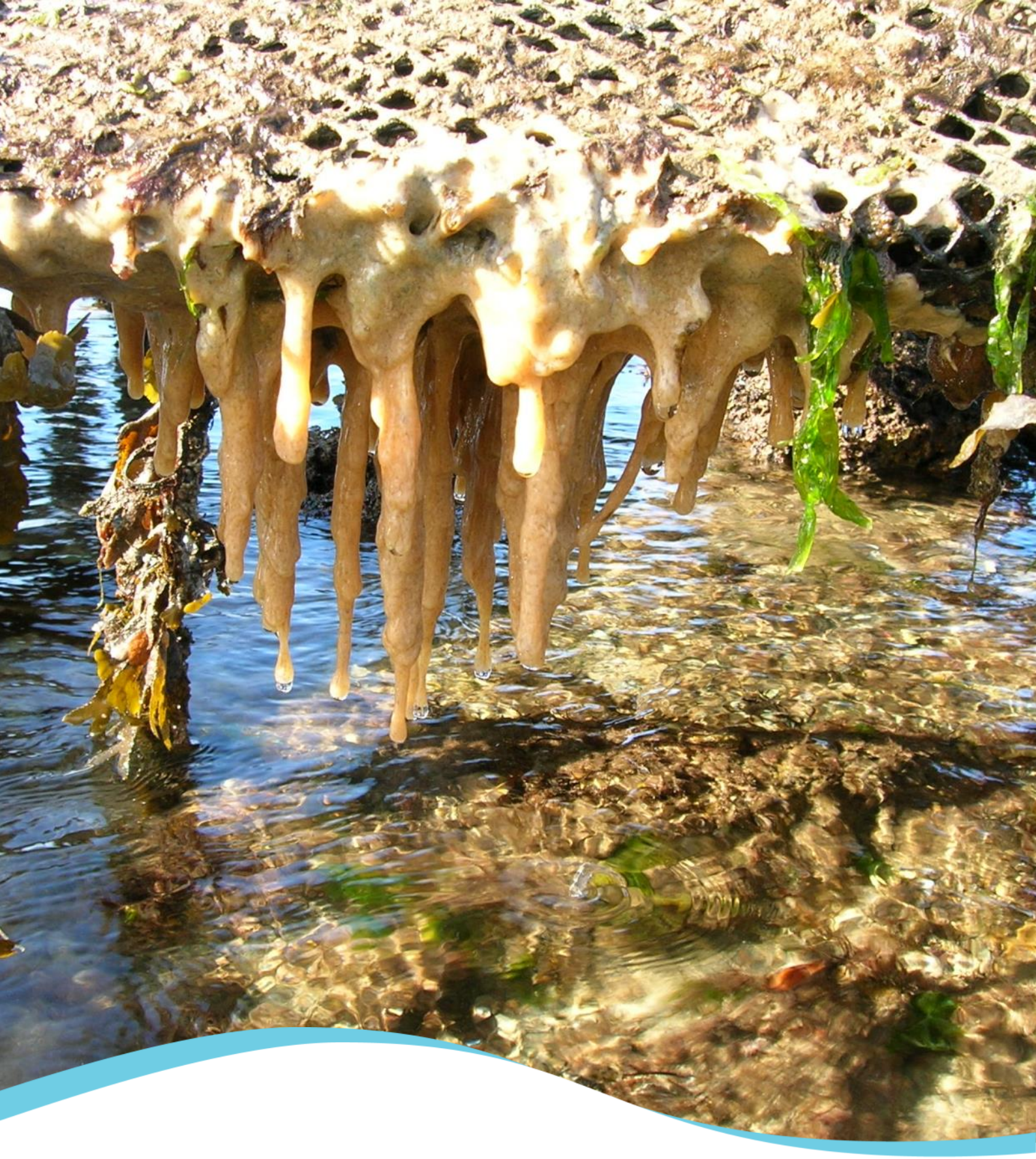

# GOOD PRACTICE MANAGEMENT

## Carpet Sea Squirt (*Didemnum vexillum*)

RAPID

Reducing and Preventing
Invasive Alien Species Dispersal

# GOOD PRACTICE MANAGEMENT GUIDE

## Carpet Sea Squirt (*Didemnum vexillum)*

**For ID guides and more information:**
http://www.nonnativespecies.org/factsheet/factsheet.cfm?speciesId=1209

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https://woodshole.er.usgs.gov/project-pages/stellwagen/

Carpet sea squirt (*Didemnum vexillum*)

Version 1: August 2018

# MANAGEMENT SUMMARY

## Ecology and impact of Carpet Sea Squirt

*Didemnum vexillum* was first recorded in the UK in 2008 in Holyhead, Wales and is now well-established in marinas along the south coast of England. This highly invasive carpet sea-squirt is a colonial ascidian, a sac-like marine invertebrate filter feeder that can form huge mats or pendulous colonies on artificial and natural hard surfaces. It is very robust, tolerating a wide range of environmental conditions. Larvae are brooded within the tunic and when released, swim for a short period before attaching to a substrate. *D. vexillum* also reproduces asexually by budding and fragments of colonies readily reattach.

Impacts include overgrowth of fish spawning grounds, smothering of shellfish beds, and fouling of ships' hulls and aquaculture equipment, mussels and oysters grown from ropes and hard substrate. It can also have ecological impacts by overgrowing substrata in the sub-tidal zone and rockpools, competing with and displacing native species. *D. vexillum* exhibits strong seasonal changes in abundance and overall numbers in colonies significantly decreases during winter presenting the best chance for eradication or control.

## Effective management: summary

The most effective eradication method identified so far is a combination of chemical and manual removal methods, though complete eradication is unlikely to be achieved. Structures fouled with *D. vexillum* can be encapsulated and concentrated vinegar (acetic acid 20%) pumped into the enclosure. This is cost effective and relatively easy to apply, if anoxic conditions are achieved under the wrapping. However, encapsulation is non-target specific and so should not be used to control fouling on cultured organisms (i.e. oysters, mussels) or in high value protected areas. In these cases, dipping or spraying lines with a chemical or physically removing the target species can be done, but eradication is unlikely and mortality in the farmed species can be high. As a last resort, fouled structures or aquaculture gear can be removed from the water and air dried. An ultimately unsuccessful eradication attempt using encapsulation with calcium hypochlorite in Holyhead marina (2009-2012) cost in excess of £800,000 (Holt, 2013; McKenzie, et al., 2017; Sambrook, et al., 2014).

# MANAGEMENT METHODS

## Chemical

Method: Chemical methods involve the use of compounds such as bleach, vinegar, lime, freshwater, or sodium hydroxide to kill the target species. In a trial in Western Australia, fouled Pacific oysters were wrapped and treated with 4% hydrated lime exposure for 4-5 minutes which reduced *D. vexillum* fouling on oysters by 85 to 96% with little impact on oysters. (Switzer et al., 2011). Decontamination berths for vessels using treatments with acetic acid and sodium hypochlorite were effective at reducing fouling by *D. vexillum* as well as containing the spread of other non-native species, but building this infrastructure can be expensive

Limitations: Encapsulation and application of chemicals will reduce amount of fouling but is likely to result in dislodging of fragments and wrapping can be pierced by oysters and tubeworms. Many of these methods are likely to result in high mortality of non-target species. Also, reduction in D. vexillum fouling created free space that allowed botryllid tunicate fouling (*Botrylloides violaceus* and *Botryllus schlosseri*) to increase and multiple applications were required to control *D. vexillum*. Although the use of 5% acetic acid for even 1 minute can be effective against *D. vexillum*, it also dramatically reduces the survival of oysters.

When to manage Carpet sea squirt with chemicals

| Jan | Feb | March | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |

# MANAGEMENT METHODS

## Manual

Method: Manual removal by handpicking or scrubbing can reduce fouling, but is highly likely to dislodge fragments and will not result in eradication. In a trial in Western Australia, manual removal via scrubbing treatments was applied prior to deployment of oysters and following sampling which reduced *D. vexillum* fouling on oysters by 85 to 96%. However, the reduction in *D. vexillum* created free space that allowed botryllid tunicate fouling (*Botrylloides violaceus* and *Botryllus schlosseri*) to increase (Switzer et al., 2011).

Limitations: Manual methods may be used to limit spread, but is unlikely to eradiate *D. vexillum* and requires repeated treatment.

When to manage Carpet sea squirt with manual removal

| Jan | Feb | March | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |

## Ineffective methods

### Biological

Sea stars, crabs, gastropods, periwinkles, sea urchins and nudibranchs have not been successful as biological treatments at controlling tunicate fouling (Switzer et al., 2011; McKenzie, et al., 2017).

### Mechanical

Seabed cover has not proved effective in controlling *D. vexillum* and causes high mortality of non-target species.

## Preventing spread

*D. vexillum* is difficult to control and eradicate and re-introduction to cleaned areas is highly likely unless pathways of introduction are managed. The GB Working Group (2010) identified five primary pathways: recreational boating, fisheries and aquaculture, ship recycling, marine industries and commercial shipping, producing recommendations and priority actions for reducing rate of spread and reintroductions of *D. vexillum*.

## Legislation

The 2004 International Convention for the Control and Management of Ships' Ballast Water and Sediment came into force in September 2017 and aims to address the issue of transport of INNS in ballast water. The European Marine Strategy Framework Directive (MSFD) requires Member States to work towards 'good environmental status' (GES) of their marine waters by 2020, including reduction in the risk of introduction and spread of non-native species through improved management and species specific management plans for high risk invasive species. The EU Invasive Alien Species regulation (2015) requires that pathway action plans be put in place to control the introduction and spread of listed species (as of 2018, the only marine species listed is the Chinese Mitten Crab).

# References

GB Didemnum vexillum Working Group (2010) Recommendations for Reducing the Rate of Spread and Potential Re-Invasion of *Didemnum vexillum* . Final report. https://secure.fera.defra.gov.uk/nonnativespecies/downloadDocument.cfm?id=672

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McKenzie, C.H., Reid, V. and Lambert, G., et al. (Eds) (2017) Alien Species Alert: *Didemnum vexillum:* Invasion, impact, and control. ICES Cooperative Research Report, No. 335.

Muñoz, J. and McDonald, J. (2014) Potential Eradication and Control Methods for the Management of the Ascidian *Didemnum perlucidum* in Western Australia. Department of Fisheries Research Report No. 252.

Sambrook, K., Holt, R.H.F., Sharp, R., Griffith, K., Roche, R.C., Newstead, R.G., Wyn, G.., Jenkins. S.R. (2014) Capacity, capability and cross-border challenges associated with marine eradication programmes in Europe: The attempted eradication of an invasive non-native ascidian, *Didemnum vexillum* in Wales, United Kingdom. *Marine Policy*, 48, 51–58.

Switzer, S.E., Therriault, T.W., Dunhama, A. and Pearce, C.M. (2011) Assessing potential control options for the invasive tunicate *Didemnum vexillum* in shellfish aquaculture. *Aquaculture*, 318 (1–2), 145-153.

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# Where To Go For More Information

http://www.invasive-species.org/
http://www.europe-aliens.org/
http://www.nonnativespecies.org/index.cfm?pageid=227
http://www.nonnativespecies.org/factsheet/factsheet.cfm?speciesId=1209
http://www.nonnativespecies.org/home
http://www.nonnativespecies.org/rapid

# RAPID

RAPID is a three year EU funded LIFE project led by the Animal and Plant Health Agency (APHA), with Natural England and Bristol Zoological Society as key partners that piloting innovative approaches to Invasive Alien Species (IAS) management in freshwater aquatic, riparian and coastal environments across England. The project is supported by a number of further Technical Partners.

http://www.nonnativespecies.org/rapid

Animal & Plant Health Agency

NATURAL ENGLAND

Bristol Zoological Society

Life

NATURA 2000