Review

Fungal Biodiversity in Salt Marsh Ecosystems

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Abstract: This review brings together the research efforts on salt marsh fungi, including their geographical distribution and host association. A total of 486 taxa associated with different hosts in salt marsh ecosystems are listed in this review. The taxa belong to three phyla wherein Ascomycota dominates the taxa from salt marsh ecosystems accounting for 95.27% (463 taxa). The Basidiomycota and Mucoromycota constitute 19 taxa and four taxa, respectively. Dothideomycetes has the highest number of taxa, which comprises 47.12% (229 taxa), followed by Sordariomycetes with 167 taxa (34.36%). Pleosporales is the largest order with 178 taxa recorded. Twenty-seven genera under 11 families of halophytes were reviewed for its fungal associates. Juncus roemerianus has been extensively studied for its associates with 162 documented taxa followed by Phragmites australis (137 taxa) and Spartina alterniflora (79 taxa). The highest number of salt marsh fungi have been recorded from Atlantic Ocean countries wherein the USA had the highest number of species recorded (232 taxa) followed by the UK (101 taxa), the Netherlands (74 taxa), and Argentina (51 taxa). China had the highest number of salt marsh fungi in the Pacific Ocean with 165 taxa recorded, while in the Indian Ocean, India reported the highest taxa (16 taxa). Many salt marsh areas remain unexplored, especially those habitats in the Indian and Pacific Oceans areas that are hotspots of biodiversity and novel fungal taxa based on the exploration of various habitats.

Keywords: halophytes; marine fungi; marine mycology; salt marsh fungi; worldwide distribution

1. Introduction

Salt marsh ecosystems are known for their high productivity, exceeding primary production estimates of species rich ecosystems (e.g., tropical rainforests, coral reefs) [1]. The flora in salt marsh ecosystems is mainly composed of grasses, herbs, and shrubs and these are terrestrial organisms variously adapted to, or tolerant of, a semi-marine environment. Halophytes are a diverse group of plants that have a worldwide distribution, and grow in different climatic regions, wherein soils have high salinity levels [2]. Halophytes are common in temperate and Mediterranean climates, and fewer both in the tropics and at high latitudes [3–6]. The vegetation in these ecosystems shows the vertical zonation of different communities as tidal submergence decreases with increasing elevation, and species tolerance to changing gradient conditions. Salt marsh vegetation generally increases the attenuation of both tidal currents and waves as they pass over the vegetated area and immobilize elements with their sediments. Furthermore, halophytes serve as a natural buffer, protecting other shoreline ecosystems from human impacts and disturbances. The
area provides a habitat and nursery for marine organisms [7]. Worldwide, salt marshes cover an area of 5,495,089 hectare in 43 countries [8].

There are over 500 species of salt marsh plants worldwide [9]. The families Amaranthaceae (subfamilies Chenopodiaceae, Salicornieae), Poaceae, Juncaceae, and Cyperaceae are the major vegetation in salt marsh ecosystems, while the minor components are Plumbaginaceae and Frankeniaceae [3], and are represented in Figures 1 and 2. Salinity, latitude, region of the world, the frequency and duration of tidal flooding, substrate, oxygen and nutrient availability, surface elevation, competition among species, disturbance by wrack deposition are interacting factors that influence the species of halophytes in the salt marshes [10,11]. For example, *Spartina alterniflora* is a dominant grass from mid-tide to high-tide levels in temperate Eastern North America, while *Puccinellia* dominates in boreal and arctic marshes [10,11].

![Figure 1](image_url)

**Figure 1.** Salt marsh ecosystems in UK (a–d) and Thailand (e–f). (b–d) Tidal grasses, *Spartina townsendii* (Poaceae) and *Phragmites* (Poaceae), dominate the salt marsh in UK (50°49′55.4″ N 0°58′25.1″ W; 51°43′03.1″ N 5°10′24.8″ W); (e) *Spartina* (Poaceae) (12°22′4.0″ N 99°59′6.7″ E) (f) and *Suaeda* (Amaranthaceae) (12°10′19.6″ N 99°58′20.3″ E) in tidal marsh areas in southern Thailand.
Figure 2. Halophytes in salt marsh ecosystems: (a) flowering inflorescence of *Spartina*, (b) *Phragmites*, (c) *Salicornia*, (d) *Typha*, (e,f) *Atriplex*, and (g,h) *Suaeda*.
Major studies on halophytes focus on ecology and conservation [12–14]. One of these is the decomposition of vascular plant material wherein the detritus breakdown was reviewed in Pomeroy and Wiegert [15], Howarth and Hobbie [16], and Long and Mason [17]. The active decomposition processes in salt marsh ecosystems reflects to the relatively high rates of primary production. Three phases of plant decomposition were noted by Valiela et al. [18]. The early phase involves the leaching of soluble compounds, resulting in a fast rate of weight loss lasting for less than a month. Organic matter breakdown by microorganisms and continuous leaching of decayed products occurs in the second phase that lasts for a year. The last phase lasts for another year when there is a slow decay of refractory materials such as humates and fulvates [19].

The continuous breakdown of detritus into smaller fragments increases the surface-to-volume ratio and this is exposed to further microbial degradation. Bacteria and fungi are key decomposers in the salt marsh ecosystem that are essential for the transformation and recycling of nutrients through the environment. The colonization of fungi on standing dead halophytes commences during the early stages of decomposition before leaf fall to the salt marsh sediment surface [20,21]. The decomposition of the senescent tissues of halophytes by salt marsh fungi is brought about by the direct penetration of the host cell wall and the production of enzymes active in degrading lignocellulosic compounds, such as lignin, cellulose, and hemicellulose [22–26]. Bacterial communities are the major decomposers in the latter stage of decomposition [27,28]. Studies in salt marsh ecosystems not only consider microbial activity and the recycling of nutrients, but also bacterial [29,30] and fungal diversity [20,31,32].

The present review compiles the published data of fungi from halophytes, including their geographical distribution and host association. When compared to other fungal groups, salt marsh fungi are underexplored, and this review brings together the research efforts on these undiscovered habitats and plants. The pertinent literature from bibliographic databases (e.g., Scopus, Web of Science, Google Scholar) and published resources on salt marsh fungi documenting halophytes were compiled. Published works, wherein the documented fungal taxa were observed directly from halophytic substrates, are included (Table 1). The different host parts, living and dead, that are either partly or wholly submerged are documented, as well as drift plant portions washed up in salt marsh areas. Salt marsh fungi isolated using cultivation-dependent techniques were not included since it is not known if these fungi were actively growing and reproducing on the halophytes. The taxa were listed based on the recent outline of fungi and fungus-like taxa by Wijayawardene et al. [33]. Since previous works only listed the taxa and the hosts [34–36], here we include the plant parts where the fungus was observed, the location (country: state/province) where the host was collected, the life mode of the fungus, and the pertinent literature citations are included (Table 1). The accepted name of the host was based on the webpage of the World Flora Online consortium (http://www.worldfloraonline.org/; accessed on 10 May 2021), GrassBase (https://www.kew.org/data/grasses-db/sppindex.htm; accessed on 10 May 2021) and CRC World Dictionary of Grasses by Quattrocchi [37]. The graphs presented in the next sections summarizes the information from Table 1 and was developed using data visualization tools (Excel Office 365, Tableau Desktop Professional Edition 19.2.2).
Table 1. Geographical distribution of salt marsh fungi recorded from various halophytes.

| Taxon | Host Part | Life Mode | Hosts | Distribution          | References |
|-------|-----------|-----------|-------|-----------------------|------------|
| ASCOMYCOTA |           |           |       |                       |            |
| DOTHIDEOMYCETES |           |           |       |                       |            |
| Acrospermales |           |           |       |                       |            |
| Acrospermum graminum Lib. | – | – | Elymus pungens | UK | [38] |
| Asterinales |           |           |       |                       |            |
| Morenoinaeae |           |           |       |                       |            |
| Morenoina phragmites J.P. Ellis | Living/decomposing leaf sheaths and stems | Saprobic | Phragmites australis | Netherlands: Zeeland | [39,40] |
| Botryosphaeriales |           |           |       |                       |            |
| Botryosphaeriaceae |           |           |       |                       |            |
| Botryosphaeria festucae (Lib.) Arx and E. Müll. | Living/decomposing leaf sheaths and stems | Saprobic | Phragmites australis | Netherlands: Zeeland | [39,40] |
| Macrophomina sp. | Decaying stems and leaf sheaths | Saprobic | Phragmites australis | China: Hong Kong | [41] |
| Taraspora balmyra Kohlm. and Volkm.-Kohlm. | Senescent culms | Saprobic | Juncus roemerianus | USA: North Carolina | [42] |
| Phyllostictaceae |           |           |       |                       |            |
| Guignardia spp. | Senescent leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |
| Phyllosticta sp. | – | Pathogenic | Spartina cynosuroides | USA: Maryland | [44] |
| Phyllosticta spartinae Brunaud | – | – | Spartina maritima | France | [45] |
| Phyllosticta suaedae Lobik | Leaves | – | Suaeda maritima | Russia | [46] |
| Capnodiales |           |           |       |                       |            |
| Cladosporiaceae |           |           |       |                       |            |
| Cladosporium algarum Cooke and Massee | – | – | Spargularia marina | – | [35] |
| Cladosporium allicinum (Fr.) Bensch, U. Braun and Crous | – | – | Suaeda maritima | – | [35] |
| Cladosporium allicinum (Fr.) Bensch, U. Braun and Crous | – | – | Elymus pungens | UK | [38] |
| Cladosporium cladosporioides (Fresen.) G.A. de Vries | Leaves | Saprobic | Distichlis spicata | Argentina: Buenos Aires | [47] |
| Cladosporium cladosporioides (Fresen.) G.A. de Vries | Living, senescent, and decaying leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |
| Cladosporium cladosporioides (Fresen.) G.A. de Vries | Leaves and roots | Saprobic | Spartina sp. | Canada: Bay of Fundy | [48] |
| Cladosporium herbarum (Pers.) Link | Leaves | Saprobic | Distichlis spicata | Argentina: Buenos Aires | [47] |
| Cladosporium herbarum (Pers.) Link | Stem | Saprobic | Spartina townsendii | UK: England | [49] |
| Cladosporium herbarum (Pers.) Link | Leaves, stems, and roots | Saprobic | Spartina sp. | Canada: Bay of Fundy | [48] |
| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| Cladosporium macrocarpum Preuss | Leaves | Saprobic | Spartina sp. | Canada: Bay of Fundy | [48] |
| Cladosporium sphaerospermum Penz. | Living, senescent, and decaying leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |
| | Living/decomposing leaf sheaths and blades | Saprobic | Phragmites australis | Netherlands: Zeeland | [39,41,50] |
| | – | Saprobic | Spartina patens | USA: Rhode Island | [36] |
| | – | Saprobic | Spartina sp. | Canada | [36] |
| Capnodiales genera incertae sedis | Senescent leaves | Saprobic | Juncus roemerianus | USA: North Carolina | [51] |
| Mucomycosphaerella eurypotami (Kohlm., Volkms.-Kohlm. and O.E. Erikss.) Quaedvl. and Crous | Senescent leaves | Saprobic | Juncus roemerianus | USA: North Carolina | [51] |
| Fulvia fulva (Cooke) Cif. | Leaves and stems | Saprobic | Spartina sp. | Canada: Bay of Fundy | [48] |
| Micronectriella agropyri Apinis and Chesters | – | – | Elymus pungens | UK | [38] |
| Mycosphaerella lineolata (Roberge ex Desm.) J. Schröt. | Living/decomposing leaf sheaths and stems | Saprobic | Phragmites australis | Netherlands: Zeeland | [39,40] |
| | – | – | Elymus pungens | UK | [38] |
| | – | – | Arthrocnemum subterminale | – | [35] |
| | – | – | Limonium sp. | – | [35] |
| | – | – | Sarcocornia perennis | – | [35] |
| | – | – | Salicornia fruticosa | – | [35] |
| | – | – | Salicornia procumbens | – | [35] |
| | – | – | Salicornia europaea | – | [35] |
| | – | – | Salicornia perennis | – | [35] |
| | – | – | Sarcocornia fruticosa | – | [35] |
| Mycosphaerella salicorniae (Auersw.) Lindau | Drying stalks and inflorescence | Saprobic | Salicornia sp. | India | [52] |
| | Dried inflorescences | Saprobic | Salicornia virginica | Bermuda | [35,53] |
| | – | Saprobic | Spartina maritima | Portugal: Alentejo, Lisbon | [54] |
| | – | – | Suaeda vermiculata | – | [35] |
### Table 1. Cont.

| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| *Drying stalks and inflorescence* | Saprobic | Suada sp. | India | [52] |
| *Mycosphaerella spp.* | – | – | Elymus pungens | UK | [38] |
| | Senescent and decaying leaves | Saprobic | Juncus roemerianus | USA: Florida, Mississippi | [43,55] |
| | Decaying leaves, leaf blades | Saprobic | Spartina alterniflora | Argentina: Buenos Aires; USA: Alabama, California, Georgia, Mississippi | [25,35,36,55–58] |
| | – | – | Spartina cf. densiflora | USA: California | [25,35] |
| | – | – | Spartina cf. pectinata | – | [35] |
| | – | – | Spartina sp. | Argentina: Buenos Aires; Canada | [35,36] |
| | Decaying leaf blades | Saprobic | Spartina foliosa | USA: California | [25] |
| | Leaf sheaths and blades, stem | Saprobic | Spartina maritima | Portugal: Alentejo, Lisbon, Centro | [54,59] |
| *Mycosphaerella staticicola (Pat.) Dias* | – | – | Armeria pungens | – | [35] |
| *Mycosphaerella suaedae-australis Hansf.* | – | – | Suaeda australis | – | [35] |
| *Rivelata ins Kohlm., Volkm.-Kohl. and O.E. Erikss.* | Tips of senescent, very old, and brittle leaves | Saprobic | Juncus roemerianus | USA: North Carolina | [60] |
| *Septoria spp.* | Living, senescent, and decaying leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |
| | Living/decomposing leaf sheaths | Saprobic | Phragmites australis | Netherlands: Zeeland | [39] |
| | Upper leaves, inflorescence, seeds | Saprobic | Spartina alterniflora | USA: Rhode Island | [61] |
| *Septoria suaedae-australis Hansf.* | Dead stems | Saprobic | Suaeda australis | South Australia | [62] |
| *Sphaerulina albispiculata Tubaki* | Sheath | Saprobic | Spartina maritima | Portugal: Alentejo, Lisbon | [54] |
| | Stem | Saprobic | Spartina maritima | Portugal: Alentejo | [63] |
| *Sphaerulina orae-maris Linder* | – | – | Ammophila arenaria | – | [35] |
| | Rhizome and root | Saprobic | Spartina densiflora | Argentina: Buenos Aires | [64] |
Table 1. Cont.

| Taxon                        | Host Part                      | Life Mode          | Hosts          | Distribution                      | References |
|------------------------------|--------------------------------|--------------------|----------------|-----------------------------------|------------|
| **Sphaerulina pedicellata** T.W. Johnson | Attached culms, stems         | Saprobic, parasitic | *Spartina townsendii* | – | [65] |
| **Sphaerulina sp.**          | Senescent and decaying leaves | Saprobic           | *Juncus roemerianus* | USA: Florida | [43] |
| **Dothideales**              |                                |                    |                |                                   |            |
| **Sacotheciaceae**           |                                |                    |                |                                   |            |
| *Aureobasidium* sp.          | Living, senescent, and decaying leaves | Saprobic | *Juncus roemerianus* | USA: Florida | [43] |
| **Pseudoseptoria donacis** (Pass.) B. Sutton | Living/decomposing leaf blades and sheaths | Saprobic | *Phragmites australis* | Netherlands: Zeeland | [39,50] |
| **Selenophoma** sp.          | Senescent and decaying leaves | Saprobic           | *Juncus roemerianus* | USA: Florida | [43] |
| **Dothideaceae**             |                                |                    |                |                                   |            |
| **Scirrhia annulata** Kohlm., Volkm.-Kohl. and O.E. Erikss. | Senescent culms and leaves | Saprobic           | *Juncus roemerianus* | USA: North Carolina | [66] |
| **Dothideomycetes families incertae sedis** |                                |                    |                |                                   |            |
| **Eriomyctaceae**            |                                |                    |                |                                   |            |
| *Heliosa barbatula* Kohlm., Volkm.-Kohl. and O.E. Erikss. | Senescent leaves              | Saprobic           | *Juncus roemerianus* | USA: North Carolina | [66] |
| **Pseudorobillardaceae**     |                                |                    |                |                                   |            |
| *Pseudorobillarda phragmitis* (Cunnell) M. Morelet | Decaying stems and leaf sheaths | Saprobic | *Phragmites australis* | China: Hong Kong | [41,67] |
| *Pseudorobillarda* sp.       | Dead stems                     | Saprobic           | *Phragmites australis* | Canada | [36] |
| **Dothideomycetes genera incertae sedis** |                                |                    |                |                                   |            |
| *Bactrodesmium atrum* M.B. Ellis, *Lautitia danica* (Berl.) S. Schatz | Living/decomposing stems | Saprobic           | *Phragmites australis* | Netherlands: Zeeland | [40] |
| *Monodictys austrina* Tubaki | Senescent leaves               | Saprobic           | *Juncus roemerianus* | USA: Florida | [43] |
| *Monodictys castaneae* (Wallr.) S. Hughes | Leaves                        | Saprobic           | *Spartina sp.* | Canada: Bay of Fundy | [48] |
| *Neottiospora australiensis* B. Sutton and Alcorn | Living/decomposing leaf blades and sheaths, stems | Saprobic | *Phragmites australis* | Netherlands: Zeeland | [39,40,50] |
| *Neottiospora* sp.           | Decaying stems and leaf sheaths | Saprobic           | *Phragmites australis* | China: Hong Kong | [41] |
Table 1. Cont.

| Taxon | Host Part | Life Mode  | Hosts                        | Distribution       | References |
|-------|-----------|------------|------------------------------|-------------------|------------|
| Otthia sp. | Senescent leaves | Saprobic    | Juncus roemerianus          | USA: Florida       | [43]       |
| Trichometasphaeria setulosa. (Sacc. and Roum.) Apinis and Chesters ined. | –               | –           | Elymus pungens               | UK               | [38]       |
| Trichometasphaeria sp. | –               | –           | Elymus pungens               | UK               | [38]       |
| Microthyriales | Microthyriaceae | –               | –           | –                             | –           |
| Microthyrium microscopicum Desm. | –               | –           | Spartina patens               | –               | [68]       |
| Microthyrium gramineum Sacc., E. Bommer and M. Rousseau | –               | –           | Elymus pungens               | UK               | [38]       |
| Muyocopronales | Muyocopronaceae | –               | –           | –                             | –           |
| Ellisiodothis inquinans (Ellis and Everh.) Thess. | –               | Saprobic    | Spartina alterniflora         | Argentina: Buenos Aires | [36]       |
| Mytiliniales | Mytilinidaceae | –               | –           | –                             | –           |
| Septonema secedens Corda | Living, senescent, and decaying leaves | Saprobic    | Juncus roemerianus          | USA: Florida       | [43]       |
| Phaeotrichales | Phaeotrichaceae | –               | –           | –                             | –           |
| Trichodelitschia bisporula (P. Crouan and H. Crouan) E. Müll. and Arx | –               | –           | Elymus pungens               | UK               | [38]       |
| | Spartina townsendii | UK               | –           | –                             | –           |
| Pleosporales | Amniculicolaceae | –               | –           | Juncus roemerianus          | –           |
| Neomassariosphaeria typhicola (P. Karst.) Y. Zhang ter, J. Fourn. and K.D. Hyde | Decaying herbaceous stems | Saprobic    | Spartina densiflora          | Argentina: Buenos Aires | [64]       |
| | –               | Saprobic    | Spartina spp.               | Argentina: Buenos Aires | [32,35,36]   |
| | –               | Saprobic    | Unidentified saltmarsh plants | USA: Mississippi | [58]       |
| Camarosporiaceae | Camarosporium feurichii Henn. | Living/decomposing leaf sheaths | Saprobic    | Phragmites australis          | Netherlands: Zeeland | [39]       |
| Taxon                                      | Host Part                  | Life Mode          | Hosts                             | Distribution                                | References |
|-------------------------------------------|----------------------------|--------------------|------------------------------------|---------------------------------------------|------------|
| Camarosporium palliatum Kohlm. and E. Kohlm. |                            | Saprobioc or perthophytic | Sarcocornia perennis               | India: Maharashtra                          | [52]       |
| Camarosporium roumeguerei Sacc.           | Twigs                      | Saprobic or perthophytic | Sarcocornia europaea               | France                                      | [35,69]    |
| Coniothyriaceae                           | Leaf sheaths and blades, stem | Saprobioc          | Spartina maritima                  | Portugal: Algarve, Centro                   | [59]       |
| Coniothyriaceae                           |                            |                    | Suaeda maritima                    |                                             | [35]       |
| Camarosporium salicorniae Hansf.          | Twigs                      |                    | Sarcocornia fruticososa            | India: Gujarat, Maharashtra, Tamil Nadu, Andhara Pradesh, West Bengal | [52]       |
| Coniothyriaceae                           | Living/decomposing leaf sheaths and stems | Saprobioc          | Phragmites australis               | Netherlands: Zeeland                        | [39,40]    |
| Coniothyriellaceae                        | Dead branches              | Saprobioc          | Suaeda vermiculata                 | Pakistan                                    | [70]       |
| Coniothyriaceae                           |                            |                    | Atriplex portulacoides             |                                             | [35]       |
| Coniothyriaceae                           | Leaf sheaths and blades, stem | Saprobioc           | Spartina maritima                  | Portugal: Algarve                           | [59]       |
| Coniothyriaceae                           | Living, senescent, and decaying leaves | Saprobioc          | Juncus roemerianus                 | USA: Florida                                | [43]       |

Table 1. Cont.
| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| *Massariosphaeria erucacea* Kohlm., Volkm.-Kohlm. and O.E. Erikss. | Senescent culms and leaves | Saprobic | *Juncus roemerianus* | USA: North Carolina | [66] |
| *Massariosphaeria scirpina* (G. Winter) Leuchtm. | – | Saprobic | *Spartina sp.* | USA: Florida, North Carolina | [71] |
| *Massariosphaeria sp.* | Living/decomposing stems | Saprobic | *Phragmites australis* | Netherlands: Zeeland | [40] |

**Dictyosporiaceae**

| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| *Dictyosporium oblongum* (Fuckel) S. Hughes | Living/decomposing leaf blades and sheaths, stems | Saprobic | *Phragmites australis* | Netherlands: Zeeland | [39,40,50] |
| *Dictyosporium pelagicum* (Linder) G.C. Hughes ex E.B.G. Jones | Decomposing culms | Saprobic | *Spartina alterniflora* | USA: Rhode Island | [35,61] |
| | – | – | *Spartina spp.* | – | [32] |
| *Jalapriya toruloides* (Corda) M.J. D’souza, Hong Y. Su, Z.L. Luo and K.D. Hyde | Stems | Saprobic | *Spartina sp.* | UK | [72] |

**Didymellaceae**

| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| *Ascochyta cf. arundinariae* Tassi | Living/decomposing leaf blades and sheaths | Saprobic | *Phragmites australis* | Netherlands: Zeeland | [39,50] |
| *Ascochyta leptospora* (Trail) Hara | Living/decomposing leaf sheaths | Saprobic | *Phragmites australis* | Netherlands: Zeeland | [39] |
| *Ascochyta salicorniae-patulae* (Trotter) Melnik | – | Saprobic, parasitic | *Salicornia spp.* | Canada, Denmark, Germany, India, UK, USA | [52] |
| *Ascochyta spp.* | Living/decomposing leaf sheaths | Saprobic | *Phragmites australis* | Netherlands: Zeeland | [39] |
| | Sheath | Saprobic | *Spartina maritima* | Portugal: Alentejo | [54] |
| *Chaetasbolisia* sp. | Decaying stems and leaf sheaths | Saprobic | *Phragmites australis* | China: Hong Kong | [41] |
| *Didymella glacialis* Rehm | Living/decomposing leaf blades and sheaths, stems | Saprobic | *Phragmites australis* | Netherlands: Zeeland | [39,40,50] |
| *Didymella glomerata* (Corda) Qian Chen and L. Cai | Rhizome and basal area | Saprobic | *Spartina densiflora* | Argentina: Buenos Aires | [64] |
| *Didymella spp.* | Living/decomposing leaf blades and sheaths | Saprobic | *Phragmites australis* | Netherlands: Zeeland | [39,50] |
| | – | Pathogenic | *Spartina cynosuroides* | USA: Louisiana | [44] |
Table 1. Cont.

| Taxon                        | Host Part                        | Life Mode       | Hosts                  | Distribution                                    | References             |
|------------------------------|----------------------------------|-----------------|------------------------|------------------------------------------------|------------------------|
| *Epicoccum nigrum* Link      | Leaves                           | Saprobiic       | *Distichlis spicata*   | Argentina: Buenos Aires                         | [47]                   |
|                              | Living, senescent, and decaying  | Saprobiic       | *Juncus roemerianus*   | USA: Florida                                    | [43]                   |
|                              | leaves                           |                 |                        |                                                 |                        |
|                              | Inflorescence, upper leaves,     | Saprobiic,      | *Spartina alterniflora*| USA: Rhode Island,                               | [36,61,73,74]          |
|                              | seeds                            | parasitic       |                        | Connecticut, Virginia, Florida, North Carolina  |                        |
| *Epicoccum* sp.              | –                                | –               | *Spartina alterniflora*|                                                 | [35]                   |
| *Microsphaeropsis* spp.      | Living/decomposing leaf blades   | Saprobiic       | *Phragmites australis* | Netherlands: Zeeland                            | [39,41,50]             |
|                              | and sheaths                      |                 |                        |                                                 |                        |
| *Phoma herbarum* Westend.    | Leaves                           | Saprobiic       | *Distichlis spicata*   | Argentina: Buenos Aires                         | [47]                   |
| *Phoma leveillei* Boerema and G.J. Bollen | Leaves                        | Saprobiic       | *Distichlis spicata*   | Argentina: Buenos Aires                         | [47]                   |
| *Phoma suaeae* Jaap           | Twigs, leaves, stems             | Saprobiic       | *Suaeda maritima, Suaeda sp.* | Germany; India                                 | [75]                   |
|                              | –                                | –               | *Suaeda maritima*       | –                                                 | [35]                   |
|                              | –                                | –               | *Crithmum maritimum*    | –                                                 | [35]                   |
|                              | –                                | –               | *Atriplex portulacoides*| –                                                 | [35]                   |
|                              | Living, senescent, and decaying  | Saprobiic       | *Juncus roemerianus*   | USA: Florida                                    | [43]                   |
|                              | leaves                           |                 |                        |                                                 |                        |
|                              | Living/decomposing leaf blades   | Saprobiic       | *Phragmites australis* | China: Hong Kong;                               | [39–41,50]             |
|                              | and sheaths, stems               |                 |                        | Netherlands: Zeeland                            |                        |
|                              | –                                | –               | *Salicornia europaea*   | –                                                 | [35]                   |
|                              | –                                | –               | *Spartina alterniflora*| USA: North Carolina,                             | [20,35,36,61,73,74]    |
|                              | –                                | –               |                        | Rhode Island                                    |                        |
|                              | –                                | Saprobiic       | *Spartina patens*      | USA: Rhode Island                                | [36]                   |
|                              | –                                | Saprobiic       | *Spartina sp.*         | Argentina: Buenos Aires; Canada; USA: Maine,    | [36,71]                |
|                              | –                                | –               |                        | South Carolina                                   |                        |
|                              | Leaf sheaths and blades, stem    | Saprobiic       | *Spartina maritina*    | Portugal: Alentejo, Lisbon, Algarve, Centro     | [54,59,63]             |
|                              | –                                | –               |                        |                                                 |                        |
| Taxon                                      | Host Part                  | Life Mode | Hosts                                | Distribution                  | References |
|-------------------------------------------|----------------------------|-----------|--------------------------------------|-------------------------------|------------|
| *Paraboeremia putaminum* (Speg.) Qian Chen and L. Cai | Leaves                     | Saprobic  | *Distichlis spicata*                 | Argentina: Buenos Aires       | [47]       |
| *Stagonosporopsis salicorniae* (Magnus) Died. | –                           | –         | *Salicornia europaea*                | –                             | [35]       |
|                                           | –                           | –         | *Salicornia patula*                  | –                             | [35]       |
| **Didymosphaeriaceae**                    |                            |           |                                      |                               |            |
| *Didymosphaeria lignomaris* Strongman and J.D. Mill. | Basal area of the sheath   | Saprobic  | *Spartina densiflora*                | Argentina: Buenos Aires       | [64]       |
| *Julella herbatils* Kohlm., Volkm.-Kohlm. and O.E. Erikss. | Senescent leaves           | Saprobic  | *Juncus roemerianus*                | USA: North Carolina           | [76]       |
| *Paraphaeosphaeria apicola* Kohlm., Volkm.-Kohlm. and O.E. Erikss. | Senescent leaves           | Saprobic  | *Juncus roemerianus*                | USA: North Carolina           | [51]       |
| *Paraphaeosphaeria pilicata* Kohlm., Volkm.-Kohlm. and O.E. Erikss. | Senescent culms            | Saprobic  | *Juncus roemerianus*                | USA: North Carolina           | [77]       |
| *Paraphaeosphaeria michotii* (Westend.) O.E. Erikss. | –                           | –         | *Elymus pungens*                     | UK                            | [38]       |
|                                           | Living/decomposing leaf sheaths | Saprobic  | *Phragmites australis*              | Netherlands: Zeeland          | [39]       |
| *Pseudopithomyces atro-olivaceus* (Cooke and Harkn.) G. Guevara, K.C. Cunha and Gené | Senescent and decaying leaves | Saprobic  | *Juncus roemerianus*                | USA: Florida                  | [43]       |
| *Pseudopithomyces chartarum* (Berk. and M.A. Curtis) Jun F. Li, Ariyaw. and K.D. Hyde | Senescent leaves           | Saprobic  | *Juncus roemerianus*                | USA: Florida                  | [43]       |
|                                           | Senescent and decaying leaves | Saprobic  | *Juncus roemerianus*                | USA: Florida                  | [43]       |
|                                           | Decaying stems and leaf sheaths | Saprobic  | *Phragmites australis*              | China: Hong Kong              | [41]       |
| *Spegazzinia tessarthra* (Berk. and M.A. Curtis) Sacc. | Living leaves              | –         | *Juncus roemerianus*                | USA: Florida                  | [43]       |
|                                           | Decaying stems and leaf sheaths | Saprobic  | *Phragmites australis*              | China: Hong Kong              | [41]       |
| *Tremateia halophila* Kohlm., Volkm.-Kohlm. and O.E. Erikss. | Lower and middle parts of senescent culms | Saprobic  | *Juncus roemerianus*                | USA: North Carolina           | [78]       |
|                                           | –                           | Saprobic  | *Spartina maritima*                 | Portugal: Alentejo, Lisbon    | [54]       |
| Taxon                                      | Host Part                                      | Life Mode | Hosts                       | Distribution                                      | References         |
|--------------------------------------------|-----------------------------------------------|-----------|-----------------------------|---------------------------------------------------|--------------------|
| **Lentitheciaceae**                        |                                               |           |                             |                                                   |                    |
| *Halobyssothecium estuariae* B. Devadatha, | Dead culm                                      | Saprobic  | *Phragmites australis*      | UK: Pembrokeshire                                  | [79]               |
| Calabon, K.D. Hyde and E.B.G. Jones        |                                               |           |                             |                                                   |                    |
| Drift stems, attached and dead culms       |                                               | Saprobic  | *Spartina alterniflora*     |                                                   |                    |
| *Halobyssothecium obiones* (P. Crouan and H.| Drift stems, attached and dead culms          | Saprobic  | *Spartina alterniflora*     |                                                   |                    |
| Crouan) Dayarathne, E.B.G. Jones and       |                                               |           |                             |                                                   |                    |
| K.D. Hyde                                  |                                               |           |                             |                                                   |                    |
| –                                          | –                                             | –         | *Spartina cynosuroides*     | –                                                 | [35]               |
| Pod and rhizome                            |                                               | Saprobic  | *Spartina densiflora*       |                                                   |                    |
| –                                          | –                                             | –         | *Spartina patens*           | USA: Rhode Island                                  | [36]               |
| Culms                                      |                                               | Saprobic  | *Spartina sp.*              | UK: England, Hampshire                            | [79,83]            |
| –                                          | –                                             | –         | *Spartina spp.*             | USA: New Jersey, South Carolina; Mississippi      | [32,35,36,58,84]   |
| Stem                                       |                                               | Saprobic  | *Spartina townsendii*       | UK: Hampshire, Wales                              | [49,65]            |
| Stem, leaf sheaths, and blades             |                                               | Saprobic  | *Spartina maritima*         | Portugal: Alentejo, Lisbon, Algarve, Centro        | [31,54,59,63]      |
| –                                          | –                                             | –         | Unidentified saltmarsh      | USA: Mississippi                                  | [55,58]            |
| –                                          | –                                             | –         | *Elymus pungens*            | –                                                 | [35]               |
| –                                          | –                                             | –         | *Atriplex portulacoides*     | –                                                 | [35]               |
| Halobyssothecium phragmitis M.S. Calabon,  | Dead culm and stem                             | Saprobic  | *Phragmites sp.*            | Sweden: Gotland                                   | [85]               |
| E.B.G. Jones, S. Tibell and K.D. Hyde      |                                               |           |                             |                                                   |                    |
| Halobyssothecium versicolor M.S. Calabon,  | Dead stem                                      | Saprobic  | *Atriplex portulacoides*     | UK: Hampshire                                     | [85]               |
| E.B.G. Jones and K.D. Hyde                 |                                               |           |                             |                                                   |                    |
| Taxon                                      | Host Part                  | Life Mode | Hosts         | Distribution                          | References |
|-------------------------------------------|----------------------------|-----------|---------------|---------------------------------------|------------|
| Keissleriella culmifida (P. Karst.) S.K. Bose | –                          | –         | Elymus pungens | UK                                   | [38]       |
| Keissleriella linearis E. Müll. ex Dennis  | Living/decomposing stems  | Saprobic  | Phragmites australis | Netherlands: Zeeland               | [40]       |
| Keissleriella linearis E. Müll. ex Dennis  | Dead culm                 | Saprobic  | Phragmites sp.  | Sweden: Gotland                      | [85]       |
| Keissleriella phragmiticola Wanas., E.B.G. Jones and K.D. Hyde | Culms                    | Saprobic  | Phragmites australis | UK: Wales                            | [79]       |
| Keissleriella rara Kohlm., Volkm.-Kohlm. and O.E. Erikss. | Senescent culms           | Saprobic  | Juncus roemerianus | USA: North Carolina                 | [77]       |
| Keissleriella spp.                         | Senescent leaves          | Saprobic  | Juncus roemerianus | USA: Florida                         | [43]       |
| Lentithecium fluviatile (Aptroot and Van Ryck.) K.D. Hyde, J. Fourn. and Ying Zhang | Living/decomposing leaf blades and sheaths, stems | Saprobic  | Phragmites australis | Netherlands: Zeeland                | [39,40,50] |
| Setoseptoria arundinacea (Sowerby) Kaz. Tanaka and K. Hiray. | –                          | –         | Elymus pungens | UK                                   | [38]       |
| Setoseptoria arundinacea (Sowerby) Kaz. Tanaka and K. Hiray. | Living/decomposing leaf blades and sheaths, stems | Saprobic  | Phragmites australis | Netherlands: Zeeland                | [39,40,50] |
| Setoseptoria phragmitis Quaedvl., Verkley and Crous | –                          | –         | Spartina sp. | USA: North Carolina, Florida          | [71]       |
| Towyspora aestuari Wanas., E.B.G. Jones and K.D. Hyde | –                          | –         | Phragmites australis | UK: Wales                            | [88]       |
| Leptosphaeriaceae                          | –                          | –         | Juncus maritimus | –                                    |            |
| Leptosphaeria albopunctata (Westend.) Sacc. | Attached culms            | –         | Phragmites australis | –                                    | [35]       |
| Leptosphaeria albopunctata (Westend.) Sacc. | Stem                      | Saprobc   | Spartina alterniflora | USA: Rhode Island                   | [35,36,61,71,73,80] |
| Leptosphaeria albopunctata (Westend.) Sacc. | –                          | –         | Spartina spp. | Canada: Bay of Fundy; USA: New Jersey, South Carolina; Argentina: Buenos Aires | [35,36,48,89,90] |
|                                            | –                          | –         | Spartina townsendii | UK: Wales                            | [35,65]    |
| Taxon                                      | Host Part                     | Life Mode | Hosts                          | Distribution | References |
|--------------------------------------------|-------------------------------|-----------|--------------------------------|--------------|------------|
| Leptosphaeria australiensis (Cribb and J.W. Cribb) G.C. Hughes | Senescent and decaying leaves | Saprobic  | Juncus roemerianus             | USA: Florida | [43]       |
|                                            | Pod                           | Saprobic  | Spartina densiflora            | Argentina: Buenos Aires | [64]       |
|                                            |                               |           | Spartina spp.                  |              | [32]       |
| Leptosphaeria culmifraga (Fr.) Ces. and De Not. |                               |           | Elymus pungens                 | UK           | [38]       |
| Leptosphaeria littoralis Sacc.              |                               |           | Elymus pungens                 | UK           | [38]       |
|                                            |                               |           | Juncus roemerianus             | USA: Maine, Rhode Island, Connecticut, New Jersey, Delaware, Virginia, North Carolina, South Carolina | [35,36,71,73,80] |
| Leptosphaeria marina Ellis and Everh.       |                               |           | Spartina alterniflora          |              | [35,36,65,89–91] |
|                                            |                               |           | Spartina spp.                  | Canada; USA: New Jersey | [32,35,36,65,89–91] |
|                                            |                               |           | Spartina townsendii            | UK           | [35,38]    |
|                                            |                               |           | Arundo donax                   |              | [35]       |
|                                            |                               |           | Lysimachia maritima            | USA: Massachusetts | [35,92]    |
| Leptosphaeria orae-maris Linder            |                               |           | Spartina alterniflora          | USA: Massachusetts, Rhode Island, North Carolina, Florida, Texas | [36,71,80,92] |
|                                            |                               |           | Spartina densiflora            | Argentina: Buenos Aires | [64]       |
|                                            |                               |           | Spartina spp.                  | UK           | [32]       |
|                                            |                               |           | Spartina townsendii            | UK           | [35,65,93] |
Table 1. Cont.

| Taxon                        | Host Part                        | Life Mode | Hosts                     | Distribution                                                                 | References       |
|------------------------------|----------------------------------|-----------|---------------------------|------------------------------------------------------------------------------|------------------|
| *Leptosphaeria pelagica* E.B.G. Jones | Decaying herbaceous stems, dead culms, decaying leaves | Saprobic  | *Elymus pungens*          | UK                                                                           | [35,38]          |
|                              |                                  |           | *Puccinellia maritima*    | USA: Connecticut, Mississippi, Rhode Island; India: Goa, Karanataka           | [38]             |
| *Leptosphaeria peruviana* Speg. | Decaying stems                    | Saprobic  | *Spartina alterniflora*   | BG                                                                         | [20,36,52,55,73,94]|
|                              |                                  |           | *Spartina densiflora*     | Argentina: Buenos Aires                                                      | [64]             |
| *Leptosphaeria peruviana* Speg. | Decaying stems                    | Saprobic  | *Spartina patens*         | USA: Rhode Island                                                           | [36]             |
|                              |                                  |           | *Spartina townsendii*     | UK                                                                           | [38]             |
| *Leptosphaeria peruviana* Speg. | Decaying stems                    | Saprobic  | *Spartina spp.*           | UK                                                                           | [32,65]          |
| *Sheath*                     |                                  |           | *Spartina maritima*       | Portugal: Alentejo, Lisbon                                                   | [54]             |
| *Stem*                       |                                  |           | *Spartina maritima*       | Portugal: Alentejo                                                           | [63]             |
| *Leptosphaeria peruviana* Speg. | Decaying leaves                   | Saprobic  | *Sarcocornia perennis*    | Argentina: Buenos Aires; in temperate marine waters                          | [52]             |
| *Leptosphaeria peruviana* Speg. | Decaying stems and leaf sheaths   | Saprobic  | *Phragmites australis*    | China: Hong Kong                                                            | [41]             |
|                              |                                  |           | *Spartina alterniflora*   | USA: Rhode Island                                                           | [74]             |
| *Leaf sheaths and blades, stem* |                                  | Saprobic  | *Spartina maritima*       | Portugal: Centro                                                            | [59]             |
| *Leptosphaeria suaedae* Hansf. | Dead twigs                        | Saprobic  | *Suaeda australis*        | South Australia                                                             | [95]             |

**Lindgomycetaceae**

| *Arundellina typhae* Wanas., E.B.G. Jones and K.D. Hyde | Dead stem | Saprobic | *Typha sp.* | UK: England | [96] |

**Lophiostomataceae**

| *Lophiostoma semiliberrum* (Desm.) Ces. and De Not. | Living/decomposing stems | Saprobic | *Phragmites australis* | Netherlands: Zeeland | [40] |
| *Lophiostoma sp.* | – | – | *Elymus pungens* | UK | [38] |
| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| Sigarispora arundinis (Pers.) Thambug., Qing Tian, Kaz. Tanaka and K.D. Hyde | Living/decomposing stems | Saprobic | Phragmites australis | Netherlands: Zeeland | [40] |
| **Massarinaceae** | | | | | |
| Helminthosporium sp. | Decaying leaf blades | Saprobic | Spartina alterniflora | USA: Georgia | [56] |
| Massarina carolinensis Kohlm., Volkm.-Kohlm. and O.E. Erikss. | Senescent culms | Saprobic | Juncus roemerianus | USA: North Carolina | [77] |
| Massarina ignaria (C. Booth) Aptroot | Decaying leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |
| Massarina phragmiticola Poon and K.D. Hyde | Decaying stems and leaf sheaths | Saprobic | Phragmites australis | China: Hong Kong | [41] |
| Massarina ricifera Kohlm., Volkm.-Kohlm. and O.E. Erikss. | Lower parts of senescent culms, decaying leaves | Saprobic | Juncus roemerianus | USA: Alabama, Mississippi, North Carolina | [55, 58, 97] |
| Massarina spp. | Senescent and decaying leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |
| Stagonospora abundata Kohlm. and Volkm.-Kohlm. | Senescent leaves and bracts | Saprobic | Juncus roemerianus | USA: Florida, Georgia, North Carolina | [98] |
| Stagonospora cylindrica Gunnell | Living/decomposing stems | Saprobic | Phragmites australis | Netherlands: Zeeland | [40] |
| Stagonospora elegans (Berk.) Sacc. and Traverso | Living/decomposing leaf sheaths, stems, culms | Saprobic | Phragmites australis | Australis; Netherlands: Zeeland | [39, 40, 95] |
| Stagonospora epicalamia (Cooke) Sacc. | – | – | Phragmites australis | Australia | [95] |
| Stagonospora haliclysta Kohlm. | Leaf sheaths and blades, stem | Saprobic | Spartina maritima | Portugal: Algarve | [59] |
| Stagonospora spp. | Living and senescent leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |
| | Living/decomposing leaf blades and sheaths, stems | Saprobic | Phragmites australis | China: Hong Kong; Netherlands: Zeeland | [39–41, 50] |
| | Senescent and dead leaves/inflorescence, living and dead seeds, decaying leaf blades | Saprobic, pathogenic | Spartina alterniflora | Canada; USA: Maine, Rhode Island, Georgia, Connecticut, New Jersey, Virginia, Florida, North Carolina; Argentina: Buenos Aires | [35, 36, 56, 73, 74] |
Table 1. Cont.

| Taxon                                    | Host Part                          | Life Mode     | Hosts                  | Distribution                  | References |
|------------------------------------------|------------------------------------|---------------|------------------------|-------------------------------|------------|
| **– Pathogenic**                         |                                    |               | **Spartina cynosuroides** | USA: Maryland                  | [44]       |
| **– Saprobic**                           |                                    |               | **Spartina patens**     | USA: Rhode Island             | [35,36]   |
| **– Saprobic**                           |                                    |               | **Spartina spp.**       | Canada                        | [35,36]   |
| **Leaf sheaths and blades, stem, limb**  | Saprobic                           |               | **Spartina maritima**   | Portugal: Alentejo, Lisbon, Algarve, Centro | [31,54,59] |
| **Stagonospora suaeae Syd. and P. Syd.** | Leaves                             |               | **Suaeda maritima**     | Germany                       | [99]       |
| **Melanommataceae**                      |                                    |               | **Stagonospora suaeae** |                               |            |
| **Aposphaeria spp.**                     | Living/decomposing leaf sheaths, stems | Saprobic       | **Phragmites australis**| Netherlands: Zeeland          | [39,40]   |
| **Bicrouania maritima (P. Crouan and H. Crouan) Kohlm. and Volkm.-Kohl.** | Dead stems                         | Saprobic       | **Atriplex portulacoides**| India                        | [35,52]   |
| **Morosphaeiaceae**                      |                                    |               | **Helicascus kanaloanus**| Kohlm.                       | [32]       |
| **Neocamarosporiaceae**                  |                                    |               | **Neocamarosporium artemisae Dayarathne and E.B.G. Jones** | **Artemisia maritima** | Sweden: Bohuslän | [100] |
| **Neocamarosporium artemisae Dayarathne and E.B.G. Jones** | –                                  | Saprobic       | **Artemisia maritima**   | Sweden: Bohuslän              | [100]     |
| **Neocamarosporium maritinae Dayarathne and E.B.G. Jones** | –                                  | Saprobic       | **Artemisia maritima**   | Sweden: Bohuslän              | [100]     |
| **Neocamarosporium obiones (Jaap) Wanas. and K.D. Hyde** | –                                  | Saprobic       | **Atriplex portulacoides**| –                            | [35]       |
| **Decaying culms**                       | **Neocamarosporium phragmitis D.N. Wanasinghe, E.B.G. Jones and K.D. Hyde** | Saprobic       | **Phragmites australis**| UK                            | [101]     |
| **Neocamarosporium salicornicola Dayar., E.B.G. Jones and K.D. Hyde** | Dead stems                         | Saprobic       | **Salicornia sp.**       | Thailand                      | [102]     |
| **Periconiaceae**                        |                                    |               | **Salicornia sp.**       |                               |            |
| **Periconia cookei E.W. Mason and M.B. Ellis** | Senescent and decaying leaves      | Saprobic       | **Juncus roemerianus**  | USA: Florida                  | [43]       |
|                                          | Living/decomposing leaf blades and sheaths | Saprobic       | **Phragmites australis** | Netherlands: Zeeland          | [39,50]   |
| **Periconia digitata (Cooke) Sacc.**     | Living, senescent, and decaying leaves | Saprobic       | **Juncus roemerianus**  | USA: Florida                  | [43]       |
| **Periconia digitata (Cooke) Sacc.**     | Living/decomposing leaf sheaths    | Saprobic       | **Phragmites australis**| Netherlands: Zeeland          | [39]       |
| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| Periconia echinochloae (Bat.) M.B. Ellis | Senescent and decaying leaves | Saprobiic | Juncus roemerianus | USA: Florida | [43] |
| Periconia minutissima Corda | Leaves | Saprobiic | Distichlis spicata | Argentina: Buenos Aires | [47] |
| Periconia sp. | – | Saprobiic | Unidentified saltmarsh plants | USA: Mississippi | [58] |
| **Phaeosphaeriaceae** | | | | | |
| Amarenomyces ammophilae (Lasch) O.E. Erikss. | – | – | Ammophila arenaria | – | [35] |
| × Ammocalamagrostis ballica | – | – | – | – | [35] |
| – | – | Uniola paniculata | – | – | [35] |
| Camarosporioides phragmitis W.J. Li and K.D. Hyde | Dead stem | Saprobiic | Phragmites australis | Germany | [96] |
| Hendersonia culmiseda Sacc. | Living/decomposing leaf blades | Saprobiic | Phragmites australis | Netherlands: Zeeland | [50] |
| – | Living/decomposing leaf sheaths | Saprobiic | Phragmites australis | Netherlands: Zeeland | [39] |
| Hendersonia spp. | Living/decomposing leaf blades and sheaths | Saprobiic | Phragmites australis | Netherlands: Zeeland; USA: Florida | [39,43,50] |
| Loratospora aestuarii Kohlm. and Volkm.-Kohlm. | Senescent culms | Saprobiic | Juncus roemerianus | USA: North Carolina | [104] |
| Loratospora aestuarii Kohlm. and Volkm.-Kohlm. | – | Saprobiic | Unidentified saltmarsh plants | USA: Mississippi | [58] |
| Ophiobolus littoralis (P. Crouan and H. Crouan) Sacc. | – | – | Elymus pungens | UK | [38] |
| Phaeoseptoria sp. | Living/decomposing leaf sheaths | Saprobiic | Phragmites australis | Netherlands: Zeeland | [39] |
Table 1. Cont.

| Taxon                                      | Host Part                          | Life Mode | Hosts                  | Distribution                              | References          |
|-------------------------------------------|------------------------------------|-----------|------------------------|-------------------------------------------|---------------------|
| Phaeosphaeria anchiala Kohlm., Volkm.-Kohlm. and C.K.M. Tsui | Senescent leaves                   | Saprobi   | *Juncus roemerianus*   | USA: Florida, Georgia, Maryland, North Carolina, Virginia | [105]               |
| Phaeosphaeria caricinella (P. Karst.) O.E. Erikss. | –                                  | –         | *Spartina sp.*         | USA: Florida, North Carolina               | [71]                |
| Phaeosphaeria culmorum (Auersw.) Leuchtm.  | Living/decomposing leaf blades and sheaths | Saprobi   | *Phragmites australis* | Netherlands: Zeeland                      | [39,50]             |
| Phaeosphaeria eustoma (Fuckel) L. Holm     | Living/decomposing leaf blades and sheaths, stems, culms | Saprobi   | *Phragmites australis* | Netherlands: Zeeland                      | [39,40,50,95]       |
| Phaeosphaeria fuckelii (Niessl) L. Holm    | –                                  | –         | *Elymus pungens*       | UK                                        | [38]                |
| Phaeosphaeria gessneri Shoemaker and C.E. Babc. | –                                  | –         | *Spartina spp.*        | –                                         | [32]                |
| Phaeosphaeria halima (T.W. Johnson) Shoemaker and C.E. Babc. | Dead culms; Decaying leaves, leaf blades | Saprobi   | *Spartina alterniflora* | India: Kerala; USA: California, Georgia, Mississippi, Vancouver, North Carolina | [25,35,52,55–58,71,80] |
|                                           | Decaying leaf blades               | Saprobi   | *Spartina densiflora*  | USA: California                           | [25]                |
|                                           |                                    |           | *Spartina spp.*        |
|                                           | Decaying leaves                    | Saprobi   | *Spartina foliosa*     | USA: California                           | [25]                |
|                                           |                                    |           | *Spartina maritima*    | Portugal: Algarve, Centro                 | [31]                |
| Phaeosphaeria herpotrichoides (De Not.) L. Holm | –                                  | –         | *Spartina patens*      | USA: North Carolina, Florida               | [71]                |
| Phaeosphaeria juncina (Auersw.) L. Holm    | –                                  | –         | *Juncus roemerianus*   | USA: Florida                              | [43]                |
| Phaeosphaeria lucuta (Niessl ex Sacc.) Y. Otani and Mikawa | Living/decomposing leaf sheaths, stems | Saprobi   | *Phragmites australis* | Netherlands: Zeeland                      | [39,40]             |
|                                           | –                                  | –         | *Elymus pungens*       | UK                                        | [38]                |
Table 1. Cont.

| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| Phaeosphaeria macrosporidium (E.B.G. Jones) Shoemaker and C.E. Babc. | Decaying stems | Saprobic | Spartina sp | UK: Wales, England | [65] |
| | Stem | Saprobic | Spartina maritima | Portugal: Lisbon | [54,63] |
| Phaeosphaeria microscopica (P. Karst.) O.E. Erikss. | – | – | Elymus pungens | UK | [38] |
| | – | – | Juncus maritimus | – | [35] |
| | – | – | Juncus roemerianus | – | [35] |
| Phaeosphaeria neomaritima (R.V. Gessner and Kohlm.) Shoemaker and C.E. Babc. | – | Saprobic | Juncus sp. | Canada; India: Maharashtra, Karnataka; USA: Virginia, North Carolina | [36,52,71,80] |
| | – | – | Spartina alterniflora | – | [35] |
| | – | Saprobic | Spartina spp. | Canada; USA: North Carolina, Virginia | [32,71,80] |
| | – | – | Spartina townsendii | UK | [35,93] |
| Phaeosphaeria nigrans (Roberge ex Desm.) L. Holm | Stem | Saprobic | Spartina maritima | Portugal: Alentejo | [63] |
| Phaeosphaeria olivacea Kohlm., Volkm.-Kohlm. and O.E. Erikss. | Senescent leaves | Saprobic | Juncus roemerianus | USA: North Carolina, Mississippi | [58,76] |
| | – | – | Elymus pungens | UK | [38] |
| Phaeosphaeria pontiformis (Fuckel) Leuchtm. | Living/decomposing leaf blades and sheaths, stems | Saprobic | Phragmites australis | Netherlands: Zeeland | [39,40,50] |
| Phaeosphaeria roemerianum Kohlm., Volkm.-Kohlm. and O.E. Erikss. | Senescent and decaying leaves | Saprobic | Juncus roemerianus | USA: Mississippi, North Carolina | [55,58,60] |
| Phaeosphaeria spartinae (Ellis and Everh.) Shoemaker and C.E. Babc. | Decaying herbaceous stems and pod | Saprobic | Spartina densiflora | Argentina: Buenos Aires | [64] |
| | – | Saprobic | Spartina maritima | Portugal: Lisbon | [54] |
Table 1. Cont.

| Taxon                        | Host Part                      | Life Mode | Hosts                  | Distribution                                                                 | References         |
|------------------------------|--------------------------------|-----------|------------------------|-------------------------------------------------------------------------------|--------------------|
| Phaeosphaeria spartinicola Leuchtm. | Dead leaves, decaying leaf blades | Saprobic  | Spartina alterniflora | Mexico; USA: Alabama, California, Georgia, Mississippi; Canada: Nova Scotia, New Brunswick | [25,36,55–58]      |
|                              | Pod, leaf blades                | Saprobic  | Spartina densiflora    | Argentina: Buenos Aires; USA: California                                      | [25,64]            |
|                              | Leaf blades                     | Saprobic  | Spartina foliosa       | USA: California                                                              | [25]               |
|                              | Leaf sheaths and blades, stem, limb | Saprobic  | Spartina maritima      | Portugal: Alentejo, Lisbon, Algarve, Centro                                   | [31,54,59,63]      |
| Phaeosphaeria spp.           | Living/decomposing leaf blades and sheaths, stems | Saprobic | Phragmites australis   | Netherlands: Zeeland                                                         | [39,40,50]         |
| Sclerostagonospora sp.       | Decaying stems and leaf sheaths | Saprobic  | Phragmites australis   | USA: Rhode Island                                                            | [74]               |
| Septoriella phragmitis Oudem. | Living/decomposing leaf sheaths and stems | Saprobic | Phragmites australis   | Netherlands: Zeeland                                                         | [39,40]            |
| Septoriella spp.             | Decaying stems and leaf sheaths and blades, stems | Saprobic | Phragmites australis   | China: Hong Kong; Netherlands: Zeeland                                       | [39–41,50]         |
| Septoriella thalassica (Speg.) Nag Raj | –                              | –         | Distichlis spicata     | –                                                                             | [35]               |
| Septoriella unigalerita Kohlm. and Volkm.-Kohlm. | Senescent leaves            | Saprobic  | Juncus roemerianus     | USA: North Carolina                                                          | [98]               |
| Septoriella vagans (Niessl) Y. Marin and Crous | –                              | –         | Elymus pungens         | UK                                                                            | [38]               |
|                              | –                              | –         | Puccinellia maritima    | UK                                                                            | [38]               |
| Pleomassariaceae             | Living, senescent, and decaying leaves | Saprobic  | Juncus roemerianus     | USA: Florida                                                                  | [43]               |
| Splanchnonema sp.           |                                |           |                        |                                                                               |                    |
| Taxon               | Host Part                                      | Life Mode   | Hosts               | Distribution          | References |
|---------------------|------------------------------------------------|-------------|---------------------|-----------------------|------------|
| **Pleosporaceae**   |                                                |             |                     |                       |            |
| *Alternaria alternata* (Fr.) Keissl. | Leaves                                    | Saprobi    | *Distichlis spicata* | Argentina: Buenos Aires | [47]       |
|                     | Living, senescent, and decaying leaves         | Saprobi    | *Juncus roemerianus* | USA: Florida           | [43]       |
|                     | Living/decomposing leaf blades and sheaths, stems | Saprobi    | *Phragmites australis* | Netherlands: Zeeland  | [39, 41, 50] |
|                     | Living, senescent, and decaying leaves         | Saprobi    | *Spartina alterniflora* | USA: North Carolina   | [74]       |
|                     | Leaves, stems, and roots                       | Saprobi    | *Spartina sp.*      | Canada: Bay of Fundy   | [48]       |
| *Alternaria infectoria* E.G. Simmons   | Living/decomposing leaf sheaths               | Saprobi    | *Phragmites australis* | Netherlands: Zeeland  | [39]       |
| *Alternaria longissima* Deighton and MacGarvie | Living, senescent, and decaying leaves         | Saprobi    | *Spartina roemerianus* | USA: Florida           | [43]       |
| *Alternaria maritima* G.K. Sutherl.   | Stem                                            | Saprobi, pathogenic | *Spartina townsendii* | UK: England           | [49]       |
| *Alternaria spp.*   | Inflorescence and upper leaves                 | Saprobi, parasitic | *Spartina alterniflora* | USA: Rhode Island    | [35, 61]  |
|                     | Culms                                           | Saprobi    | *Spartina sp.*      | Thailand              | This study |
| *Bipolaris cynodontis* (Marignoni) Shoemaker | Leaves                                    | Saprobi    | *Distichlis spicata* | Argentina: Buenos Aires | [47]       |
| *Curvularia hawaiiensis* (Bugnic. ex M.B. Ellis) Manamgoda, L. Cai and K.D. Hyde | Living and senescent leaves                  | Saprobi    | *Juncus roemerianus* | USA: Florida           | [43]       |
|                     | Decaying stems and leaf sheaths                | Saprobi    | *Phragmites australis* | China: Hong Kong      | [41]       |
| *Curvularia protuberata* R.R. Nelson and Hodges | Leaves                                    | Saprobi    | *Distichlis spicata* | Argentina: Buenos Aires | [47]       |
|                     | Senescent leaves                               | Saprobi    | *Juncus roemerianus* | USA: Florida           | [43]       |
| *Curvularia spp.*   | Living, senescent, and decaying leaves         | Saprobi    | *Juncus roemerianus* | USA: Florida           | [43]       |
|                     |                                                 | Saprobi    | *Spartina alterniflora* | USA: North Carolina   | [74]       |
### Table 1. Cont.

| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| *Curvularia tuberculata* B.L. Jain | Senescent and decaying leaves | Saprobic | *Juncus roemerianus* | USA: Florida | [43] |
| | Stems | Saprobic | *Atriplex sp.* | UK: Portsmouth | [106] |
| | – | – | *Atriplex portulacoides* | – | [35] |
| | – | – | *Sarcocornia perennis* | – | [35] |
| | – | – | *Sarcocornia fruticosa* | – | [35] |
| | – | – | *Salicornia europaea* | – | [35] |
| | – | – | *Salicornia sp.* | – | [35] |
| | Leaf sheaths and blades, stem | Saprobic | *Spartina maritima* | Portugal: Algarve | [59] |
| | – | – | *Suada maritima* | – | [35] |
| *Drechslera* sp. | Living, senescent, and decaying leaves | Saprobic | *Juncus roemerianus* | USA: Florida | [43] |
| | – | – | *Distichlis spicata* | – | [35] |
| *Exserohilum rostratum* (Drechsler) K.J. Leonard and Suggs | Living, senescent, and decaying leaves | Saprobic | *Juncus roemerianus* | USA: Florida | [43] |
| | Senescent and dead leaves | Saprobic | *Spartina alterniflora* | USA: Rhode Island, North Carolina, Florida | [35,36,73] |
| | – | – | *Spartina spp.* | – | [32] |
| *Paradendryphiella arenariae* (Nicot) Woudenb. and Crous | Decomposing culms | Saprobic | *Spartina alterniflora* | USA: Rhode Island | [35,61] |
| | Decaying leaves | Saprobic | *Juncus roemerianus* | USA: Florida | [43] |
| | – | – | *Puccinellia maritima* | – | [35] |
| | – | – | *Salicornia europaea* | – | [35] |
| *Paradendryphiella salina* (G.K. Sutherl.) Woudenb. and Crous | Decomposing culms | Saprobic | *Spartina alterniflora* | USA: Rhode Island | [35,61] |
| | – | – | *Spartina spp.* | – | [32] |
| | – | – | *Spartina townsendii* | – | [35] |
| | Leaves and stems | Saprobic | *Spartina sp.* | Canada: Bay of Fundy | [48] |
| | – | – | *Suada maritima* | – | [35] |
| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| *Pleospora abscondita* Sacc. and Roum. | Living/decomposing leaf sheaths | Saprobic | *Phragmites australis* | Netherlands: Zeeland | [39] |
| *Pleospora pelagica* T.W. Johnson | Decomposing culms; decaying leaf blades | Saprobic | *Spartina alterniflora* | USA: Georgia, Rhode Island, North Carolina, Florida | [35,36,52,56,71,73,74,80] |
| | Decaying leaf blades | Saprobic | *Spartina densiflora* | USA: California | [25] |
| | | | *Spartina spp.* | USA: South Carolina | [32,36] |
| | | Saprobic | *Typha sp.* | | [35] |
| *Pleospora pelvetiae* G.K. Sutherl. | – | Saprobic | Unidentified saltmarsh plants | USA: Mississippi | [58] |
| *Pleospora spp.* | – | – | *Salicornia virginica* | – | [35] |
| *Pleospora spartinae* (J. Webster and M.T. Lucas) Apinis and Chesters | Decaying stems and leaf sheaths | Saprobic | *Phragmites australis* | China: Hong Kong | [41] |
| | Decaying leaf blades | Saprobic | *Spartina alterniflora* | USA: Georgia | [56] |
| | Stem | Saprobic | *Spartina spp.* | Canada: Bay of Fundy | [32,48] |
| | – | – | *Spartina townsendii* | UK | [35,38,107] |
| *Pleospora straminis* Sacc. and Speg. | – | – | *Elymus pungens* | UK | [38] |
| *Pleospora vagans* Niessl var. vagans | Living/decomposing leaf sheaths | Saprobic | *Phragmites australis* | Netherlands: Zeeland | [39] |
| | Dead culms | Saprobic | *Spartina alterniflora* | USA: Rhode Island | [73] |
| *Pyrenophora tritici-repentis* (Died.) Drechsler | – | – | *Elymus pungens* | UK | [38] |
| *Stemphylium botryosum* Wallr. | Leaves | Saprobic | *Distichlis spicata* | Argentina: Buenos Aires | [47] |
| *Stemphylium lycopersici* (Enjoji) W. Yamam. | Living leaves | – | *Juncus roemerianus* | USA: Florida | [43] |
| *Stemphylium maritimum* T.W. Johnson | – | Saprobic | *Spartina sp.* | UK | [65] |
| *Stemphylium spp.* | – | – | *Salsola kali* | – | [35] |
| | Leaves | Saprobic | *Spartina spp.* | Canada: Bay of Fundy | [35,48] |
| *Stemphylium vesicarium* (Wallr.) E.G. Simmons | – | – | *Elymus pungens* | UK | [38] |
| | Living, senescent and decaying leaves | Saprobic | *Juncus roemerianus* | USA: Florida | [43] |
| | – | Saprobic | *Lysimachia maritima* | USA: Massachusetts | [92] |
Table 1. Cont.

| Taxon                              | Host Part                     | Life Mode          | Hosts                  | Distribution                                                                 | References |
|------------------------------------|-------------------------------|--------------------|------------------------|------------------------------------------------------------------------------|------------|
| Stempylium triglochincola B. Sutton and Piroz. | –                             | Saprobic           | Spartina alterniflora   | USA: Rhode Island                                                           | [61]       |
|                                    | Glumes, rachis                | –                  | Spartina townsendii     | UK: England                                                                 | [38,49]    |
|                                    |                               |                    |                        | Saprina sp.                                                                 | [65]       |
| Dead leaves and inflorescences     | Saprobic                      |                    |                        | Triglochin maritima                                                          | [35,87]    |
|                                    |                               |                    |                        | Sweden: Västergötland                                                        |            |
| Typhicola typharum (Desm.) Crous   | Senescent and dead leaves     | Saprobic, pathogenic | Spartina alterniflora   | Canada; USA: Maine, Rhode Island, Connecticut, New Jersey, Virginia, North Carolina, Florida | [35,36,61,73,74] |
|                                    | –                             | Saprobic           | Spartina patens        | USA: Rhode Island                                                           | [36]       |
|                                    | –                             | Saprobic           | Spartina townsendii     | UK                                                                            | [38]       |
|                                    | –                             | Saprobic           | Spartina sp.            | Argentine: Buenos Aires; Canada; USA: Maine                                  | [35,36]    |
|                                    | Stems                         | Saprobic           | Spartina townsendii     | UK: England                                                                  | [35,49,65] |
| Pleosporales genera incertae sedis | Phialophorophoma litoralis Linder | Stem and sheath   | Spartina maritima       | Portugal: Alentejo, Lisbon                                                   | [54,63]    |
|                                    | Phialophorophoma spp.         | Living/decomposing leaf sheaths, stems | Saprobic | Phragmites australis | Netherlands: Zeeland | [39,40] |
|                                    | Pyrenochaeta sp.               | Living leaves      | Saprobic | Juncus roemerianus | USA: Florida | [43] |
|                                    | Scolecobasidium humicola G.L. Barron and L.V. Busch | Living, senescent, and decaying leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |
| Roussoeillaceae                     | Cytoplea sp.                  | Decaying stems and leaf sheaths | Saprobic | Phragmites australis | China: Hong Kong | [41] |
| Sporormiaceae                       | Preussia funiculata (Preuss) Fuckel | –                   | –                      | Spartina townsendii | UK | [38] |
|                                    | Preussia terricola Cain       | –                   | –                      | Elymus pungens | UK | [38] |
|                                    | Sporormia longipes Masseee and E.S. Salmon | –                   | –                      | Elymus pungens | UK | [38] |
|                                    | Sporormia sp.                 | Senescent and decaying leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |
| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| Sporormiella intermedia (Auersw.) S.I. Ahmed and Cain ex Kobayasi | – | – | Elymus pungens | UK | [38] |
| Sporormiella lagenifornis (Fuckel) S.I. Ahmed and Cain | – | – | Spartina townsendii | UK | [38] |
| Sporormiella minima (Auersw.) S.I. Ahmed and Cain | – | – | Elymus pungens | UK | [38] |
| – | – | – | Spartina townsendii | UK | [38] |

**Teichosporaceae**

| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| Teichosporistra (Kohlm. and Volkm.-Kohlm.) Jaklitsch and Voglmayr | Senescent leaves and inflorescences | Saprobic | Juncus roemerianus | USA: North Carolina, Virginia | [98] |
| Teichospora suaedae Spec. | Dead branches | Saprobic | Suaeda divaricata | Argentina: Mendoza | [109] |

**Testudinaceae**

| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| Verruculina enalia (Kohlm.) Kohlm. and Volkm.-Kohlm. | Decaying stems and leaf sheaths | Saprobic | Phragmites australis | China: Hong Kong | [41] |

**Tetraplosphaeriaceae**

| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| Tetrapsou aristata Berk. and Broome | Leaves | Saprobic | Distichlis spicata | Argentina: Buenos Aires | [47] |
| | Senescent and decaying leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |
| | Decaying stems and leaf sheaths | Saprobic | Phragmites australis | China: Hong Kong | [41] |

**Torulaceae**

| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| Torula herbarum (Pers.) Link | Decaying leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |

**Trematosphaeriaceae**

| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| Halomassarina thalassiae (Kohlm. and Volkm.-Kohlm.) Suetrong, Sakay, E.B.G. Jones, Kohlm., Volkm.-Kohlm. and C.L. Schoch | Decaying stems and leaf sheaths | Saprobic | Phragmites australis | China: Hong Kong | [41] |

**EUROTIOMYCETES**

**Chaetothyriales**

| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| Rhinocladiella spp. | Living, senescent, and decaying leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |
| | Decaying stems and leaf sheaths | Saprobic | Phragmites australis | China: Hong Kong | [41] |

**Eurotiales**

| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| Veronae sp. | Decaying leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |
Table 1. Cont.

| Taxon                          | Host Part                                      | Life Mode       | Hosts          | Distribution       | References |
|-------------------------------|-----------------------------------------------|-----------------|----------------|-------------------|------------|
| Aspergillus fumigatus Fresen. | –                                              | –               | Elymus pungens | UK                | [38]       |
| Aspergillus nidulans (Eidam) G. Winter | –                                              | –               | Elymus pungens | UK                | [38]       |
| Aspergillus niger Tiegh.      | Living, senescent, and decaying leaves         | Saprobic        | Juncus roemerianus | USA: Florida | [43]       |
| Aspergillus spp.              | Living, senescent, and decaying leaves         | Saprobic        | Juncus roemerianus | USA: Florida | [43]       |
| Monascus purpureus Went       | –                                              | –               | Elymus pungens | UK                | [38]       |
| Penicillium aurantiogriseum Dierckx | Leaves                                          | Saprobic        | Spartina sp.   | Canada: Bay of Fundy | [48]       |
| Penicillium brevicompactum Dierckx | Roots                                          | Saprobic        | Spartina sp.   | Canada: Bay of Fundy | [48]       |
| Penicillium chryseogenum Thom  | Roots                                          | Saprobic        | Spartina sp.   | Canada: Bay of Fundy | [48]       |
| Penicillium lidium Westling   | Leaves and stems                               | Saprobic        | Spartina sp.   | Canada: Bay of Fundy | [48]       |
| Penicillium spp.              | Living, senescent, and decaying leaves         | Saprobic        | Juncus roemerianus | USA: Florida | [43]       |
|                              | Decaying stems and leaf sheaths                | Saprobic        | Phragmites australis | China: Hong Kong | [41]       |
|                              | –                                              | –               | Spartina townsendii | UK: England | [49]       |
| Thermoascus crustatus (Apinis and Chesters) Stolk | –                                              | –               | Elymus pungens | UK                | [38]       |
| Paecilomyces spp.             | Senescent and decaying leaves                  | Saprobic        | Juncus roemerianus | USA: Florida | [43]       |
|                              | Decaying stems and leaf sheaths                | Saprobic        | Phragmites australis | China: Hong Kong | [41]       |
|                              | –                                              | –               | Spartina townsendii | Salt marsh plants | India: Goa [52] |
| Trichocomaceae                |                                               |                 |                |                   |            |
| Thermomyces dupontii (Griffon and Maubl.) Houbraken and Samson | –                                              | –               | Elymus pungens | UK                | [38]       |
| Onygenales                    |                                               |                 |                |                   |            |
| Onygenaceae                   |                                               |                 |                |                   |            |
| Amauroascus albicans (Apinis) Arx | –                                              | –               | Elymus pungens | UK                | [38]       |
| Amauroascus albicans (Apinis) Arx | –                                              | –               | Spartina townsendii | UK             | [38]       |
Table 1. Cont.

| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| **LECANOROMYCETES** | | | | | |
| **Ostropales** | | | | | |
| **Stictidaceae** | | | | | |
| Glomerobolus gelineus Kohlm. and Volkm.-Kohlm. Stictis sp. | Senescent culms | Saprobic | Juncus roemerianus | USA: North Carolina | [110] |
| | Living/decomposing leaf sheaths | Saprobic | Phragmites australis | Netherlands: Zeeland | [39] |
| **LEOTIOMYCETES** | | | | | |
| **Helotiales** | | | | | |
| **Amorphothecaceae** | | | | | |
| Amorphotheca resinae Parbery | Roots | Saprobic | Spartina sp. | Canada: Bay of Fundy | [48] |
| **Calloniaceae** | | | | | |
| Cistella fugens (W. Phillips) Matheis | Living/decomposing stems | Saprobic | Phragmites australis | Netherlands: Zeeland | [40] |
| **Heliotiaceae** | | | | | |
| Cyathicula culnicola (Desm.) De Not. | – | – | Elymus pungens | UK | [38] |
| Helotium sp. | – | – | Elymus pungens | UK | [38] |
| **Lachnaceae** | | | | | |
| Brunnipila palarrum (Desm.) Baral | – | – | Elymus pungens | UK | [38] |
| Lachnum controversum (Cooke) Keun | – | – | Spartina townsendii | UK | [38] |
| Lachnum spartinae S.A. Cantrell | Decaying leaf sheaths | Saprobic | Spartina alterniflora | USA: Georgia | [56,111] |
| – | – | – | Spartina spp. | – | [32] |
| **Mollisiaceae** | | | | | |
| Belonopsis atrriella (Cooke) Lindau | – | – | Spartina cynosuroides | USA: Louisiana | [68,90,112] |
| Mollisia hydrophila (P. Karst.) Sacc. | Living/decomposing leaf sheaths | Saprobic | Phragmites australis | Netherlands: Zeeland | [39] |
| Mollisia palustris (P. Karst.) P. Karst. | Living/decomposing leaf sheaths | Saprobic | Phragmites australis | Netherlands: Zeeland | [39] |
| Trichobolium kneiffii (Wallr.) J. Schröt. | Living/decomposing leaf sheaths, stems | Saprobic | Phragmites australis | Netherlands: Zeeland | [39,40] |
| **Ploetnerrulacaceae** | | | | | |
| Cadophora melini Nannf. | Leaves | Saprobic | Spartina sp. | Canada: Bay of Fundy | [48] |
| **Sclerotiniaceae** | | | | | |
Table 1. Cont.

| Taxon                                      | Host Part          | Life Mode | Hosts         | Distribution                      | References |
|--------------------------------------------|--------------------|-----------|---------------|-----------------------------------|------------|
| Botrytis cinerea Pers.                     | Stem               |           | Spartina townsendii | UK: England                       | [49]       |
|                                            | Leaves             | Saprobic  | Spartina sp.   | Canada: Bay of Fundy              | [48]       |
| Monilia sp.                                | Decaying leaves    | Saprobic  | Juncus roemerianus | USA: Florida                      | [43]       |
| Solenopeziaceae                            |                    |           |               |                                   |            |
| Halenospora varia (Anastasiou) E.B.G. Jones| Senescent leaves   | Saprobic  | Juncus roemerianus | USA: Florida                      | [43]       |
|                                            | Basal area of the sheath | Saprobic | Spartina densiflora | Argentina: Buenos Aires | [64]       |
| Helotiales genera incertae sedis           |                    |           |               |                                   |            |
| Cejpi hystrix (De Not.) Baral               | –                  | –         | Elymus pungens | UK                                | [38]       |
| Dactylaria sp.                             | Decaying stems and leaf sheaths | Saprobic | Phragmites australis | China: Hong Kong               | [41]       |
| Crocicreas gramineum (Fr.) Fr.             | –                  | –         | Elymus pungens | UK                                | [38]       |
| Leotiales                                  |                    |           |               |                                   |            |
| Leotiales genera incertae sedis            | Living leaves      | –         | Juncus roemerianus | USA: Florida                      | [43]       |
| Flagellospora sp.                          |                    |           |               |                                   |            |
| Rhytismatales Rhytismataceae               |                    |           |               |                                   |            |
| Lophodermium arundinaceum (Schrad.) Chevall.| Living/decomposing leaf sheaths, stems | Saprobic | Phragmites australis | Netherlands: Zeeland              | [39,40]    |
| Thelebolales                               |                    |           |               |                                   |            |
| Thelebolaceae                              |                    |           |               |                                   |            |
| Thelebolus crustaceus (Fuckel) Kimbr.      | –                  | –         | Elymus pungens | UK                                | [38]       |
| –                                          | –                  | –         | Puccinellia maritima | UK                                | [38]       |
| –                                          | –                  | –         | Spartina townsendii | UK                                | [38]       |
| ORBILIOMYCETES                             |                    |           |               |                                   |            |
| Orbilales                                  |                    |           |               |                                   |            |
| Orbiliaceae                                |                    |           |               |                                   |            |
| Arthrobotrys conoides Drechsler            | Decaying stems and leaf sheaths | Saprobic | Phragmites australis | China: Hong Kong               | [41]       |
| Arthrobotrys sp.                           | Decaying stems and leaf sheaths | Saprobic | Phragmites australis | China: Hong Kong               | [41]       |
| Orbilia junct Kohlm., Baral and Volkm.-Kohlm.| Tips of senescent leaves | –         | Juncus roemerianus | USA: North Carolina             | [113]      |
| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| **PEZIZOMYCETES** | | | | | |
| Peziales | | | | | |
| Pezizaceae | | | | | |
| Belonium heteromorphum (Ellis and Everh.) Seaver | – | – | Spartina cynosuroides | USA: Louisiana | [68,114] |
| **SACCHAROMYCETES** | | | | | |
| Saccharomycetales | | | | | |
| Debaryomycetaceae | | | | | |
| Debaryomyces hansenii (Zopf) Lodder and Kregger-van Rij | Decaying leaf blades | Saprobic | Spartina alterniflora | USA: Louisiana | [56] |
| Scheffersomyces spartinae (Ahearn, Yarrow and Meyers) Kurtzman and M. Suzuki | Decaying leaf blades | Saprobic | Spartina alterniflora | USA: Louisiana | [56] |
| **SORDARIOMYCETES** | | | | | |
| Amphischierales | | | | | |
| Amphisphaeriaceae | | | | | |
| Massariella sp. | – | – | Spartina townsendii | UK | [38] |
| Ommatomyces coronatus Kohlm., Volkm.-Kohlm. and O.E. Erikss. | Lower parts of senescent culms | Saprobic | Juncus roemerianus | USA: North Carolina | [97] |
| Pestalotia sp. | Living, senescent and decaying leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |
| **Apiosporaceae** | | | | | |
| Arthrinium arundinis (Corda) Dyko and B. Sutton | Living/decomposing leaf sheaths | Saprobic | Phragmites australis | Netherlands: Zeeland | [39] |
| | Dead culms | Saprobic | Phragmites sp. | South Australia | [62] |
| Arthrinium phaeospermum (Corda) M.B. Ellis | Living/decomposing leaf blades and sheaths, stems | Saprobic | Phragmites australis | Netherlands: Zeeland | [39,40,50] |
| | Inflorescence and upper leaves | Saprobic | Spartina patens | USA: Rhode Island | [61] |
| | – | Saprobic | Spartina alterniflora | USA: Rhode Island | [36] |
### Table 1. Cont.

| Taxon                          | Host Part                          | Life Mode | Hosts          | Distribution          | References |
|-------------------------------|------------------------------------|-----------|----------------|-----------------------|------------|
| *Arthrinium* spp.             | Living leaves                      | Saprobic  | *Juncus roemerianus* | USA: Florida         | [43]        |
|                               | Decaying stems and leaf sheaths    | Saprobic  | *Phragmites australis* | China: Hong Kong     | [41]        |
| *Nigrospora oryzae* (Berk. and Broome) Petch | Leaves                          | Saprobic  | *Distichlis spicata* | Argentina: Buenos Aires | [47]        |
|                               | Living, senescent, and decaying leaves | Saprobic  | *Juncus roemerianus* | USA: Florida         | [43]        |
| *Beltraniaceae*               |                                    |           |                |                       |            |
| *Beltrania guerna* Harkn.     | Decaying leaves                    | Saprobic  | *Juncus roemerianus* | USA: Florida         | [43]        |
| *Hyponectriaceae*             |                                    |           |                |                       |            |
| *Phygnonectria* ellipsoidea M.K.M. Wong, Goh and K.D. Hyde | Intertidal to aerial culms       | Saprobic  | *Phragmites australis* | China: Hong Kong     | [115]       |
| *Phygnonectria* marina M.K.M. Wong, Poon and K.D. Hyde | Decaying stems and leaf sheaths   | Saprobic  | *Phragmites australis* | China: Hong Kong     | [41]        |
| *Physalospora citogerminans* Kohlm., Volkm.-Kohlm. and O.E. Erikss. | Lower and upper parts of senescent culms | Saprobic  | *Juncus roemerianus* | USA: North Carolina | [116]       |
| *Sporocadaceae*               |                                    |           |                |                       |            |
| *Discostroma* sp.             | Living/decomposing leaf sheaths    | Saprobic  | *Phragmites australis* | Netherlands: Zeeland | [39]        |
| *Pestalotiopsis juncestris* Kohlm. and Volkm.-Kohlm. | Senescent involucral leaves and culms | Saprobic  | *Juncus roemerianus* | USA: North Carolina | [117]       |
| *Pestalotiopsis planium* (Vize) Steyaert | –                                  | Saprobic  | *Spartina alterniflora* | USA: Rhode Island    | [61]        |
| *Pestalotiopsis* sp.          | Decaying stems and leaf sheaths    | Saprobic  | *Phragmites australis* | China: Hong Kong     | [41]        |
| *Coronophorales*              |                                    |           |                |                       |            |
| *Melanospora* sp.             | Decaying leaves                    | Saprobic  | *Juncus roemerianus* | USA: Florida         | [43]        |
| *Microthecium fimicola* E.C. Hansen, Schigel, Guarro and Cano | –                                  | –         | *Elymus pungens*   | UK                    | [38]        |
| *Microthecium lectionum* Udagawa and Cain | Dead leaves/culms                 | Saprobic  | *Spartina alterniflora* | USA: Rhode Island    | [61]        |
| *Coronophorales genera incertae sedis* |                                   |           |                |                       |            |
| *Papulaspora halina* Anastasiou | Living and decaying leaves        | Saprobic  | *Juncus roemerianus* | USA: Florida         | [43]        |
| *Papulosa amerospora* Kohlm. and Volkm.-Kohlm. | Senescent culms                   | Saprobic  | *Juncus roemerianus* | USA: North Carolina  | [118]       |
| *Diaphorales*                 |                                    |           |                |                       |            |
| *Diaporthaceae*               |                                    |           |                |                       |            |
| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| **Phomopsis spp.** | Senescent and decaying leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |
| | Decaying stems and leaf sheaths | Saprobic | Phragmites australis | China: Hong Kong | [41] |
| Gnomoniaceae | – | – | Spartina sp. | – | [71] |
| Gnomonia salina E.B.G. Jones (probably a nomen dubium and possibly a Halosarpheia species) | – | Saprobic | Spartina alterniflora | USA: Connecticut | [36] |
| | – | – | Spartina spp. | – | [32,35] |
| **Diaporthales incertae sedis** | Senescent and decaying leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |
| **Glomerellales** | Senescent leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |
| **Glomerellaceae** | Decaying stems and leaf sheaths | Saprobic | Phragmites australis | China: Hong Kong | [41] |
| **Plectosphaerellaceae** | Senescent leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |
| **Hypocreales** | Leaves | Saprobic | Distichlis spicata | Argentina: Buenos Aires | [47] |
| Acremonium spp. | Living, senescent, and decaying leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |
| | Decaying stems and leaf sheaths | Saprobic | Phragmites australis | China: Hong Kong | [41] |
| **Clonostachys rosea** (Link) Schroers, Samuels, Seifert and W. Gams | Leaves | Saprobic | Spartina sp. | Canada: Bay of Fundy | [48] |
| Fusariella obstipa (Pollack) S. Hughes | Decaying leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |
| **Glomastix spp.** | Senescent and decaying leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |
| midrule **Hydropisphaera arenula** (Berk. and Broome) Rosman and Samuels | Decaying stems and leaf sheaths | Saprobic | Phragmites australis | China: Hong Kong | [41] |
| | Living/decomposing leaf sheaths | Saprobic | Phragmites australis | Netherlands: Zeeland | [39] |
| **Hydropisphaera erubescens** (Roberge ex Desm.) Rosman and Samuels | Decaying leaf blades | Saprobic | Spartina alterniflora | USA: Georgia | [56] |
| | – | – | Spartina spp. | – | [32] |
| Taxon                  | Host Part | Life Mode                  | Hosts                          | Distribution                                      | References      |
|-----------------------|-----------|----------------------------|--------------------------------|---------------------------------------------------|-----------------|
| *Atkinsonella hypoxylon* (Peck) Diehl | –         | –                          | *Spartina cynosuroides*       | –                                                 | [68]            |
|                        | –         | Saprobic                   | *Phragmites australis*        | UK: England (Southampton Hampshire, Sussex, Oxon) | [119,120]       |
| *Claviceps purpurea* (Fr.) Tul. | Replaced seeds in the inflorescence, ovaries of the flowers | Saprobic, parasitic          | *Spartina alterniflora*        | USA: Rhode Island; Argentina                        | [36,61,68,73,121,122] |
|                        | –         | Pathogenic                 | *Spartina anglica*            | UK                                               | [123]           |
|                        | –         | Saprobic, parasitic        | *Spartina cynosuroides*       | USA: New York, Florida, Mississippi               | [44,68,121,124] |
|                        | –         | –                          | *Spartina patens*             | USA: Maryland, Mississippi                        | [44,68,124,125] |
|                        | –         | –                          | *Spartina townsendii*         | UK: England                                      | [120,126]       |
|                        | –         | –                          | *Spartina sp.*                | Argentina                                        | [122]           |
|                        | –         | –                          | *Spartina foliosa*            | USA: California                                  | [127]           |
| *Metarhizium anisopliae* (Metschn.) Sorokin | Leaves | Saprobic                   | *Distichlis spicata*          | Argentina: Buenos Aires                           | [47]            |
| *Hypocreaceae*         |           |                            |                                |                                                   |                 |
| *Cladobotryum* sp.     | Decaying leaves | Saprobic                  | *Juncus roemerianus*          | USA: Florida                                      | [43]            |
| *Gliocladium* sp.      | Senescent leaves | Saprobic                  | *Juncus roemerianus*          | USA: Florida                                      | [43]            |
| *Trichoderma* citrinum* (Pers.) Jaklitsch, W. Gams and Voglmayr | Leaves | Saprobic                   | *Spartina sp.*                 | Canada: Bay of Fundy                              | [48]            |
| *Trichoderma* sp.      | Decaying stems and leaf sheaths | Saprobic                  | *Phragmites australis*        | China: Hong Kong                                  | [41]            |
| *Trichoderma* viride* Pers. | Living, senescent, and decaying leaves | Saprobic                  | *Juncus roemerianus*          | USA: Florida                                      | [43]            |
| *Nectriaceae*          |           |                            |                                |                                                   |                 |
| *Calonectria* sp.      | –         | –                          | *Elymus pungens*              | UK                                               | [38]            |
| *Fusarium* fujikuroi* Nirenberg | –         | Saprobic                   | *Suaeda australis*            | South Australia                                   | [62]            |
| *Fusarium* graminearum* Schwabe | Living/decomposing leaf sheaths, stems | Saprobic                  | *Phragmites australis*        | Netherlands: Zeeland                              | [39,40]         |
| *Fusarium* heterosporum* Nees and T. Nees | –         | –                          | *Spartina maritima*           | –                                                | [128]           |
| Taxon                                         | Host Part                  | Life Mode | Hosts                      | Distribution          | References |
|-----------------------------------------------|----------------------------|-----------|----------------------------|-----------------------|------------|
| Fusarium incarnatum (Desm.) Sacc.             | Leaves                     | Saprobic  | Distichlis spicata         | Argentina: Buenos Aires | [47]       |
| Fusarium oxysporum Schltld.                   | Leaves                     | Saprobic  | Distichlis spicata         | Argentina: Buenos Aires | [47]       |
| Fusarium poae (Peck) Wollenw.                 | Leaves                     | Saprobic  | Distichlis spicata         | Argentina: Buenos Aires | [47]       |
| Fusarium solani (Mart.) Sacc.                 | Decaying stems and leaf sheaths | Saprobic | Phragmites australis       | China: Hong Kong      | [41]       |
| Fusarium spp.                                 | Living, senescent, and decaying leaves | Saprobic | Juncus roemerianus        | USA: Florida          | [43]       |
| Gibberella sp.                                | Leaf sheaths and blades, stem | Saprobic  | Spartina maritima          | Portugal: Algarve     | [59]       |
| Nectria sp.                                   | Senescent and decaying leaves | Saprobic  | Juncus roemerianus        | USA: Florida          | [43]       |
| Tubercularia pulvulenta Speg.                 | Decaying leaf blades       | Saprobic  | Spartina alterniflora      | USA: Georgia          | [56]       |
| Volutella ciliata (Alb. and Schwein.) Fr.     | Leaves                     | Saprobic  | Distichlis spicata         | Argentina: Buenos Aires | [47]       |
| Sarocladiaceae                                |                            |           |                            |                       |            |
| Sarocladium implicatum (J.C. Galman and E.V. Abbott) A. Giraldo, Gene and Guarro | Leaves                     | Saprobic  | Distichlis spicata         | Argentina: Buenos Aires | [47]       |
| Sarocladium sp.                               | Decaying stems and leaf sheaths | Saprobic  | Phragmites australis       | China: Hong Kong      | [41]       |
| Stachybotryaceae                              |                            |           |                            |                       |            |
| Albitimbria verrucaria (Alb. and Schwein.) L. Lombard and Crous | Leaves                     | Saprobic  | Distichlis spicata         | Argentina: Buenos Aires | [47]       |
| Paramyrothecium roridum (Tode) L. Lombard and Crous | Living, senescent, and decaying leaves | Saprobic  | Juncus roemerianus        | USA: Florida          | [43]       |
| Taxon                                      | Host Part                        | Life Mode | Hosts   | Distribution | References |
|-------------------------------------------|----------------------------------|-----------|---------|--------------|------------|
| *Stachybotrys chartarum* (Ehrenb.) S. Hughes | Senescent and decaying leaves    | Saprobic  | *Juncus roemerianus* | USA: Florida | [43]       |
| *Stachybotrys cylindrosporus* C.N. Jensen   | Decaying leaves                  | Saprobic  | *Juncus roemerianus* | USA: Florida | [43]       |
| *Stachybotrys echinatus* (Rivolta) G. Sm.   | Senescent and decaying leaves    | Saprobic  | *Juncus roemerianus* | USA: Florida | [43]       |
| *Stachybotrys kampalensis* Hansf.           | Senescent leaves                 | Saprobic  | *Juncus roemerianus* | USA: Florida | [43]       |
| *Stachybotrys nephrosporus* Hansf.          | Senescent and decaying leaves    | Saprobic  | *Juncus roemerianus* | USA: Florida | [43]       |
| *Stachybotrys* spp.                        | Senescent and decaying leaves    | Saprobic  | *Juncus roemerianus* | USA: Florida | [43]       |
|                                            | Decaying stems and leaf sheaths  | Saprobic  | *Phragmites australis* | China: Hong Kong | [41]       |
|                                            | Decaying leaf blades             | Saprobic  | *Spartina alterniflora* | USA: Georgia | [56]       |
| *Striaticonidium cinctum* (Corda) L. Lombard and Crous | Living/decomposing leaf sheaths | Saprobic  | *Phragmites australis* | Netherlands: Zeeland | [39] |
| *Xepicula jollymannii* (N.C. Preston) L. Lombard and Crous | Senescent and decaying leaves    | Saprobic  | *Juncus roemerianus* | USA: Florida | [43]       |
| **Hypocreales genera incertae sedis**       |                                  |           |         |              |            |
| *Cephalosporium* spp.                      | Dead leaves/culms                | Saprobic  | *Spartina alterniflora* | USA: Rhode Island | [61]       |
| **Lulworthiales**                          |                                  |           |         |              |            |
| **Lulworthiaceae**                         |                                  |           |         |              |            |
| *Cumulospora marina* I. Schmidt             | Dead culm                        | Saprobic  | *Phragmites australis* | Iraq, Egypt, Germany, Thailand | [129] |
|                                           | –                                 | –         | *Spartina spp.*     | –            | [32]       |
| *Halazoon fuscus* (I. Schmidt) Abdel-Wahab, K.L. Pang, Nagah., Abdel-Aziz and E.B.G. Jones | Decaying rhizomes                | Saprobic  | *Phragmites australis* | France, Germany, Japan | [35,130] |
|                                           | Rhizomes and culms                | Saprobic  | *Phragmites sp.* | Sweden | [87]       |
| *Halazoon melhae* Abdel-Aziz, Abdel-Wahab and Nagahama | Decaying stem                   | Saprobic  | *Phragmites australis* | Egypt: Port Said | [130] |
| *Lulworthia floridana* Meyers              | –                                 | Saprobic  | *Spartina alterniflora* | USA: North Carolina, Rhode Island | [20,131] |
| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| Lulworthia medusa (Ellis and Everh.) Cribb and J.W. Cribb | Stems | Saprobic | Spartina townsendii | UK: England (Wales); USA: Virginia, North Carolina, South Carolina, Florida, Texas | [38,49,71,72,89,132–134] |
| | | | | | |
| | | | Elymus pungens | UK | [38] |
| | | | Spartina cynosuroides | USA: New Jersey | [89,132] |
| | | | Spartina spp. | USA: New Jersey | [32,89] |
| Lulworthia spp. | Dead culms | Saprobic | Spartina alterniflora | Argentina: Buenos Aires; USA: Rhode Island, North Carolina | [35,36,61,73,74] |
| | | | | | |
| | | | Spartina cynosuroides | | [35] |
| | | | Spartina sp. | Argentina: Buenos Aires; Canada; USA: Maine, North Carolina | [36] |
| | | | | | |
| | | | Spartina townsendii | | [35] |
| | Leaf sheaths and blades, stem | Saprobic | Spartina maritima | Portugal: Alentejo, Lisbon, Algarve, Centro | [31,54,59,63] |
| | | | | Egypt: Port Said | [130] |
| Moleospora maritima Abdel-Wahab, Abdel-Aziz and Nagah. | Decayed stems | Saprobic | Phragmites australis | | |
| Magnaporthales | | | | | |
| Ceratosphaeriaceae | Senescent leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |
| Magnaporthaceae | Lower stem and leaf sheath during the growth phase of the plant/living and dead; decaying leaf blades | Saprobic, parasitic | Spartina alterniflora | USA: Alabama, Rhode Island, Maine, New Hampshire, Connecticut, Mississippi, New Jersey, Virginia, North Carolina, Florida, Georgia | [20,35,36,55,56,58,61,73,74,82,92] |
Table 1. Cont.

| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
|       | Leaves    | Saprobic  | Spartina spp. | Canada: Bay of Fundy; USA: South Carolina; UK | [32,35,36,48,65] this study |
|       | Leaf sheaths and blades, stem | Saprobic | Spartina maritima | Portugal: Alentejo, Lisbon, Algarve, Centro | [31,54,59] |
| Gaeumannomyces sp. | Decaying stems and leaf sheaths | Saprobic | Phragmites australis | China: Hong Kong | [41] |
| Kohlmeyeriopsis medullaris (Kohlm., Volk. - Kohlm. and O.E. Erikss.) Klaubauf, M.-H. Lebrun and Crous | Lower parts of senescent culms | Saprobic | Juncus roemerianus | USA: North Carolina | [97,135] |
| Utrechtiella roumeguerel (Cavara) Videira and Crous | Living/decomposing leaf blades and sheaths | Saprobic | Phragmites australis | Netherlands: Zeeland | [39,50] |
| Pseudohalonectriaceae | Decaying stems and leaf sheaths | Saprobic | Phragmites australis | China: Hong Kong | [41] |
| Pseudohalonectria falcata Shearer | Fragments of leaves and culms in the wrack | Saprobic | Juncus roemerianus | USA: North Carolina | [105] |
| Meliolales | Meliolaceae | – | Phragmites australis | Australia: Queensland | [62] |
| Microascales | Halosphaeriaceae | – | – | – | – |
| Aniptodera chesapeakensis Shearer and M.A. Mill. | Dead leaves | Saprobic | Juncus roemerianus | USA: North Carolina | [35] |
| Aniptodera chesapeakensis Shearer and M.A. Mill. | Decaying stems and leaf sheaths | Saprobic | Phragmites australis | China: Hong Kong | [41] |
| Aniptodera phragmiticola O. K. Poon et K. D. Hyde | Leaf sheaths and blades, stem | Saprobic | Spartina maritima | Portugal: Alentejo, Algarve, Centro | [59,63] |
| Aniptodera juncicola Volk. - Kohlm. and Kohlm. | Dead standing culms | Saprobic | Juncus roemerianus | India: Kerala, West Bengal, Tamil Nadu; USA: North Carolina | [52,136] |
| Aniptodera phragmiticola O. K. Poon et K. D. Hyde | Decaying stems and leaf sheaths | Saprobic | Phragmites australis | China: Hong Kong | [41] |
Table 1. Cont.

| Taxon                                                                 | Host Part, hosts, Life Mode                                      | Distribution | References   |
|-----------------------------------------------------------------------|----------------------------------------------------------------|--------------|--------------|
| Ceriosporopsis halima Linde                                           | – Submerged seeds Saprobic, Spartina alterniflora USA          |              | [35]         |
|                                                                       | – Stem Saprobic, Spartina maritima Portugal: Alentejo          |              | [63]         |
| Cirrenalia macrocephala (Kohlm.) Meyers and R.T. Moore               | – Decaying culms Saprobic, Juncus roemerianus USA: Florida     |              | [43]         |
|                                                                      | – Senescent leaves Saprobic, Juncus roemerianus USA: Florida   |              | [43]         |
| Cirrenalia pseudomacrocephala Kohlm.                                   | – Submerged leaves Saprobic, Spartina alterniflora USA: Rhode Island |              | [20, 35, 61, 137] |
| Corollospora maritima Werderm.                                        | – Stem Saprobic, Spartina maritima Portugal: Alentejo          |              | [63]         |
| Corollospora ramulosas (Meyers and Kohlm.) E.B.G. Jones and Abdel-Wahab | – Saprobic, Unidentified saltmarsh plants USA: Mississippi     |              | [58]         |
| Haligena elaterophora Kohlm.                                           | – Saprobic, Spartina alterniflora USA: North Carolina          |              | [74]         |
| Halosarpevia culminipera Kohlm., Volkm.-Kohlm. and O.E. Erikss.       | Lower parts of senescent culms Saprobic, Juncus roemerianus USA: North Carolina |              | [97]         |
| Halosarpevia sp.                                                      | Stem Saprobic, Spartina maritima Portugal: Alentejo          |              | [63]         |
| Halosarpevia viscosa I. Schmidt ex Shearer and J.L. Crane             | Decaying leaf blades Saprobic, Spartina alterniflora USA: Georgia |              | [56]         |
| Halosphaeria appendiculata Linder                                     | – Saprobic, Spartina maritima Portugal: Lisbon                 |              | [54]         |
| Halosphaeria sp.                                                      | Submerged seeds Saprobic, Spartina alterniflora USA            |              | [137]        |
| Lautisporopsis circumvestita (Kohlm.) E.B.G. Jones, Yusoff and S.T. Moss | – Saprobic, Arundo donax USA                                  |              | [35]         |
Table 1. Cont.

| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| *Lignincola laevis* Höhnk | – | Saprobic | *Spartina spp.* | USA: North Carolina | [32, 138] |
| | – | Saprobic | *Spartina townsendii* | – | [35] |
| | Stem | Saprobic | *Spartina maritima* | Portugal: Alentejo | [63] |
| | – | Saprobic | *Elymus farctus* | – | [35] |
| *Magnisphaera spartinae* (E.B.G. Jones) J. Campb., J.L. Anderson and Shearer | – | Saprobic | *Phragmites australis* | USA: Rhode Island | [20, 35, 61] |
| | – | Saprobic | *Spartina alterniflora* | USA: Rhode Island | [20, 35, 61] |
| | – | Saprobic | *Spartina spp.* | – | [32] |
| | – | Saprobic | *Spartina patens* | USA: Rhode Island | [36] |
| | Stem | Saprobic | *Spartina townsendii* | UK: Wales | [35, 139] |
| | – | Saprobic | *Typha sp.* | – | [35] |
| *Nais inornata* Kohlm. | Decomposing culms | Saprobic | *Spartina alterniflora* | USA: Rhode Island | [20, 35, 61] |
| | | | *Spartina spp.* | – | [32] |
| *Natantiospora unipolaris* K.L. Pang, S.Y. Guo and E.B.G. Jones | Dead stem | Saprobic | *Phragmites australis* | Taiwan: Nankunshen | [140] |
| *Natantiospora retorquens* (Shearer and J.L. Crane) J. Campb., J.L. Anderson and Shearer | Leaf sheaths and blades, stem | Saprobic | *Spartina maritima* | Portugal: Alentejo, Lisbon, Algarve, Centro | [31, 54, 59, 63] |
| *Oceanitis unicaudata* (E.B.G. Jones and Camp.-Als.) J. Dupont and E.B.G. Jones | Decaying stems and leaf sheaths | Saprobic | *Phragmites australis* | China: Hong Kong | [41] |
| | Stem | Saprobic | *Spartina maritima* | Portugal: Alentejo | [63] |
| *Panorbis viscosus* (I. Schmidt) J. Campb., J.L. Anderson and Shearer | Leaf sheaths and blades, stem | Saprobic | *Spartina maritima* | Portugal: Alentejo, Algarve | [59, 63] |
| | – | Saprobic | *Elymus pungens* | UK | [35, 38] |
| *Remispora hamata* (Höhnk) Kohlm. | Senescent and decaying leaves | Saprobic | *Juncus roemerianus* | USA: Florida | [43] |
| | Living/decomposing leaf blades and sheaths, stems | Saprobic | *Phragmites australis* | Netherlands: Zeeland | [39, 40, 50] |
Table 1. Cont.

| Taxon                              | Host Part                         | Life Mode | Hosts                  | Distribution                      | References |
|------------------------------------|-----------------------------------|-----------|------------------------|-----------------------------------|------------|
| –                                  | Saprobič                          | Saprobič  | Phragmites sp.         | Sweden                            | [87]       |
| Dead leaves                        | Saprobič                          | Saprobič  | Spartina alterniflora  | USA: Rhode Island, Maine, Florida | [20,35,61,73] |
| –                                  | Saprobič                          | Saprobič  | Spartina patens        | USA: Rhode Island                 | [36]       |
| –                                  | Saprobič                          | Saprobič  | Spartina sp.           | USA: North Carolina; Argentina: Buenos Aires | [36,138] |
| –                                  | –                                 | –         | Spartina townsendii    | –                                 | [35]       |
| Remispora trullifera Kohlm.        | Leaf sheaths and blades, stem     | Saprobič  | Spartina maritima      | Portugal: Centro                  | [59]       |
| Tirispora unicaudata E.B.G. Jones and Vrijmoed | Stem                          | Saprobič  | Spartina maritima      | Portugal: Alentejo                | [63]       |
| Microascaceae                      |                                   |           |                        |                                   |            |
| Scopulariopsis spp.                | Living, senescent, and decaying leaves | Saprobič  | Juncus roemerianus    | USA: Florida                       | [43]       |
| Myrmecidiiales                     |                                   |           |                        |                                   |            |
| Myrmecidiaceae                     |                                   |           |                        |                                   |            |
| Myrmecidium schulzeri (Sacc.) Arzanlou, W. Gams and Crous | Leaves | Saprobič  | Distichlis spicata    | Argentina: Buenos Aires           | [47]       |
| Ophiostomatales                    |                                   |           |                        |                                   |            |
| Ophiostomataceae                   |                                   |           |                        |                                   |            |
| Sporothrix sp.                     | Senescent leaves                  | Saprobič  | Juncus roemerianus    | USA: Florida                       | [43]       |
| Phomatosporales                    |                                   |           |                        |                                   |            |
| Phomatosporaceae                   |                                   |           |                        |                                   |            |
| Phomatospora bellaminuta Kohlm., Volkm.-Kohlm. and O.E. Erikss. | Lower parts of senescent culms | Saprobič  | Juncus roemerianus    | USA: North Carolina                | [116]      |
| Phomatospora berkeleyi Sacc.       | Living/decomposing leaf blades and sheaths, stems | Saprobič  | Phragmites australis  | Netherlands: Zeeland              | [39,40,50] |
| Phomatospora dinemasporium J. Webster | Decaying stems and leaf sheaths, stems | Saprobič  | Phragmites australis  | China: Hong Kong; Netherlands: Zeeland | [40,41] |
| –                                  | –                                 | Saprobič  | Phragmites sp.         | South Australia                    | [62]       |
| –                                  | –                                 | –         | Spartina townsendii    | UK                                 | [38]       |
| Phomatospora phragmiticola Poon and K.D. Hyde | Decaying stems and leaf sheaths | Saprobič  | Phragmites australis  | China: Hong Kong                    | [41]       |
| Taxon                          | Host Part                        | Life Mode     | Hosts                    | Distribution                     | References              |
|--------------------------------|----------------------------------|---------------|--------------------------|-----------------------------------|-------------------------|
| **Phomatospora spp.**          | Senescent and decaying leaves    | Saprobic      | Juncus roemerianus       | USA: Florida                      | [43]                    |
|                                | Living/decomposing leaf sheaths, stems | Saprobic      | Phragmites australis     | Netherlands: Zeeland              | [39,40]                 |
| **Phyllachorales**             |                                  |               |                          |                                   |                         |
| **Phyllachoraceae**            |                                  |               |                          |                                   |                         |
| **Phyllachora graminis** (Pers.) Fuckel | –                              | –             | Elymus pungens          | UK                                | [38]                    |
| **Phyllachora cynodontis** Niessl. | –                              | –             | Spartina alterniflora   | USA: Massachusetts                | [44]                    |
| **Phyllachora paludicola** Kohlm. and Volkm.-Kohlm. | Dead leaves (lower half of standing culms) | Saprobic    | Spartina alterniflora   | USA: Florida, Georgia, North Carolina, Maryland, Delaware | [142] |
| **Phyllachora sylvatica** Sacc. and Speg. | –                              | Saprobic      | Spartina patens         | USA: South Carolina               | [141]                  |
| **Savoryellales**              |                                  |               |                          |                                   |                         |
| **Savoryellaceae**             |                                  |               |                          |                                   |                         |
| **Savoryella paucispora** (Cribb and J.W. Cribb) J. Koch | –                              | –             | Elymus pungens          | –                                 | [35]                    |
| **Sordariales**                |                                  |               |                          |                                   |                         |
| **Sordariales**                |                                  |               |                          |                                   |                         |
| **Chaetomiaceae**              |                                  |               |                          |                                   |                         |
| **Achaetomium sp.**            | Decaying leaves                  | Saprobic      | Juncus roemerianus      | USA: Florida                      | [43]                    |
| **Chaetomium clatum** Kunze    | –                                | –             | Elymus pungens          | UK                                | [38]                    |
| **Chaetomium globosum** Kunze   | –                                | –             | Puccinellia maritima    | UK                                | [38]                    |
|                                | –                                | –             | Spartina townsendii     | UK                                | [38]                    |
|                                | –                                | –             | Elymus pungens          | UK                                | [38]                    |
| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| Chaetomium spirale Zopf | – | – | Puccinellia maritima | UK | [38] |
| | – | – | Spartina townsendii | UK | [38] |
| Chaetomium thermophilum La Touche | – | – | Elymus pungens | UK | [38] |
| | – | – | Puccinellia maritima | UK | [38] |
| | – | – | Spartina townsendii | UK | [38] |
| Chaetomium sp. | Stem | Saprobic | Typha sp. | UK | This study |
| Corynascus sepedonium (C.W. Emmons) Arx | – | – | Elymus pungens | UK | [38] |
| | – | – | Puccinellia maritima | UK | [38] |
| Dichotomopilus funicola (Cooke) X.Wei Wang and Samson | – | – | Elymus pungens | UK | [38] |
| | – | – | Spartina townsendii | USA: Rhode Island | [61] |
| | – | – | Spartina alterniflora | USA: Rhode Island | [61] |
| | – | – | Spartina townsendii | UK | [38] |
| Dichotomopilus indicus (Corda) X.Wei Wang and Samson | – | – | Elymus pungens | UK | [38] |
| Humicola sp. | Living, senescent, and decaying leaves | Saprobic | Juncus roemerianus | USA: Florida | [43] |
| | Decaying stems and leaf sheaths | Saprobic | Phragmites australis | China: Hong Kong | [41] |
| Thermothielavioides terrestris (Apinis) X. Wei Wang and Houbraken | – | – | Elymus pungens | UK | [38] |
| | – | – | Puccinellia maritima | UK | [38] |
| Trichocladium constrictum I. Schmidt | Stem | Saprobic | Spartina maritima | Portugal: Alentejo | [63] |
| Trichocladium crispatum (Fuckel) X. Wei Wang and Houbraken | – | – | Elymus pungens | UK | [38] |
| | – | – | Spartina townsendii | UK | [38] |
| Lasiosphaeriaceae | – | – | – | – | – |
| Schizothecium hispidulum (Spreg.) N. Lundq. | Living/decomposing leaf sheaths | Saprobic | Phragmites australis | Netherlands: Zeeland | [39] |
| Zopfiella latipes (N. Lundq.) Malloch and Cain | Decaying stems and leaf sheaths | Saprobic | Phragmites australis | China: Hong Kong | [41] |
| Sordariaceae | – | – | Elymus pungens | UK | [38] |

Neurospora calospora (Mouton) Dania Garcia, Stichigel and Guarro
| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| *Sordaria fimicola* (Roberge ex Desm.) Ces. and De Not. | Leaves | Saprobic | *Elymus pungens* | UK | [38] |
| | – | – | *Distichlis spicata* | Argentina: Buenos Aires | [47] |
| | – | – | *Puccinellia maritima* | UK | [38] |
| | – | – | *Spartina townsendii* | UK | [38] |
| **Sordariomycetes families incertae sedis** | | | | | |
| *Koorchaloma galateae* Kohlm. and Volk.-Kohlm. | Senescent culms | Saprobic | *Juncus roemerianus* | USA: North Carolina | [117] |
| *Koorchaloma spartinicola* V.V. Sarma, S.Y. Newell and K.D. Hyde | Decaying leaf blades | Saprobic | *Spartina alterniflora* | USA: Georgia | [56] |
| *Koorchaloma* sp. | Decaying leaf blades | Saprobic | *Spartina alterniflora* | USA: Georgia | [56] |
| *Lautospora simillima* Kohlm., Volk.-Kohlm. and O.E. Erikss. | Lower parts of senescent, soft culms | Saprobic | *Juncus roemerianus* | USA: North Carolina | [78] |
| **Sordariomycetes genera incertae sedis** | | | | | |
| *Aquamarina speciosa* Kohlm., Volk.-Kohlm. and O.E. Erikss. | Senescent culms | Saprobic | *Juncus roemerianus* | USA: Georgia, North Carolina, Virginia | [77] |
| *Aropsiclus junaci* (Kohlm. and Volk.-Kohlm.) Kohlm. and Volk.-Kohlm. | Senescent culms | Saprobic | *Juncus roemerianus* | USA: North Carolina | [143] |
| *Zalerion maritima* (Linder) Anastasiou | Basal area of the sheath | Saprobic | *Spartina densiflora* | Argentina: Buenos Aires | [64] |
| *Ellisenbia* sp. | Decaying stems and leaf sheaths | Saprobic | *Phragmites australis* | China: Hong Kong | [41] |
| **Torpedosporales** | | | | | |
| **Juncigenaceae** | | | | | |
| *Juncigena adarca* Kohlm., Volk.-Kohlm. and O.E. Erikss. | Senescent leaves | Saprobic | *Juncus roemerianus* | USA: North Carolina | [76] |
| **Moheitosporales adarca** (Kohlm., Volk.-Kohlm. and O.E. Erikss.) Abdel-Wahab, Abdel-Aziz and Nagah | Stems | Saprobic | *Juncus roemerianus* | USA | [130] |
| **Moheitosporales fruticosae** Abdel-Wahab, Abdel-Aziz and Nagah. | Decayed stems | Saprobic | *Suada vermiculata* | Egypt: Alexandria | [130] |
| **Tracyllalales** | | | | | |
| **Torpedospora radiata** Meyers | – | Saprobic | Unidentified saltmarsh plants | USA: Mississippi | [58] |
| Taxon | Host Part | Life Mode | Hosts | Distribution | References |
|-------|-----------|-----------|-------|--------------|------------|
| **Tracyllaceae** | | | | | |
| *Tracylla spartinae* (Peck) Tassi | – | Saprobic, pathogenic | *Spartina patens* | USA: Mississippi | [44,68] |
| **Xylariales** | | | | | |
| **Diatrypaceae** | | | | | |
| *Cryptovalsa suaedicola* Spooner | Dead twigs | Saprobic | *Suaeda vermiculata* | UK: Great Britain | [144] |
| *Halocryptovalsa salicorniae* Dayar. and K.D. Hyde | Dead stem | Saprobic | *Salicornia sp.* | Thailand: Prachuap Khiri Khan | [145] |
| **Xylariaceae** | | | | | |
| *Anthostomella atroalba* Kohlm., Volkm.-Kohlm. and O.E. Erikss. | Senescent leaves | Saprobic | *Juncus roemerianus* | USA: North Carolina | [60] |
| *Anthostomella lugubris* (Roberge ex Desm.) Sacc. | – | – | *Elymus pungens* | UK | [38] |
| *Anthostomella phaeosticta* (Berk.) Sacc. | – | – | *Elymus pungens* | UK | [38] |
| *Anthostomella poecila* Kohlm., Volkm.-Kohlm. and O.E. Erikss. | Lower and upper parts of senescent culms, decaying leaves | Saprobic | *Juncus roemerianus* | USA: Alabama, Mississippi, North Carolina | [55,58,116] |
| *Anthostomella punctulata* (Roberge ex Desm.) Sacc. | Living/decomposing leaf blades and sheaths | Saprobic | *Phragmites australis* | Netherlands: Zeeland | [39,50] |
| *Anthostomella semitecta* Kohlm., Volkm.-Kohlm. and O.E. Erikss. | Senescent culms | – | *Juncus roemerianus* | USA: North Carolina | [116] |
| *Anthostomella spissitecta* Kohlm. and Volkm.-Kohlm. | Leaf sheaths of senescent culms | Saprobic | *Spartina alterniflora, S. densiflora.* | USA: Connecticut, Florida, North Carolina, Rhode Island; Argentina: Buenos Aires | [32] |
| | – | – | *Spartina sp.* | – | [32] |
| | Leaf sheaths and blades, stems | Saprobic | *Spartina maritima* | Portugal: Algarve | [59] |
| *Anthostomella spp.* | – | – | *Elymus pungens* | UK | [38] |
| | – | Saprobic | *Spartina alterniflora* | USA: Connecticut, Florida, North Carolina, Rhode Island; Argentina | [36,61] |
| | – | Saprobic | *Spartina townsendii* | USA: North Carolina | [38] |
| *Geniculosporium* sp. | Living, senescent, and decaying leaves | Saprobic | *J uncus roemerianus* | USA: Florida | [43] |
| Taxon                          | Host Part                  | Life Mode | Hosts                          | Distribution       | References |
|-------------------------------|----------------------------|-----------|--------------------------------|--------------------|------------|
| *Rosellinia* sp.              | Dead leaves/culms          | Saprobic  | *Spartina alterniflora*        | USA: Rhode Island  | [61]       |
| *Virgaria nigra* (Link) Nees  | Senescent leaves           | Saprobic  | *Juncus roemerianus*          | USA: Florida       | [43]       |
| *Zygosporiaceae*              |                            |           |                                |                    |            |
| *Zygosporium* g. *gibbum* (Sacc., M. Rousseau and E. Bommer) S. Hughes | Decaying leaves              | Saprobic  | *Juncus roemerianus*          | USA: Florida       | [43]       |
| *Zygosporium masonii* S. Hughes | Decaying leaves            | Saprobic  | *Juncus roemerianus*          | USA: Florida       | [43]       |
| *Zygosporium* sp.             | Decaying leaves            | Saprobic  | *Juncus roemerianus*          | USA: Florida       | [43]       |
| *Xylariales genera incertae sedis* |                        |           |                                |                    |            |
| *Circinotrichum maculiforme* Nees | Decaying leaves            | Saprobic  | *Juncus roemerianus*          | USA: Florida       | [43]       |
| *Xylariomycetidae* family *incertae sedis* |                   |           |                                |                    |            |
| *Cainiaceae*                  |                            |           |                                |                    |            |
| *Atrotorquata* lineata Kohlm. and Volkrm.-Kohlm.* | Senescent culms          | Saprobic  | *Juncus roemerianus*          | USA: North Carolina| [104]      |
|                               |                            | Saprobic  | Unidentified saltmarsh plant   | USA: Mississippi   | [58]       |
| *Ascomycota genera incertae sedis* |                        |           |                                |                    |            |
| *Asteromyces* cruciatus C. Moreau and Moreau ex Hennebert | –                        | –         | *Agropyron* sp.               | –                  | [35]       |
|                               |                            | –         | *Amphophila arenaria*          | –                  | [35]       |
|                               |                            | –         | *Spartina* spp.               | –                  | [32,35]    |
|                               |                            | –         | *Zostera* sp.                 | USA: California    | [74]       |
| *Cremasteria cymatilis* Meyers and R.T. Moore Nomen dubium | Senescent leaves          | Saprobic  | *Juncus roemerianus*          | USA: Florida       | [43]       |
| *Cytoplacosphaeria phragmiticola* Poon and K.D. Hyde | Decaying stems and leaf sheaths | Saprobic  | *Phragmites australis*        | China: Hong Kong   | [41]       |
|                               |                            | Saprobic  | *Phragmites australis*        | Netherlands: Zeeland| [39,40]    |
| *Cytoplacosphaeria rimosa* (Oudem.) Petr. | Living/decomposing leaf sheaths, stems | Saprobic  | *Phragmites australis*        |                     |            |
| *Cytosporina* sp.             | Living, senescent, and decaying leaves | Saprobic  | *Juncus roemerianus*          | USA: Florida       | [43]       |
| *Didymosamarospora* euryhalina T.W. Johnson and H.S. Gold | Culms                      | Saprobic  | *Juncus roemerianus*          | USA: North Carolina| [146]      |
| *Haplobasidion* lelebci Sawada ex M.B. Ellis | Living, senescent, and decaying leaves | Saprobic  | *Juncus roemerianus*          | USA: Florida       | [43]       |
| *Hymenopsis* chlorothrix Kohlm. and Volkrm.-Kohlm. | Senescent culms         | Saprobic  | *Juncus roemerianus*          | USA: North Carolina| [147]      |
| *Hyphopolynema* junctatile Kohlm. and Volkrm.-Kohlm. | Senescent leaves       | Saprobic  | *Juncus roemerianus*          | USA: North Carolina| [148]      |
**Table 1. Cont.**

| Taxon                                              | Host Part                                      | Life Mode | Hosts                  | Distribution         | References |
|----------------------------------------------------|------------------------------------------------|-----------|------------------------|----------------------|------------|
| Kolletes undulatus Kohlm. and Volkm.-Kohlm.        | Senescent leaves and culms                    | Saprobic  | Juncus roemerianus     | USA: North Carolina  | [105]      |
| Minimimidochium parrum Cabello, Aramb. and Cazau   | Leaves                                         | Saprobic  | Distichlis spicata     | Argentina: Buenos Aires | [47]       |
| Monodictys pelagica (T. Johnson) E.B.G. Jones      | Decomposing culms                             | Saprobic  | Spartina alterniflora  | USA: Rhode Island    | [20, 25, 61, 73] |
| Minimidochium parvum Cabello, Aramb. and Cazau     | –                                               | –         | Juncus sp.             | –                    | [35]       |
| Monodictys pelagica (T. Johnson) E.B.G. Jones      | –                                               | –         | Spartina spp.          | –                    | [32]       |
| Neottiospora sp.                                   | Living, senescent, and decaying leaves        | Saprobic  | Juncus roemerianus     | USA: Florida         | [43]       |
| Octopodotus stupendus Kohlm. and Volkm.-Kohlm.     | Dead leaves (lower half of standing culms)    | Saprobic  | Spartina alterniflora  | USA: North Carolina  | [142]      |
| Pycnodallia dupla Kohlm. and Volkm.-Kohlm.         | Senescent inflorescences (involutral leaves and branchlets) | Saprobic  | Juncus roemerianus     | USA: North Carolina  | [147]      |
| Sphaeonaema sp.                                    | Senescent leaves                              | Saprobic  | Juncus roemerianus     | USA: Florida         | [43]       |
| Stauronema sp.                                     | Decaying stems and leaf sheaths                | Saprobic  | Phragmites australis   | China: Hong Kong     | [41]       |
| Tetranacriella papillata Kohlm. and Volkm.-Kohlm.  | Senescent leaves                              | Saprobic  | Juncus roemerianus     | USA: North Carolina  | [117]      |
| Tetranacrium sp.                                   | Decaying stems and leaf sheaths                | Saprobic  | Phragmites australis   | China: Hong Kong     | [41]       |
| Zythia spp.                                        | Living, senescent, and decaying leaves         | Saprobic  | Juncus roemerianus     | USA: Florida         | [43]       |
| Psammmina sp.                                      | Senescent leaves                              | Saprobic  | Juncus roemerianus     | USA: Florida         | [43]       |

**BASIDIOMYCOTA**

**AGARICOMYCETES**

**Agaricales**

**Niaceae**

| Merisnodoes bresadolae (Grelet) Singer             | Living/decomposing stems                       | Saprobic  | Phragmites australis   | Netherlands: Zeeland | [40]       |
| Nia globispora Barata and Basilio                 | Stem                                            | Saprobic  | Spartina maritima      | Portugal: Alentejo   | [63]       |
| Nia vibrissa R.T. Moore and Meyers               | Old stem                                        | Saprobic  | Spartina alterniflora  | USA: North Carolina  | [35, 149]  |
|                                                | –                                               | Saprobic  | Spartina spp.          | USA: North Carolina  | [32, 150]  |
|                                                | Stem                                            | Saprobic  | Spartina maritima      | Portugal: Alentejo   | [63]       |
Table 1. Cont.

| Taxon                                      | Host Part                      | Life Mode | Hosts                  | Distribution                  | References          |
|-------------------------------------------|--------------------------------|-----------|------------------------|-------------------------------|---------------------|
| AGARICOSTILBOMYCETES                      |                                |           |                        |                               |                     |
| Agaricostilbales                          |                                |           |                        |                               |                     |
| Chionosphaeraceae                         |                                |           |                        |                               |                     |
| *Stilbum* sp.                             | Decaying leaves                | Saprobic  | *Juncus roemerianus*   | USA: Florida                  | [43]                |
| BARTHELETIOMYCETES                        |                                |           |                        |                               |                     |
| Sebacinales                               |                                |           |                        |                               |                     |
| Sebacinaceae                              |                                |           |                        |                               |                     |
| *Chaetospermum camelliae* Agnihothr.      | Decaying stems and leaf sheaths | Saprobic  | *Phragmites australis* | China: Hong Kong            | [41]                |
| MICROBOTRYOMYCETES                        |                                |           |                        |                               |                     |
| Sporidiobolales                           |                                |           |                        |                               |                     |
| Sporidiobolaceae                          |                                |           |                        |                               |                     |
| *Sporobolomyces roseus* Kluyver and C.B. Niel | Leaves                       | Saprobic  | *Spartina sp.*         | Canada: Bay of Fundy          | [48]                |
| *Sporobolomyces* spp.                     | Living/decomposing leaf blades and sheaths | Saprobic  | *Phragmites australis* | Netherlands: Zeeland          | [39,50]             |
| PUCCINIOMYCETES                           |                                |           |                        |                               |                     |
| Pucciniales                               |                                |           |                        |                               |                     |
| Pucciniaceae                              |                                |           |                        |                               |                     |
| *Puccinia distichlidis* Ellis and Eeverh. | –                              | –         | *Distichlis spicata*   | USA                           | [151]               |
| *Puccinia magnusiana* Körn.               | Living/decomposing leaf blades and sheaths | Saprobic  | *Phragmites australis* | Netherlands: Zeeland          | [39,50]             |
| *Puccinia phragmitis* (Schumach.) Tul.    | Living/decomposing leaf blades and sheaths | Saprobic  | *Phragmites australis* | Netherlands: Zeeland          | [39,50]             |
| *Puccinia sparganioidis* Ellis and Barthol. | –                              | Saprobic, parasitic | *Spartina alterniflora* | USA: Maine, New Hampshire, Massachusetts, Rhode Island, Delaware, Virginia, North Carolina, Florida, Mississippi | [36,44,68,73,152] |
|                                            | –                              | –         | *Spartina cynosuroides* | USA: New Jersey, Delaware, Maryland, South Carolina, Florida, Louisiana | [44,68,153]         |
| Taxon                                  | Host Part          | Life Mode               | Hosts                        | Distribution                                                                 | References       |
|----------------------------------------|--------------------|-------------------------|------------------------------|-------------------------------------------------------------------------------|------------------|
|                                        |                    | Saprobic, pathogenic    | Spartina patens              | USA: Connecticut, Maryland, New Jersey, New York                               | [44,68,153]      |
| Uromyces acuminatus Arthur             |                    | Saprobic, pathogenic    | Spartina alterniflora        | USA: Maine, New Hampshire, Massachusetts, Connecticut, New York, New Jersey,    | [44,68,152]      |
|                                        |                    | Saprobic, pathogenic    | Spartina cynosuroides        | USA: Florida                                                                  | [44,68,153]      |
|                                        |                    | Saprobic                | Spartina patens              | USA: Connecticut, Delaware, Florida, Maine, Maryland, Massachusetts, New       | [44,68]          |
|                                        |                    |                         |                              | Hampshire, New Jersey, New York                                               |                  |
| Uromyces argutus F. Kern               |                    | Saprobic, pathogenic    | Spartina alterniflora        | France; USA: Florida                                                          | [44,68,152]      |
| Uromyces salicorniae (DC.) de Bary     |                    |                         |                              | South Australia                                                               | [95]             |
| Pucciniales genera incertae sedis      |                    |                         |                              |                                                                              |                  |
| Aecidium suaeae Thüm.                  | Leaves             |                         |                              |                                                                              | [154]            |
| TREMELLOMYCETES                         |                    |                         |                              |                                                                              |                  |
| Tremellales                             |                    |                         |                              |                                                                              |                  |
| Tremellaceae                            |                    |                         |                              |                                                                              |                  |
| Tremella spicifera Van Ryck., Van de Put and P. Roberts | Living/decomposing leaf sheaths and stems | Saprobic | Phragmites australis | Netherlands: Zeeland | [39,40] |
| USTILAGINOMYCETES                      |                    |                         |                              |                                                                              |                  |
| Ustilaginales                           |                    |                         |                              |                                                                              |                  |
| Ustilaginaceae                          |                    |                         |                              |                                                                              |                  |
| Tranzscheliella distichlidis (McAlpine) Vánky | –                  | Pathogenic              | Distichlis spicata           | Australia: Victoria                                                           | [155]            |
| Ustilaginales genera incertae sedis    |                    |                         |                              |                                                                              |                  |
| Parvulago marina (Durieu) R. Bauer, M. Lutz, Piętek, Vánky and Oberw. | –                  | –                       | Eleocharis parvula             | Finland, France, Germany, UK, Norway, Sweden                                  | [156]            |
| Urocystidales                           |                    |                         |                              |                                                                              |                  |
| Urocystidaceae                          |                    |                         |                              |                                                                              |                  |
Table 1. Cont.

| Taxon                                               | Host Part                          | Life Mode | Hosts          | Distribution     | References |
|-----------------------------------------------------|------------------------------------|-----------|----------------|------------------|------------|
| *Flamingomyces ruppiae* (Feldmann) R. Bauer, M. Lutz, Piątek, Vánky and Oberw. | –                                   | Parasitic | *Ruppia maritima* | France         | [156]      |
| **MUCOROMYCOTA**                                    |                                    |           |                |                  |            |
| **MUCOROMYCETES**                                   |                                    |           |                |                  |            |
| **Mucorales**                                       |                                    |           |                |                  |            |
| **Choanephoraceae**                                 |                                    |           |                |                  |            |
| *Blakeslea trispora* Thaxt.                        | Senescent and decaying leaves      | Saprobian | *Juncus roemerianus* | USA: Florida   | [43]       |
| **Mucoraceae**                                      |                                    |           |                |                  |            |
| *Mucor* sp.                                         | Senescent leaves                   | Saprobian | *Juncus roemerianus* | USA: Florida   | [43]       |
| Roots                                               | Saprobian                          |           | *Spartina sp.*  | Canada: Bay of Fundy | [48]       |
| **Rhizopodaceae**                                   |                                    |           |                |                  |            |
| *Rhizopus stolonifer* (Ehrenb.) Vuill.             | Stems                              | Saprobian | *Spartina townsendii* | UK: England | [49]       |
| **Syncephalastraceae**                              |                                    |           |                |                  |            |
| *Syncephalastrum racemosum* Cohn ex J. Schröt.     | Living and senescent leaves        | Saprobian | *Juncus roemerianus* | USA: Florida | [43]       |
2. Taxonomic Classification of Salt Marsh Fungi

2.1. Phyla

Calado and Barata [34] documented 332 taxa associated with Juncus roemerianus, Phragmites australis, and Spartina spp. In this review, we list 486 taxa that belong to three phyla (Ascomycota, Basidiomycota, Mucoromycota) (Table 1, Figure 3) and selected species are illustrated in Figure 4. Ascomycota dominates the taxa from salt marsh ecosystems, accounting for 95.27% (463 taxa). Nineteen species in twelve genera (Aecidium, Chaetospermum, Falmingomyces, Merismodes, Nia, Parvulago, Puccinia, Sporobolomyces, Stilbum, Tranzscheliella, Tremella, Uromyces) belong to Basidiomycota (3.91%), while Mucoromycota account for 0.82% (four species) of the salt marsh fungi.

2.2. Class

Salt marsh fungi are distributed into 17 classes (Table 1, Figure 5). Dothideomycetes has the highest number of taxa, which comprises 47.12% (229 taxa), followed by Sordariomycetes with 167 taxa (34.36%). Twenty-one species (in 20 genera) can be referred to as Ascomycota genera incertae sedis. The Ascomycetes with the least number of species include Leotiomycetes (21 species, 4.32%), Eurotiomycetes (16 species, 3.29%), Orbiliomycetes (3 species, 0.62%), Saccharomycetes (3 species, 0.62%), Lecanoromycetes (2 species, 0.41%), and Pezizomycetes (1 species, 0.21%).

Seven classes represent the Basidiomycota (Figure 5). Puccinomycetes has the highest number of taxa documented (eight species, three genera) followed by Agaricomycetes (three species, two genera), Ustilaginomycetes (three species, three genera), and Microbotryomycetes (two taxa, one genus). Agaricostilbomycetes, Bartheletiomycetes, and Tremelomycetes have one representative taxon each.

The Mucoromycota account for the taxa Blakeslea trispora, Mucor sp., Rhizopus stolonifera, and Syncephalastrum racemosum [43,48,49].

![Figure 3. The distribution of salt marsh fungi among three fungal phyla.](image-url)
Figure 4. Salt marsh fungi. (a,b) *Halobyssothecium obiones* from *Atriplex portulacoides*; (c,d) *Halobyssothecium phragmites* from culms of *Phragmites* sp.; (e,f) *Buergenerula spartinae* from culms of *Spartina* sp.; (g,h) *Chaetomium* sp. from stem of *Typha* sp.; (i,j) *Alternaria* sp. from culms of *Spartina* sp. Scale bars: (a,g) = 500 µm; (b,d,f,h,j) = 20 µm; (c,i) = 200 µm; (e) = 100 µm.
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Figure 5. The distribution of salt marsh fungi in different fungal classes.

2.3. Orders

Salt marsh fungi recorded from different halophytes were distributed among 48 orders (Table 1, Figure 6). The Pleosporales is the largest order, with 178 taxa recorded followed by Hypocreales (41), Microascales (26), Capnodiales (22), Helotiales (18), Xylariales (17), Sordariales (16), Amphisphaeriales (15), and Eurotiales (13). The remaining 41 orders have less than 10 species (Table 1, Figure 5). Forty-two taxa belong to incertae sedis (Ascomycota genera incertae sedis: 21; Dothideomycetes families incertae sedis: 11; Sordariomycetes families incertae sedis: 9; Xylariomycetidae family incertae sedis: 1).

2.4. Families

A total of 108 families and 12 incertae sedis were recorded to be associated with salt marsh fungi (Table 1, Figure 7). Phaeosphaeriaceae and Pleosporaceae account for the largest families with 34 and 31 taxa recorded, respectively. Thirteen families have ten or more taxa and include Nectriaceae (25), Halosphaeriaceae (25), Didymellaceae (17), Mycosphaerellaceae (14), Lentitheciaceae (13), Massarinaceae (13), Chaetomiaceae (12), Xylariaceae (11), Didymosphaeriaceae (10), Leptosphaeriaceae (10), and Aspergillaceae (10). The remaining 95 families have less than ten species recorded. Forty-four taxa are placed as incertae sedis, wherein 21 of these belong to Ascomycota genera incertae sedis.
Figure 6. The distribution of salt marsh fungi in major fungal orders.

Figure 7. The distribution of salt marsh fungi among major fungal families.

3. Diversity of Fungi in Halophytes

Twenty-seven genera under 11 families (Amaranthaceae, Apiaceae, Caryophyllaceae, Compositae, Juncaceae, Juncaginaceae, Plumbaginaceae, Poaceae, Primulaceae, Ruppiaceae, Typhaceae, Zosteraceae) of halophytes were reviewed for its fungal associates (Table 1, Figure 8). Halophytic species are represented in Figures 1 and 2.

Figure 8. The number of taxa observed from different hosts in salt marsh ecosystems.

3.1. Amaranthaceae
3. Diversity of Fungi in Halophytes

Twenty-seven genera under 11 families (Amaranthaceae, Apiaceae, Caryophyllaceae, Compositae, Juncaceae, Juncaginaceae, Plumbaginaceae, Poaceae, Poaceae, Primulaceae, Ruppiaceae, Typhaceae, Zosteraceae) of halophytes were reviewed for its fungal associates (Table 1, Figure 8). Halophytic species are represented in Figures 1 and 2.

Figure 8. The number of taxa observed from different hosts in salt marsh ecosystems.

3.1. Amaranthaceae

Six genera (Arthrocnemum, Atriplex, Salicornia, Salsola, Sarcocornia, Suaeda) represent the Amaranthaceae. Suaeda and Salicornia are the most studied hosts in Amaranthaceae. Ascomycota account for 96.30% of the 52 taxa recorded in Amaranthaceae (Figure 9, Table 1). Two Pucciniomycetes species, Aecidium suaedae [154] and Uromyces salicorniae [95], represent Basidiomycota. The taxa in Amaranthaceae represent three classes wherein Dothideomycetes accounts for 85.19% (46 taxa), followed by Sordariomycetes with six taxa reported.

Fungi associated with Suaeda total 18 taxa. Dothideomycetes was represented by 14 taxa (77.78%), while three taxa were Sordariomycetes (Crypotovalsa suaedica [144], Fusarium fujikuroi [62], Mohietospora fruticosae [130]) and one taxon of Pucciniomycetes (Aecidium suaedae [154]).

A total of 14 taxa were documented in Salicornia. Eleven of these belong to Dothideomycetes (Pleosporales: 10; Capnodiales: 1), followed by Sordariomycetes (two taxa: Halocryptovalsa salicorniae [145], Tubercularia pulverulenta [35]), and Pucciniomycetes (one taxon: Uromyces salicorniae [95]).

Fungi from Atriplex total 11 taxa (10 genera) and all of these belong to Pleosporales (Dothideomycetes). Sarcocornia harbors seven taxa (six Dothideomycetes, one Sordariomycetes). Only two taxa (Alternaria spp., Stemphylium spp.) and a single taxon (Mycosphaerella salicorniae) were reported from Salsola [35] and Arthrocnemum [35], respectively.
Six genera (Arthrocnemum, Atriplex, Salicornia, Salsola, Sarcocornia, Spartina) are the most studied hosts in Amaranthaceae. The association of fungi with grasses have been documented and most of the host plants are members of Poaceae. Ten genera of salt marsh grasses under Poaceae are included in this review wherein Spartina is the most studied of halophytic hosts for direct observation of marine fungi. In addition to Spartina, salt marsh grasses such as Phragmites and Distichlis were well studied also for their fungal associates.

Salt marsh fungi are not well-documented from grasses such as Spartina anglica, S. pectinata, Spergularia marina, Uniola paniculata, Elymus farctus, × Ammocalamagrostis baltica, and Agropyron sp. with one taxon recorded for each host [35]. Furthermore, there are few studies on the fungal composition of Arundo donax (4 taxa) [35] and Ammophila arenaria (four taxa). Marram grass (Ammophila arenaria) is more common in sand dunes and supports quite a diverse fungal community [157,158], while arbuscular mycorrhizal fungi (AMF) play a key role in the establishment, growth, and survival of plants [159].

### 3.2. Poaceae

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#### 3.2.1. Distichlis spicata

Ascomycota dominates the taxa associated with Distichlis spicata (93.55%) wherein 16 and 13 species are members of Dothideomyctetes and Sordariomyctetes, respectively. Pleosporalean taxa constitute the majority of fungi associated with D. spicata (14 species), followed by Hypocreales with nine species recorded. Puccinia distichlidiis and Tranzscheliella distichlidiis represent the Basidiomycota. A total of 26 genera were recorded as associates of D. spicata and were mostly observed on senescent and decaying leaves.

#### 3.2.2. Elymus pungens

Sixty-seven taxa were recorded in Elymus pungens and belong to Ascomycota. Most of the taxa belong to Dothideomyctetes (32 taxa), followed by Sordariomyctetes (21 taxa), Leotiomyctetes, and Eurotiomyctetes (6 taxa) (Table 1, Figure 10).
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Ascomycota dominates the taxa associated with Distichlis spicata (93.55%) wherein 16 and 13 species are members of Dothideomycetes and Sordariomycetes, respectively. Pleosporalean taxa constitute the majority of fungi associated with D. spicata (14 species), followed by Hypocreales with nine species recorded. Puccinia distichlidis and Tranzschelia distichlidis represent the Basidiomycota. A total of 26 genera were recorded as associates of D. spicata and were mostly observed on senescent and decaying leaves.

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Sixty-seven taxa were recorded in Elymus pungens and belong to Ascomycota. Most of the taxa belong to Dothideomycetes (32 taxa), followed by Sordariomycetes (21 taxa), Leotiomycetes, and Eurotiomycetes (6 taxa) (Table 1, Figure 10).

3.2.3. Puccinellia maritima
A total of 12 taxa (six Sordariomycetes; the following five Dothideomycetes: Micronectriella agropyri, Lautitia danica, Leptosphaeria pelagica, Septoriella vagans, Paradendryphiella salina; one Leotiomycetes: Thelebolus crustaceus) were recorded in Puccinellia maritima [38]. All the taxa from Sordariomycetes belong to Sordariales (Chaetomium elatum, C. globosum, C. thermophilum, Corynascus sepedonium, Thermothielavioides terrestris, Sordaria fimicola) [38].

3.2.4. Spartina
A total of 149 taxa (141 Ascomycota, 6 Basidiomycota, 2 Mucoromycota) were recorded in Spartina. The majority of the taxa belong to Dothideomycetes (70 taxa), followed by Sordariomycetes (59 taxa). Pleosporaceae and Halosphaeriaceae dominate the fungi documented in Spartina with 19 and 17 taxa recorded, respectively. Spartina alterniflora, S. maritima, and Spartina × townsendii harbor 79, 46, and 49 taxa, respectively (Figure 11, Table 1). A total of 78 taxa were recorded in the unidentified Spartina species. The identification of the Spartina species can be challenging, wherein species are morphologically similar.
Figure 11. The distribution of fungal taxa associated with Spartina.

*Halobyssothecium obiones* was recorded from six species of Spartina (*S. alterniflora* [20,35,52,61,71,74,80–82], *S. cynosuroides* [35], *S. densiflora* [64], *S. maritima* [31,54,59,63], *S. patens* [36], *S. townsendii* [49,65], and the unidentified *Spartina* sp. [32,35,36,58,84]), while six Spartina spp. harbors unidentified *Mycosphaerella* species. Six species (*Leptosphaeria pelagica, Lulworthia* spp., *Phaeosphaeria halima, Phaeosphaeria spartinicola, Phoma* spp., *Stagonospora* spp.) were recorded in five different hosts. The unidentified *Spartina* species harbors 28 unique species. Amongst the taxa found in *Spartina*, 32 species can only be found in *S. alterniflora*, while *S. maritima* harbors 21 unique species, the most intensively surveyed species.
3.2.5. Phragmites

A total of 138 taxa have been documented in Phragmites (Figure 12, Table 1). Most of the taxa belong to Ascomycota (131 taxa), while six taxa represent the Basidiomycota. Dothideomycetes dominates half of the taxa in Phragmites (71 taxa, 51.45%) followed by Sordariomycetes (44 taxa, 31.88%), Leotiomycetes (6 taxa, 4.35%), Ascomycota genera incertae sedis (5 taxa, 3.62%), Eurotiomycetes (3 taxa, 2.17%), Orbiliomycetes (2 taxon, 1.45%), and Pucciniomycetes (1 taxa, 1.45%). One taxon each were recorded to Agaricomycetes [40], Bartheletiomycetes [41], Lecanoromycetes [39], Microbotryomycetes [39,50], and Tremellomycetes [39,40]. Pleosporalean taxa accounts for the highest number of fungi associated with Phragmites (42.75%, 59 taxa).

Figure 12. The distribution of fungal taxa associated with Phragmites.

Phragmites australis harbors diverse fungi that totals to 137 taxa (101 genera) [39–41,50,79,115]. Seven species (Arthrinium arundinis [62], Halazoon fuscus [87], Halobyssothecium phragmitis [85], Keissleriella linearis [85], Phomatospora dinemaspornium [62], Remispora hamata [87], Setoseptoria phragmitis [87]) were recorded in unidentified Phragmites species.

3.3. Juncaceae

Juncus roemerianus, J. maritimus, and an unidentified Juncus species represent Juncaceae. Salt marsh fungi are diverse in Juncus and dominated by Ascomycota, which constitutes 97.58% of the 165 reported taxa (Figure 13, Table 1). Stilbum sp. represented the Basidiomycota, while three taxa (Blakeslea trispora, Mucor sp., Syncephalastrum race-mosum) of Mucoromycota were recorded. Dothideomycetes and Sordariomycetes account for the highest number of Juncus-associated fungi with 72 (43.64%) and 64 (38.79%) taxa documented.
Figure 13. The distribution of fungal taxa associated with Juncus.

_Juncus roemerianus_ has been extensively studied for its associates with 162 documented taxa [32,42,43,60,66,76–78,97,98,104,105,110,116–118,135,147,148]. Few species were reported to _Juncus maritimus_ that harbor only two taxa ( _Leptosphaeria albopunctata, Phaeosphaeria neomaritima_ [35], _Phaeosphaeria neomaritima_ [36,52,71,80], _P. spartinicola_ [52], and _Monodictys pelagica_ [35]) were observed in an unidentified species of _Juncus_.

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3.4. Other Families

Few reports on salt marsh fungi are from the following hosts: Apiaceae: *Crithmum maritimum* (one taxon: *Phoma* sp.), Typhaceae: *Typha* spp. (five taxa: *Arundellina typhae, Chaetotium* sp., *Magnisphaera spartinae, Pleospora pelagica, Remipsa hamata*); Compositae: *Artemisia maritima* (two taxa: *Neocamarosporium artemisiae, N. maritimae*); Caryophyllaceae: *Spergularia marina* (one taxon: *Cladosporium algarum*); Plumbaginaceae: *Limonium* sp. (one taxon: *Mycoloma salicorniae*); Armeriaceae: *Chaetomium* sp. and *T. maritima* (one taxon: *Stemphylium tricholichnicola*); Primulaceae: *Lysimachia maritima* (two taxa: *Leptosphaeria orae-maris, Stemphylium vesicarium*); Ruppiaceae: *Ruppia maritima* (one taxon: *Flamingomyces ruppii*); and Zosteraceae: *Zostera marina* (one taxon: *Corollospora ramulosa* and *Zostera sp.*). Alva et al. [160] report *Penicillium chrysogenum* as an endophyte from *Zostera japonica*.

Fourteen taxa were documented from unidentified salt marsh plants. All of the taxa belong to Ascomycota (seven Dothideomycetes, five Sordariomycetes, one Eurotiomycetes). Pleosporalean taxa from six families account for half of the taxa (the following seven species: *Camarosporium palliatum, C. roumeguerei, Coniothyrium obiones, Halobyssothecium obiones, Periconia sp., Loratospora aestuarii, Pleospora pelvetiae*).

4. Geographical Distribution of Salt Marsh Fungi

The salt marsh fungi reported are from countries of three major oceans, as documented in Figure 14. The Atlantic Ocean consists of 12 countries, wherein the USA had the highest number of species recorded (232 taxa) followed by the UK (101 taxa), the Netherlands (74 taxa), and Argentina (51 taxa). China had the highest number of salt marsh fungi in the Pacific Ocean with 165 taxa reported, while in the Indian Ocean, India reported the highest taxa (16 taxa). Most of the biodiversity studies documenting salt marsh fungi in the Atlantic Ocean are mostly from the USA and the UK and this reflects the high number of taxa [32,36,38,49,61]. China ranked second with the most number of salt marsh fungal taxa, mainly due to the biodiversity study in *Phragmites australis* conducted by Poon et al. [41].

Figure 14. The number of salt marsh fungi reported in the Pacific, Atlantic, and Indian Oceans.

The geographical distribution of salt marsh fungi and the different halophytes are presented in Figure 15. The fungi associated with salt marsh grass *Phragmites australis* have been studied in different countries (Australia, Belgium, Egypt, France, Germany, China, Iraq, Japan, the Netherlands, South Australia, Thailand). *Spartina alterniflora* was recorded
in countries along the Atlantic (Argentina, Canada, France, USA) and the Indian Ocean (India), but lacks data from countries in the Pacific Ocean.

**Figure 15.** Map of countries showing the global distribution of fungal diversity studies in halophytes. The different color of each pie chart represents the hosts, and the angle measured the number of their fungal associates.

**United States of America**

Most of the studies of halophytes-associated fungi were concentrated on the United States of America (USA) (Figure 16). Table 1 lists the salt marsh fungi in 20 states. Florida has been the frequently studied, wherein seven hosts (*Juncus roemerianus*: 108 taxa; *Spartina × townsendii*: 1; *Spartina alterniflora*: 16; *Spartina cynosuroides*: 3; *Spartina densiflora*: 1; *Spartina patens*: 2; *Spartina spp.*: 3) were observed for salt marsh fungi. Six hosts were studied in North Carolina, wherein *Juncus roemerianus* harbored the highest number of fungi (48 taxa). In Rhode Island, *Spartina alterniflora* accounts for the highest number of fungi, with 41 taxa recorded.

**Figure 16.** Map of the United States of America (USA) showing the distribution of fungal diversity studies of halophytes in different states. The different color of each pie chart represents the hosts, and the angle measured the number of their fungal associates.
5. Conclusions and Future Perspectives

Most studies of fungi on salt marsh plants are from *Spartina*, *Juncus*, and *Phragmites*, probably due to the huge biomass generated by these taxa. The mycota of less bulky halophytes (e.g., *Limonium*, *Triglochin*, *Uniola*) and litter from the surrounding sea grass beds washed off to marsh areas (e.g., *Zostera japonica*, *Z. marina*, *Z. noltii*) are also less represented, or these hosts are yet to be explored. The checklist presented in the current study updates the list of Calado and Barata [34] and the inclusion of fungi associated with rarely studied halophytes record 486 taxa worldwide. Ascomycota dominate the taxa (463 taxa) and are comprised mostly of Dothideomycetes with their ability to eject their ascospores forcibly and widely, spore type, the formation of ascomata or ascostromata under a clypeus or just immersed in thin leaves, and an ability to decompose lignocellulose substrates [57,161]. Meyers et al. [162] showed that salt marsh yeasts and the ascomycete, *Buergenerula spartinae*, produce degradative enzymes and utilize simple carbon and nitrogen compounds. The yeast, *Pichia spartinae*, produces β-glucosidase and other degradative enzymes. Gessner [74] demonstrated that a number of salt marsh fungi isolated from *Spartina alterniflora*, *Zostera* sp., and *Z. marina* produced enzymes capable of degrading cellulose, cellobiose, lipids, pectin, starch, tannic acid, and xylan and, thus, play a key role in the degradation of storage and structural compounds. Salt marsh fungi might possess high biotransformation and metabolic abilities, which could be related to their ecology.

Basidiomycota (19 taxa) and Mucoromycota (4 taxa) are poorly represented in salt marsh ecosystems as they are in other marine habitats [163]. There are no records of Chytridiomycota listed in the present work and only a few authors detected this group, and other basal fungal lineages, in salt marsh ecosystems using molecular analysis [164–167]. These groups are worth exploring to determine the overall fungal communities in the salt marsh ecosystems. Many chytrids and other basal fungi are more challenging to cultivate and require different isolation methods (e.g., baiting techniques in liquid culture) than the saprobes, methods that have rarely been applied in the study of saltmarsh plants. When appropriate techniques are used, chytrids and other zoosporic organisms have been reported. For example, the fungal-like organism *Phytophthora inundata* has been recovered from the halophilic plants *Aster tripolium* and *Salicornia europaea*, while *P. gemini* and *P. chesapeakeinsis* occur on *Zostera marina*, and *Salisapilia nakagirii* on the decaying litter of *Spartina alterniflora* (www.marinefungi.org; accessed on 10 May 2021, [163]). Marine chytrids have been isolated from substrates such as seaweeds and mangrove leaves [163].

The taxa listed are mostly saprobes and these can be attributed to the inclusion of salt marsh fungi observed directly from the different host parts, which are mostly submerged decaying substrates. When compared to saprobic fungi in halophytes, few studies have been carried out on the diversity of endophytes and pathogens and their interaction in the salt marsh ecosystems. Surveys on endophytic fungi from halophytes using cultivation-dependent methods coupled with molecular approaches, showed that endophytes were dominated by Ascomycota and a few belonged to Basidiomycota and Zygomycota [168–175]. Pathogenic fungi from salt marsh ecosystems are poorly documented but play a significant role in the dynamics of the ecosystem [176–178]. For example, Govers et al. [179] reported that the fungal-like organisms *Phytophthora gemini* and *P. inundata* caused widespread infection of the common seagrass species, *Zostera marina* (eelgrass), across the northern Atlantic and Mediterranean that threatened the conservation and restoration of vegetated marine coastal systems. Likewise, *Claviceps purpurea* affects the viability of *Spartina townsendii* in south coast UK salt marshes. Fisher et al. [180] noted that *Cl. purpurea* in the Alabama and Mississippi coastlines rendered the seeds of one of the primary salt marsh grasses sterile. Raybold et al. [181] recorded epidemics of *C. purpurea* on *Spartina anglica* in Poole Harbor (UK) and that ergot growth was detrimental to seed production. These underexplored fungal groups are worthy to be explored for their ecological and biotechnological importance.

This shows how salt marsh fungal studies were concentrated in countries in the Atlantic Ocean specifically the USA (232 taxa) and the UK (101 taxa). Many salt marsh areas remain
unexplored, especially those in the Indian and Pacific Oceans, and these areas are hotspots of biodiversity and novel fungal taxa based on the exploration of various habitats [85,100,163,182–187]. Recently, novel species were isolated in halophytes [85,100,145] and further taxa remain to be discovered, isolated, and sequenced, while vast areas worldwide have yet to be surveyed. For example, salt marsh plants are immensely numerous, diverse, and common along the south-east coast of Australia, yet little is known of their fungal associates [188].

The salt marsh vegetation and its fungal associates are adapted to salt stress and inundation and are subjected to extreme environmental conditions such as being periodically wet to different lengths of time leading to drying out at low tides and exposure to high temperatures and drying out at midday. Many are well adapted to prevailing conditions by their fleshy leaves (Suaeda australis), others can tolerate high flooding.

Few data are currently available on the specificity of fungi on their salt marsh hosts. Figure 17 shows the number of fungal taxa recorded from the three commonly studied hosts, Juncus, Phragmites, and Spartina, wherein there is little overlap in the species composition. One of the common species on Spartina plants is undoubtedly Halobyssothecium obiones, while Leptosphaeria pelagica is common. A common ascomycete on Atriplex portulacoides and Suaeda maritima is Decorospora gaudefoyi. Host plants that have been little surveyed for fungi are Limonium vulgare (sea lavender) and Atriplex portulacoides (sea purslane), yet they do support a number of taxa, e.g., Neocamarosporium obiones and Amarenomyces annophilae. The fungal community reported on Juncus roemerianus in the salt marsh at North Carolina is significantly different from those on Spartina and Phragmites. It remains to be seen if this is due to the host plant or its geographical location.

Figure 17. Venn diagram showing the association of salt marsh fungi from commonly studied halophytes.

Another groups of fungi that have not been fully studied in the salt marsh habitat are yeasts, as these also require specific techniques for their isolation from the water column or from plant tissue. Spencer et al. [189] recovered a number of yeasts from the vicinity of Spartina townsendii, as follows: very numerous Cryptococcus spp.; Trichosporon cutaneum; Trichosporon pullulans; the relatively rare species, Metschnikowia bicuspidata and Cryptococcus flavus; and Saturnospora ahearnii [190]. Although marine yeasts are common in sea water and deep seawater vents [163], their large-scale sampling in salt marshes remains a challenge for the future.

Currently, the salt marsh ecosystem has been threatened both by global warming and human activity. Sea-level rises brought about by climate change alter the location and character of the land–sea interface wherein salt marsh vegetation moves upward and inland. The increase in the sea level may not lead to the loss of coastal marshes, but the resiliency will depend on the ability of halophytes to migrate upland. Susceptible
areas are organogenic marshes and areas where sediment is limited, potentially leading to catastrophic shifts and marsh loss. In this paper, a total of 57 plant taxa under 27 genera were reviewed for their fungal associates. The halophytes included here are only approximately 11% of the total number of species of salt marsh plants worldwide. Thus, many salt marsh fungi await discovery with wider host plant sampling and the use of a wider range techniques for their isolation. For this reason, it is imperative to study the halophytic fungi to document not just biodiversity but also to discover novel taxa restricted only to this kind of habitat.

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