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Ecological observations on arenicolous marine fungi

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I. Introduction

For more than 20 years freshwater fungi, especially Hyphomycetes, have attracted increasing attention in many parts of the world. Spores of these fungi aggregate in great numbers in foam and scum of rivers, ponds, and lakes. Although foam from freshwater and fungal spores trapped therein have been investigated frequently (NILSSON, 1964), literature on marine fungi is lacking information on occurrence of spores in foam of seawater.

During the past two years we collected many samples of foam (Figs. 3, 6, 7) from several coasts bordering the Atlantic Ocean and searched these for fungal spores. Only a few species were found, but the number of spores was high at times, thus an abundant growth of these species in the intertidal zone could be assumed. Ecology and spore morphology, often adapted to the habitat, are described.

II. Methods

A. Collecting of Spores

On sandy beaches receding waves leave a more or less dense band of foam. When the surge is strong and the water rich in finely-ground organic material, rather firm patches of foam form. These are blown a considerable distance along the beach by the wind. A heavy plastic bag 20×23 cm is used to collect samples of foam. The mouth of the bag is stretched to form a flat opening; with the lower edge of the opening held against the sand, foam glides into the bag with the receding water immediately after the wave has reached its highest point on the beach. After the bag is filled half, the opening is drawn together, the foam pressed into a bottle and the water discarded. When foam is poor in organic matter, the foam bubbles soon burst and all remaining water is used for microscopical examination.

B. Sampling and microscopical examination

Bottled samples are stored for several hours in a refrigerator at 5–10 °C to allow suspended particles to settle. The low temperature prevents germination of spores. Part of the sediment is removed by pipette, placed in a droplet on a slide and covered with a large cover glass.

Microscopic examination at $150\times$ to $300\times$ is made best in dark field as oil-droplets and walls of fungal spores light up and contrast sharply against surrounding organic or inorganic particles (compare Figs. 2 a—c). Each slide is examined by scanning the width of the slide ten times; about five slides are prepared of each collection to obtain a representative sample of the number and diversity of spores. The samples collected in Africa which could not be examined immediately were mixed with alcohol for preservation.

C. Incubation of plant debris from intertidal zones

To determine if fungi collected from foam were the same species as those growing intertidally, plant remains from beaches like leaves and rhizomes of *Zostera marina* L. and pieces of *Sargassum* sp. were incubated in Petri dishes for several weeks at room temperature. The plant parts projected through a layer of sterilized seawater which barely covered the bottom of each Petri dish.

III. Results: Species found in seawater foam and beach materials

The present investigations are mainly based on collections from the North Carolina coast. Besides these, foam collections from Georgia, Florida, the Canary Islands, and Liberia were examined.

It would be desirable to compare the absolute number of spores collected at different geographic localities and to determine seasonal changes in the number of spores at certain habitats. NILSSON (1964) presents quantitative and qualitative data on spores of freshwater Hyphomycetes in foam samples from Swedish rivers. Such quantitative analyses are not yet possible for spores from foam of the marine habitat, as environmental conditions differ greatly from the freshwater habitat. At the seashore there is an influence of tides and the consistency of foam varies considerably, depending on velocity and direction of winds and possibly other factors.

Foam collections from open ocean beaches yielded mainly spores of three species: the Ascomycetes *Corollospora maritima* Werdermann and *C. trifurcata* (Höhnk) Kohlm. and the recently described Hyphomycete *Varicosporina ramulosa* Meyers et Kohlm. Besides these, occasional uncharacteristic spores of non-identifiable species were found which presumably entered the sea from a non-marine habitat via air or rivers. In foam from estuaries, spores of the three above-mentioned species were regularly associated with, or in habitats of low salinity were replaced by, spores of other marine species developing on substrates from salt marshes, e. g. *Spartina*.

A. Spores in fresh foam

1. Sandy beaches at open ocean

a. North Carolina

Along the North Carolina coast we observed spores of marine fungi in foam (Fig. 3) for the first time in the summer of 1963. Since 1964 more intensive collecting of foam samples was done and during the summer of 1965 collections were made regularly at least once a week. The principal collecting locality was the sandy shore facing the Atlantic Ocean at Bogue Banks, an elongated barrier island running parallel to the coast near Morehead City.

The following species were found: *Corollospora maritima* (Fig. 1 c), *C. trifurcata* (Fig. 1 b), *C. comata* (Kohlm.) Kohlm., and *Varicosporina ramulosa* (Figs. 1 d, 2 a—c). The first species was the most common, the second occurring less frequently, the ratio between *C. maritima* and *C. trifurcata* being about 10:1. Conidia of *V. ramulosa* were found in this locality quite often; its frequency was one conidium on two ascospores of *C. maritima*. Only one spore was observed of *C. comata*. Each of two foam collections had one spore of *C. lacera* (Linder) Kohlm. (Fig. 1a). Besides the three main species, single spores of mostly non-

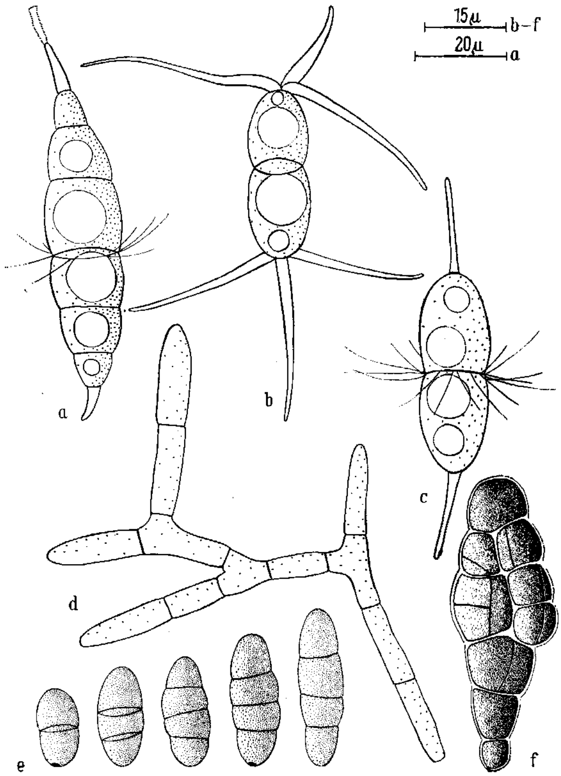

Fig. 1. Ascospores and conidia occurring in marine foam. — a: *Corollospora lacera* (Linder) Kohlm. (in dried foam, Bogue Banks, N.C., 13 June 1965, Herb. J. K. No. 1999); b: *C. trifurcata* (Höhnk) Kohlm. (in foam, locality as above, 11 July 1965); c: *C. maritima* Werderm. (in foam, locality as above, 4 July 1965); d: *Varicosporina ramulosa* Meyers et Kohlm. (on incubated leaves of *Zostera marina* L., Bogue Sound, N.C., 29 June 1964); e: *Dendryphiella arenaria* Nicot (on incubated parts of *Sargassum* sp., Bogue Banks, N.C., 13 June 1965); f: *Alternaria* sp. (in foam, Adams Creek, N.C., 15 August 1965)

identifiable fungi occur in the foam, species which cannot be very active in this habitat when their scarcity in the foam is considered. Determinable single conidia or spores were those of *Pestalotia* sp. and *Leptosphaeria discors* Sacc. et Ellis. The latter species develops on *Spartina*, the stems of which may drift out of the estuary occasionally at low tide and be washed up on the open beach (Figs. 4 and 5).

b. Georgia

One collection of very dense foam was made on the open shore of Jekyll Island, Georgia, on 4 April 1964. *Corollospora maritima* was again the prevailing species, *C. trifurcata* being found in a ratio of 1:8 to the first species. Besides an occasional conidium of *Alternaria* sp. (Fig. 1f) and a few non-identifiable spores an interesting discovery was made. Two ascospores of *Corollospora lacera* (Fig. 1a) were observed in the slides prepared from this collection. This rare species was

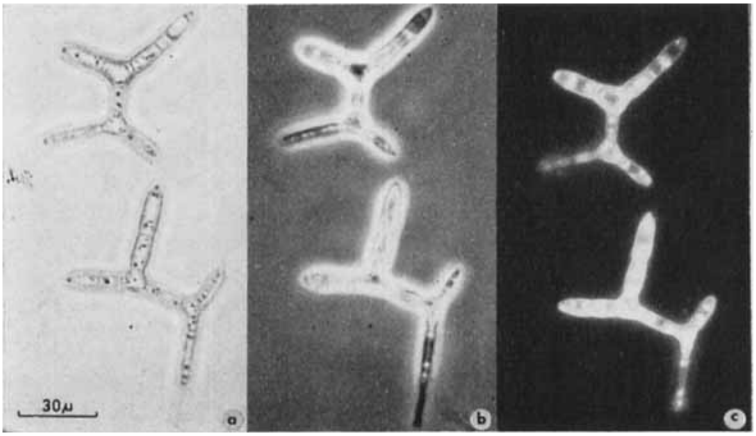

Fig. 2. Conidia of *Varicosporina ramulosa* Meyers et Kohlm. (on incubated leaves of *Zostera marina* L., Bogue Banks, N.C., 15 June 1964). — **a: bright field; b: phase contrast (empty basal cell appears black);** c: dark field

Fig. 3. Foam covering dead leaves of *Zostera marina* L. Open ocean shore, Bogue Banks, N.C., 25 July 1965

Fig. 4. Debris at high-tide line, containing *Sargassum* sp., leaves of *Zostera marina* L., stems of *Spartina alterniflora* Lois., and shells of *Emerita talpoida* Say. Bogue Banks, N.C., 25 July 1965

also detected in fresh foam and in a sample of dried foam from North Carolina beaches. The conclusions drawn from the occurrence of *C. lacera* in these localities will be discussed below.

c. Canary Islands (Tenerife)

On the sandy beach at El Medano, on the south shore of Tenerife, foam was collected on 3 December 1964. The waves formed but little foam, hence the collection was poor in fungal spores, containing mainly planktonic algae. In preparations made from sediment of the sample, ascospores of *Corollospora maritima* and of *C. trifurcata* were found. Because of the paucity of material no comparison could be made between frequency of occurrence of the two species at this site.

Fig. 5. Dark patch of dried foam at high tide line, containing *Sargassum* sp., stems of *Spartina alterniflora* Lois., and shells of *Emerita talpoida* Say. Bogue Banks, N.C., 13 June 1965

Fig. 6. Foam along the shore line of an estuary. Bogue Sound near Gales Creek, N.C., 6 June 1965

On rocks along the beach of El Medano representatives of the following genera of algae occur: *Cystoseira*, *Fucus*, *Galaxaura*, and *Sargassum*. Parts of these algae were washed ashore, and when buried in the sand, may serve as a substrate for arenicolous fungi.

d. Florida (see addendum)

A collection of foam made on the shore of Big Pine Key, Florida, on 6 January 1964 contained no fungal spores.

Fig. 7. Foam among old stems of *Spartina alterniflora* Lois. Washed up thallus of *Gracillaria* sp. at the left. Bogue Sound near Gales Creek, N.C., 6 June 1965

e. Africa

In Liberia (West Africa) three collections of foam were made in March 1965; on the sandy beach of Waterhouse Bay at Lower Buchanan, on the seashore at the mouth of St. John's River near Upper Buchanan, and along the shore of Mamba Point at Monrovia. None of the samples yielded fungal spores.

2. Estuarine waters of North Carolina

Collections of foam were frequently taken along the shores of Bogue Sound and in the mouth of Newport River near Morehead City and Beaufort, North

Carolina (Fig. 6). These waters are bordered in many parts with dense stands of *Spartina alterniflora* Lois. Many beds of *Zostera marina* are found in deeper waters, and several species of algae (Fig. 7) occur in muddy places, as well as on jetties (EARLE and HUMM, 1964).

On the shores of Pivers Island and Radio Island where *Spartina* is growing, *Corollospora trifurcata* was the most abundant species in the foam while *C. maritima* was less frequently observed, the ratio between *C. trifurcata* and *C. maritima* being 3:1. *Varicosporina ramulosa* occurs in this habitat also, the number of spores equalling those of *C. maritima*. Other less frequently found fungi were *Alternaria* sp., *Leptosphaeria discors*, *Lignincola laevis* Höhnk, and *Metasphaeria australiensis* Cribb et Cribb.

Foam collected on the shore at the Institute of Fisheries Research near *Zostera* beds yielded no spores of any of the *Corollospora* species although *Varicosporina ramulosa* was rather frequent. Some single conidia of *Alternaria* sp. and *Dendryphiella arenaria* Nicot (Fig. 1e) occurred in this habitat also (salinity varying between 21 and 36 ‰). At this same location *Zostera* leaves form dense banks along the shore which are partly covered by sand. Bundles of these leaves were washed vigorously with water and the sediment examined for fungal spores. The washed leaves contained conidia of *V. ramulosa* like the foam of this habitat.

One collecting location was a small, flat island in the marshes of Newport River, covered by *Spartina alterniflora*. Here also Corollosporas were not observed, and *Varicosporina* was absent as well. Predominant species were *Leptosphaeria discors* and *Lignincola laevis*, and less frequently *Pleospora pelagica* Johnson. Some conidia of *Alternaria* sp. were found.

Other foam collections from North Carolina inshore waters were made on the banks of Adams Creek near the mouth of Neuse River at Merrimon (salinity = 8.2 ‰). None of the three typical arenicolous marine fungi (*Corrollospora maritima*, *C. trifurcata*, *Varicosporina ramulosa*) were observed here, but conidia of *Alternaria* sp. (Fig. 1f) occurred most abundantly and, besides those, some scattered spores of non-identifiable species.

B. Spores in dried foam on the seashore

In June and August, 1965, collections of dry foam were made on the open shore of Bogue Banks, North Carolina. At its upper edge high tide had left heavy patches of foam which collapsed and dried to form a dirty brownish-grey deposit (Fig. 5). This crust enclosed debris of *Spartina*, *Zostera*, *Sargassum* and remains of the mole crab, *Emerita*. A thin superficial layer of sand containing dry foam was scraped off, shaken in water, and the sediment examined for fungal spores. The first collection contained several ascospores of *Corollospora maritima* (Fig. 1c) and two spores of *C. lacera* (Fig. 1a). In the second collection one spore of *C. lacera* was found. The occurrence of this species is remarkable, as mentioned above when collected in fresh foam from Georgia and North Carolina.

C. Fungi developing in incubated plant remains from beaches

Particles of marine plants, like rhizomes and leaves of *Zostera marina* and parts of *Sargassum* were incubated in Petri dishes as described above. Between one and two weeks after incubation dense colonies of *Varicosporina ramulosa* and *Alternaria* sp. had developed on leaves of *Zostera*. Imbedded in the leaves were pycnidia of *Phoma* sp. About two weeks after the start of incubation, perithecia of *Corollospora maritima* were formed on the leaves, mainly on sand grains, but some grew also on the crusty calcareous algae covering part of the leaves.

On thalli of *Sargassum*, incubated for two weeks at room temperature, colonies of *Varicosporina ramulosa* and *Dendryphiella arenaria* developed.

IV. Discussion

In the few ecological investigations on marine fungi reported to the present time, organisms had been trapped by incubating samples of seawater, mud, or test blocks of wood immersed for a certain time in the sea. This incubation method may be indispensable for isolation of Phycomycetes, which are usually too delicate to be detected in nature directly and must be isolated for identification. For higher marine fungi, however, it is desirable to locate them in the habitat where they actually grow and reproduce. Incubation in the laboratory of materials with a marine origin may serve as means of confirmation of findings. The advantage of direct observation over the indirect method of trapping and incubating is evident as it can be determined which species are active in a certain habitat. By use of the second method organisms which originally came from other environments (e.g. terrestrial or freshwater) may be trapped or may appear in incubated samples among the "true" inhabitants of this location.

From our observations we conclude that spores found in foam along the seashore (Figs. 3, 5, 6) are representative of the fungal flora active in the intertidal sand zone. NILSSON (1964) in his paper on freshwater Hyphomycetes had similar conclusions when he stated that "These samples (of scum and foam, J. K.) give a fairly good idea of the species occurring in the stream system above the sampling area. In fact species that are not represented by spores in a number of such samples are rarely encountered in a stream. In some large streams or stream systems 75 per cent of the Swedish species may be represented in one sample of foam."

Along the open ocean shore, mainly three species of typical marine fungi are found in foam; *Corollospora maritima* is most common, *Varicosporina ramulosa* occurs somewhat less frequently and *C. trifurcata* is rarest. *Corollospora maritima* is mentioned in literature often and has been found all over the world growing on wood and bark and also on sand grains or calcareous particles attached to the wood or bark. The same habitat yields *C. trifurcata* which is rarer and, therefore, mentioned less frequently in literature. *Varicosporina ramulosa* was decribed recently and is known only from North Carolina and Florida (MEYERS and KOHLMEYER, 1965) but certainly the knowledge of its distribution will be extended in the future.

Corollospora lacera is the fourth and least frequent marine fungus in collections of foam on the ocean shore. This species has been described only twice, from the type locality in Massachusetts (LINDER, 1944) and from California (KOHLMEYER, 1960). Both times, fruiting bodies had developed on driftwood in the intertidal zone. The above-mentioned four collections of ascospores from North Carolina and Georgia suggest that *C. lacera* is not as rare as indicated in the literature. Possibly this species develops on certain substrates in sandy beaches and, occurring on wood only rarely, has been overlooked. The same may be true also for the fifth fungus, *Corollospora comata*, a species described from the western coast of the United States. It was found in our collections from North Carolina only once.

Other, sporadically occurring spores found in foam from the ocean seem to belong to non-marine species or at least to fungi from the estuarine habitat, like *Leptosphaeria discors*, which might be washed out of the estuary on its substrate, namely culms of *Spartina* (Figs. 4 and 5).

On the whole the fungus flora found in foam on open ocean shores and thus active in the intertidal zone, seems to be very poor in species compared with the diversity found in freshwater collections (NILSSON, 1964). It can be assumed that the main species growing and reproducing in the tide-washed sand are included in our collections. Significant increases in number of species cannot be expected although single species with inconspicuous spores might have been overlooked in preparations full of detritus. Thus, *Phoma* developing in incubated *Zostera* leaves in the laboratory has pycnidiospores smaller than one μ and can hardly be detected in microscopic preparations of foam samples.

It is difficult to understand why foam collections from Africa and Florida contained no spores. *Corollospora* species were found in tropical and subtropical regions before. CRIBB and CRIBB (1956) described *C. trifurcata* from Queensland, Australia (sub *Halosphaeria trifurcata*) and MEYERS (1957) reported *C. maritima* from Biscayne Bay, Florida (sub *Peritrichospora integra* Linder). The beach sands of Liberia were certainly poor in plant debris; seagrasses were lacking at the collecting sites and algae were rather rare being confined to some cliffs. Thus, with paucity of plant material the sand-inhabiting fungi have little or no chance to develop. As foam was also rare at these African sites, the probability of catching spores was small.

We have no explanation for the absence of spores in the foam sample from Big Pine Key, Fla. Because only one sample was available, no conclusions can be drawn regarding occurrence of fungi in this habitat. There was no lack of organic substances because leaves of *Thalassia* are abundant on the shores of this island.

On beaches of North Carolina the number of spores varies considerably between collections. An attempt was made to determine the influence of tides and velocity of the wind but no correlation was found. At times samples taken at the same location at high tide were richer in spores than those taken a few hours later at falling tide. Another time just the opposite was found. Exact quantitative analyses of number of spores cannot be made yet. This appears to be different with collections from freshwater habitats where consistency of foam may be the same over a longer period of time, the direction and velocity of the streaming water being unchanged. NILSSON (1964) could thus determine seasonal fluctuations in spore production, the number of spores in foam being highest during late fall and winter, in conformity with increase of leaves in the rivers at that time.

Although no exact quantitative analyses can be based on our collections, a certain tendency of species to increase or decrease in number according to habitat is obvious. *Corollospora maritima* was the most frequently occurring species along the open shore line. In the mouth of estuaries this species is still represented abundantly, but *C. trifurcata* was even more abundant. At salinities below

$20^0/_{00}$ these two species were not found in foam and thus, appear to be rare or even absent in such habitats.

Varicosporina ramulosa seems to be associated mainly with decaying algae and sea grasses, as its conidia were always found in those localities where leaves of *Zostera* or parts of algae were buried in the sand (Fig. 3–5, 7). The conidia of *V. ramulosa* appear to occur in almost equal numbers along the open ocean as well as in estuarine locations with salinities of about $21-36^0/_{00}$. Going farther upstream none of the Corollosporas or *V. ramulosa* were found in foam collections. Decreasing salinity may be the reason for their restriction to higher saline coastal waters. JOHNSON and SPARROW (1961) report a single collection of *Corollospora maritima* in brackish water of $8-14^0/_{00}$. These authors review an unpublished thesis of G. C. HUGHES who categorizes *C. maritima* as a polyhaline species, inhabiting waters of $18-30^0/_{00}$ salinity. In pure-culture experiments BARGHOORN (1944) found that *C. maritima* (= *Peritrichospora integra* Linder) develops more rapidly in seawater than in freshwater and JONES and JENNINGS (1964) stated that this species produced a significantly greater dry weight in a seawater medium than in a distilled water medium. Thus, *C. maritima* is certainly affected by changes of salinity.

GOLD (1959) in his work on distribution of lignicolous fungi in the estuary of Newport River, North Carolina, used wood panels as traps and submerged them at stations with salinities from $36-0^0/_{00}$. SIEPMANN and JOHNSON (1960) also isolated fungal species from test panels immersed at salinities from $31.1 - 0^0/_{00}$ in North Carolina and also from pilings and driftwood. In neither of these two surveys were any Corollosporas or *Varicosporina* (this genus not named at that time) isolated. According to the frequency in foam samples *Corollospora maritima* and *C. trifurcata* are very active around Pivers Island, a station also used by SIEPMANN and JOHNSON. This demonstrates that the method of "trapping" marine fungi by means of wood panels or isolation from wood after incubation cannot give a complete picture of the species occurring in a certain habitat. Other substrates should be used also.

In foam samples from the estuarine habitat with decreasing salinity *Corollospora* and *Varicosporina* are gradually replaced by species developing on saltmarsh plants. Foam collections near stands of *Spartina alterniflora* (Fig. 7) contained ascospores of *Leptosphaeria discors*, *Lignincola laevis*, *Pleospora pelagica*, and conidia of *Alternaria* sp. All these species were reported to occur on *Spartina*, a host from which 15 fungi are presently known (J. and E. KOHLMEYER, 1964).

In foam from the Newport River estuary, *Metasphaeria australiensis* was found frequently which might have developed on wood or *Spartina*. *Dendryphiella arenaria* which had developed on incubated *Sargassum* was also collected with foam from the same estuary several times. This species is able to adapt itself physiologically to the saline habitat (NICOT, 1958).

Fungi, with spores occurring regularly in foam along marine and estuarine shores, are believed to be active inhabitants of sand. Here they thrive on organic material, especially remains of marine plants (Figs. 3–5, 7). They have the same function as terrestrial fungi in decomposition of plant litter in soils. Cellulosic material in marine beaches is deteriorated by action of these arenicolous fungi and possibly by bacteria. *Corollospora maritima* is known to have strong cellulolytic abilities (BARGHOORN, 1944; MEYERS and REYNOLDS, 1959; JOHNSON et al., 1959; KOHLMEYER, 1963). *Varicosporina ramulosa* dissolves cellulose foil in pure culture (KOHLMEYER, unpublished notes). No data are available on cellulolytic activities of the rarer species of *Corollospora comata*, *C. lacera*, and *C. trifurcata*, but all these have been collected on wood; thus, it is probable that they decompose cellulose also.

Two of the arenicolous species, namely *Corollospora maritima* and *C. trifurcata* show a pronounced affinity to sand and calcareous material as they develop fruiting bodies chiefly on sand grains and shells of animals (HÖHNK, 1954; MEYERS, 1957; FIZE, 1960; KOHLMEYER, 1960, 1961). The significance of this affinity is not known. There could be a corrosion on the surface of sand grains and calcareous particles during the development of fruiting bodies, but this must be demonstrated.

Frequent discussions have been presented concerning the advantages spore appendages or radiate spore shapes may have for distribution and settlement of aquatic fungi (HÖHNK, 1954; INGOLD, 1959; WEBSTER, 1959; NILSSON, 1964). What has been said by some of these authors for freshwater Hyphomycetes applies to *Varicosporina ramulosa* also; its radiate conidia (Figs. 1d, 2a—c) are adapted to the aquatic habitat in that they are caught by currents more easily than a simple-shaped (e.g. globose) conidium can be.

All Corollosporas found in foam (*C. comata, C. lacera, C. maritima, C. trifurcata*) have ascospores with appendages (Figs. 1a—c). These appendages may contribute to the trapping of the spores in foam. However, other fungi caught in foam have no appendages on spores or conidia (e. g. *Leptosphaeria discors, Lignincola laevis, Alternaria* sp. [Fig. 1f], *Dendryphiella arenaria* [Fig. 1e]). Thus, one should be careful not to overemphasize the importance of spore morphology for the distribution of aquatic species.

It is assumed that accumulation of spores in foam is advantageous for sand-inhabiting marine fungi. When spores are washed away from the substrate where they developed, they become dispersed in the water and carried by waves. They might not attach to a suitable substrate until they are thrown on the beach above the line of wave action. If spores are trapped in foam, they will finally be deposited at the high tide mark in organic debris (Figs. 3—7) where germination and further development of mycelium may occur.

We conclude from collections of foam made along ocean beaches and in estuary habitats that spores of marine fungi can be found in considerable numbers only in the immediate neighborhood of their origin. At a distance from their place of development spores are "diluted" in the immense water volume of the ocean. Thus, obligate marine arenicolous fungi like *Corollospora comata, C. lacera, C. maritima,* and *C. trifurcata* were found only along polyhaline shores but fungi from *Spartina* or *Zostera* were collected only near stands or debris of these plants. Although many of the typical wood-inhabiting members of the Halosphaeriaceae with appendages are common on pilings and driftwood along the North Carolina coast, none occurred in our foam samples.

V. Summary

Samples of foam were taken along ocean beaches and shores of estuaries in North Carolina; some from Georgia, Florida, the Canary Islands, and Liberia were added for comparison. Spores found in these collections are representative for species active in this particular habitat. Prevailing species occurring in beach sands of North Carolina were two Ascomycetes [*Corollospora maritima* Werdermann and *C. trifurcata* (Höhnk) Kohlm.] and the

Deuteromycete *Varicosporina ramulosa* Meyers et Kohlm. Less frequent were the Ascomycetes *Corollospora comata* (Kohlm.) Kohlm. and *C. lacera* (Linder) Kohlm.

Along ocean beaches, *C. maritima* predominated, but *C. trifurcata* was dominant in mouths of rivers. Conidia of *V. ramulosa* were chiefly found in the vicinity of beds of *Zostera marina* L. or in places where *Zostera* leaves were buried in the sand. All these species were absent upstream at salinities below about $10^0/_{00}$. The imperfect fungus *Dendryphiella arenaria* Nicot was collected near *Zostera* also.

Spores of the following species were found in foam near stands of *Spartina alterniflora* Lois.; the Ascomycetes *Leptosphaeria discors* Sacc. et Ellis, *Lignincola laevis* Höhnk, *Metasphaeria australiensis* Cribb et Cribb, *Pleospora pelagica* Johnson, and the Deuteromycete *Alternaria* sp.

Incubated leaves of *Zostera marina* and parts of *Sargassum* from ocean shores showed growths of *Alternaria* sp., *Corollospora maritima, Dendryphiella arenaria, Phoma* sp., and *Varicosporina ramulosa.*

Foam collections from Georgia and the Canary Islands contained ascospores of *Corollospora maritima* and *C. trifurcata*; that from Georgia also had *C. lacera* and *Alternaria* sp.

Samples taken on Big Pine Key (Florida) and in Liberia had no fungal spores.

The importance of arenicolous marine fungi for decomposition of plant material in saline habitats is discussed. Morphology of the spores and its possible significance for distribution is considered.

Spores of marine fungi can be found in considerable numbers only in the immediate vicinity of their origin.

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Addendum

Three additional collections of foam and scum from the Keys (20—21 Nov. 1965) showed no marine fungi. Foam from the shore of Miami Beach (19 Nov. 1965) contained *Corrollospora maritima*, *C. trifurcata*, and *Varicosporina ramulosa*.