carpet sea squirt
Didemnum vexillum

Synonyms: *Didemnum vestium, Didemnum vestitum*
Other common names: colonial sea squirt, ascidian, colonial tunicate,marine vomit
Family: Didemnidae
AphiaID. 250126

Description

D. vexillum is a marine colonial tunicate with rapid growth and mat-forming capabilities that colonizes and dominates artificial and natural hard substrata. A colony of *D. vexillum* consists of a number of sac-shaped zooids connected by a common tunic. The surface of the colony is smooth like firm gelatin, wet-leathery, often veined in appearance, and dotted with many fine pores. The colony can form a thin or thick encrusting mat, or form large or small lobes.. Color varies between orange, pink, tan, creamy yellow or greyish-white and the tunic is sparsely strengthened by stellate spicules with nine to eleven rays (Bullard et al., 2007). In areas with little water movement, colonies may dangle in ropey masses from hard substrates such as the hulls of vessels. Rope-like tendrils can break off, float away and are capable of reattachment and growth (Bullard et al., 2007).

D. *Vexillum.* Photo by Meuret-Woody

Similar species: Didemnum perlucidem is classified as invasive in other regions.

Ecological impact

Impact on community composition, structure, and interactions: D. vexillum colonies can smother benthic communities which can result the marked decrease in select species, or biodiversity as a whole. This occurs directly through reduced access to resources (e.g., light, food), competition for resources (e.g., substrate), or through exudation of biochemicals which discourages predation and prevents the larvae of other species from settling on it (Pisut & Pawlik, 2002; Bullard et al., 2007). Studies suggest the presence of this species may inhibit recruitment of shellfish (Morris et al., 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 serious threat to aquaculture industries (Valentine et al. 2007).

Biology and invasive potential

Reproductive potential: Like all colonial ascidians, *D. vexillum* reproduces sexually and asexually. Rapid reproductive growth can result in massive colonies that overgrow almost every other sessile species (Kott, 2002).
Potential for long-distance dispersal: Organisms may be dispersed great distances on vessel hulls or on the surface of marine debris such as free-floating net pens or dock segments (Lambert, 2007; Ruiz et al., 2000).
Potential to be spread by human activity: Transport often occurs as biofouling on vessel

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hulls, as fouling on infested aquatic farm gear or infrastructure, or in ballast water as colony fragments (Lambert, 2007; Ruiz et al., 2000)
Habitat requirements: Inshore marine areas such coastal regions, estuaries, and inland saline areas. Requires substrate to settle. Tolerant of water salinity 20-45 PSU and temperatures of 0-28°C (Bullard et al., 2007; Dijkstra et al, 2007).

Congeneric biota: Didemnum is the most specious genus in the *Didemnid* family

Legal Listings

- ☐ Has not been declared invasive
- ☑ Listed invasive in Alaska
- ☑ Listed invasive by other states
- ☐ Federal invasive species
- ☑ Listed invasive in Canada or other countries

Distribution and abundance

Believed to originate from Japan, *D. vexillum is* undergoing world-wide expansion in temperate waters. Globally, it has been reported from northern Europe (Lambert, 2009; Arenas et al., 2006), Ireland, France (Lambert, 2009), Canada (Lambert, 2009), eastern and western United States (Bullard et al.,2007; Dijkstra et al, 2007), and New Zealand (Coutts & Forrest, 2002). Although the lecithotrophic larvae are free swimming for only a short period, the ease of transfer of larvae and zooids through human-related vectors facilitates rapid distribution of the species.

Management

Coutts and Forrest (2007) tested several methods of eradication, finding that regional eradication was ineffective, but local eradication possible. Similarly, McCann et al. (2013) tested local eradication methods using biocides and mechanical removal and were able to achieve significant a significant reduction in *D. vexillum* cover. These methods show promise in the removal of *D. vexillum* from harbors, which could reduced transport of the species. The uncertainty of removal methods and ease of transport indicates that the current best method of reducing the impacts of *D. vexillum* is to establish effective education and monitoring programs to promote early detection and rapid response.

References

Arenas, F., Bishop, J., Carlton, J., Dyrynda, P., Farnham, .W, Gonzales, D., Jacobs, M., Lambert C, Lambert G, Nielsen S, Pederson, J., Porter, J., Ward, S., & Wood, C., (2006). Alien species and other notable records from a rapid assessment survey of marinas on the south coast of England. *Journal of the Marine Biological Association UK*, 86:1329-1337

Bullard, S.G., Lambert, G., Carman, M.R., Byrnes, J., Whitlatch, R.B., Ruiz, G.M., Miller, R.J., Harris, L.G., Valentine, P.C., Collie, J.S., Pederson, J., McNaught, D.C., Cohen, A.N., Asch, R.G., Dijkstra, J., & Heinonen, K., (2007). The Invasive colonial ascidian Didemnum sp.: current distribution, basic biology, and potential threat to marine communities of the northeast and west coasts of the United States. *Journal of Experimental Marine Biology and Ecology*, 342:99-108

Coutts, A.D.M., & Forrest, B.M., (2007). Development and application of tools for incursion response: lessons learned from the management of the fouling pest Didemnum vexillum. *Journal of Experimental Marine Biology and Ecology*, 342(1):154-162.

Dijkstra, J., Sherman, H., & Harris, L.G., (2007). The role of colonial ascidians in altering biodiversity in marine fouling communities. *Journal of Experimental Marine Biology and Ecology*, 342(1):169-171.

Kott, P., (2002). A complex didemnid ascidian from Whangamata, New Zealand. *Journal Marine Biological Association UK*, 82:625-628

Lambert, L., (2009). Adventures of a sea squirt sleuth: unraveling the identity of Didemnum vexillum, a global ascidian invader. *Aquatic Invasions*. 5-28.

McCann, L.D., Holzer, K.K., Davidson, I.C., Ashton, G.V., Chapman, M.D. & Ruiz, G.M., (2013). Promoting invasive species control and eradication in the sea: Options for managing the tunicate invader Didemnum vexillum in Sitka, Alaska. *Marine pollution bulletin*, 77(1), pp.165-171.

Morris, J.A., Carman, M.R., Hoagland, K.E., Green-Beach, E.R.M., & Karney, R.C., (2009). Impact of the invasive colonial tunicate Didemnum vexillum on the recruitment of the bay scallop (Argopecten irradians irradians) and implications for recruitment of the sea scallop (Placopecten magellanicus) on Georges Bank. *Aquatic Invasions*, 4(1):207-211.

Pisut, D.P., & Pawlik, J.R., (2002). Anti-predatory chemical defenses of ascidians: secondary metabolites or inorganic acids? *Journal of Experimental Marine Biology and Ecology*, 270:203-214

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

Valentine, P.C., Collie, J.S., Reid, R.N., Asch, R.G., Guida, V.G., & Blackwood, D.S., (2007). The occurrence of the colonial ascidian Didemnum sp. on Georges Bank gravel habitat: Ecological observations and potential effects on groundfish and scallop fisheries. *Journal of Experimental Marine Biology and Ecology*. 179-181.