Preliminary Data on the Productivity of the Mangrove Environments of Sinai

by

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Abstract

Primary productivity of the phytoplankton and of the dominant macrophytic algae in the Sinai Mangal was measured. Chlorophyll concentrations in the water column and in the bottom sediments were estimated. It appears that the productivity of the phytobenthos in the mangrove area is more than a hundred times greater than that of the phytoplankton.

Résumé

La production primaire de phytoplancton et des algues macrophytes dominantes dans le Sinai Mangal a été mesurée. Les concentrations de chlorophyll dans la colonne d'eau et dans les sediments du fond ont été estimées. Il s'avere que la prodcutivité des phytobenthos dans les regions de mangrove est plus de cent fois supérieure à celle du phytoplancton.

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Mangrove environments are considered to be high productivity enclaves within the tropical seas.

The mangrove growths of the southern end of the Sinai peninsula are monospecific forests of Avicennia marina which grow under high salinity conditions (42–47°/oo) and on relatively clean coralligenous sand bottoms. Since there is no influx of nutrients from the surrounding desert and the Red Sea is known as one of the low-productivity tropical seas, the presence of oases of rich plant and animal life there is a remarkable circumstance.

The productivity basis of this environment can be: 1) the phytoplankton; 2) the mangrove trees; 3) the benthic macrophytic algae; 4) the microscopic algae and bacteria of the sedimentary bottoms.

In May 1976, chlorophyll content of phytoplankton was about 0.3 ug chl. a/l. Planktonic primary production, as measured in situ by the ^{14}C method, amounted to 9 ug C/l/day only; considering water depth of 0.5-0.1 m, most of the area was producing less than 9 mg C/m^2/day. In spite of being preliminary, such values clearly depict an oligotrophic environment, a conclusion which is substansiated by the few nutrient analyses which were performed at the same time: 0.2 ug at/l for either nitrate or phosphate concentrations. The low N/P ratio suggests that biological fixation of molecular nitrogen might occur here, as it has been demonstrated in some coral reef environments.

Several sets of measurements were carried out either with detached benthic algae in illuminated and dark bottles, or by measuring oxygen under light and darkened glass bells which covered undisturbed alga-covered bottoms. The measurements were performed in September 1976.

Data on four species of widely distributed algae are given here: Spirydia filamentosa, Digenea simplex, Laurencia papillosa, and Sargassum sp. In the bottle experiments it was found that Spirydia and Laurencia exhibit a gross primary productivity in the same range with the peak of 7-8 mg O_2/g dry w./hr occurring at noon. Activity of Digenea, though exhibiting a similar course as in the other red algae, was lower: noon productivity was 2-3 mg O_2/g dry w./hr only. Sargassum showed a different pattern of productivity: the peak of 8-9 mg O_2/g dry w./hr was found early in the morning and at noon a strong depression occurred, while a second small peak appeared in the afternoon. The same pattern was shown by the respiration.

Areas of 204 cm^2 of a Digenea field were closed under light and dark glass bells. The average primary production was in the range of 3000-4000 mg O_2/m^2/day, as calculated for 10 hours of photosynthesis, Thus, the macrophytobenthos had a productivity (per square meter) about 150 times as high as that of the phytoplankton in the mangrove.

Large areas of the mangrove bottom consist of white sands without macroscopic algal life, but they obviously harbor a wealth of microphytobenthos: chlorophyll content of such sediements ranged from 2 to 4 ug chl. a per g of dry sand, or about 100 mg chl. a/m^2. Thus, if one considers a typical 0.5 m depth station with a chlorophyll content of 0.15 mg/m^2 as phytoplankton (see above), there would be some 700 times more plant biomass in the sediment than in the water above. Preliminary identifications have shown that the sediment of the mangrove lagoons harbors Cyanophyta: Chroococcus, Microcoleus, Phormidium and Oscillatoria, Also, the sediment contains high numbers of zooxanthellae-harboring Foraminifera. Preliminary bell experiments have shown that the sediment has a marked photosynthetic activity.

The trophically isolated enclaves of the mangrove oases of Sinai seem to be dependent in a great measure on the benthic productivity and on the rapid recycling of the nutrients