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Diversity of marine ascomycetes from Maharashtra (India)-III

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Abstract
Present paper deals with four marine fungi: *Haiyanga salina*, *Lignincola laevis*, *Lulworthia grandispora*, *Verruculina enalia* that were isolated form intertidal wood and foam samples from the coast of Thane District of Maharashtra.

Keywords: foam samples, intertidal wood, marine fungi

Introduction
The study of marine fungi continues to attract mycologist, ecologist, physiologist and those interested in bioactive compounds. In the last decades, research on natural products (bioactive compounds) of marine fungi is on the rise and there are over 1,000 bioactive compounds described from marine fungi. From marine habitats, majority of the fungi recorded so far were Ascomycetous forms. Jones *et al.* (2015) [10] classified this group as 805 species in 352 genera. Using data from molecular studies, a number of new families have been added to the list of marine taxa within the Do thideomycetes (Kohlmeyer *et al.* 1995; Inderbitzin *et al.* 2001; Mugambi and Huhndorf, 2009; Suetrong *et al.* 2009, 2011; Zhang *et al.* 2009a, b) [11, 9, 12, 28, 29, 32].

Material and Methods
Samples of intertidal woody debris, drift wood, dead stems, roots, leaves and fruits of mangroves, and foam samples from sandy beaches were collected during 2012-2013 at low tide at study sites along the coastal regions of Thane district and placed in polythene bags. Samples were transported to the laboratory. Collections contaminated by sediments or fouling organisms were washed with seawater. Specimens were observed for sporulating structures (Ascomata). After initial observations, samples were placed in plastic boxes and after two weeks examined for the presence of fungal fruiting bodies. Permanent voucher slides were made by using double cover glass method (Volkmann-Kohlmeyer and Kohlmeyer, 1996). Identifications of marine fungi were confirmed with the help of Monographs and illustrated taxonomic keys provided by Kohlmeyer and Kohlmeyer (1979), Kohlmeyer and Volkmann - Kohlmeyer (1991), Hyde *et al.* (2000) [27], Jones *et al.* (2009) [29], Borse *et al.* (2012) [3] and other relevant published literature.

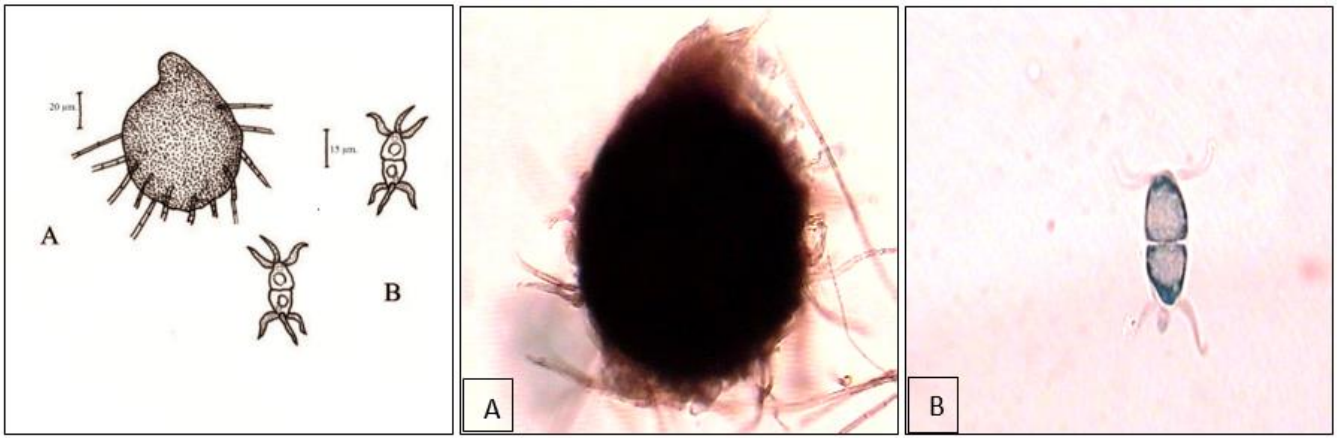
Texonomic account
1. *Haiyanga salina* (Meyers) K.L Pang & E.B.G. Jones
The Raffles Bull. Zool., 19- 8 (2008).= *Arenariomycec salina* Meyers, *Mycologia*, 49-505 (1957); = *Remispora salina* (Meyers) Kohlm., *Mycologia*, 60-262 (1968); = *Halosphaeria salina* (Meyers) Kohlm., *Can. J. Bot*., 50-1957 (1972); = *Antennospora salina* (Meyers) Yusoff *et al. Mycol. Res.*, 98-1003 (1994).

Ascomata are 100-425 µm in diam. globose or subcylindrical, completely or partly immersed or becoming exposed, ostiolate, papillate, membranaceous or coriaceous, dark brown or black, surrounded by brown hyphae, solitary or gregarious. *Peridium* is 8-12 µm thick. *Necks* are 68-165 µm long, 28-52 µm in diam. *Catenophyses* present. *Asci* were not seen as deliquising early. *Ascospores* are 19-28 x 8-13.5 µm (excluding appendages), ellipsoidal, 1-septate, not or slightly constricted at the septum, hyaline, appendaged. *Appendages* at each end 3 or 4 (rarely five) radiating appendages, 12-19 µm long, 1.5-2.5 µm in diam at the base, subterminal, obclavate, curved, attenuate, semirigid, indistinctly spoon shaped at the base and release a drop of mucilage from their tips.

Material examined
On intertidal wood, Dahanu; S. A. Gosavi 1112 (PGDB), 02 April 2011.

Distribution in India-*West Coast*
Diu Island- Borse *et al.* (1999b) [7]; Guj.- Patil and Borse (2001) [18]; M.S.- Borse (1987a) [1]; Goa- Borse *et al.* (1999a) [5]; Kerala- Raveendran and Manimohan (2007) [14]; *East Coast*- T.N.- Nambiar and Raveendran (2009k) [17]; W.B.- Pawar and Borse (2004) [21].

Remark
The descriptions and measurements of Ascomata, Asci and Ascospores are agreed with that of *H. salina* (Meyers) K.L Pang and E.B.G. Jones (2008). Therefore, it is assigned to that species. It is being reported for the first time from Thane district.



A- Ascoma, B- Ascospore

Fig 1

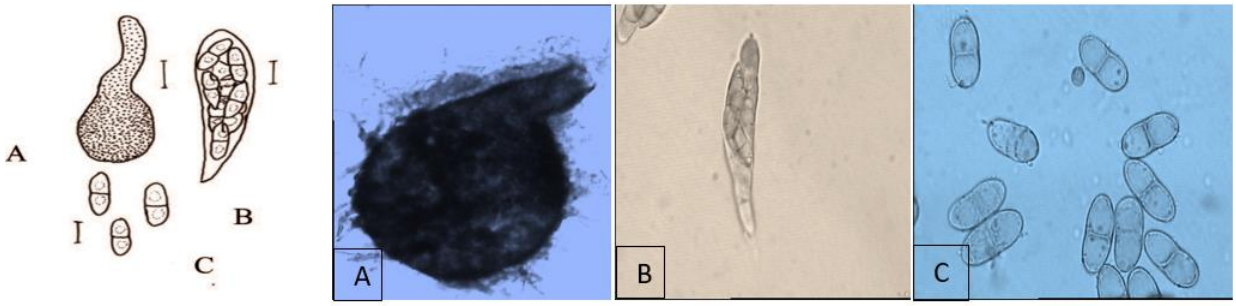
2. *Lignincola laevis* Hohnk *Veroeff. Inst. Meeresforsch. Bremerhaven*, 3- 216 (1955).

Ascomata are 132-254 µm in diam., subglobose or ellipsoidal, immersed or superficial, ostiolate, papillate, coriaceous, hyaline, light brown, fuscous or blackish, solitary or gregarious. *Peridium* composed of 2-5 layers of elongate thick–walled cells with large lumina, forming a *textura angularis*. *Necks* are upto 4 mm long and 28-40 µm in diameter. *Catenophyses* are of pseudoparenchyma of thin- walled cells with large lumina filling the venter of young ascomata, eventually breaking up into catenophyses. *Ascus* 46-68 x 14-22 µm. 8-spored, clavate or subfusiform, short pedunculate, unitunicate, thin–walled, aphysoclastic, without apical apparatuses, persistent; *Ascospores* are 14-24 x 6-8 µm, irregularly biseriate, ellipsoidal, one-septate, slightly constricted at the septum, hyaline, without appendages.

Material examined: On intertidal wood of *Avicennia officinalis*, Kalamb-Rajodi; S. A. Gosavi 1113 (PGDB), 8 July 2013.

Distribution in India- *East coast*- T.N.- Raghu kumar (1973) [13]; A.P.- Vittal and Sarma (2005) [30]; W.B.- Pawar and Borse (2004) [21]; *West coast*- M.S.- Patil and Borse (1983a); Goa- Borse *et al.* (1999a); Kerala- Nambiar and Raveendran (2006); Daman- Borse *et al.* (2000b); Guj.- Patil and Borse (2001) [19]; P.M.- Nambiar and Raveendran (2008d) [16].

Remarks: The descriptions and measurements of Ascomata, Asci and Ascospores are agreed with that of *L. laevis* Hohnk (Jones *et al.* 2009) [29]. Hence, it is assigned to that species. It is being reported for the first time from Thane district.



A- Ascoma, B-Ascus, C- Ascospores

Fig 2

3. *Lulworthia grandispora* Meyers, *Mycologia*, 49-513 (1957). = *L. grandispora* var. *apiculata* T.W. Johnson, *Mycologia*, 50-159 (1958).

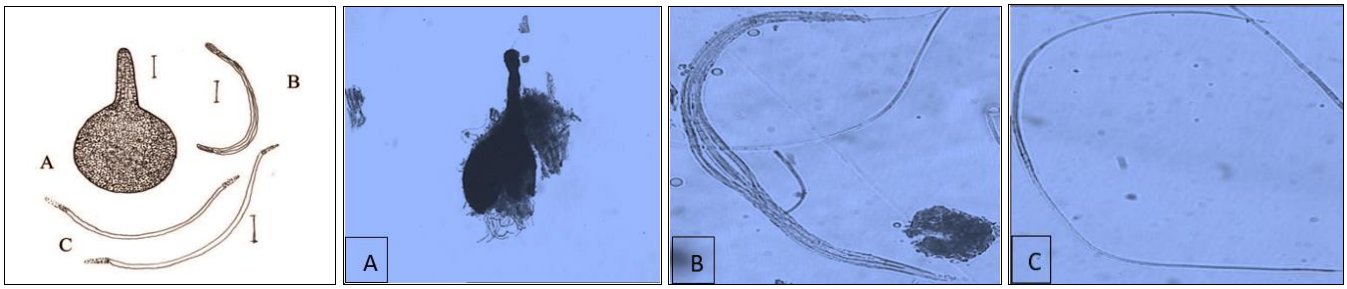
Ascomata are 188-320 µm in diam.globose or subglobose to pyriform, immersed or superficial, ostiolate, with long neck, brown to black, solitary or gregarious. *Necks* are 75-1400 x 15-33 µm, cylindrical, straight or curved, sometimes two on one ascomata. *Asci* are 490-524 x 22-28 µm.8-spored, elongate-fusiform or cylindrical, unitunicate, thin-walled, early deliquescing. *Ascospores* are 508-780 x 2.5-5 µm (including apical chambers), filamentous, curved, hyaline, tapering at each end into an elongate conical process or apical chamber. *Apical Processes* are (3–7 µm.) long, acute or rounded filled with mucus that is released through an apical pore.

Material examined: On intertidal wood, Ghodbundar; S. A. Gosavi 1114 (PGDB), 20 Dec. 2013.

Distribution in India-*East coast*: T.N.- Nambiar and Raveendran (2006) [13]; A.P.- Sarma and Vittal (2000) [27]; W.B.- Pawar and Borse (2004) [21]; *West coast*-- M.S.- Ramesh and Borse (1989) [24]; Goa- Tuwar (2009); Kerala- Nambiar and Raveendran (2006) [13]; Diu- Borse *et al.* (1999b) [7]; Daman- Borse *et al.* (2000b) [6]; Guj.- Borse *et al.* (2000a); P.M.- Nambiar and Ravindran (2007). (Source- Borse *et al.* 2012, 2013) [2, 3].

Remarks

The descriptions and measurements of Ascomata, Asci and Ascospores are completely agreed with that of *Lulworthia grandispora* Meyers (Jones *et al.* 2009) [29]. Therefore, it is assigned to that species. It is being reported for the first time from Thane district.



A- Ascoma, B-Ascus, C- Ascospore

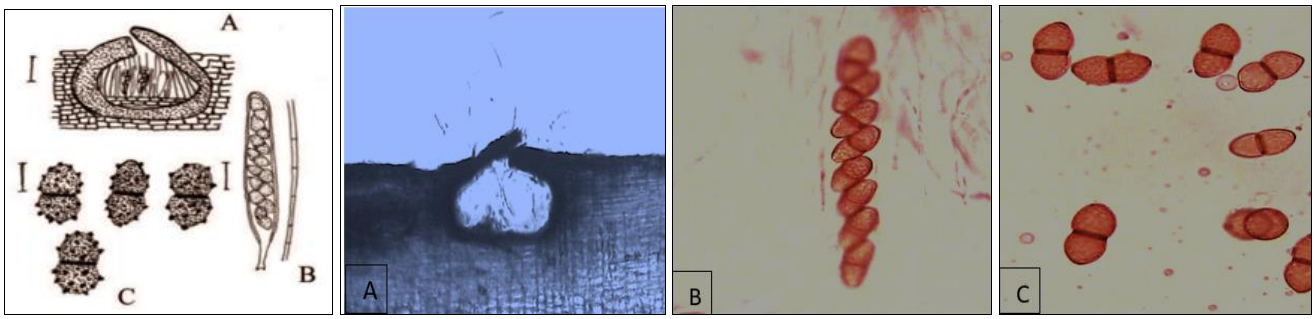
Fig 3

4. *Verruculina enalia* (Kohlm.) Kohlm. & Volkm.-Kohlm. *Mycol. Res.*94- 689 (1990).
   = *Didymosphaeria enalia* Kohlm, *Ber. Destch, Bot. Ges.*, 79- 28 (1966).

Ascomata are 286–494 µm high, 265–474 µm in diam. subglobose, ampulliform or depressed ellipsoidal, partly or completely immersed, ostiolate, papillate, clypeate, carbonaceous, black and solitary. *Peridium* is 8–14 µm thick. *Necks* are 72-144 µm long, 135-310 µm in diameter (including clypeus. *Pseudoparaphyses* are 1.5–2 µm in diameter, septate, rarely branched, attached at both ends and reaching into the ostiolar canal; connected to each other by a gelatinous outer layer. *Asci* are 118–134 x 11–14 µm.8-spored, cylindrical, pedunculate, bitunicate, thick-walled, physoclastic, without apical apparatuses are developing at the base of the ascomata venter. *Ascospores* are 16-24 x 6.5-10 µm, obliquely uniseriate, ellipsoidal, one-septate, constricted at the septum, dark brown, verrucose to verruculose.

Material examined: On intertidal wood of *Avicennia marina*, Arnala; S. A. Gosavi 1116 (PGDB), 15 April 2013.

Distribution in India-*East coast*: T.N- Nambiar *et al.* (2008b) [15]; Pondecherry Karaikkal (P.K.)- Ravi kumar *et al.* (2009) [29]; A.P.- Sarma and Vittal (1998-99);W.B.- Pawar *et al.* (2009) [22]; Orissa- Borse *et al.* (2009) [8]; A. & N. Islands- Chinnaraj (1993a). *West coast*- M.S.- Patil and Borse (1985) [20]; Kerala- Nambiar and Raveendran (2006) [13]; Diu- Borse *et al.* (1999b) [7]; Goa- Borse *et al.* (1999a) [5]; Daman- Borse *et al.* (2000b) [6]; Guj.- Borse *et al.* (2000a) [4]; P.M.- Nambiar and Raveendran (2008d) [16]; Goa- Borse *et al.* (1999a) [5] (Source- Borse *et al.* 2012, 2013) [2, 3].



A- Ascoma, B-Ascus, C- Ascospores

Fig 4

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