GOOD PRACTICE MANAGEMENT

Pacific oyster (*Crassostrea gigas*)

RAPID
Reducing and Preventing
Invasive Alien Species Dispersal

GOOD PRACTICE MANAGEMENT GUIDE

Pacific oyster (*Crassostrea gigas*)

Other names: Pacific giant oyster, Pacific cupped oyster
Crassostrea gigas and *Crassostrea angulata* are thought to be the same species (JNCC, n.d.)

For ID guides and more information:

https://www.cabi.org/isc/datasheet/87296

http://jncc.defra.gov.uk/page-1714

Cover image: Pacific oysters on beach © Sonty567 (Public domain)
Image: Upper and lower valve © Rosser1954 (CC BY-SA 4.0)

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MANAGEMENT SUMMARY

Ecology and impact of Pacific oyster

Pacific oysters are now one of the most 'globalised' marine invertebrates, dominating bivalve aquaculture in many regions. The shell is variable and irregular depending on substrate and degree of crowding. *C. gigas* can have a rounded shape with extensive fluting on hard substrates; an ovate, smooth shell on soft surfaces; and a solid shape with irregular margins on mini-reefs. The two valves are unequal in size and shape: left slightly convex and right deep and cup shaped. One valve is usually cemented to the substrate. Normally, the length of shells is 8-20 cm, though exceptional specimens can attain 40 cm. Pacific oysters may live up to thirty years. *C. gigas* will attach to almost any hard surface in sheltered waters and will also settle on other bivalve species. They form very dense aggregations, resulting in limitation of food and space for other intertidal benthic species. They are filter feeders and will ingest bacteria, protozoa, diatoms, larval forms of invertebrates, and detritus. Pacific oysters are extremely fertile and over a period of 3-4 weeks, depending on water temperature, will produce between 50-100 million eggs over several spawning bursts. When settling, the larvae group together, searching for a suitable hard substratum to which they can cement their lower shell valves. Wild populations have become established in southern England and Wales, with potential to displace native species and modify ecosystems. *C. gigas* can reduce commercial mussel production and the oysters also pose a threat to humans by cutting feet and shoes with sharp shells (Nehring, 2006).

Effective management: summary

Total eradication of Pacific oyster is not feasible as densities are now so high that sufficient brood stock is likely to remain and settlement will continue, plus it is very likely that reintroduction will happen via aquaculture or wild dispersion. One of the only feasible modes of containment for non-native species within the aquaculture industry is reproductive sterility. By crossbreeding diploid and tetraploid Pacific oysters, triploid oysters are produced which have considerably lower reproductive potential and is the most promising measure for biological containment. Bashing oysters with hammers has been used to reduce population expansion in the early stages of invasion and to control established numbers (Herbert et al., 2016).

MANAGEMENT METHODS

Biocontrol

Triploid breeding

One of the only feasible modes of containment for non-native species within the aquaculture industry is reproductive sterility. By crossbreeding diploid and tetraploid Pacific oysters, triploid oysters are produced which have considerably lower reproductive potential, less than 2% of diploid ones (Herbert et al., 2016). Triploid animals can also be produced by chemical induction, but this method is less efficient and involves the use of toxic chemicals on oysters intended for the market. Therefore, mating between diploid and tetraploid broodstock is now the most common method of triploid production (Kochman, J., 2012).

Manual

NOTE: It is vital that volunteers are experienced in identifying Pacific oysters and do not confuse them with native oysters (*Ostrea edulis),* a 'Species of Principle Importance' for the purpose of conservation and biodiversity under the Natural Environment and Rural Communities Act 2006. Do not destroy oysters if you have any doubts over identification. (Natural England, n.d.)

Bashing with hammer

In Kent, a one-year field trial was carried out by volunteers to physically reduce the number of oysters towards a pre-determined target. Initially, whole oysters were removed but this resulted in a high rate of damage to the protected chalk reef. Where oysters were attached directly to the chalk, they were removed by striking the upper valve at the hinge with a hammer resulting in a sheer along the longitudinal axis, displacing the upper valve but leaving the lower valve in place. On non-chalk substrates both valves were removed. Oyster numbers were considerably reduced at the trial site and the lower shore had been transformed from oyster reef to scattered individual spat. The method had minimal impact on native species and habitats but was labour-intensive, warranting the

MANAGEMENT METHODS

Manual (cont)

use of volunteers. This method of short-term control could be used effectively in other similar situations (McKnight & Chudleigh, 2015). In Northern Ireland, C. gigas were broken with a hammer during the spring. In the year following the cull, although densities at un-culled sites continued to rise, oyster density at culled sites had dropped by nearly 100 % (Herbert et al., 2016)

Method: Break hinge and remove upper valve; reach and remove oysters high on groynes or walls with edging knife. Where oysters are attached directly to a chalk reef, remove by striking the upper valve at the hinge with a hammer resulting in a sheer along the longitudinal axis. This displaces the upper valve but leaves the lower valve in place ensuring that no damage occurred to the chalk. On non-chalk substrates both valves may be removed.

Equipment: 22oz Dry Wall Hammer, 1m long edging knife

Timing: When Pacific oysters are 'bashed' there is a possibility that the stress results in release of gametes or 'emergency spawning'. If temperatures have been high, eggs and sperm may have been produced and could be released when the shell is damaged. For this reason Natural England advises that control is undertaken ONLY during winter and early spring when water temperatures are lowest (Natural England, n.d.)

Handpicking

Handpicking was used between 1976 and 1981 in The Netherlands to reduce the wild stock of Pacific oysters, but these attempts failed. However, another study has shown potential for economic exploitation of small oyster populations. In the UK, guided walks to the oyster reefs are being organised for visitors to collect wild oysters for food. With a favourable market, it is possible that some effective control of wild Pacific oyster settlement could be possible through regulated fishing and hand-collecting. In ports, harbours and marinas, where fouled vessels may contribute to wild oyster introduction, harvesting oysters may be a viable way of controlling the stock. (Herbert et al., 2016)

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Mechanical

Dredging

The Marennes–Oléron Basin in France is an example of successful mechanical reduction measures. The thorough removal of wild *C. gigas* and, at the same time, its trophic competitor the slipper limpet (*Crepidula fornicata*) and its predator the Japanese oyster drill (*Ocinebrellus inornatus*), involved the use of large machinery such as caterpillar tractors and snow ploughs, especially equipped for marine activities. A barge was also equipped to collect abandoned shellfish gear, and unwanted stones, sand, mud and animals for removal from the cleaned areas (Miossec and Goulletquer, 2009). Experimental dredging of 50 ha of intertidal wild oysters and sub-littoral cultivated beds was carried out using mussel dredges in the Netherlands. The oysters could be effectively removed with 940 boat hours (20 boat hours per hectare). Oysters subsequently settled on the cleared areas, and it was concluded that beds would need to be cleared every 5–7 years which could cause considerable habitat damage (Herbert et al., 2018).

Environmental

Thermal treatment

In contained areas such as cooling water systems, exposure to hot water has been used to kill biofouling species. *C. gigas* appear to be tolerant of much higher temperatures than other major marine fouling animals. In one study, 100% mortality of *C. gigas* was observed after about 3 h of exposure at 39 °C and 100% mortality of all size groups *of C. gigas* could be achieved by raising the temperature to 42 °C and maintaining for about 60 min; those exposed to 45 °C took 2 min. Currently, temperatures for treatment of pipes for blue mussels (*Mytilus edulis*) are about 38–40 °C for 1 hour. Study results also indicated that previous exposure of C. gigas to sublethal high temperatures could make them more resistant to subsequent thermal treatment (Rajagopal, et al., 2005).

Preventing spread

Take care not to create further biosecurity risks while carrying out Pacific oyster control, such as spreading the Oyster Herpes Virus or introducing Pacific oysters to new areas. Always follow 'Check, Clean, Dry' biosecurity procedures.

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).

Health and Safety

The link below is to a useful webpage on the GBNNSS website which provides resources and guidance on health and safety when planning a project working with invasive species:

http://www.nonnativespecies.org/index.cfm?pageid=266

References

JNCC, n.d. http://jncc.defra.gov.uk/page-1714

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Kochman, J. (2012) Into the Wild Documenting and Predicting the Spread of Pacific Oysters (*Crassostrea gigas*) in Ireland. PhD Dissertation, University College Dublin.

McKnight, W. & Chudleigh, I.J. (2015) Pacific oyster Crassostrea gigas control within the inter-tidal zone of the North East Kent Marine Protected Areas, UK. *Conservation Evidence*, 12, 28-32

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Nehring, S. (2006): NOBANIS – Invasive Alien Species Fact Sheet – *Crassostrea gigas*. From: Online Database of the North European and Baltic Network on Invasive Alien Species (NOBANIS) www.nobanis.org

Rajagopal, S., van der Velde, G., Jansen, J., van der Gaag, M., Atsma, G., Janssen-Mommen, J.P.M., Polman, H., Jenner, J.A. (2005) Thermal tolerance of the invasive oyster *Crassostrea gigas*: Feasibility of heat treatment as an antifouling option. *Water Research,* 39(18), 4335-4342.

Where To Go For More Information

http://www.europe-aliens.org/
http://www.nonnativespecies.org/home
http://www.nonnativespecies.org/rapid
http://jncc.defra.gov.uk/page-1711

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

NATURA 2000