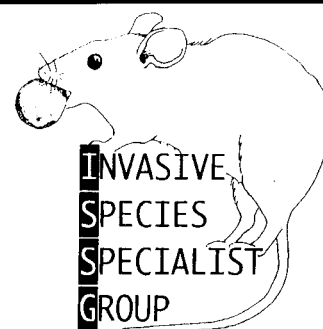


Invasive Species Specialist Group of the IUCN Species Survival Commission

ALIENS

Number 17 2003

**SPECIAL ISSUE ON INVASIVE ALIEN SPECIES AND
PROTECTED AREAS**



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**Pacific oysters in the European Wadden Sea:
An irreversible impact in a highly protected ecosystem**

Sponsored by:



Manaaki Whenua
Landcare Research

ISSN: 1173-5988

PACIFIC OYSTERS IN THE EUROPEAN WADDEN SEA: AN IRREVERSIBLE IMPACT IN A HIGHLY PROTECTED ECOSYSTEM

The Wadden Sea is the largest European wetland area and its tidal flats form the largest unbroken stretch of mudflats worldwide. Biophysically it represents an interconnected morphological system with the adjacent North Sea, significant in terms of unique ecological, socio-economic, scientific and cultural characteristics. At the beginning of the 1970s, a process began which resulted in the protection and conservation of the entire Wadden Sea with nature reserves and national parks and the establishment and extension of the trilateral Wadden Sea cooperation between The Netherlands, Germany and Denmark. In parallel, parts of the area were designated as Wetlands of International Importance (Ramsar Areas), Bird and Habitat Directives areas and as Man and Biosphere (MAB) Reserves.

Potential nomination as a natural World Heritage Site

An important topic of the 9th Trilateral Governmental Conference in Esbjerg (30 October 2001) was the potential nomination of the Wadden Sea national parks and nature reserves or parts of them as a natural World Heritage Site. This is a follow-up of decisions of previous conferences and a recent feasibility study has concluded that an inscription in the World Heritage List under the current conservation and management arrangements is feasible.

Historical status of oyster beds

Until the beginning of the 20th century the native European oyster *Ostrea edulis* was widely spread in the Wadden Sea and formed extensive oyster beds from low tide level down to about -6 m. These reefs were regarded to belong to the most characteristic biotope types of the Wadden Sea and provided secondary habitats to numerous species. The last living reef of the European oyster was found in 1940. After that *O. edulis* was declared to be extinct in the region. 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. Through the destruction of the oyster reefs, many associated invertebrate populations severely declined or disappeared completely.

Pacific oysters invasion

More than once in the past, attempts have been made to revive exploited stocks of the European oyster with imported American *Crassostrea virginica* and Portuguese *C. angulata* at several sites on the North Sea coasts. These attempts largely failed. In the 1960s, Dutch oyster farmers began to cultivate the Pacific oyster (*Crassostrea gigas*) in the Oosterschelde estuary. One assumed that the introduction of the Pacific oyster as seed stock had to be accepted because these oysters, native to Japan, were not able to reproduce at the latitude of the Netherlands. However, in 1975 a spatfall occurred during a very warm summer and resulted in millions of so-called weed oysters in the estuary. Within several years the Pacific oyster has

expanded enormously and they nowadays interfere with the recreational use of the estuary because of their razor-sharp shells. Since the 1980's this alien was frequently observed in the Dutch Wadden Sea. In 1996 a first settlement of the Pacific oyster occurred in the western Wadden Sea area of Germany as well, which may have been dispersed from the Netherlands by natural means (Fig. 1).

Spat and larvae of *C. gigas* were repeatedly introduced into the German Wadden Sea since 1971, mostly for aquacultural experiments and studies. Since 1985 commercial farming activities started up in the northern area of the Wadden Sea near the island of Sylt (Fig. 2). These oysters reproduced successfully, too and in 1991 the first oysters were found outside the culture plot. Spat settled on any hard substrate in the intertidal zone but preferentially upon wild banks of the blue mussel *Mytilus edulis*. In the following years, significant dispersal with increasing abundances took place. It was estimated that the wild Pacific oyster population at Sylt was in the region of 1 million oysters in 1995, with a mean oyster density of 8 individuals / m² in a mussel bed. In 2002, the mean oyster density came up to 83 individuals / m² and the blue mussel beds are currently about to transform into oyster reefs (Reise pers. comm.).

Oysters as vectors

Over the last 100 years, the Wadden Sea and its estuaries have been invaded by numerous alien species. In the past oyster transports certainly served as an important vector for associated parasites and exotic species. Some of the aliens became massively abundant, such as the American slipper limpet *Crepidula fornicata*, the Japanese brown algae *Sargassum muticum* and several phytoplankton species. Nowadays, the worldwide scale of oyster imports has become less important for Europe. However, since the regular culturing of the Pacific oyster began in 1986 at Sylt, five benthic species are suspected to have been inadvertently transferred with imported spat to the Wadden Sea of Sylt.

Most of the introductions by transfers occurred before the ICES Code of Practice on the Introductions and Transfers of Marine organisms was worked out in 1994. The code is based on quarantine measures and provides a practical set of rules to prevent introductions through the import of oysters and other non-indigenous organisms. However, such a measure can slow down introductions of new aliens but not prevent them completely. Aquaculture is the fastest growing sector within fisheries due to increasing demand for aquatic products. Therefore, the threats of intensified aquaculture and increasing international transfer of exotic species for stocking and culture posed to natural communities, needs to be pushed up to political agenda.

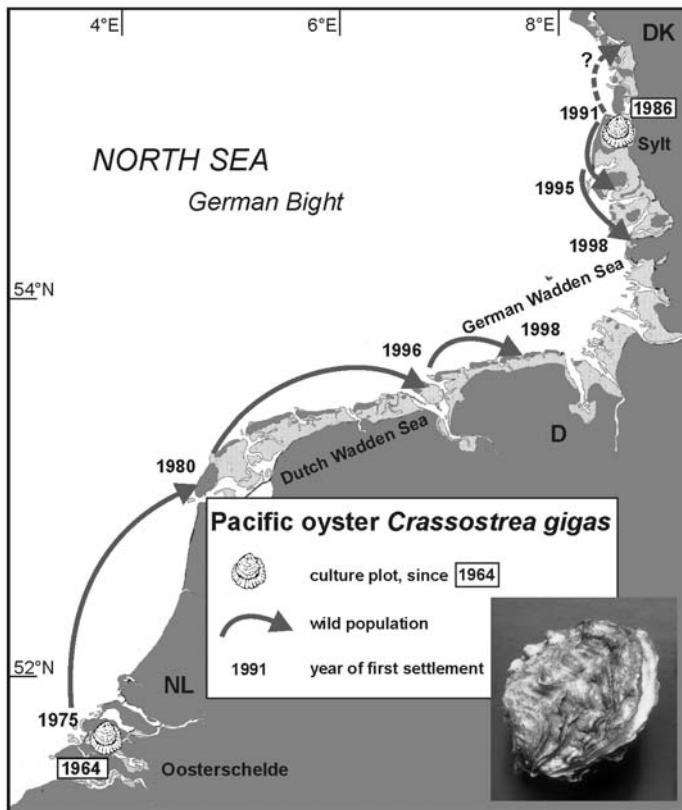


Fig. 1. The invasion of the Pacific oyster in the Wadden Sea.

Ecological consequences

Among the introduction of alien species by the oyster vector with all its consequences for the native biocoenoses, the most important aspect of competition is the ability of exotic oyster species to reproduce successfully in new environments. The Pacific oyster appears to be more ecologically potent, *i.e.* more adaptive, than the European oyster *O. edulis*, although it requires warmer water for spawning. 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. In North America Pacific oysters has been known to settle in dense aggregations, excluding other intertidal species. In Dutch waters, at the same time as *C. gigas* increased in the Oosterschelde estuary, the stocks of blue mussels and cockles decreased, the same goes for an important shellfish-feeding bird, the oystercatcher *Haematopus ostralegus*. However, it is not yet clear if this is a causal relationship. Much remains unknown in terms of the patterns and processes of the invasion of the Pacific oyster in the European Wadden Sea.

Outlook

Alien invasions in aquatic systems are irreversible and

should be avoided wherever possible. These species pose a serious impact to native biodiversity because they have the potential to alter the natural state of an ecosystem into which they were introduced. Such changes, and especially the example of the Pacific oyster in the highly protected Wadden Sea, may consequently affect nature conservation interests. At the present time, most analyses that evaluate patterns of aquatic invasion or test specific hypotheses derive data from existing literature, which is extremely uneven in space and time. In order to establish effective management plans, much more information is needed on the principles of successful establishments of aquatic alien species. For the Pacific oyster, a coordinated environmental program in order to document the spreading and effects on the native biocoenoses in detail, should be designed and realized on the level of the Trilateral Co-operation on the Protection of the Wadden Sea.

Further reading

- Nehring, S. 1999. *Oyster beds and Sabellaria reefs*. In: De Jong, F. et al. (eds.): Wadden Sea Quality Status Report. Wadden Sea Ecosystem No. 9: 146-147.
- Reise, K. 1998. *Pacific oysters invade mussel beds in the European Wadden Sea*. Senckenbergiana maritima 28: 167-175.
- Wehrmann, A. et al. 2000. *The distribution gap is closed - First record of naturally settled Pacific Oysters Crassostrea gigas in the East Frisian Wadden Sea, North Sea*. Senckenbergiana maritima 30: 153-160.

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Fig. 2. Pacific oyster farming near the German island of Sylt. Oysters are cultivated in plastic mesh bags, called 'poches', fastened onto steel trestles with rubber bands. Photo: Stefan Nehring