

*Crassostrea gigas*  正體中文

**System:** Marine

Kingdom	Phylum	Class	Order	Family
Animalia	Mollusca	Bivalvia	Ostreida	Ostreidae

**Common name** giant Pacific oyster (English), immigrant oyster (English), giant oyster (English), Japanese oyster (English), Miyagi oyster (English), Pacific oyster (English)

**Synonym** *Ostrea gigas* , Thunberg, 1793  
*Ostrea laperousi* , Schrenk, 1861  
*Ostrea talienwhanensis* , Crosse, 1862

**Similar species** *Ostrea edulis*, *Ostrea lurida*, *Crassostrea virginica*

**Summary** The bivalve *Crassostrea gigas* is a filter feeder. It has been introduced from Asia across the globe. In North America and the Australasia-Pacific regions *C. gigas* is known to settle into dense aggregations, and exclude native intertidal species. It has been documented destroying habitat and causing eutrophication of the water bodies it invades.



[view this species on IUCN Red List](#)

## Species Description

*C. gigas* is a bivalve, epifaunal, suspension/filter feeder that cements itself to rocks and other hard substrata and feeds primarily on phytoplankton and protists (CIESM, 2000; NIMPIS, 2002). CIESM (2000) states that "*C. gigas*'s shell is extremely variable in shape depending on the substrate. It will have a rounded shape with extensive fluting on hard substrata, an ovate and smooth shell on soft substrata, and a solid shape with irregular margins on mini-reefs. The upper valve (rv) is flattened with a low round umbo. The lower valve (lv) is larger, more convex, and has a more well developed umbo that is much higher than on rv. *C. gigas*'s anterior margin is longer than the posterior margin." NIMPIS (2002) reports that, "*C. gigas* has a white elongated shell, with an average size of 150-200mm. The two valves are solid, but unequal in size and shape. The left valve is slightly convex and the right valve is quite deep and cup shaped. One valve is usually entirely cemented to the substrata. The shells are sculpted with large, irregular, rounded, radial folds." Reise *et al.* (2005) reports that, "The largest specimen found in the European Wadden Sea was of the gigantic size of 310mm." CIESM (2000) states that, "exceptional specimens can attain 400mm."

## Notes

Mitchell *et al.* (2000) report that, "The majority of introductions of *C. gigas* have been undertaken as a replacement/alternative for collapsed fisheries of native species." The Portuguese oyster '*Crassostrea angulata*' (Lamarck, 1819) was deliberately introduced from Portugal and France several times into coastal waters of Northern Europe, but did not establish itself (Wolff & Reise, 2002). Boudry *et al.* (1998) consider '*C. angulata*' to be identical to *C. gigas*. However, O'Foighil *et al.* (1998) consider '*C. angulata*' to be closely related, but not identical to Japanese *C. gigas*.

## Lifecycle Stages

The Port Stephens Fisheries Centre (2003) states that, "*C. gigas* change sex during their life, usually spawning first as a male and subsequently as a female. Spawning is temperature dependent and occurs in the summer months. *C. gigas* females can produce between 30 to 40 million eggs per spawning, often giving the surrounding water a milky appearance. Fertilization takes place in the water column. The larvae are planktonic and free swimming, developing for three to four weeks before finding a suitable clean hard surface to settle on. Although they usually attach to rocks, they can also settle in muddy or sandy areas (where they attach to small stones, shell fragments or other debris) or on top of other adult oysters. A very small percentage of oysters survive this phase; those that do are called "spat". Pacific oysters have very high growth rates (they can grow to over 75mm in their first 18 months) and high rates of reproduction. *C. gigas* can live up to 10 years and reach an average size of 150-200mm." The Prince William Sound Regional Citizens' Advisory Council (2004) states that, "The Pacific Oyster is extremely fertile. During the breeding season the reproductive organs may form 50% of the body's volume. Pacific oysters typically produce between 50-100 million eggs which are released over several spawning bursts. The female discharges her eggs up to 12 inches from its body in the form of white clouds. The male oyster also discharges its sperm. Fertilization must occur within 10-15 hours after spawning."

## Uses

Hopkins (2001) states that, "The Pacific oyster (*C. gigas*) has been introduced into Europe as a commercial species of importance for aquaculture in countries such as the UK and France."

## Habitat Description

NIMPIS (2002) states that, "*C. gigas* will attach to almost any hard surface in sheltered waters. Whilst they usually attach to rocks, the oysters can also be found in muddy or sandy areas. Oysters will also settle on adult oysters of the same or other species. They prefer sheltered waters in estuaries where they are found in the intertidal and shallow subtidal zones, to a depth of about three metres." Reise (1998) reports that, "After larval settlement, the lower valve of *Crassostrea gigas* becomes partially or almost completely cemented to a hard substrate. At Sylt [in the German Wadden Sea], 85% were found to be attached to [the native blue mussel] *Mytilus edulis*, i.e. to living individuals (47%) as well as to empty shells. Other bivalves (8%) were of minor importance as substrates. There were two instances with juvenile oysters being attached to living adults of *C. gigas*."

## Reproduction

NIMPIS (2002) reports that, "*C. gigas* begins life as a male oyster and after a year functions as a female. Spawning is temperature dependant and throughout their range, *C. gigas* are summer breeders. Fertilization occurs externally and larvae are planktonic, spending about three weeks in this free-swimming phase. When settling, the larvae group together and crawl around the sea floor, searching for a suitable hard substratum to which they can cement their lower shell valves. The oyster grows at around 25mm per year."

## Nutrition

*C. gigas* is a filter feeder. It will ingest bacteria, protozoa, a wide variety of diatoms, larval forms of other invertebrate animals, and detritus (PWSRCAC, 2004).

## General Impacts

The AMCS Bulletin 1998 reports that, "*C. gigas* is well known for its tendency to colonize areas of coastline many kilometres away from its parent organisms. Spat have been documented spreading up to 1,300 km on ocean currents. Once established, they have the potential to smother other marine life, such as scallops, destroying habitat and causing eutrophication that affects water quality. They pose a direct threat to human safety because of their propensity to cut feet and shoes with their sharp shells."

Eno *et al.* (1997) report that, "In North America, *C. gigas* can settle in dense aggregations, and exclude other intertidal species". This could result in limitations of food and space availability for other intertidal species (NIMPIS, 2002). The Port Stephens Fisheries Centre (2003) states that, "*C. gigas* ability to change the species balance with its introduction also has the potential to impact on non-oyster species, through a modification of their habitat." Hopkins (2001) states that, "There is great concern that the indigenous European oyster (*Ostrea edulis*) has, as a result in part from *C. gigas* introductions, become a threatened species."

In the area of the European Wadden Sea, however, the last living reef of the European oyster was found in 1940. After that *O. edulis* was declared to be extinct in the region (Nehring 2001). There has been some debate about the actual cause of the decline but more recent accounts on the subject seem to prove that overexploitation by oyster fishery since the 18th century exterminated these populations (Nehring 2003). Since 1964, the Pacific oyster *C. gigas* has been imported for cultivation to several places in Northern Europe, including the Wadden Sea. These oysters reproduced successfully and since the 1980's first individuals were found outside the culture plots in the Wadden Sea (Nehring 2003). While no viable population of the native *O. edulis* is left in the Wadden Sea, the Pacific *C. gigas* is now firmly established. Ecologically these oysters are very different. *O. edulis* occurred in the Wadden Sea subtidally and has a narrower tolerance range for temperature and salinity than *C. gigas* which lives primarily in the intertidal. An interference between the two oyster species in the Wadden Sea is not to be expected (Reise 1998). Nehring (2003) states that, "The recently expanding occurrence of *C. gigas* in the Wadden Sea makes it likely that oyster reefs, together with their associated community of organisms, will 're-establish', at least in the intertidal zone. If these irreversible changes in the biota of the North Sea can be classified as a positive example of population 'enrichment' is still under discussion. Due to the higher growth rate and the larger size of oysters, blue mussels are eventually overgrown and killed." Reise *et al.* (2005) reports that, "Many oyster beds are now rapidly developing into solid reefs at several sites in the region. Thus *C. gigas* is expected to take over in the Wadden Sea, both as an ecosystem engineer generating solid reefs and as a competitive suspension feeder."

## Management Info

**Preventative measures:** A two year study was undertaken for the Department of Environment and Heritage (Australia) by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to identify and rank introduced marine species found within Australian waters and those not found within Australian waters. All of the non-native potential target species identified in this report are ranked as high, medium and low priority, based on their invasion potential and impact potential. *Crassostrea gigas* is identified as one of ten most damaging potential domestic target species, based on overall impact potential (economic and environmental). A hazard ranking of potential domestic target species based on invasion potential from infected to uninfected bioregions identifies *C. gigas* as a 'medium priority species' - these species have a reasonably high impact/or invasion potential.

For more details, please see [Hayes et al. 2005](#).

The rankings determined in Hayes et al. 2005 will be used by the National Introduced Marine Pest Coordinating Group in Australia to assist in the development of national control plans which could include options for control, eradication and/or long term management.

**Physical:** Reise et al. (2005) states that, "No control is feasible which would not also harm other components of the Wadden Sea ecosystem."

**Biological:** To prevent the further spread of *C. gigas*, the Mariculture Committee (2003) reports that, "Sterile triploid *C. gigas* can be produced. There are two methods to produce triploid animals. One is via chemical induction and the other is crossing of tetraploids with diploid broodstock. The dangers in the former technique are that less than 100% of the animals produced are triploid while the dangers of the latter technique would be the unintentional release of tetraploids into the marine environment, which could potentially interact with natural diploids producing sterile triploids." Humphry (1995) states that, "*Mytilicola* sp. are copepod parasites of the intestinal tract of marine molluscs and have caused catastrophic mortalities in infected hosts (Sparks 1985, Bauer 1991). *Mytilicola orientalis* was introduced in seed oysters *C. gigas* transplanted from Japan to the USA and France in an attempt to control the species. A turbellarian parasite *Pseudostylochus* sp. was associated with high mortalities in *C. gigas* imported from Japan into Vanuatu for experimental aquaculture. The mudworm *Polydora* sp. caused severe shell damage in imported oysters *C. gigas* in Vanuatu and French Polynesia (Eldredge 1993, Hallier 1977). The sponge *Cliona* sp. resulted in severe shell damage to imported Japanese oysters, *C. gigas* in Vanuatu (Hallier 1977). Shell damage associated with uncharacterized epiphytic sponges is also reported in cultured giant clams (Anon 1991)." Reise et al. (2005) states that, "The trematode parasite *Renicola roscovita* which takes periwinkles as first, cockles and mussels as second intermediate host and gulls and eider ducks as final host, is also infesting *C. gigas* but at lower intensity."

## Pathway

Its introduction from France to Britain is thought to have been on ships' hulls (Fletcher & Manfredi 1995) (Eno et al. 1997).

**Principal source:** [NIMPIS, 2002. \*Crassostrea gigas\* species summary. National Introduced Marine Pest Information System \(Eds: Hewitt C.L., Martin R.B., Sliwa C., McEnnulty, F.R., Murphy, N.E., Jones T. & Cooper, S.\)](#)

**Compiler:** National Biological Information Infrastructure (NBII) & IUCN/SSC Invasive Species Specialist Group (ISSG)

**Review:** Dr. Stefan Nehring, AeT umweltplanung, Koblenz, Germany

**Publication date:** 2005-07-01

## ALIEN RANGE

[5] ATLANTIC - NORTHEAST

[1] BELGIUM

[1] CHILE

[5] AUSTRALIA

[2] CANADA

[1] CHINA

[1] CYPRUS  
[1] FRANCE  
[1] GERMANY  
[1] JERSEY  
[1] MALTA  
[2] NETHERLANDS  
[1] NORWAY  
[1] SOUTH AFRICA  
[1] SPAIN  
[10] UNITED KINGDOM  
[1] VANUATU

[1] DENMARK  
[1] FRENCH POLYNESIA  
[1] GREECE  
[1] KOREA, REPUBLIC OF  
[1] MOROCCO  
[1] NEW ZEALAND  
[1] PORTUGAL  
[1] SOUTH AMERICA  
[1] TUNISIA  
[6] UNITED STATES

## BIBLIOGRAPHY

41 references found for *Crassostrea gigas*

### Management information

AMCS Bulletin (Australian Marine Conservation Society). 1998. Marine and Coastal Updated. Bulletin Volume 20, No.2 Autumn 1998.  
[Centre for Environment, Fisheries & Aquaculture Science \(CEFAS\), 2008. Decision support tools-Identifying potentially invasive non-native marine and freshwater species: fish, invertebrates, amphibians.](#)

**Summary:** The electronic tool kits made available on the Cefas page for free download are Crown Copyright (2007-2008). As such, these are freeware and may be freely distributed provided this notice is retained. No warranty, expressed or implied, is made and users should satisfy themselves as to the applicability of the results in any given circumstance. Toolkits available include 1) FISK- Freshwater Fish Invasiveness Scoring Kit (English and Spanish language version); 2) MFISK- Marine Fish Invasiveness Scoring Kit; 3) MI-ISK- Marine invertebrate Invasiveness Scoring Kit; 4) FI-ISK- Freshwater Invertebrate Invasiveness Scoring Kit and AmphISK- Amphibian Invasiveness Scoring Kit. These tool kits were developed by Cefas, with new VisualBasic and computational programming by Lorenzo Vilizzi, David Cooper, Andy South and Gordon H. Copp, based on VisualBasic code in the original Weed Risk Assessment (WRA) tool kit of P.C. Pheloung, P.A. Williams & S.R. Halloy (1999).

The decision support tools are available from:

<http://cefas.defra.gov.uk/our-science/ecosystems-and-biodiversity/non-native-species/decision-support-tools.aspx> [Accessed 13 October 2011]

[The guidance document](http://www.cefas.co.uk/media/118009/fisk_guide_v2.pdf) is available from [http://www.cefas.co.uk/media/118009/fisk\\_guide\\_v2.pdf](http://www.cefas.co.uk/media/118009/fisk_guide_v2.pdf) [Accessed 13 January 2009].

[Hewitt, C.L., Campbell, M.L. and Gollasch, S. 2006. Alien Species in Aquaculture. Considerations for responsible use. IUCN, Gland, Switzerland and Cambridge, UK. viii + 32 pp.](#)

**Summary:** This publication aims to first provide decision makers and managers with information on the existing international and regional regulations that address the use of alien species in aquaculture, either directly or indirectly; and three examples of national responses to this issue (New Zealand, Australia and Chile).

Available from: <http://data.iucn.org/dbtw-wpd/edocs/2006-036.pdf> [Accessed 22 September 2008]

Humphry, J.D. 1995. Introductions of Aquatic Animals to the Pacific Islands: Disease Threats and Guidelines for Quarantine. Perspectives in Aquatic Exotic Species Management in the Pacific Islands, Volume 2. SPC Inshore Fisheries Research Project Technical Document No. 8 SPREP Reports and Studies Series No. 78.

[International Commission for the Scientific Exploration of the Mediterranean Sea \(CIESM\), 2000. Crassostrea gigas \(Thunberg, 1793\).](#)

**Summary:** Available from: <http://www.ciesm.org/atlas/Crassostreagigas.html> [Accessed 21 March 2005]

Jenner, Henk A. and Janssen-Mommen Jake 2004. Exotic cooling water fouling organisms in the Netherlands with emphasis on heat treatment of the Japanese oyster *Crassostrea gigas*. In Abstracts: 13th International Conference on Aquatic Invasive Species, September 20-24, 2004. Lynch West County Hotel, Ennis, County Clare, Ireland.

**Summary:** Report on the effectiveness of heat treatment on *Crassostrea gigas* in the Netherlands.

Langston, W. J., B. S. Chesman, G. R. Burt, S. J. Hawking, J. Readman, and P. Worsfold. 2003. Characterization of European Marine Sites: The Exe Estuary. Marine Biology Association Occasional publication no. 10.

Mariculture Committee. 2003. Report of the Working Group on Marine Shellfish Culture. Mariculture Committee: ICES CM 2003/F:05.

[National Introduced Marine Pest Information System \(NIMPIS\), 2002. Crassostrea gigas species summary. National Introduced Marine Pest Information System \(Eds: Hewitt C.L., Martin R.B., Sliwa C., McEnnulty, F.R., Murphy, N.E., Jones T. & Cooper, S.\). Web publication](#)

**Summary:** Species summary available from: <http://www.marine.csiro.au/crimp/nimpis/spSummary.asp?txa=6130> [Accessed 21 March 2005]

NIMPIS web publication available from: <http://crimp.marine.csiro.au/nimpis>

[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](#)

**Summary:** The North European and Baltic Network on Invasive Alien Species (NOBANIS) has developed a network of common databases on alien and invasive species of the region. By establishing a common portal access to IAS-related data, information and knowledge in the region is facilitated. The NOBANIS network has a national contact in each of the participating countries - Denmark, Estonia, Finland, Faroe Islands, Germany, Greenland, Iceland, Latvia, Lithuania, Norway, Poland, Sweden and the European part of Russia.

NOBANIS is available from <http://www.nobanis.org>; this page is available from: [http://www.nobanis.org/files/factsheets/Crassostrea\\_gigas.pdf](http://www.nobanis.org/files/factsheets/Crassostrea_gigas.pdf) [Accessed 24 September 2006]

[Port Stephens Fisheries Centre. 2003. Pacific oyster Crassostrea gigas. NSW Department of Primary Industries: Fisheries.](#)

**Summary:** Available from: <http://www.fisheries.nsw.gov.au/thr/species/fn-pacific-oyster.htm> [Accessed 21 March 2005]



[PWSRCAC \(Prince William Sound Regional Citizens Advisory Council\). 2004. Non-indigenous aquatic species of concern for Alaska. Fact Sheet - Pacific \(Japanese\) Oyster \*Crassostrea gigas\*.](#)

**Summary:** Available from: [http://www.pwsrac.org/NISfiles/F3\\_PacificOyster.pdf](http://www.pwsrac.org/NISfiles/F3_PacificOyster.pdf) [Accessed 24 June 2005]

Reise, K., Dankers, N. and Essink, K. 2005. Introduced species. In: Essink, K., Dettmann, C., Farke, H., Laursen, K., Løerøen, G., Marencic, H. & Wiersinga, W. (Eds.), Wadden Sea Quality Status Report 2004. Wadden Sea Ecosystem No. 19: 155-161.

**Summary:** Overview on the occurrence and impacts of *Crassostrea gigas* in the European Wadden Sea.

[Varnham, K. 2006. Non-native species in UK Overseas Territories: a review. JNCC Report 372. Peterborough: United Kingdom.](#)

**Summary:** This database compiles information on alien species from British Overseas Territories.

Available from: <http://www.jncc.gov.uk/page-3660> [Accessed 10 November 2009]

Cole, R. 2002. Impacts of marine farming on wild fish populations. Final Research Report for Ministry of Fisheries Research Project ENV2000/08 Objective One. National Institute of Water and Atmospheric Research.

## General information

Boudry, P., Heurtebise, S., Collet, B., Cornette, F. and Gerard, A. 1998. Differentiation between populations of the Portuguese oyster, *Crassostrea angulata* (Lamarck) and the Pacific oyster, *Crassostrea gigas* (Thunberg), revealed by mtDNA RFLP analysis. J. exp. mar. Biol. Ecol. 226: 279-291.

**Summary:** Taxonomic studies.

[Boyd, M.J. 2003. Nonindigenous marine species in Humboldt Bay, California. In Abstracts: Third International Conference on Marine Bioinvasions, March 16-19, 2003. Scripps Institution of Oceanography La Jolla, California](#)

**Summary:** Report on nonindigenous species present in Humboldt Bay, California

Available from: <http://massbay.mit.edu/resources/pdf/MarinePDF/2003/MBI2003abs1.pdf> [Accessed 21 March 2005]

[Buhle, E.R. and Ruesink, J.L. 2003. Context-dependent impacts of multiple invasive species on a threatened native species in a west coast estuary. In Abstracts: Third International Conference on Marine Bioinvasions, March 16-19, 2003. Scripps Institution of Oceanography La Jolla, California](#)

**Summary:** Presence of *Crassostrea gigas* seems to decrease predation on native oyster by invasive oyster drills in Willapa Bay.

Available from: <http://massbay.mit.edu/resources/pdf/MarinePDF/2003/MBI2003abs1.pdf> [Accessed 21 March 2005]

[CONABIO. 2008. Sistema de información sobre especies invasoras en México. Especies invasoras - Moluscos. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. Fecha de acceso.](#)

**Summary:** English:

The species list sheet for the Mexican information system on invasive species currently provides information related to Scientific names, family, group and common names, as well as habitat, status of invasion in Mexico, pathways of introduction and links to other specialised websites. Some of the higher risk species already have a direct link to the alert page. It is important to notice that these lists are constantly being updated, please refer to the main page (<http://www.conabio.gob.mx/invasoras/index.php/Portada>), under the section Novedades for information on updates.

Invasive species - Molluscs is available from: [http://www.conabio.gob.mx/invasoras/index.php/Especies\\_invasoras\\_-\\_Moluscos](http://www.conabio.gob.mx/invasoras/index.php/Especies_invasoras_-_Moluscos) [Accessed 30 July 2008]

Spanish:

La lista de especies del Sistema de información sobre especies invasoras de México cuenta actualmente con información acerca de nombre científico, familia, grupo y nombre común, así como hábitat, estado de la invasión en México, rutas de introducción y ligas a otros sitios especializados. Algunas de las especies de mayor riesgo ya tienen una liga directa a la página de alertas. Es importante resaltar que estas listas se encuentran en constante proceso de actualización, por favor consulte la portada (<http://www.conabio.gob.mx/invasoras/index.php/Portada>), en la sección novedades, para conocer los cambios.

Especies invasoras - Moluscos is available from: [http://www.conabio.gob.mx/invasoras/index.php/Especies\\_invasoras\\_-\\_Moluscos](http://www.conabio.gob.mx/invasoras/index.php/Especies_invasoras_-_Moluscos) [Accessed 30 July 2008]

[Diederich, S., Thielges, D. and Reise, K. 2003. Are invasions predictable? American slipper limpets \(\*Crepidula fornicata\*\) and pacific oysters \(\*Crassostrea gigas\*\) in the Northern Wadden Sea \(North Sea, Europe\). In Abstracts: Third International Conference on Marine Bioinvasions, March 16-19, 2003. Scripps Institution of Oceanography La Jolla, California](#)

**Summary:** Report showing the unpredictability of invasions.

Eno, N. C., A. Robin, and C.W.G. Sanderson. 1997. Non-native marine species in British waters: a review and directory. Joint Nature Conservation Committee Monkstone House, City Road Peterborough PE1 1JY UK.

[Food and Agriculture Organisation of the United Nations \(FAO\). 2005. Species Fact Sheet - \*Crassostrea gigas\* \(Thunberg, 1793\). FIRM-FAO Species Identification and Data Programme-FAO Catalogues: Species of the World](#)

**Summary:** Available from: <http://www.fao.org/figis/servlet/species?fid=3514> [Accessed 12 June 2005]

Galil, B.S. & Zenetos, A. 2002. Exotics in the eastern Mediterranean - a sea change. In E. Leppakoski, S. Gollasch & S. Olenin (Eds.), *Invasive Aquatic Species in Europe. Distribution, Impacts and Management* (pp. 325-336). Dordrecht, Boston, London: Kluwer Academic Publishers.

[Griffiths, C.L. and Robinson, T.B. 2003. Status and impacts of marine alien species in South Africa. In Abstracts: Third International Conference on Marine Bioinvasions, March 16-19, 2003. Scripps Institution of Oceanography La Jolla, California](#)

**Summary:** Discussion into the effects and impacts of alien marine invertebrates in South Africa.

Available from: <http://massbay.mit.edu/resources/pdf/MarinePDF/2003/MBI2003abs4.pdf> [Accessed 21 March 2005]

[Haydar, D. and Wolff, W.J. 2003. \*Crassostrea gigas\* as a vector for alien species introduction in Northwest European coastal waters. In Abstracts: Third International Conference on Marine Bioinvasions, March 16-19, 2003. Scripps Institution of Oceanography La Jolla, California](#)

**Summary:** Study into the possibility of oyster transports being a vector for the spread of other invasive species.

Available from: <http://massbay.mit.edu/resources/pdf/MarinePDF/2003/MBI2003abs5.pdf> [Accessed 21 March 2005]

Hopkins, C. 2001. A review of introductions and transfers of alien marine species in the North Sea Area.

[ITIS \(Integrated Taxonomic Information System\). 2005. Online Database \*Crassostrea gigas\*](#)

**Summary:** An online database that provides taxonomic information, common names, synonyms and geographical jurisdiction of a species. In addition links are provided to retrieve biological records and collection information from the Global Biodiversity Information Facility (GBIF) Data Portal and bioscience articles from BioOne journals.

Available from: [http://www.itis.gov/servlet/SingleRpt/SingleRpt?search\\_topic=TSN&search\\_value=79868](http://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=79868) [Accessed March 2005]

[JNCC \(Joint Nature Conservation Committee\). UNDATED. \*Crassostrea gigas\*.](#)

**Summary:** Available from: <http://www.jncc.gov.uk/page-1714> [Accessed 21 March 2005]

Mitchell, J., A. Jones, and C. Crawford. 2000. Distribution of feral pacific oysters and environmental conditions. Natural Heritage Trust Final Report: NHT Project No. (FAP13077).

Nehring, S. 1999. Oyster beds and Sabellaria reefs. In: De Jong, F., Bakker, J.F., van Berkel, C.J.M., Dankers, N.M.J.A., Dahl, K., Götje, C., Marencic, H. & Potel, P. (Eds.), Wadden Sea Quality Status Report. Common Wadden Sea Secretariat Wilhelmshaven, Wadden Sea Ecosystem No. 9: 146-147.

**Summary:** Report on first free-living individuals of *Crassostrea gigas* in the European Wadden Sea.

Nehring, S. 2003. Alien species in the North Sea: invasion success and climate warming. Ocean Challenge 13(3): 12-16.

**Summary:** Discussion into the effects of alien species in the North Sea and climate-induced change in the biocoenosis in the future.

Nehring, S. 2003. Pacific oysters in the European Wadden Sea - an irreversible impact in a highly protected ecosystem. Aliens 17: 20-21.

**Summary:** Report on the occurrence of *Crassostrea gigas* in the European Wadden Sea.

O Foighil, D., Gaffney, P.M., Wilbur, A.E. and Hilbisch, T.J. 1998. Mitochondrial cytochrome oxidase I gene sequences support an Asian origin for the Portuguese oyster *Crassostrea angulata*. Mar. Biol. 131:497-503.

**Summary:** Taxonomic studies.

[Orensanz, J.M., Bortolus, A., Casas, G., Darrigran, G., Elias, R., Lopez Gappa, J.J., Obenat, S., Pascual, M., Pastorino, G., Penchaszadeh, P., Piriz, M.L., Scarabino, F., Schwindt, E., Spivak, E.D. and Vallarino, E.A., 2001. No longer pristine confine of the world ocean- A survey of exotic marine species in the Southwest Atlantic. In Abstracts: Second International Conference on Marine Bioinvasions, March 9-11, 2001. New Orleans, LA](#)

**Summary:** Report into the presence of invsaves in the Southwest Atlantic

Available from: <http://massbay.mit.edu/resources/pdf/MarinePDF/2001/MBI2001abs1.pdf> [Accessed 21 March 2005]

[Patil, J.G., Deagle, B.E., Gunasekera, R.M., Bax, N.J. and Hewitt, C.L. 2003. Molecular detection techniques for monitoring three key pest species in ballast water samples. In Abstracts: Third International Conference on Marine Bioinvasions, March 16-19, 2003. Scripps Institution of Oceanography La Jolla, California](#)

**Summary:** Report on the development of a molecular identification method.

Available from: <http://massbay.mit.edu/resources/pdf/MarinePDF/2003/MBI2003abs10.pdf> [Accessed 28 October 2004]

[PSMFC \(Pacific States Marine Fisheries Commission\). 1996. Pacific Oyster.](#)

**Summary:** Available from: [http://www.psmfc.org/habitat/edu\\_oyster\\_fact.html](http://www.psmfc.org/habitat/edu_oyster_fact.html) [Accessed 21 March 2005]

Reise, K. 1998. Pacific oysters invade mussel beds in the European Wadden Sea. Senckenbergiana maritima 28: 167-175.

**Summary:** Report on first free-living individuals of *Crassostrea gigas* in the European Wadden Sea.

[Ruesink, J. 2001. Biotic resistance against an invasive oyster: Impacts of native predators and competitors. In Abstracts: Second International Conference on Marine Bioinvasions, March 9-11, 2001. New Orleans, LA](#)

**Summary:** Report into the conditions that are most conducive for invasive oyster growth and spread.

Available from: <http://massbay.mit.edu/resources/pdf/MarinePDF/2003/MBI2003abs2.pdf> [Accessed 21 March 2005]

Smaal, A. C., B. J. Kater., J. Wijsman., 2009. Introduction, establishment and expansion of the PaciWc oyster *Crassostrea gigas* in the Oosterschelde (SW Netherlands). Helgol Mar Res (2009) 63:75-83 DOI 10.1007/s10152-008-0138-3

Wolff, W.J. 2005. Non-indigenous marine and estuarine species in The Netherlands. Zoologische Mededelingen. Vol. 79, No. 1: 1-116.

**Summary:** A review of non-indigenous aquatic species in the Netherlands.

Wolff, W.J. and Reise, K. 2002. Oyster imports as a vector for the introduction of alien species into northern and western European coastal waters. In: Leppkoski, E., S. Gollasch & S. Olenin (Eds.), Invasive Aquatic Species of Europe - Distribution, Impacts and Management. Kluwer Academic Publishers, Dordrecht: 193-205.

**Summary:** Overview on the introduction and occurrence of oysters and other alien species in European coastal waters.