup> ALONG THE MEDITERRANEAN SANDY SHORE OF ISRAEL <sup>2)</sup>

BY

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## INTRODUCTION

*Gastrosaccus sanctus* (van Beneden, 1861) of the sub-family Gastrosaccinae (Mysidacea, Mysidae) has a characteristic burrowing behavior. In daytime it burrows in the uppermost centimeter of sand on the foreshore near the limit of the wave wash (Băcescu, 1934; Fishelson & Loya, 1968). This species is widely distributed along the Atlantic shore of western Europe, from Britain and the southern part of the North Sea south to Morocco, the Canaries, and along the western coast of Africa and in South Africa. In the Mediterranean *G. sanctus* was found along the coasts of France, Italy and in the northern Adriatic, Algeria and Tunisia. It is also mentioned from the Black Sea and the Sea of Azov (Fage, 1933; Băcescu, 1934, 1941; Tattersall & Tattersall, 1951; Tattersall, 1955; Giordani Soika, 1955; Furnestin, 1959; Hoenigman, 1961). The first collection in the eastern Mediterranean was made at Port Said (Tattersall, 1927). In 1966 this species was found for the first time on the Israeli coast (Fishelson & Loya, 1968).

Information on the daily burrowing habits of the species is relatively rare. Băcescu (1934) was the first to mention the dual cycle of diurnal burrowing and of nocturnal pelagic life. Lately this species was collected from the sand for physiological research purposes (Pora & Băcescu, 1939). Giordani Soika (1955), working on the interstitial macrofauna of the Mediterranean sandy shore, using the transect technique, discovered a dense population of *G. sanctus* only at Vasto (Adriatic coast of Italy) and a few specimens on several other localities (Anzio on western coast of Italy, Oran in Algeria and Tabarka in Tunisia). Preliminary transects performed by Fishelson & Loya (1968) on Bat-Yam beach (Israel, south of Tel-Aviv, locality marked no. 8 in fig. 1) showed a very dense population of this species.

The present investigation has been carried out in two stages. During the first stage a survey of the Israel coasts was performed, from Gaza in the south to Rosh Ha Niqra in the north (fig. 1). The next stage was a more detailed study along the Bat-Yam shore.

<sup>1)</sup> Specimens sent to Dr. M. Băcescu were identified by him as the recently described species *Gastrosaccus mediterraneus* Băcescu, 1970.

<sup>2)</sup> A part of M.Sc.-thesis performed under the supervision of Dr. L. Fishelson and submitted to the Tel-Aviv University, Department of Zoology.

## ISRAEL MEDITERRANEAN COAST SURVEY

During the period June 1967 to August 1967 the Mediterranean sandy shore of Israel was surveyed for *Gastrosaccus sanctus*. Sampling was performed by glass jars with a diameter of  $6.01 \pm 0.04$  cm at random at various points along the sandy shore. Every point was searched, starting below the water-line and ending on the upper limit of the wave wash. The sampling jar was pressed into the sand vertically, mouth down, to a depth of 3 to 5 cm, and in this way a sand sample was taken. The material collected was fixed in ethanol 70% and the mysids and other animals were sorted out.

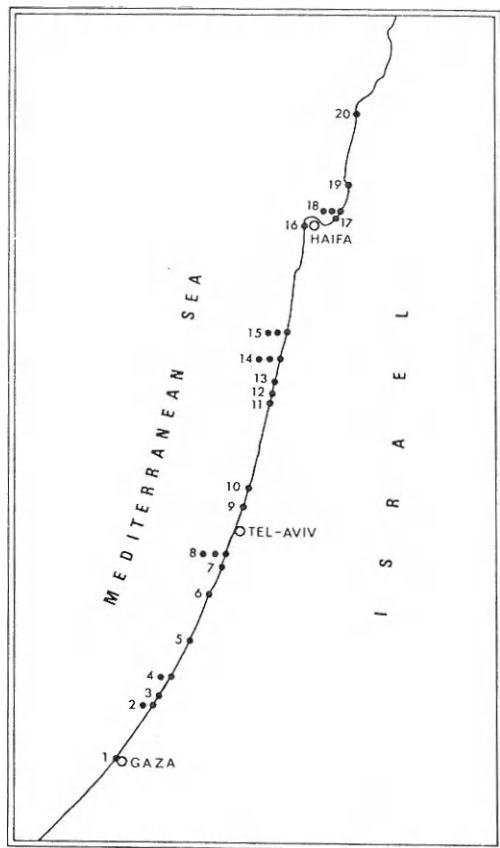


Fig. 1. Israel Mediterranean coast survey. The black dots indicate the beaches on which specimens of *Gastrosaccus sanctus* (van Beneden) were found. Two dots — beaches with a relatively dense population; three dots — beaches with the densest population.

The sites in which specimens of *Gastrosaccus sanctus* were found are shown on the map (fig. 1). They are the following (from south to north): (1) Gaza, (2) Ashkelon (National Park beach), (3) Ashkelon (beach), (4) Nizanim, (5) Ashdod (south of port), (6) Palmahim, (7) Rishon Le Zion, (8) Bat-Yam (southern beach), (9) Tel-Baruch (northern limit of Tel-Aviv), (10) Herzlia,

(11) Bet Yannay, (12) Mikhmoret, (13) Giv'at Olga, (14) Sedot Yam (beach), (15) Ma'agan Mikhael, (16) Haifa (southern beach), (17) Qiryat Hayim, (18) Qiryat Yam, (19) Akko (southern fence of beach), (20) Rosh Ha Niqra (Nahal Bezet estuary). In all these localities the coast is a sandy beach, open to wave action and of low inclination (Emery & Neev, 1960). All the specimens were found in the awash zone of the sandy littoral. At Ashdod and Rosh Ha Niqra some of the animals were found in sandy sections between rock plates. The number of specimens per sample was found to be very variable. This method of sampling enabled only a rough estimate of the population size.

On account of this survey, Bat-Yam beach was estimated to be most densely populated by *Gastrosaccus sanctus* and this locality was therefore chosen to be the region for a more detailed investigation. Ashkelon and Sedot Yam (Nos. 2 and 14 in fig. 1) were chosen as control areas.

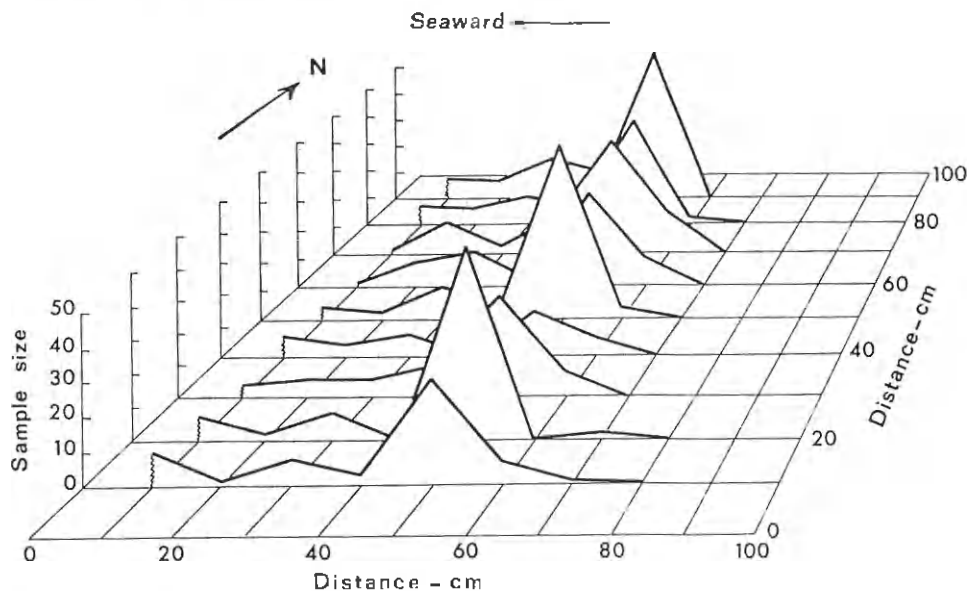


Fig. 2. Microdistribution of the population of *Gastrosaccus sanctus* (van Beneden) on a sandy Mediterranean beach (Bat-Yam, 23 Oct. 1967, 10 a.m.). The parallel lines indicate the net. Sampling was done at the crossing points. The left side of the frame is facing the sea and is parallel to the water line.

#### BAT-YAM BEACH SURVEY

The distribution of the population of *G. sanctus* at Bat-Yam was investigated by means of transects perpendicular to the water line. Along those transects samples were taken every 20 cm with the above-mentioned glass jars technique. In addition, the quadrant system was applied, using a frame of  $1 \times 1$  m on which a coordinating net was stretched, 10 cm between the lines (pl. 1). This frame was placed a few centimeters above the sand and the collecting jars were forced into the sand under the crossing points of the net. Thus 81 samples were taken in every

quadrant, covering 26 per cent ( $2600 \text{ cm}^2$ ) of the area. The samples were treated with ethanol as mentioned above.

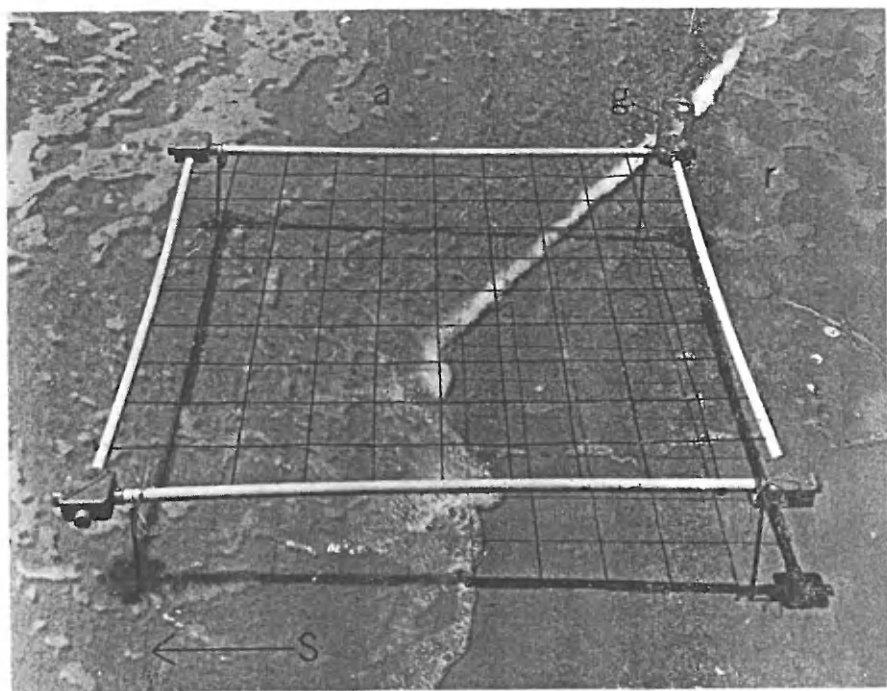
The survey along Bat-Yam shore showed that the population of *G. sanctus* is distributed discontinuously in patches ranging from a few meters to some tens of meters wide.

The quadrant sampling results are summarized in fig. 2. The results obtained were tested by analysis of variance for two variables (Dixon & Massey, 1957), and in our case they are the sampling parallel-to-water-line and the sampling orthogonal-to-water-line. The tested hypotheses are whether the means (calculated parallel or orthogonal to the water-line) are equal at the 99 per cent level of significance. The results showed that the means calculated orthogonal to the water line are equal ( $F_{8,61} = 1.68$ ), and those calculated parallel to the water line are equal ( $F_{8,64} = 39.4$ ). This means that as far as the microdistribution in the inhabited patches along the shore is concerned the distribution of *G. sanctus* is continuous, fluctuating parallel to the water line. The results prove also that there is a significant horizontal zonation of the *G. sanctus* population along the shoreline, of which the maximum density field forms a narrow line parallel to the water line and shifted towards the shore.

It ought to be pointed out that in most of the transects the above described shift is less than the one illustrated in the example demonstrated in fig. 2.

#### DISCUSSION

The zonation of *G. sanctus* along the shore fits well with similar phenomena described for other species of Mysidacea (Clutter, 1967). What seems to be interesting in *G. sanctus* is that the distribution of its population along the shore is in the form of alternate areas with or without animals, and the populated patches demonstrate a typical "aggregate" distribution. According to Băcescu (1940: 762) "durant la journée *G. sanctus* est typiquement benthique et ne passe au domaine pélagique que la nuit". During the daytime the mysids burrow in the upper cm of sand along the shore and at night they are found in the open sea, down to 1-2 m depth (Băcescu, 1934). Large numbers of *G. sanctus* were caught in the open sea at night by the aid of light (Băcescu, 1934, 1940; Furnestin, 1959). It seems possible that *G. sanctus* aggregates at night, forming large shoals. This suggestion is supported by Clutter's work (1969) on the shoaling behaviour of mysids. It can be assumed that when a large group of animals (named by Clutter a "shoal") settles down on the beach, it will cover a relatively short shore section. Clutter described the "shoal" as consisting mostly of smaller cohesive groups, which are referred to either as "schools" or "swarms". Perhaps, if such a "shoal" settles and burrows into the sand, keeping its social structure, a quadrant sampling during the daytime would demonstrate the division of the "shoal" into smaller aggregates — the "swarms".



The quadrant sampling, *a*, the breakers upward; *r*, their retreat. A sampling glass jar (*g*) was put on the frame for demonstration. *S*, seaward.

## ACKNOWLEDGMENTS

Thanks are due to Dr. L. Fishelson for his guidance and advice during the research, to Dr. M. Brown for statistical advice, to Mr. M. Goren and Mr. N. Sharon for assistance in the survey and collection of samples, and to Mr. A. Shub and Mr. R. Kalif for their assistance in preparing the illustrations.

## RÉSUMÉ

La distribution du Mysidacé fouisseur *Gastrosaccus sanctus* (van Beneden, 1861) a fait l'objet de recherches le long des côtes sableuses méditerranéennes d'Israël. Un relevé détaillé effectué sur la plage de Bat-Yam (fig. 1) a montré une distribution inégale de la population de *G. sanctus* le long de la côte. Dans les endroits peuplés les animaux forment des rassemblements, suivant des zonation horizontales, parallèles à la ligne d'eau.

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Received for publication 30 November 1970.