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Seagrass Ecosystems

A SCIENTIFIC PERSPECTIVE

about the book . . .

Seagrass Ecosystems: A Scientific Perspective consists of a review and summation of research to date in the field, as initially presented at the International Seagrass Workshop held in Leiden, the Netherlands, and revised and expanded in accord with criticism and information provided by workshop participants. Five general research aspects of seagrass ecosystems are covered: productivity/physiology, systematics, decomposition, consumers, and system oceanography. Additional papers, covering such topics as the wasting disease and geographic reviews of areas whose seagrass ecosystems have been little reported until now, including Mexico, Israel, and Australia, have also been incorporated into the book at the suggestion of those involved

The only book available that addresses the ecosystems of seagrasses rather than their biology alone, *Seagrass Ecosystems: A Scientific Perspective* is a valuable source of information on the nearshore sea for students, scientists, and coastal managers.

about the editors . . .

PETER McROY is an Associate Professor at the Institute of Marine Science, the University of Alaska, and is on the Editorial Advisory Board of *Aquatic Botany*. He was chairman of the International Seagrass Workshop and has published more than thirty articles on various aspects of oceanography and marine science. He received his Ph.D. in Marine Science from the University of Alaska (1970), and is a member of nine professional organizations, including the American Society of Limnology and Oceanography; the Marine Biological Association, United Kingdom; and the American Association for the Advancement of Science.

[illegible] HEFFERNAN is Project Assistant, Processes and Resources of the Bering Sea Shelf [illegible] the Institute of Marine Science, the University of Alaska. She was coordinator [illegible] International Seagrass Workshop and the 21st Alaska AAAS Conference. Ms. [illegible] has edited several scientific books and reports, and has published numerous [illegible] coordination and other subjects.

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SEAGRASS VEGETATION OF SINAI AND ISRAEL

Y. Lipkin

Department of Botany
Tel Aviv University
Tel Aviv, Israel

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I. INTRODUCTION

The nine seagrass species which have been recorded from the Red Sea by various authors (see Lipkin, 1975a) are the following: *Halodule uninervis* (Forssk.) Aschers., *Cymodocea rotundata* Ehrenb. et Hempr. ex Aschers., *C. serrulata* (R. Br.) Aschers., *Syringodium isoetifolium* (Aschers.) Dandy, *Thalassodendron ciliatum* (Forssk.) den Hartog, *Enhalus acoroides* (L. *f.*) Royle, *Thalassia hemprichii* (Ehrenb.) Aschers., *Halophila ovalis* (R. Br.) J. D. Hook., and *H. stipulacea* (Forssk.) Aschers.

All except *Enhalus acoroides* have been reported from stations on the coast of the Sinai Peninsula. However, the only record of *Cymodocea serrulata* from Sinai (Rayss, 1959) is probably based on misidentification of *Thalassodendron ciliatum*. In addition, only one collection of *Thalassia hemprichii* from Sinai has been reported (at Et Tūr, by Ehrenberg and Hemprich in 1823-1824; see Ascherson, 1867, p. 159, and Solms-Lauback in Schweinfurth, 1867, p. 194). The latter species has never been found again at Et Tūr, despite intensive survey. Actually, only the latter and the remaining six species are found on the Sinai Red Sea coast. The distribution of these species on that coast is summarized in Table 1. Et Tūr, which used to be the only town on the Sinai Red Sea coast and thus served as an important station for the naval traffic in the Red Sea, is the main locality on this coast from which seagrasses have been reported. Here many vessels stopped enroute to the central and southern parts of the Red Sea, providing the travellers and scientists on board an opportunity for collecting. Many collections have been made, and almost all seagrasses presently known from the Sinai Peninsula have been found at Et Tūr; most of them have been collected several times. Only occasional collections have been made at other coastal stations of Sinai. While a considerable number of visits have been paid to stations on the coast of the Gulf of Suez (by Ehrenberg and Hemprich, Bové, Lefèvre, Protier, Ascherson, Fielding, Rehabeti, Nayal, Palmer, and Walter; see Lipkin, 1975a), exceptionally few collections have been made along the Sinaian coast of the Gulf of Elat. The first collection of seagrasses from the

latter coast was made only in 1949 (by the "Manihine" Expedition, see den Hartog, 1970) and a few others were made in 1956 (by members of the Department of Botany, the Hebrew University Jerusalem; see Rayss, 1959). Intensive collection of seagrasses at most Sinaian Red Sea stations (other than Et Tür and the northernmost end of the Gulf of Elat) did not start before 1967.

The ecology of the seagrasses of Sinai has not been the subject of any particular publication. Even remarks of an ecological nature are almost nonexistent in the papers dealing with them. Furthermore, for the whole Red Sea such information is very meager. Most Red Sea seagrasses have been reported to grow on sandy bottoms or in sand-bottomed pools among coral reefs (Klunzinger, 1878, Boissier, 1884; Täckholm, Täckholm and Drar, 1941; Beets, 1953, den Hartog, 1970). Reported depths are: 1-45 m for *Halophila stipulacea*, 1-10 m for *H. ovalis*, 1-6 m for *Halodule uninervis*, "shallow waters" for *Cymodocea rotundata* and *Thalassodendron ciliatum*, "shallow waters" to 10 m for *Cymodocea serrulata* and *Syringodium isoetifolium* (Piccone, 1900; Post, 1933; Täckholm, Täckholm and Drar, 1941).

Four of the five species of seagrasses presently known to dwell in the Mediterranean Sea are native to this sea. These are: *Cymodocea nodosa* (Ucria) Aschers., *Posidonia oceanica* (L.) Delile, *Zostera noltii* Hornem., and *Z. marina* L. Only the first three presently occur in the southeastern Mediterranean. *Halophila stipulacea*, a recent immigrant from the Red Sea (Fritsch, 1895), occurs here too. It occupies extensive areas in the eastern basin (see Lipkin, 1975c) and seems to expand westward (Lanfranco, 1970; den Hartog, 1972).

From the Mediterranean Sinai coast very little information concerning seagrasses is available. *Z. noltii* (as *Z. nana*) has been reported from Ez Zaraniq (Ascherson, 1888; Ascherson and Schweinfurth, 1887), which is situated at the easternmost part of the large lagoon of Sabkhat el Bardawill (= the Sirbonian Sea), at its opening to the Mediterranean. The lagoon itself was inhabited by *Ruppia cirrhosa* (Petange) Grande (Ascherson, 1888). Aleem (1955) reported the occurrence of *P. oceanica* from the few rocky places between Port Said and El A'rish.

10 m, as well as in shallower waters, while the other four species have never been found below 10 m.

Most seagrasses have one main growing season which is during late spring and early summer. Consequently, most seagrass stands show seasonal changes of size. During winter the vegetation of the marginal parts of the fields deteriorates and they diminish rapidly. This is a result of the winter storms and the fact that the plants do not grow actively during the intervals between the storms to compensate for storm losses. During spring the plants grow vigorously, and in a few weeks the lost areas are regained. Usually it is easy to distinguish, until very late in summer, between the newly colonized areas and those permanently occupied.

All seagrasses seem to reproduce vegetatively more readily than by seeds. Although considerable amounts of seeds of several species such as *Halophila stipulacea*, *Thalassodendron ciliatum*, or *Cymodocea nodosa* have been found, seedlings were very rare in the field. This may be the reason why pure stands of the different seagrasses are the rule, while mixed populations are less common. In many cases such pure stands may be the result of vegetative growth originating from a single seedling. In these cases the stand will, of course, be unisexual if the species is dioecious.

IV. RED SEA VEGETATION

The information reported is summarized under the dominating species, which are given in their order of abundance. Ecological remarks concerning each species and descriptions of the plant communities in which it is the main component are presented.

A. *Halophila stipulacea*: Ecology and Vegetation

Halophila stipulacea seems to show the widest ecological distribution as compared with the other seagrasses of Sinai. It grows from the lower parts of the intertidal zone (infralittoral fringe and even the lower midlittoral), where it is exposed during low tides, down to

50 m and probably even deeper; it grows in normal marine habitats with moderate fluctuations of salinity and temperature, as well as in small and shallow lagoons (e.g., the lagoon of Jezirat el Far'un) with considerable fluctuations; it grows on a variety of substrates from fine mud in lagoons to coarse sand in small pockets on reef flats. It is also worth noting that this is the only Red Sea seagrass which succeeded in the Mediterranean after penetrating through the Suez Canal.

Although growing in a wide range of habitats, the plants do not show great morphological differences in the different habitats. Plants growing in dim light bear larger leaves and show a brighter green color as compared to those which grow in full sunlight. Lime often deposits on the leaves of the latter plants and never on those of the former. The leaves of *H. stipulacea* often carry various organisms, the most common of which are foraminifers such as *Marginopora* (Avidor, 1969), and small algae. Schools of grazing fish were often observed nibbling in the meadows of *H. stipulacea*. It is assumed that these fishes graze on the epiphytic algae, since the latter have never been found fully developed in this habitat.

The plants of *H. stipulacea* are occasionally attacked by a parasitic fungus, *Tetramyxa marina* Lipkin et Avidor, which has never been found to cause any considerable damage to the community (Lipkin and Avidor, 1974).

H. stipulacea is very common on all Red Sea coasts of Sinai: in the Gulf of Elat, in the Gulf of Suez and in the Suez Canal. It has not been found on the Mediterranean coast of Sinai, other than at the mouth of the Suez Canal at Port Said (Fox, 1926; Aleem, 1962), although it is common in several Eastern Mediterranean regions such as Cyprus and the Aegean Sea.

Flowering plants were found in July through October. The main flowering season seems to be May to August. Male flowers have been found only rarely (Lipkin, 1975d). Fruits were usually found during June to August.

Ruppietum cirrhosae

The community forms a dense vegetation of plants up to 2 m tall. It occupies approximately the western third of the lagoon, in which the upper layer of the bottom is aerated. The eastern part, in which anaerobic conditions occur at the bottom, is clear of any macrophytic growth. The area occupied by this community in the lagoon fluctuates considerably according to the changes of the external conditions influencing the amount of oxygen in the water and sediment.

VI. DISCUSSION

A. Significance of the Ecological Range of the Seagrasses on the Sinai Red Sea Coast

Most Red Sea seagrasses are tropical species. Two of them, *Enhalus acoroides* and *Cymodocea serrulata*, do not reach the Sinai coasts which are situated 550 to 800 km N of the Tropic of Cancer. *Cymodocea rotundata* are rather rare on this coast. Others, which do reach the Sinai coast, seem to occupy here a much narrower ecological range as compared with that which they occupy in tropical seas.

Halodule uninervis and *Halophila ovalis** appear to be extremely eurybiontic (den Hartog, 1970). In the tropical seas they dwell in a very wide range of habitats. On Sinai Red Sea coasts, however, *H. ovalis* is restricted to a very few habitats, and *Halodule uninervis*, although growing in a number of habitats, occupies an ecological range much narrower than it does in the tropics. The same seems to be true for *Thalassodendron ciliatum* and *Syringodium isoetifolium* as well.

Halophila stipulacea seems to be an exception. This species occupies on Sinai Red Sea coasts the widest range of habitats. Its ecological range in other regions of its area of distribution is insufficiently known (den Hartog, 1970, p. 260), but it seems that

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*Den Hartog (1970) regards this species as a "collective species." Thus, the wide ecological range reported for *H. ovalis* may represent a combination of several narrower ranges of the different closely allied taxa composing this collective species.

in Sinai it is wider than in the tropical seas. Moreover, it seems that it is rather abundant in the Red Sea while not so in the tropical parts of its area of distribution (which may be the reason for the large gaps in its reported distribution, as indicated by den Hartog, 1970, p. 260); and in the northern Red Sea more so than in its southern part. It appears that it is more common in the southern part of Madagascar, just beyond the Tropic of Capricorn, than in its northern, tropical part (Pichon, personal communication). Furthermore, along the coast of Sinai it flowers and sets fruit readily, while until very recently the male flower has not been known at all (den Hartog, 1972) and only a few female flowers have been collected (den Hartog, 1970, p. 261). Consequently, it is assumed that *H. stipulacea* is not of a typical tropical nature, but does better in subtropical waters rather than in tropical

If this assumption is correct, it may explain why *H. stipulacea* has been the only Red Sea seagrass which succeeded in the Mediterranean. Here it seems to do very well; once it invaded the Mediterranean it seemed to expand both geographically and ecologically, and is even flowering* regularly. Already Politis (1926), when first reporting the occurrence of established populations of *H. stipulacea* in the Aegean Sea, reported also that it was flowering there.

Many plant species are known to occupy a wider variety of habitats in the central parts of their area of distribution than at its margins. The ecological range of most seagrasses in Sinai implies that they grow here near their world geographical limit. This may explain why Red Sea seagrasses other than *H. stipulacea*, including *Halodule uninervis*, which is the only other seagrass that penetrated into the Suez Canal, failed to immigrate successfully into the Mediterranean. The latter species, although it did penetrate into the Canal, failed even to establish flourishing populations in it (Lipkin,

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*It is curious that the male flower of this species was first described from the Mediterranean and not from its original area of distribution.

1972b). It was postulated earlier (Lipkin, 1972a) that transportation from one sea to the other seems not to be limiting for the immigration of a species into the other basin. However, problems concerning colonization, such as whether environmental conditions in the new basin are in harmony with the autecological demands of the species under question, or whether competition with local species occurs, may prevent the successful establishment of populations of the same.

B. Seagrass Vegetation in the Gulf of Suez

Seagrass flora and vegetation of the Gulf of Suez is much poorer as compared to that of the Gulf of Elat. Furthermore, it becomes poorer from east to west, toward the end of the Gulf.

Syringodium isoetifolium has not been found on the Sinai coast of the Gulf of Suez and *Cymodocea rotundata* and *Thalassodendron ciliatum* have been found only in its eastern part. Only *Halophila stipulacea* and *Halodule uninervis* reach its western end, while *Halophila ovalis* was found in the central part, but was not abundant.

Halophiletum stipulaceae and *Haloduletum univervis* are the most common seagrass communities on this coast, and they compose exclusively the seagrass vegetation of its western part. Mixed communities are almost nonexistent in the Gulf, especially in its western part, and where they do occur, they cover very small areas.

The phenomenon of dwindling of communities and lowering of species diversity in the Gulf of Suez is also shown by both the macrobenthic algal flora and vegetation and by many animal groups. The Gulf of Suez is much shallower than that of Elat. Consequently, the environmental conditions fluctuate in it within a wider range, and more so in its western part than in the eastern. This may prevent the settlement and development of many of the stenobiontic species, which contribute so much to the high species diversity of the Gulf of Elat, and thus explains the different levels of species diversity occurring in the two gulfs.

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