

Fouling Bryozoa of Korean Ports and Harbours

Hyun Sook Chae^{1,2}, Ji Eun Seo^{1,3,*}

¹Marine Bryozoans Resources Bank of Korea, Jincheon 27841, Korea

²Department of Food-Biotechnology, Woosuk University, Samnye 55338, Korea

³Department of Eco-Biological Science, Woosuk University, Jincheon 27841, Korea

ABSTRACT

This study aims to investigate the fouling bryozoans which attach to artificial structures of Korean ports and harbours. The materials have been collected from 56 sites during the period from 2008 to 2012. As a result of the present study, 40 species of fouling bryozoans were identified. The most abundant species are *Bugula neritina* (Linnaeus, 1758), *Tricellaria occidentalis* (Trask, 1857), *Watersipora subtoquata* (d'Orbigny, 1852), and *Cryptosula pallasiana* (Moll, 1803). Three species, *Flustrellidra armata* Grischenko, Seo and Min, 2010, *Cauloramphus korensis* Seo, 2001, and *Parasmittina contraria* Seo, 1993 are endemic to Korea. A total of 70 species of fouling bryozoans have been reported in Korea with 16 new bryozoans resulting from this study.

Keywords: fouling bryozoans, artificial, ports, harbours, Korea

INTRODUCTION

Bryozoans are sessile organisms attached to various living and nonliving substrates, such as shell, rock, algae, worm tube, hydroid, sea-bottom, bryozoan, coral, rubber, steel, wood, sponge and surface of living or dead animals (Ryland, 1970; Hayward, 1985; Seo, 2005). When such organisms affect the performance or functioning of man-made structures, they are referred to as 'fouling'. Fouled structures can include intake pipes for industrial or power plants in marine and fresh waters, oil rigs, buoys, moorings, current meters, and hulls and other surfaces of boats, ships, and submarines (Gordon and Mawatari, 1992) (Fig. 1). The fouling bryozoans have been studied by Edmondson and Ingram (1939), Brock (1985), Gordon and Mawatari (1992), Stevens et al. (1996), Gong and Seo (2003, 2004), etc. The port and harbor, representative artificial structures, have a lot of ship activities such as domestic and international travel, the maritime trade, fishery etc. by man.

It is important to study about fouling bryozoan on fouled structures of port and harbor, because fouling marine organisms may provide insight into controlling biofouling of marine technology. Next to barnacles, bryozoans are the most common invertebrates fouling anthropogenic marine surfaces

(Christie and Dalley, 1987; Key et al., 1999).

Korea, surrounded by water on three sides, has around 1,000 National harbors, local harbors and fishing village ports (<http://www.mof.go.kr>). Since *Reteporellina denticulata* was reported from the artificial reefs of Yeosu waters by Bae and Lee (1981), 54 fouling bryozoans were so far recorded from Korea (Song, 1985; Je et al., 2003; Gong and Seo, 2003, 2004; Seo, 2005; Seo and Min, 2009). This study aims to investigate the fouling bryozoans which attach to artificial structures of Korean ports and harbours.

MATERIALS AND METHODS

The materials examined in the present study were collected from 56 localities during the period from 2008 to 2012 (Fig. 2). All samples attached to artificial structures (ships, flat-bottomed boat, buoys, ropes, fishing net, tire, quay walls, and test panels) of Korean ports and harbours were collected by using a chisel. Collected materials were preserved in 95% ethyl alcohol and transported to the laboratory for microscopical study.

© This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

***To whom correspondence should be addressed**
Tel: 82-43-531-2891, Fax: 82-43-531-2881
E-mail: jeseo@woosuk.ac.kr



Fig. 1. Substrata of fouling bryozoans. A, *Bugula neritina* attaching to flat-bottomed boat; B, *Bugula neritina* attaching to rope; C, *Bugulina californica* attaching to fishing net; D, *Celleporina porosissima* attaching to tire.

RESULTS

As a result of the present study, 40 species, 34 genera, 26 families, three orders, two classes of fouling bryozoans were identified. Single asterisks (*) indicate the 16 species which are newly added as fouling bryozoans in Korea (Table 1).

Phylum Bryozoa Ehrenberg, 1831
 Class Stenolaemata Borg, 1926
 Order Cyclostomata Busk, 1852
 Family Crisiidae Johnston, 1838
 Genus *Crisia* Lamouroux, 1812

1. *Crisia eburneodenticulata* Smitt ms in Busk, 1875

Material examined. Korea: Songjeong, 14 Aug 2009; Jeju, 6 Jan 2011.

Substratum. Ropes.

Distribution. Korea, Japan, Pacific, and Atlantic.

Family Lichenoporidae Smitt, 1867

Genus *Disporella* Gray, 1848

*2. *Disporella novaehollandiae* (d'Orbigny, 1853)

Material examined. Korea: Hwasun, 15 Aug 2008; Songjeong, 14 Aug 2009; Seogwipo, 28 Jun 2010.

Substratum. Ropes and quay walls.

Remarks. This species is newly reported as fouling bryozoans to Korea.

Distribution. Korea, Japan, Pacific, Indian, Atlantic, and Cosmopolitan.

Class Gymnolaemata Allman, 1856

Order Ctenostomata Busk, 1852

Family Flustrellidridae Bassler, 1953

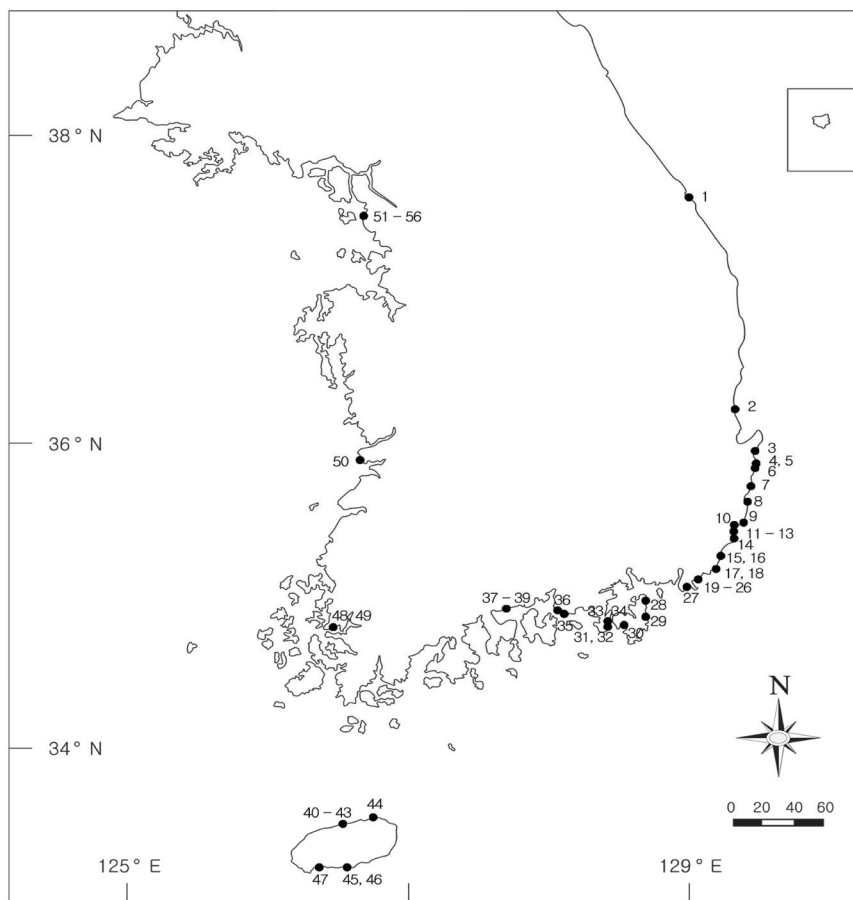


Fig. 2. Map of South Korea showing the collection localities in this study. 1, Donghae; 2, Ganggu; 3, Guryongpo; 4–5, Yangpo 2 sites; 6, Gampo; 7, Eupchen; 8, Jeongja; 9, Bangeojin; 10, Jangsaengpo; 11–13, Ulsan 3 sites; 14, Onsan; 15–16, Daebyeon 2 sites; 17–18, Songjeong 2 sites; 19–26, Busan 8 sites; 27, Dadaepo; 28, Deokpo; 29, Gujora; 30, Geoje Passenger Terminal; 31–34, Tongyeong 4 sites; 35–36, Samcheonpo 2 sites; 37–39, Gwangyang 3 sites; 40–43, Jeju 4 sites; 44, Kimnyeong; 45–46, Seogwipo 2 sites; 47, Hwasun; 48–49, Mokpo 2 sites; 50, Bieung; 51–56, Incheon 6 sites.

Genus *Flustrellidra* Bassler, 1953

***3. *Flustrellidra armata* Grischenko, Seo and Min, 2010**

Material examined. Korea: Songjeong, 14 Aug 2009; Daebyeon, 20 Oct 2010.

Substratum. Quay walls.

Remarks. This is an endemic species, and is newly reported as fouling bryozoans to Korea.

Distribution. Korea.

Family Nolellidae Harmer, 1915
Genus *Nolella* Gosse, 1855

***4. *Nolella stipata* Gosse, 1885**

Material examined. Korea: Songjeong, 23 Aug 2012; Seo-

wipo, 16 Nov 2012; Guryongpo, 22 Dec 2012.

Substratum. Ropes, buoys, and fishing net.

Remarks. This species is newly reported as fouling bryozoans to Korea.

Distribution. Korea, Japan, Pacific, and Indian.

Family Vesiculariidae Johnston, 1847
Genus *Amathia* Lamouroux, 1812

5. *Amathia distans* Busk, 1886

Material examined. Korea: Samchenopo, 13 Aug 2008; Seogwipo, 15 Aug 2008; Jeju, 15 Aug 2008; Kimnyeong, 15 Aug 2008; Tongyeong, 14 Nov 2008; Tongyeong, 14 Aug 2009; Deokpo, 15 Aug 2009; Tongyeong, 14 Nov 2009; Tongyeong, 26 Jun 2010; Seogwipo, 28 Jun 2010; Tongyeong, 21 Oct 2010; Jeju, 6 Jan 2011; Songjeong, 25 Jun 2011;

Tongyeong, 26 Jun 2011; Bangeojin, 23 Aug 2012; Bangeojin, 23 Aug 2012; Daebyeon, 23 Aug 2012; Tongyeong, 24 Aug 2012.

Substratum. Ships, ropes, buoys, quay walls, and fishing net.

Distribution. Korea, Japan, Pacific, Indian, and Atlantic.

Order Cheilostomata Busk, 1852

Family Aeteidae Smitt, 1867

Genus *Aetea* Smitt, 1867

***6. *Aetea anguina* (Linnaeus, 1758)**

Material examined. Korea: Seogwipo, 15 Aug 2008.

Substratum. Ropes.

Remarks. This species is newly reported as fouling bryozoans to Korea.

Distribution. Cosmopolitan.

Family Membraniporidae Busk, 1854

Genus *Membranipora* de Blainville, 1830

***7. *Membranipora villosa* Hincks, 1880**

Material examined. Korea: Jangsaengpo, 11 Aug 2008; Ulsan, 12 Aug 2008; Jangsaengpo, 13 Nov 2008; Samcheonpo, 14 Nov 2008; Songjeong, 14 Aug 2009; Gujora, 15 Aug 2009; Hwasun, 18 Aug 2009; Ulsan, 25 Jun 2010; Busan, 26 Jun 2010; Daebyeon, 20 Oct 2010; Guryongpo, 24 Oct 2011; Yangpo, 24 Oct 2011; Songjeong, 25 Oct 2011; Jangsaengpo, 25 Oct 2011.

Substratum. Buoys and quay walls.

Remarks. This species is newly reported as fouling bryozoans in Korea. *Membranipora serrilamella* Osburn, 1950 was synonymized into *Membranipora villosa* Hincks, 1880 (see Dick et al., 2005).

Distribution. Korea, Japan, Alaska, and Pacific.

Genus *Jellyella* Taylor and Monks, 1997

8. *Jellyella tuberculata* (Bosc, 1802)

Material examined. Korea: Kimnyeong, 15 Oct 2008; Busan, 13 Nov 2008; Samcheonpo, 14 Nov 2008; Gujora, 15 Aug 2009; Yangpo, 13 Nov 2009; Mokpo, 27 Jun 2010.

Substratum. Buoys, ropes, and quay walls.

Remarks. *Membranipora tuberculata* (Bosc, 1802) was synonymized into *Jellyella tuberculata* (Bosc, 1802) (see Taylor and Monks, 1997).

Distribution. Widespread.

Family Calloporidae Norman, 1903

Genus *Cauloramphus* Norman, 1909

9. *Cauloramphus korensis* Seo, 2001

Material examined. Korea: Daebyeon, 25 Jun 2010; Jangsaengpo, 25 Jun 2010.

Substratum. Ropes.

Remarks. This is endemic species to Korea.

Distribution. Korea.

Genus *Tegella* Levinsen, 1909

10. *Tegella incrustans* Silén, 1941

Material examined. Korea: Busan, 11 Mar 2009; Songjeong, 14 Aug 2009.

Substratum. Ropes and quay walls.

Distribution. Korea and Japan.

Family Bugulidae Gray, 1848

Genus *Bugula* Oken, 1815

11. *Bugula neritina* (Linnaeus, 1758)

Material examined. Korea: Guryongpo, 11 Aug 2008; Jangsaengpo, 11 Aug 2008; Busan, 12 Aug 2008; Tongyeong, 13 Aug 2008; Samcheonpo, 13 Aug 2008; Jeju, 14 Aug 2008; Hwasun, 15 Oct 2008; Donghae, 27 Aug 2008; Guryongpo, 12 Nov 2008; Onsan, 13 Nov 2008; Ulsan, 13 Nov 2008; Busan, 13 Nov 2008; Tongyeong, 14 Nov 2008; Samcheonpo, 14 Nov 2008; Jeju, 9 Jan 2009; Gampo, 12 Aug 2009; Guryongpo, 12 Aug 2009; Jeongja, 13 Aug 2009; Bangeojin, 13 Aug 2009; Dadaepo, 14 Aug 2009; Busan, 14 Aug 2009; Tongyeong, 14 Aug 2009; Geoje, 15 Aug 2009; Gujora, 15 Aug 2009; Gwangyang, 16 Aug 2009; Seogwipo, 18 Aug 2009; Hwasun, 18 Aug 2009; Yangpo, 24 Jun 2010; Daebyeon, 25 Jun 2010; Bangeojin, 25 Jun 2010; Dadaepo, 26 Jun 2010; Busan, 26 Jun 2010; Tongyeong, 26 Jun 2010; Gwangyang, 27 Jun 2010; Bieung, 1 Jul 2010; Ganggu, 19 Oct 2010; Guryongpo, 19 Oct 2010; Yangpo, 19 Oct 2010; Dadaepo, 20 Oct 2010; Songjeong, 20 Oct 2010; Daebyeon, 20 Oct 2010; Jangsaengpo, 20 Oct 2010; Tongyeong, 21 Oct 2010; Gwangyang, 21 Oct 2010; Bieung, 22 Oct 2010; Seogwipo, 6 Jan 2011; Gampo, 24 Oct 2011; Guryongpo, 24 Oct 2011; Yangpo, 24 Oct 2011; Dadaepo, 25 Oct 2011; Bangeojin, 25 Oct 2011; Jangsaengpo, 25 Oct 2011; Tongyeong, 26 Jun 2011; Gwangyang, 26 Jun 2011; Guryongpo, 22 Aug 2012; Gampo, 22 Aug 2012; Yangpo, 22 Aug 2012; Bangeojin, 23 Aug 2012; Ulsan, 23 Aug 2012; Jangsaengpo, 23 Aug 2012; Daebyeon, 23 Aug 2012; Busan,

23 Aug 2012; Dadaepo, 23 Aug 2012; Tongyeong, 23 Aug 2012; Gwangyang, 24 Aug 2012; Bieung, 25 Aug 2012; Incheon, 25 Aug 2012; Bieung, 19 Dec 2012; Incheon, 19 Dec 2012; Daebyeon, 21 Dec 2012; Dadaepo, 21 Dec 2012; Guryongpo, 22 Dec 2012; Yangpo, 22 Dec 2012.

Substratum. Ship, buoys, ropes, fishing net, quay walls, test panels, and flat-bottomed boat.

Distribution. Cosmopolitan.

Genus *Bugulina* Gray, 1848

12. *Bugulina californica* (Robertson, 1905)

Material examined. Korea: Busan, 12 Aug 2008; Samcheonpo, 13 Aug 2008; Jeju, 14 Aug 2008; Donghae, 27 Aug 2008; Guryongpo, 12 Nov 2008; Ulsan, 13 Nov 2008; Tongyeong, 14 Nov 2008; Gampo, 12 Aug 2009; Jeongja, 13 Aug 2009; Bangeojin, 13 Aug 2009; Dadaepo, 14 Aug 2009; Tongyeong, 14 Aug 2009; Geoje, 15 Aug 2009; Gwangyang, 16 Aug 2009; Yangpo, 24 Jun 2010; Bangeojin, 25 Jun 2010; Tongyeong, 26 Jun 2010; Gwangyang, 27 Jun 2010; Mokpo, 27 Jun 2010; Seogwipo, 28 Jun 2010; Tongyeong, 21 Oct 2010; Gwangyang, 21 Oct 2010; Seogwipo, 6 Jan 2011; Tongyeong, 26 Jun 2011; Ulsan, 23 Aug 2012; Dadaepo, 23 Aug 2012; Mokpo, 24 Aug 2012; Seogwipo, 16 Nov 2012; Daebyeon, 21 Dec 2012; Guryongpo, 22 Dec 2012; Yangpo, 22 Dec 2012.

Substratum. Ropes, fishing net, and quay walls.

Remarks. *Bugula californica* Robertson, 1905 was synonymized into *Bugulina californica* (Robertson, 1905) (see Fehlaue-Ale et al., 2015).

Distribution. Korea, Japan, Pacific, and Atlantic.

Genus *Virididentula* Fehlaue-Ale, Winston, Tilbrook, Nascimento and Vieira, 2015

13. *Virididentula dentata* (Lamouroux, 1816)

Material examined. Korea: Busan, 11 Mar 2009.

Substratum. Ropes.

Remarks. *Bugula dentata* (Lamouroux, 1816) was synonymized into *Virididentula dentata* (Lamouroux, 1816) (see Fehlaue-Ale et al., 2015).

Distribution. Widespread.

Family Beaniidae Canu and Bassler, 1927

Genus *Beania* Johnston, 1840

14. *Beania hexaceras* (Ortmann, 1890)

Material examined. Korea: Kimnyeong, 15 Oct 2008; Song-

jeong, 14 Aug 2009; Hwasun, 18 Aug 2009; Jeju, 6 Jan 2011.

Substratum. Ropes, buoys, and quay walls.

Distribution. Korea and Japan.

*15. *Beania mirabilis* Johnston, 1840

Material examined. Korea: Hwasun, 15 Oct 2008; Yangpo, 24 Oct 2011.

Substratum. Ropes.

Remarks. This species is newly reported as fouling bryozoans to Korea.

Distribution. Cosmopolitan.

Family Candidae d'Orbigny, 1851

Genus *Scrupocaberea* Vieira, Spencer Jones, Winston, Migotto and Marques, 2014

*16. *Scrupocaberea maderensis* (Busk, 1860)

Material examined. Korea: Jeju, 6 Jan 2011.

Substratum. Ropes.

Remarks. This species is newly reported as fouling bryozoans in Korea. *Scrupocellaria maderensis* Busk, 1860 was synonymized into *Scrupocaberea maderensis* (Busk, 1860) (see Vieira et al., 2014b).

Distribution. Widespread in warm water.

Genus *Tricellaria* Fleming, 1828

17. *Tricellaria occidentalis* (Trask, 1857)

Material examined. Korea: Guryongpo, 11 Aug 2008; Jangsaengpo, 11 Aug 2008; Onsan, 12 Aug 2008; Busan, 12 Aug 2008; Tongyeong, 13 Aug 2008; Samcheonpo, 13 Aug 2008; Jeju, 14 Aug 2008; Seogwipo, 15 Oct 2008; Kimnyeong, 15 Oct 2008; Donghae, 27 Aug 2008; Incheon, 4 Sep 2008; Guryongpo, 12 Nov 2008; Onsan, 13 Nov 2008; Jangsaengpo, 13 Nov 2008; Busan, 13 Nov 2008; Tongyeong, 14 Nov 2008; Samcheonpo, 14 Nov 2008; Jeju, 7 Jan 2009; Seogwipo, 9 Jan 2009; Guryongpo, 12 Aug 2009; Bangeojin, 13 Aug 2009; Jeongja, 13 Aug 2009; Dadaepo, 14 Aug 2009; Songjeong, 14 Aug 2009; Busan, 14 Aug 2009; Tongyeong, 14 Aug 2009; Gujora, 15 Aug 2009; Deokpo, 16 Aug 2009; Jeju, 18 Aug 2009; Hwasun, 18 Aug 2009; Jeju, 18 Aug 2009; Gampo, 13 Nov 2009; Yangpo, 24 Jun 2010; Guryongpo, 24 Jun 2010; Bangeojin, 25 Jun 2010; Ulsan, 25 Jun 2010; Jangsaengpo, 25 Jun 2010; Dadaepo, 26 Jun 2010; Busan, 26 Jun 2010; Tongyeong, 26 Jun 2010; Gwangyang, 27 Jun 2010; Mokpo, 27 Jun 2010; Seogwipo, 28 Jun 2010; Yangpo, 19 Oct 2010; Busan, 20

Oct 2010; Jangsaengpo, 20 Oct 2010; Tongyeong, 21 Oct 2010; Bieung, 22 Oct 2010; Gampo, 24 Oct 2011; Guryongpo, 24 Oct 2011; Yangpo, 24 Oct 2011; Dadaepo, 25 Oct 2011; Songjeong, 25 Oct 2011; Mokpo, 26 Jun 2011; Bieung, 27 Jun 2011; Incheon, 27 Jun 2011; Guryongpo, 22 Aug 2012; Gampo, 22 Aug 2012; Yangpo, 22 Aug 2012; Bangeojin, 23 Aug 2012; Jangsaengpo, 23 Aug 2012; Busan, 23 Aug 2012; Tongyeong, 24 Aug 2012; Gwangyang, 24 Aug 2012; Bieung, 25 Aug 2012; Incheon, 25 Aug 2012; Jeju, 17 Nov 2012; Incheon, 19 Dec 2012; Daebyeon, 21 Dec 2012; Busan, 21 Dec 2012; Songjeong, 21 Dec 2012; Guryongpo, 22 Dec 2012; Gampo, 22 Dec 2012; Yangpo, 22 Dec 2012.

Substratum. Ship, buoys, ropes, fishing net, quay walls, test panels, and flat-bottomed boat.

Remarks. This species is typical fouling bryozoans in Korea, together with *Watersipora subtorquata* and *Bugula neritina*.

Distribution. Cosmopolitan.

Family Thalamoporellidae Levinsen, 1902
Genus *Thalamoporella* Hincks, 1887

18. *Thalamoporella lioticha* (Ortmann, 1890)

Material examined. Korea: Hwasun, 15 Oct 2008; Kimnyeong, 17 Aug 2009; Tongyeong, 26 Jun 2010.

Substratum. Ship and buoys

Distribution. Korea, Japan, and Pacific.

Family Cellariidae Fleming, 1828
Genus *Cellaria* Ellis and Solander, 1786

19. *Cellaria punctata* (Busk, 1852)

Material examined. Korea: Hwasun, 15 Oct 2008.

Substratum. Ropes.

Distribution. Korea, Japan, Pacific, and Atlantic.

Family Catenicellidae Busk, 1852
Genus *Catenicella* de Blainville, 1830

*20. *Catenicella elegans* Busk, 1852

Material examined. Korea: Jeju, 15 Oct 2008; Jeju, 6 Jan 2011.

Substratum. Ropes.

Remarks. This species is newly reported as fouling bryozoans in Korea.

Distribution. Widespread.

Family Adeonidae Busk, 1884

Genus *Adeonella* Busk, 1884

*21. *Adeonella lichenoides* (Lamarck, 1816)

Material examined. Korea: Hwasun, 15 Oct 2008; Kimnyeong, 15 Oct 2008.

Substratum. Quay walls.

Remarks. This species is newly reported as fouling bryozoans in Korea.

Distribution. Widespread.

Family Lepraliellidae Vigneaux, 1949
Genus *Celleporaria* Lamouroux, 1821

22. *Celleporaria aperta* (Hincks, 1882)

Material examined. Korea: Jeju, 14 Aug 2008; Donghae, 27 Aug 2008.

Substratum. Ships and quay walls.

Distribution. Cosmopolitan.

*23. *Celleporaria brunnea* (Hincks, 1884)

Material examined. Korea: Gampo, 12 Aug 2009; Guryongpo, 12 Aug 2009; Bangeojin, 13 Aug 2009; Busan, 14 Aug 2009; Tongyeong, 14 Aug 2009; Gujora, 15 Aug 2009; Geoje, 15 Aug 2009; Jeju, 17 Aug 2009; Seogwipo, 18 Aug 2009; Hwasun, 18 Aug 2009; Yangpo, 24 Jun 2010; Seogwipo, 28 Jun 2010; Guryongpo, 19 Oct 2010; Yangpo, 19 Oct 2010; Busan, 20 Oct 2010; Seogwipo, 6 Jan 2011; Jeju, 6 Jan 2011; Yangpo, 24 Oct 2011; Songjeong, 25 Oct 2011; Bangeojin, 25 Oct 2011; Jangsaengpo, 25 Oct 2011; Ganggu, 22 Aug 2012; Gampo, 22 Aug 2012; Tongyeong, 23 Aug 2012; Bangeojin, 23 Aug 2012; Seogwipo, 16 Nov 2012; Daebyeon, 21 Dec 2012; Gampo, 22 Dec 2012.

Substratum. Buoys, ropes, quay walls, test panels, and flat-bottomed boat.

Remarks. This species is newly reported as fouling bryozoans in Korea.

Distribution. Korea and Pacific.

*24. *Celleporaria wakayamensis* (Okada and Mawatari, 1938)

Material examined. Korea: Busan, 12 Aug 2008; Tongyeong, 13 Aug 2008; Samcheonpo, 13 Aug 2008; Hwasun, 15 Oct 2008; Donghae, 27 Aug 2008; Onsan, 13 Nov 2008; Busan, 13 Nov 2008; Seogwipo, 9 Jan 2009; Busan, 11 Mar 2009; Gampo, 12 Aug 2009; Busan, 14 Aug 2009; Kimnyeong, 17 Aug 2009; Hwasun, 18 Aug 2009; Yangpo, 13

Substratum. Buoys.

Distribution. Korea and Japan.

Genus *Smittoidea* Osburn, 1952

30. *Smittoidea prolifica* Osburn, 1952

Material examined. Korea: Hwasun, 15 Oct 2008; Busan, 11 Mar 2009.

Substratum. Buoys and ropes.

Distribution. Korea, Japan, and Pacific.

Family Bitectiporidae MacGillivray, 1895

Genus *Metroperiella* Canu and Bassler, 1917

***31. *Metroperiella montferrandii* (Audouin, 1826)**

Material examined. Korea: Kimnyeong, 17 Aug 2009.

Substratum. Ropes.

Remarks. This species is newly reported as fouling bryozoans in Korea.

Distribution. Korea, Japan, Pacific, and Indian.

Family Watersiporidae Vigneaux, 1949

Genus *Watersipora* Neviani, 1895

32. *Watersipora subtorquata* (d'Orbigny, 1852)

Material examined. Korea: Guryongpo, 11 Aug 2008; Jangsaengpo, 11 Aug 2008; Busan, 12 Aug 2008; Tongyeong, 13 Aug 2008; Samcheonpo, 13 Aug 2008; Jeju, 14 Aug 2008; Seogwipo, 15 Oct 2008; Hwasun, 15 Oct 2008; Donghae, 27 Aug 2008; Incheon, 4 Sep 2008; Busan, 30 Oct 2008; Guryongpo, 12 Nov 2008; Onsan, 13 Nov 2008; Jangsaengpo, 13 Nov 2008; Busan, 13 Nov 2008; Tongyeong, 14 Nov 2008; Samcheonpo, 14 Nov 2008; Jeju, 7 Jan 2009; Seogwipo, 9 Jan 2009; Incheon, 25 Feb 2009; Gampo, 12 Aug 2009; Guryongpo, 12 Aug 2009; Bangeojin, 13 Aug 2009; Jeongja, 13 Aug 2009; Busan, 14 Aug 2009; Tongyeong, 14 Aug 2009; Gujora, 15 Aug 2009; Deokpo 15 Aug 2009; Jeju, 17 Aug 2009; Seogwipo, 18 Aug 2009; Hwasun, 18 Aug 2009; Gampo, 13 Nov 2009; Guryongpo, 13 Nov 2009; Tongyeong, 14 Nov 2009; Gampo, 24 Jun 2010; Yangpo, 24 Jun 2010; Guryongpo, 24 Jun 2010; Jangsaengpo, 25 Jun 2010; Busan, 26 Jun 2010; Tongyeong, 26 Jun 2010; Gwangyang, 27 Jun 2010; Mokpo, 27 Jun 2010; Seogwipo, 28 Jun 2010; Gampo, 19 Oct 2010; Guryongpo, 19 Oct 2010; Yangpo, 19 Oct 2010; Daebyeon, 20 Oct 2010; Busan, 20 Oct 2010; Bangeojin, 20 Oct 2010; Jangsaengpo, 20 Oct 2010; Tongyeong, 21 Oct 2010; Seogwipo, 6 Jan 2011; Gampo, 24 Oct 2011; Guryongpo, 24 Oct 2011; Yangpo, 24 Oct 2011; Dadaepo, 25 Oct

2011; Bangeojin, 25 Oct 2011; Jangsaengpo, 25 Oct 2011; Tongyeong, 26 Jun 2011; Mokpo, 26 Jun 2011; Incheon, 27 Jun 2011; Guryongpo, 22 Aug 2012; Gampo, 22 Aug 2012; Yangpo, 22 Aug 2012; Bangeojin, 23 Aug 2012; Jangsaengpo, 23 Aug 2012; Busan, 23 Aug 2012; Tongyeong, 24 Aug 2012; Incheon, 25 Aug 2012; Bangeojin, 21 Dec 2012; Jangsaengpo, 21 Dec 2012; Daebyeon, 21 Dec 2012; Busan, 21 Dec 2012; Guryongpo, 22 Dec 2012; Gampo, 22 Dec 2012; Yangpo, 22 Dec 2012.

Substratum. Ships, buoys, ropes, fishing net, quay walls, and test panels.

Remarks. This species is the commonest fouling bryozoans in Korean waters.

Distribution. Cosmopolitan.

Family Schizoporellidae Jullien, 1883

Genus *Schizoporella* Hincks, 1877

33. *Schizoporella unicornis* (Johnston, 1847)

Material examined. Korea: Guryongpo, 11 Aug 2008; Tongyeong, 13 Aug 2008; Jeju, 14 Aug 2008; Seogwipo, 15 Oct 2008; Hwasun, 15 Oct 2008; Ulsan, 29 Oct 2008; Busan, 30 Oct 2008; Guryongpo, 12 Nov 2008; Onsan, 13 Nov 2008; Ulsan, 13 Nov 2008; Tongyeong, 14 Nov 2008; Jeju, 7 Jan 2009; Seogwipo, 9 Jan 2009; Gampo, 12 Aug 2009; Guryongpo, 12 Aug 2009; Bangeojin, 13 Aug 2009; Gujora, 15 Aug 2009; Deokpo 15 Aug 2009; Jeju, 17 Aug 2009; Seogwipo, 18 Aug 2009; Hwasun, 18 Aug 2009; Gampo, 13 Nov 2009; Gampo, 24 Jun 2010; Yangpo, 24 Jun 2010; Guryongpo, 24 Jun 2010; Daebyeon, 25 Jun 2010; Tongyeong, 26 Jun 2010; Seogwipo, 28 Jun 2010; Bieung, 1 Jul 2010; Ganggu, 19 Oct 2010; Guryongpo, 19 Oct 2010; Songjeong, 19 Oct 2010; Daebyeon, 20 Oct 2010; Bangeojin, 20 Oct 2010; Seogwipo, 6 Jan 2011; Gampo, 24 Oct 2011; Ganggu, 24 Oct 2011; Guryongpo, 24 Oct 2011; Yangpo, 24 Oct 2011; Dadaepo, 25 Oct 2011; Tongyeong, 26 Jun 2011; Bieung, 27 Jun 2011; Gampo, 22 Aug 2012; Yangpo, 22 Aug 2012; Tongyeong, 24 Aug 2012; Bieung, 25 Aug 2012; Seogwipo, 16 Nov 2012; Jeju, 17 Nov 2012; Guryongpo, 22 Dec 2012; Gampo, 22 Dec 2012.

Substratum. Ships, flat-bottomed boat, tires, buoys, ropes, fishing net, quay walls, and test panels.

Distribution. Cosmopolitan.

Family Cryptosulidae Vigneaux, 1949

Genus *Cryptosula* Canu and Bassler, 1925

34. *Cryptosula pallasiana* (Moll, 1803)

Material examined. Korea: Guryongpo, 11 Aug 2008; Jang-

saengpo, 11 Aug 2008; Tongyeong, 13 Aug 2008; Samcheonpo, 13 Aug 2008; Jeju, 14 Aug 2008; Seogwipo, 15 Oct 2008; Donghae, 27 Aug 2008; Incheon, 4 Sep 2008; Busan, 30 Oct 2008; Guryongpo, 12 Nov 2008; Onsan, 13 Nov 2008; Ulsan, 13 Nov 2008; Jangsaengpo, 13 Nov 2008; Tongyeong, 14 Nov 2008; Samcheonpo, 14 Nov 2008; Jeju, 7 Jan 2009; Seogwipo, 9 Jan 2009; Incheon, 25 Feb 2009; Gampo, 12 Aug 2009; Guryongpo, 12 Aug 2009; Eupchen, 13 Aug 2009; Bangeojin, 13 Aug 2009; Jeongja, 13 Aug 2009; Daebyeon, 14 Aug 2009; Dadaepo, 14 Aug 2009; Busan, 14 Aug 2009; Tongyeong, 14 Aug 2009; Gujora, 15 Aug 2009; Deokpo, 15 Aug 2009; Jeju, 17 Aug 2009; Seogwipo, 18 Aug 2009; Gampo, 13 Nov 2009; Guryongpo, 13 Nov 2009; Guryongpo, 24 Jun 2010; Yangpo, 24 Jun 2010; Songjeong, 25 Jun 2010; Daebyeon, 25 Jun 2010; Bangeojin, 25 Jun 2010; Jangsaengpo, 25 Jun 2010; Busan, 26 Jun 2010; Tongyeong, 26 Jun 2010; Mokpo, 27 Jun 2010; Seogwipo, 28 Jun 2010; Bieung, 1 Jul 2010; Gampo, 19 Oct 2010; Guryongpo, 19 Oct 2010; Yangpo, 19 Oct 2010; Songjeong, 20 Oct 2010; Daebyeon, 20 Oct 2010; Bangeojin, 20 Oct 2010; Jangsaengpo, 20 Oct 2010; Tongyeong, 21 Oct 2010; Incheon, 22 Oct 2010; Jeju, 6 Jan 2011; Gampo, 24 Oct 2011; Guryongpo, 24 Oct 2011; Yangpo, 24 Oct 2011; Songjeong, 25 Oct 2011; Bangeojin, 25 Oct 2011; Jangsaengpo, 25 Oct 2011; Tongyeong, 26 Jun 2011; Mokpo, 26 Jun 2011; Bieung, 27 Jun 2011; Incheon, 27 Jun 2011; Ganggu, 22 Aug 2012; Guryongpo, 22 Aug 2012; Yangpo, 22 Aug 2012; Bangeojin, 23 Aug 2012; Jangsaengpo, 23 Aug 2012; Busan, 23 Aug 2012; Tongyeong, 24 Aug 2012; Bieung, 25 Aug 2012; Incheon, 25 Aug 2012; Seogwipo, 16 Nov 2012; Incheon, 19 Dec 2012; Bangeojin, 21 Dec 2012; Jangsaengpo, 21 Dec 2012; Daebyeon, 21 Dec 2012; Busan, 21 Dec 2012; Guryongpo, 22 Dec 2012; Gampo, 22 Dec 2012; Yangpo, 22 Dec 2012.

Substratum. Flat-bottomed boat, ropes, quay walls, and test panels.

Distribution. Widespread.

Family Microporellidae Hincks, 1879
Genus *Fenestrulina* Jullien, 1888

35. *Fenestrulina malusii* (Audouin, 1826)

Material examined. Korea: Songjeong, 14 Aug 2009; Geoje, 15 Aug 2009; Kimnyeong, 17 Aug 2009; Guryongpo, 13 Nov 2009; Yangpo, 19 Oct 2010; Yangpo, 24 Oct 2011.

Substratum. Ropes.

Distribution. Widespread.

***36. *Fenestrulina mutabilis* (Hastings, 1932)**

Material examined. Korea: Gampo, 24 Oct 2011.

Substratum. Ropes.

Remarks. This species is newly reported as fouling bryozoans in Korea.

Distribution. Korea, Japan, Pacific, and Atlantic.

Family Petraliidae Levinsen, 1909
Genus *Petraliella* Canu and Bassler, 1927

***37. *Petraliella magna* (d'Orbigny, 1852)**

Material examined. Korea: Hwasun, 15 Oct 2008.

Substratum. Buoys.

Remarks. This species is newly reported as fouling bryozoans in Korea. *Hippopetraliella magna* (d'Orbigny, 1852) was synonymized into *Petraliella magna* (d'Orbigny, 1852) (see Chae et al., 2016).

Distribution. Cosmopolitan.

Family Celleporidae Johnston, 1838
Genus *Celleporina* Gray, 1848

38. *Celleporina porosissima* Harmer, 1957

Material examined. Korea: Jeju, 7 Jan 2009; Songjeong, 17 Aug 2009; Geoje, 15 Aug 2009; Gujora, 15 Aug 2009; Yangpo, 24 Jun 2010; Yangpo, 19 Oct 2010; Yangpo, 24 Oct 2011; Jangsaengpo, 25 Oct 2011; Yangpo, 22 Aug 2012.

Substratum. Ropes and tires.

Distribution. Korea and Japan.

Family Phidoloporidae Gabb and Horn, 1862
Genus *Phidolopora* Gabb and Horn, 1862

39. *Phidolopora pacifica* (Robertson, 1908)

Material examined. Korea: Busan, 30 Oct 2008.

Substratum. Quay walls.

Distribution. Korea, Japan, and Pacific.

Genus *Reteporellina* Harmer, 1933

40. *Reteporellina denticulata* (Busk, 1884)

Material examined. Korea: Jeju, 7 Jan 2009.

Substratum. Quay walls.

Distribution. Cosmopolitan.

CONCLUSION

Since *Reteporellina denticulata* was reported from the arti-

Table 2. A total of 70 species of Korean fouling bryozoans recorded in both previous and present paper

Species list	Bae and Lee (1981)	Song (1985)	Je et al. (2003)	Gong and Seo (2003)	Gong and Seo (2004)	Seo (2005)	Seo and Min (2009)	This study
1 <i>Tubulioora flabellaris</i>		+						
2 <i>Crisia eburneodenticulata</i>				+				+
3 <i>Lichenopora radiata</i>				+				
4 <i>Disporella novaezealandiae</i>								+
5 <i>Flustrellidra armata</i>								+
6 <i>Nolella stipata</i>								+
7 <i>Amathia convoluta</i>						+		
8 <i>Amathia distans</i>				+	+	+		+
9 <i>Aetea anguina</i>								+
10 <i>Biflustra crenulata</i>						+	+	
11 <i>Biflustra perfragilis</i>				+		+	+	
12 <i>Membranipora villosa</i>								+
13 <i>Jellyella tuberculata</i>				+			+	+
14 <i>Electra tenella</i>		+		+	+	+	+	
15 <i>Cauloramphus korensis</i>				+		+		+
16 <i>Tegella incrustans</i>				+		+	+	+
17 <i>Bugula neritina</i>				+	+	+	+	+
18 <i>Bugula umbelliformis</i>		+						
19 <i>Bugulina californica</i>		+		+	+	+	+	+
20 <i>Virididentula dentata</i>		+						+
21 <i>Beania discodermiae</i>				+		+		
22 <i>Beania hexaceras</i>		+						+
23 <i>Beania mirabilis</i>								+
24 <i>Amastigia rudis</i>				+			+	
25 <i>Caberea bursifera</i>		+						
26 <i>Caberea hataii</i>				+		+		
27 <i>Caberea lata</i>				+		+	+	
28 <i>Scrupocaberea maderensis</i>								+
29 <i>Tricellaria occidentalis</i>		+		+	+	+	+	+
30 <i>Microporina articulata</i>				+				
31 <i>Thalamoporella lioticha</i>						+	+	+
32 <i>Cellaria punctata</i>							+	+
33 <i>Catenicella elegans</i>								+
34 <i>Eurystomella bilabiata</i>					+	+		
35 <i>Adeonella lichenoides</i>								+
36 <i>Celleporaria aperta</i>		+			+	+	+	+
37 <i>Celleporaria brunnea</i>								+
38 <i>Celleporaria wakayamensis</i>								+
39 <i>Escharoides excavata</i>				+	+	+	+	+
40 <i>Escharoides sauroglossa</i>		+						
41 <i>Exochella tricuspis</i>								+
42 <i>Parasmittina areolata</i>								+
43 <i>Parasmittina contraria</i>						+	+	+
44 <i>Parasmittina triangularis</i>		+						+
45 <i>Parasmittina serrula</i>						+		
46 <i>Smittoidea pacifica</i>				+		+	+	
47 <i>Smittoidea prolifica</i>		+				+		+
48 <i>Smittoidea reticulata</i>						+		
49 <i>Metroperiella montferrandii</i>								+
50 <i>Metroperiella parviavicularia</i>				+	+	+	+	
51 <i>Metroperiella spatulata</i>		+						
52 <i>Schizomavella acuta</i>		+						
53 <i>Schizomavella auriculata</i>		+						
54 <i>Watersipora subtorquata</i>		+		+	+	+	+	+
55 <i>Schizoporella nivea</i>		+						
56 <i>Schizoporella unicornis</i>		+		+	+	+	+	+
57 <i>Calyptotheca symmetrica</i>						+	+	
58 <i>Cryptosula pallasiana</i>				+		+	+	+
59 <i>Mucropetraliella perforat</i>				+	+			
60 <i>Fenestrulina malusii</i>		+			+	+	+	+
61 <i>Fenestrulina mutabilis</i>								+

Table 2. Continued

Species list	Bae and Lee (1981)	Song (1985)	Je et al. (2003)	Gong and Seo (2003)	Gong and Seo (2004)	Seo (2005)	Seo and Min (2009)	This study
62 <i>Petraliella magna</i>								+
63 <i>Celleporina geminata</i>					+			
64 <i>Celleporina rostellata</i>							+	
65 <i>Celleporina porosissima</i>		+		+		+	+	+
66 <i>Celleporaria triangula</i>						+		
67 <i>Iodictyum</i> sp.		+						
68 <i>Phidolopora pacifica</i>		+		+		+	+	+
69 <i>Reteporellina denticulata</i>	+	+						+
70 <i>Triphyllozoon hirsutum</i>			+					
Total	1	23	1	25	14	31	25	40
Added species (cumulative species)	1 (1)	22 (23)	1 (24)	18 (42)	2 (44)	8 (52)	2 (54)	16 (70)

ficial reefs of Yeosu waters by Bae and Lee (1981), 54 fouling bryozoans were so far recorded by Song (1985), Je et al. (2003), Gong and Seo (2003, 2004), Seo (2005) and Seo and Min (2009) from Korea. Sixteen species are added to the list of fouling bryozoans herein. They are as follows: *Disporella novaehollandiae*, *Flustrellidra armata*, *Nolella stipata*, *Aetea anguina*, *Membranipora villosa*, *Beania mirabilis*, *Scrupocaberea maderensis*, *Catenicella elegans*, *Adeonella lichenoides*, *Celleporaria brunnea*, *Celleporaria wakayamensis*, *Exochella tricuspis*, *Parasmittina areolata*, *Metroperiella montferrandii*, *Fenestrulina mutabilis*, and *Petraliella magna* are added to the list of Korean fouling bryozoans. A total of 70 species of fouling bryozoans from Korea are reported up to the present (Table 2).

Fifty-four species of Korean fouling bryozoans have been reported in previous studies, of which, only 40 species have found in this study. Fifty-four species in the previous studies were collected from not only ports and harbours, but also artificial structures in intertidal zones and coasts, whereas 40 species have been found in this study were collected from only ports and harbours of the mainland of the Korean Peninsula. Furthermore, it is remarkable that 18 of 54 species have no additional report since they were first reported as Korean fouling bryozoans.

In terms of abundance of fouling bryozoans, 40 species were collected from 56 localities, the most abundant fouling species being *Bugula neritina*, *Tricellaria occidentalis*, *Watersipora subtoquata* and *Cryptosula pallasiana* in this study (Table 3, Fig. 3). *Bugula neritina* is best known as a marine-fouling organism (Gordon and Mawatari, 1992; Ryland et al., 2011). *Tricellaria occidentalis* is one of the most common fouling organisms on setting nets and ships' bottoms (Mawatari, 1951) and is a distinctive species, often co-occurring with *Bugula* species or alone in dense swards. It dominates the fouling-bryozoans fauna at the port of Gisborne

Table 3. The ten most abundant species of Korean ports and harbours

Species	No. of localities (%)
<i>Watersipora subtoquata</i>	40 (71.4)
<i>Tricellaria occidentalis</i>	39 (69.6)
<i>Cryptosula pallasiana</i>	38 (67.9)
<i>Bugula neritina</i>	34 (60.7)
<i>Schizoporella unicornis</i>	25 (44.6)
<i>Celleporaria brunnea</i>	21 (37.5)
<i>Bugulina californica</i>	20 (35.7)
<i>Biflustra perfragilis</i>	16 (28.6)
<i>Celleporaria wakayamensis</i>	15 (26.8)
<i>Amathia distans</i>	13 (23.2)

where it may be seen at low tide dangling beneath horizontal concrete beams between pilings, and at Paremata, Porirua Harbour, it can form dense swards on the hulls of pleasure craft, attaining 4–5 cm length in a year (Gordon and Mawatari, 1992). *Watersipora subtoquata* has been widely reported as a fouling species in harbor areas, from tropical to temperate waters (Vieira et al., 2014a). *Cryptosula pallasiana* is well known as a fouling species (Brock, 1985) and is one of the more ubiquitous fouling bryozoans in New Zealand (Gordon and Mawatari, 1992). Recently, *C. pallasiana* and *T. occidentalis* are known as widespread species, and *B. neritina* is cosmopolitan (<http://www.bryozoa.net>).

This result closely corresponds to the previous studies, which *B. neritina*, *T. occidentalis* and *W. subtoquata* have been found to be the most abundant species (Gong and Seo, 2003, 2004; Seo, 2005). However, *Cryptosula pallasiana* from Korea has not been known to be the one of most abundant species. *Cryptosula pallasiana*, which was recorded from Korea by Seo (1992) for the first time, was reported as a fouling bryozoan by Gong and Seo (2003). Remarkably, this study shows that *C. pallasiana* appeared to be the one of the most abundant species. This result is coincident with the fact

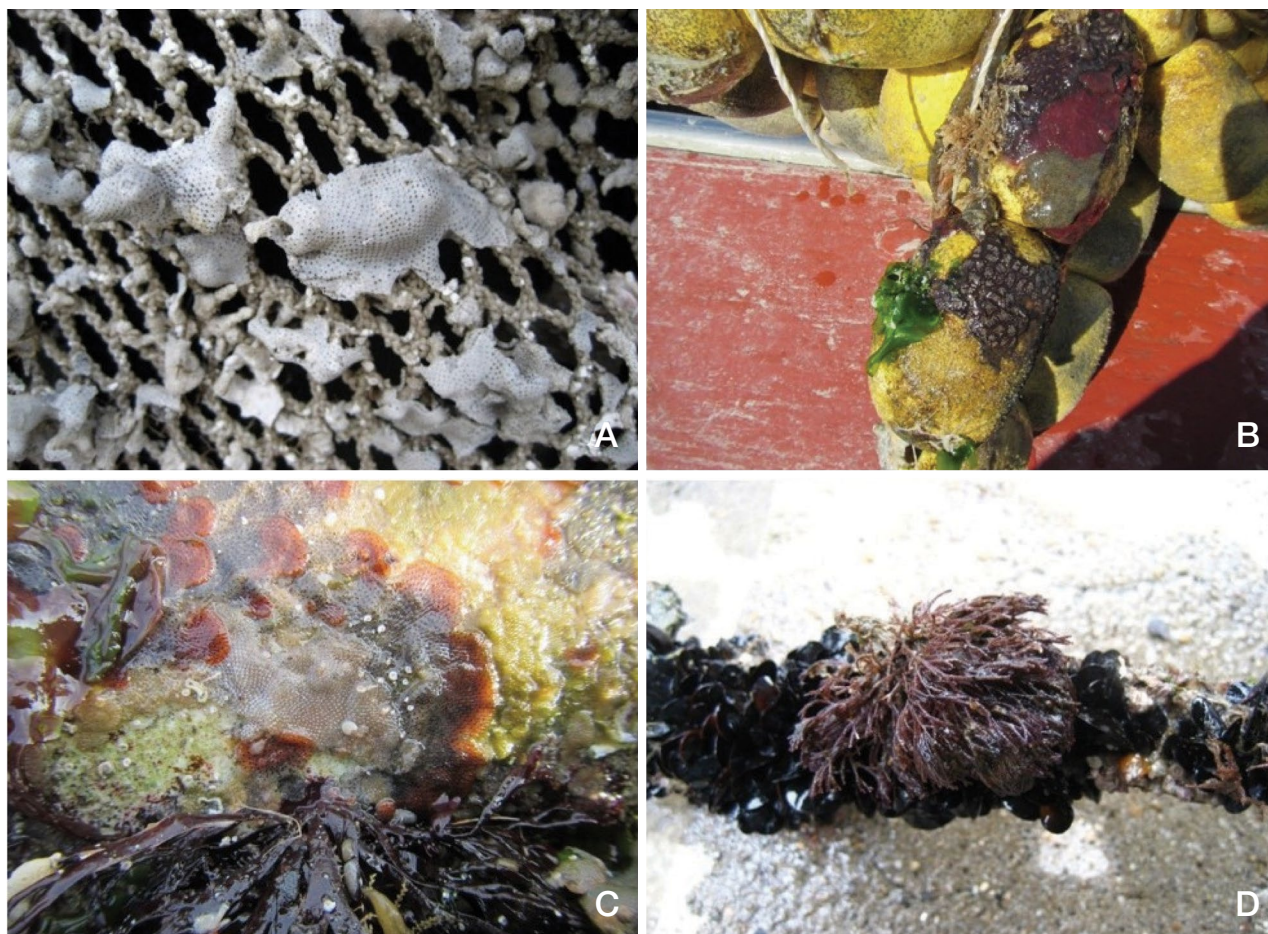


Fig. 3. The most abundant fouling bryozoans of Korean ports and harbours. A, *Watersipora subtorquata*; B, *Tricellaria occidentalis*; C, *Cryptosula pallasiana*; D, *Bugula nertitina*.

that *C. pallasiana* is widespread around the world, particularly in ports, harbor, and estuarine situations (Gordon and Mawatari, 1992).

Three species, *Flustrellidra armata* Grischenko, Seo and Min, 2010, *Cauloramphus korensis* Seo, 2001 and *Parasmitina contraria* Seo, 1993 are endemic to Korea. *Flustrellidra armata* Grischenko, Seo and Min, 2010 is newly reported as a fouling bryozoan herein.

ORCID

Hyun Sook Chae: <https://orcid.org/0000-0002-2702-9095>

Ji Eun Seo: <https://orcid.org/0000-0001-5764-5457>

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

ACKNOWLEDGMENTS

This research was supported by the Marine Biotechnology Program of the Korea Institute of Marine Science and Technology Promotion (KIMST) funded by the Ministry of Oceans and Fisheries (MOF) (No. 20170431).

REFERENCES

- Bae SH, Lee JH, 1981. Biological studies on the artificial reefs. The summer biota of Sohoenggan Do and fouling organisms on the artificial reefs (1). Bulletin of Gunsan Fisheries College, 15:15-21.
- Brock FJ, 1985. South Australian fouling bryozoans. In: Bryozoa: Ordovician to recent (Eds., Nielsen C, Larwood GP). Olsen and Olsen, Fredensborg, pp. 45-49.
- Chae HY, Kil HJ, Seo JE, 2016. Taxonomic study on bryozoans-new additions to the Korean fauna and new species of *Petarliella* from Seogwipo waters of Jeju Island. Journal of

- Species Research, 5:551-565.
- Christie AO, Dalley R, 1987. Barnacle fouling and its prevention. In: Barnacle biology (Ed., Southward AJ). A. A. Balkema, Rotterdam, pp. 419-433 (cited from Key et al., 1999)
- Dick MH, Grischenko AV, Mawatari SF, 2005. Intertidal Bryozoa (Cheilostomata) of Ketchikan, Alaska. *Journal of Natural History*, 39:3687-3784. <https://doi.org/10.1080/00222930500415195>
- Edmondson CH, Ingram WM, 1939. Fouling organisms in Hawaii. Occasional Paper of the Bernice P. Bishop Museum, 14:251-300.
- Fehlauer-Ale KH, Winston JE, Tilbrook KJ, Nascimento KB, Vieira LM, 2015. Identifying monophyletic groups within *Bugula* sensu lato (Bryozoa, Buguloidea). *Zoologica Scripta*, 44:334-347. <http://doi.org/10.1111/zsc.12103>
- Gong YH, Seo JE, 2003. Fouling bryozoan from the East Sea. *Journal of HRDEC*, 4:1-22.
- Gong YH, Seo JE, 2004. A taxonomic study on fouling bryozoans from Korea: preliminary report. *Underwater Science and Technology*, 5:11-16.
- Gordon DP, Mawatari SF, 1992. Atlas of marine-fouling Bryozoa of New Zealand ports and harbours. Miscellaneous Publications, New Zealand Oceanographic Institute, 107:1-52.
- Hayward PJ, 1985. Ctenostome Bryozoans. In: Synopsis of the British fauna. Vol. 33 (Eds., Kermack DM, Barnes RSK). The Linnean Society of London and the Estuarine and Brackish-Water Sciences Association, E.J. Brill/Dr. W. Backhuys, London, pp. 1-169.
- Je JG, Lee HG, Shin SH, 2003. Underwater observation on artificial reefs in the coastal water of Gyeonggi-do, Korea. *Underwater Science and Technology*, 4:9-26.
- Key MM Jr, Winston JE, Volpe JW, Jeffries WB, Voris HK, 1999. Bryozoan fouling of the blue crab *Callinectes sapidus* at Beaufort, North Carolina. *Bulletin of Marine Science*, 64:513-533.
- Mawatari S, 1951. On *Tricellaria occidentalis* (Trask), one of the fouling bryozoans in Japan. *Miscellaneous Reports of the Research Institute for Natural Resources*, Tokyo, 22:9-16.
- Ryland JS, 1970. Bryozoans. Hutchinson University Library London, pp. 1-175.
- Ryland JS, Bishop JDD, de Blauwe H, El Nagar A, Minchin D, Wood CA, Yunnice ALE, 2011. Alien species of *Bugula* (Bryozoa) along the Atlantic coasts of Europe. *Aquatic Invasions*, 6:17-31. <https://doi.org/10.3391/ai.2011.6.1.03>
- Seo JE, 1992. A systematic study on the Bryozoans from the South Sea in Korea I. Cheilostomata. *Korean Journal of Systematic Zoology*, 8:141-160.
- Seo JE, 2005. Illustrated encyclopedia of fauna and flora of Korea, Vol. 40. Bryozoa. Ministry of Education and Human Resources Development, Seoul, pp. 1-596.
- Seo JE, Min BS, 2009. A faunistic study on cheilostomatous bryozoans from the shoreline of South Korea, with two new species. *Animal Systematics, Evolution and Diversity*, 25:19-40. <https://doi.org/10.5635/KJSZ.2009.25.1.019>
- Song JI, 1985. Studies on the fouling animals in Wolsung and Seocheon. *Journal of Korean Research Institute for Better Living*, 36:69-78.
- Stevens LM, Gregory MR, Foster BA, 1996. Fouling bryozoans on pelagic and moored plastics from northern New Zealand. In: *Bryozoans in space and time* (Eds., Gordon DP, Smith AM, Grant-Mackie JA). National Institute of Water and Atmospheric Research Ltd., Wellington, pp. 321-340.
- Taylor PD, Monks N, 1997. A new cheilostome bryozoan genus pseudoplanktonic on molluscs and algae. *Invertebrate Biology*, 116:39-51. <https://doi.org/10.2307/3226923>
- Vieira LM, Spencer-Jones ME, Taylor PD, 2014a. The identity of the invasive fouling bryozoans *Watersipora subtorquata* (d'Orbigny) and some other congeneric species. *Zootaxa*, 3857:151-182. <https://doi.org/10.11646/zootaxa.3857.2.1>
- Vieira LM, Spencer-Jones ME, Winston JE, Migotto AE, Marques AC, 2014b. Evidence for polyphyly of the genus *Scrupocellaria* (Bryozoa: Candidae) based on a phylogenetic analysis of morphological characters. *PLoS ONE*, 9:e95296. <https://doi.org/10.1371/journal.pone.0095296>

Received September 30, 2019
Accepted October 10, 2019