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On the role of phycomycetes in the food web of different mangrove swamps with brackish waters and waters of high salinity

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Abstract

Mangrove swamps of Brazil, Florida, Mexico, Bermuda, Sinai and Papua New Guinea were investigated with respect to phycomycetes that degrade cellulose, chitin and keratin. Strains of *Phlyctochytrium mangrovis* Ulken, and species of *Thraustochytrium*, *Schizochytrium* and *Ulkenia* were isolated and kept in pure culture. Phycomycetes as nutrient for protozoans and invertebrates were observed.

Introduction

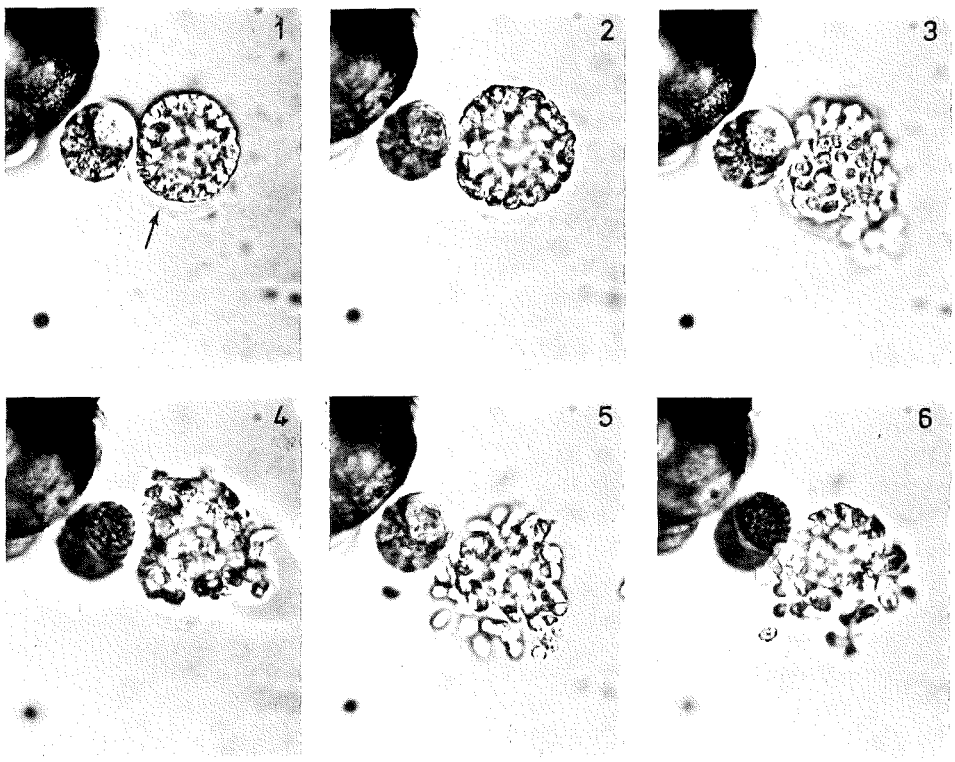
Mangrove detritus serves as the energy base for an extensive food web (ODUM and HELD 1975). KOHLMEYER and KOHLMEYER (1979) investigated the degradative activity of higher fungi which live on lignin or cellulose of mangrove trees. Lower fungi of mangrove muds have been investigated since 1969 (ULKEN 1970, 1972, 1975, 1977, 1978, 1980 a, b). Some studies on the food web in this biotope were done using soil samples from different mangrove areas of Papua New Guinea.

Material and methods

Different strains of *Phlyctochytrium mangrovis* were used for investigations regarding the influence of temperature and light on the degradation of keratinous and chitinous materials. In July 1980 samples from Papua New Guinea were collected in sterilized plastic jars and baited with different baits like pine pollen, crab skeleton, hair, cellophane, purified chitin and keratin (ULKEN 1980) and ground seedings and leaves of mangrove trees (NEWELL 1976). For preparation of the samples see ULKEN 1980 b.

Results and discussion

The phycomycete flora showed a great variety from uniflagellate to biflagellate species in mangrove swamps where the salinity varied from oligo- to polyhaline during a year as was the case at Cananéia (Brazil), Hawaii and Veracruz (ULKEN 1970, 1975, 1977). In the polyhaline swamps of Sinai only biflagellate fungi were found. In Bermuda too, mostly biflagellate species occurred, however with one exception (ULKEN 1980 b). The area with mangroves in Sinai was described by POR et al. (1977). Attemperatures between 20 and 30°C light had a stimulatory effect on most strains of *Phlyctochytrium mangrovis*, while at lower as well as at higher temperatures light inhibited growth of the fungi tested (ULKEN 1980 b). In one sample from Papua New Guinea (soil on which the angiosperm *Bruguiera gymnorhiza* L was found to grow in Lang Island), the dominant phycomycete found was *Thraustochytrium roseum* Goldstein, the sporulation mechanism of which was observed (figs. 1–6). In the same sample there were unidentified amoebae which apparently fed on these fungi. It could be observed that amoebae of sizes of about 80 microns and more floated around sporangia and carried the thalli within their food vacuoles (fig. 7) and digested them during several hours. In one case an amoeba was observed to float into the vicinity of a



Figures 1–6
Thraustochytrium roseum Goldstein
1 mature sporangium (arrow) adjacent to young thalli,
2 spores become motile, **3–6** spores swim away,
6 single spore with two flagella below the spore mass

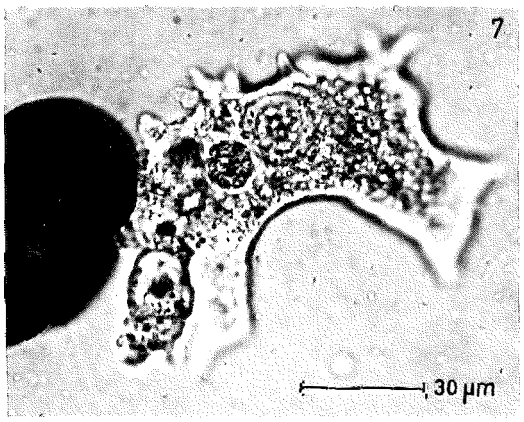


Figure 7
Amoeba with food vacuoles and ingested sporangia

pollen grain which was infested by two sporangia. The amoeba surrounded one sporangium with its pseudopodia and took it away from the pollen grain. The sporangium was incorporated into the amoeba and after a while (about half an hour) the membrane as well as the spores seemed to lose their distinct contours. The amoeba also appeared to ingest spores near a sporulating sporangium.

Feeding of the invertebrates on phycomycetes was observed. Nematodes of the genus *Diplolaimelloides* occurring in muddy samples from Papua New Guinea were fed on a culture of *P. mangrovis*. They multiplied and seemed to be quite healthy after two weeks of cultivation. However, no fungal thalli could be detected in the intestine of the animals. Probably they were obscured by the oil droplets of the gill. Another explanation could be that the bacteria present along with the nematodes in the culture degraded the lysing fungal thalli. The bacteria in turn might be consumed and digested by nematodes.

Summarizing the results of the experiments with temperature and light it can be stated that the degradative activity of the fungi tested on chitinous and keratinous materials seemed to be facilitated by temperatures between 20 and 30°C with an optimum rate at 25°C. At this temperature light had a stimulatory effect. This probably means that the degradation of crab exoskeleton and mammal hairs will be increased in and on the mud if the temperature does not rise above 30°C. At temperatures below 20 and above 30°C growth of the fungi tested was not good. Only one isolate showed slight increase in growth at a temperature of 30°C. This does not seem to be a high temperature in the tropics. However, LINDEN and JERNELÖV (1980) reported that in "... true tropical waters the normal water temperature may be close to the upper thermal limits of many organisms". Invertebrates and protozoans seem to feed on phycomycetes. This could be demonstrated with an amoeba from Papua New Guinea and *Thraustochytrium roseum* Goldstein from the same sample. PAGE (1976) reported that the medium-sized and large amoebae do not feed on bacteria or bacteria alone. A test for preference of food should be made with cultures of amoebae, bacteria and fungi.

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I should like to dedicate this paper to my teacher, Prof. Dr. H. Engel, on the occasion of his 80th birthday.

References

KOHLMEYER, J. and E. KOHLMEYER, 1979. Marine mycology: The higher fungi. Academic Press, New York, London.

LINDEN, O. and A. JERNELÖV, 1980. The mangrove swamp – an ecosystem in danger. Ambio **9**, 81–88.

NEWELL, S. Y., 1976. Mangrove fungi: The succession in the mycoflora of red mangrove (*Rhizophora mangle*) seedlings. In: E.B.G. JONES (ed.) Recent advances in aquatic Mycology. Wiley, New York, pp. 51–91.

ODUM, W.E. and E.J. HELD, 1975. Mangrove forests and aquatic productivity. In: Coupling of land and water systems. Ecological Studies **10** (A.D. HASLER, ed.) Springer Verlag: New York.

PAGE, F. C., 1976. An illustrated key to freshwater and soil amoebae with notes on cultivation and ecology. Freshwater Biological Association Scientific publication **34**. The Ferry House. Ambleside.

POR, F.D., I. DOR, and A. AMIR, 1977. The mangal of Sinai: Limits of an ecosystem. Helgol. Wiss. Meeresunters. **30**, 295–314.

ULKEN, A., 1970. Phycomyceten aus der Mangrove bei Cananéia (Sao Paulo, Brasilien). Veröff. Inst. Meeresforsch. Bremerh. **12**, 313–319.

ULKEN, A., 1972. Physiological studies on a phycomycete from a mangrove swamp at Cananéia, Sao Paulo, Brazil. Veröff. Inst. Meeresforsch. Bremerh. **13**, 217–230.

ULKEN, A., 1975. Phycomyceten und *Actinoplanes* sp. aus Mangrovesümpfen von Hawaii. Veröff. Inst. Meeresforsch. Bremerh. **15**, 27–36.

ULKEN, A., 1977. Phycomyceten aus der Laguna de Mandinga, Veracruz, Mexico. Veröff. Inst. Meeresforsch. Bremerh. **16**, 177–189.

ULKEN, A., 1978. Phycomycetes in the Cockroach Bay, Florida, U.S.A. Proc. fifth Ann. Conf. on restoration of coastal vegetation in Florida, 245–255.

ULKEN, A., 1980 a. The fungi of the mangal. In: Ecology of the mangal ecosystem. Ecological Studies. F.D. POR and I. DOR (eds.), Springer, (in press.).

ULKEN, A., 1980 b. Distribution of phycomycetes in mangrove swamps with brackish waters and waters of high salinity. Second Intern. Symposia on Biology and Management of Mangroves and Tropical Shallow Water Communities, Papua, New Guinea July 20 – August 2, 1980. H. TEAS [ed.] (in press.).