violet tunicate
Botrylloides violaceus

Synonyms: *Botrylloides aurantius, Botrylloides aurantium, Botrylloides carnosum,*
Other common names: chain tunicate, lined colonial tunicate, orange sheath tunicate, ascidian
Family: Styelidae
AphiaID. 148715

Description (Curran & Chan, 2013)
B. violaceus is a marine colonial tunicate with rapid growth and mat-forming capabilities that colonizes and dominates artificial and natural hard substrata. They form flat sheets and occasionally lobate structures. A colony consists of a number of teardrop-shaped zooids, connected by a common tunic, that are arranged in elongated clusters. Zooids have 10-11 rows of stigmata and 9-12 stomach folds. Each zooid is a single color, and all the zooids within a colony are the same color, usually orange, yellow, red, purple or tan, and occasionally brown or lavender. The matrix is usually clear, though in some older colonies it can be the same color as the zooids. Blood vessels can be seen extending through the matrix with pigmented blobs at their terminus.

B. violaceus. Photo by Dann Blackwood (USGS)

Similar species: Botrylloides diegensis, Botrylloides perspicum

Ecological impact
Impact on community composition, structure, and interactions: B. violaceus colonies can displace other fouling organisms through competition for resources, which can result the marked decrease in select species, or biodiversity as a whole (Myers 1990, Osman & Whitlatch, 1995; Bullard et al. 2004; Dijkstra and Harris 2009).
Impact on ecosystem processes:
Reduced biodiversity and limited species access to resources can limit ecosystem productivity and lessen ecosystem resilience to disturbance.
Economic Impact: *D. vexillum* poses a nuisance to aquaculture activities and is expected to have substantial impacts on the shipping and fisheries industry (Gittenberger, 2009; Carman et al., 2010; Bullard et al. 2015)

Biology and invasive potential
Reproductive potential: Like all colonial ascidians, *B. violaceus* reproduces sexually and asexually. Larvae are lecithotrophic and spend less than 24 hours in the water column before settling and developing into adult colonies (Brown et al., 2009).
Potential for long-distance dispersal:
Transoceanic transport of *B. violaceus* is unlikely because the planktonic stage is short.
Potential to be spread by human activity:
Transport occurs as biofouling on vessel hulls and infrastructure, shipping of live seafood, or in ballast and bilge water (Dijkstra et al., 2008; Lambert, 2007; Ruiz et al., 2000)
Habitat requirements: B. violaceus can tolerate a wide range of temperature, salinity, and nutrient

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conditions (Carman et al., 2007; Dijkstra et al., 2008). They can survive in temperatures ranging from -1 to 27°C and salinities of 15 to 34. Grows on hard substrata and occurs in the intertidal to 50 m and can persist out of water during tidal cycles (CABI, 2021).
Congeneric biota: At the time of writing, *Botrylloides* is a parent to over 68 species.

Legal Listings

- [ ] Has not been declared invasive
- [x] Listed invasive in Alaska
- [x] Listed invasive by other states
- [ ] Federal invasive species
- [x] Listed invasive in Canada or other countries

Distribution and abundance

B. violaceus is native to the northwest Pacific from northern Japan and China, extending to southern Korea. It has since spread to the eastern Pacific (Lambert & Sanamyan 2001; Bock et al., 2011), parts of the northern Atlantic (Stachowics et al., 2002), Mediterranean and Black Sea (Zanilolo et al., 1998). It is a common fouling organism throughout much of its range.

Management

Eradication of invasive tunicates becomes difficult after significant geographic dispersal. However, local control methods have been applied using X-ray radiation (Rinkevich & Weissman, 1990), chemical methods such as application of organotics (Cima et al., 1995), and use of anti-fouling agents to prevent settlement (Terlizzi et al., 1997). However, anti-fouling methods have been cautioned against as they may exacerbate spread by facilitating colony fragmentation (Coutts and Sinner, 2004). The uncertainty of removal methods and ease of transport indicates that the current best method of reducing the impacts of *B. violaceus* is to establish effective education and monitoring programs to promote early detection and rapid response.

References

Bock, D.G., Zhan, A., Lejeusne, C., MacIsaac, H.J., & Cristescu, M.E., (2011). Looking at both sides of the invasion: patterns of colonization in the violet tunicate Botrylloides violaceus. *Molecular Ecology*, 20(3):503-516.

Brown, F.D., Keeling, E.L., A.D., & Swalla, B.J., (2009). Whole body regeneration in a colonial ascidian, Botrylloides violaceus. *Journal of Experimental Zoology*, 312B(8):885-900.

Bullard, S.G., Whitlatch, R.B., & Osman, R.W., (2004). Checking the landing zone: do invertebrate larvae avoid settling near superior spatial competitors?, *Marine Ecological Progress Series,* 280:239-247

CABI, (2021). *Botrylloides violaceus*. In: Invasive Species Compendium. Wallingford, UK: CAB International.

Carman, M.R., Bullard, S.G., & Donnelly, J.P., (2007). Water quality, nitrogen pollution, and ascidian diversity in coastal waters of southern Massachusetts, USA. Journal of *Experimental Marine Biology and Ecology*, 342(1):175-178.

Cima, F., Ballarin, L.B., & Sabbadin, A., (1995). Immunotoxicity of butyltins in tunicates. *Applied Organic Chemistry,* 9(7): 567-572.

Coutts, A.D.M., & J. Sinner. (2004). An updated benefit-cost analysis of management options for Didemnum vexillum in Queen Charlotte Sound. Cawthron Report No. 925 prepared for the Marlborough District Council. 14 p.

Curran L., & Chan S., (2013) A field guide to invasive colonial tunicates in the Pacific Northwest. Oregon Sea Grant, Corvallis, 32 p

Dijkstra, J., Dutton, A., Westerman, E., & Harris, L., (2008). Heart rates reflect osmotic stress in two introduced colonial ascidians:

Botryllus schlosseri and Botrylloides violaceus. *Marine Biology*, 154:805-811.

Gittenberger, A., (2009). Invasive tunicates on Zeeland and Prince Edward Island mussels, and management practices in The Netherlands. *Aquatic Invasions* [Proceedings of the 2nd International Invasive Sea Squirt Conference, Prince Edward Island, Canada, 2-4 October 2007.], 4(1):279-281.

Lambert, G., & Sanamyan, K., (2001). Distaplia alaskensis sp. nov. (Ascidiacea, Aplousobranchia) and other new ascidian records from south-central Alaska, with a redescription of Ascidia columbiana (Huntsman 1912). *Canadian Journal of Zoology*. 79(10): 1766- 1781.

Lambert, G., (2007). Invasive sea squirts: A growing global problem. *Journal of Experimental Marine Biology and Ecology*, 342:3-4

Osman, R.W., & Whitlatch, R.B., (1995). Predation on early ontogenic life stages and its effect on recruitment into a marine epifaunal community. *Marine Ecology-Progress Series*, 117:111-126.

Rinkevich, B., & Weissman, I.L., (1990). Botryllus schlosseri Tunicata whole colony irradiation. Do senescent zooid resorption and immunological resorption involve similar recognition event? *Journal of Experimental Zoology*. 253(2): 189-201

Ruiz, G.M., Fofonoff, P.W., Carlton, J.T., Wonham, M.J., & Hines, A.H., (2000). Invasion of coastal marine communities in North America: apparent patterns, processes and biases. *Annual Review of Ecology and Systematics*, 31:481-531.

Stachowicz, J.J., Fried, H., Osman, R.W., & Whitlatch, R.B., (2002). Biodiversity, invasion resistance and marine ecosystem function: reconciling pattern and process. *Ecology,* 83(9): 2575-2590.

Terlizzi, A., Conte, E., Zupo, V., & Mazzella, L., (1997). Antifouling effectiveness of newly developed non-polluting coatings. 4th International Marine Biotechnology conference - Abstracts. p. 345.

Zaniolo, G., Manni, L., Brunetti, R. & Burighel, P., (1998). Brood pouch differentiation in Botrylloides violaceus, a viviparous ascidian (Tunicata). *Invertebrate Reproductive Development*, 33: 11-24.