Conclusions and Recommendations
from the Trilateral Workshop on
Pacific Oyster Invasion in the Wadden Sea
Consequences for Ecology, Monitoring and Management
22 March 2007, Wilhelmshaven

Background

The Pacific Oyster has spread over the entire Wadden Sea. Results from ongoing research projects have indicated that spreading of the Pacific oyster has increased considerably during the last 5 years.

In order to obtain an up-date of the status of the Pacific oyster invasion and to assess the possible consequences for the ecosystem, as well as for monitoring and management, also with regard to the EC Habitats and Water Framework Directive, a trilateral report with a comprehensive data analysis was compiled by Georg Nehls and Heike Büttger (BioConsult SH) on behalf of the Common Wadden Sea Secretariat.

The work was co-funded by the Interreg IIIB project HARBASINS and supported by the Research Institute Senckenberg (Wilhelmshaven), the Schleswig-Holstein National Park Agency (Tönning) and the Lower Saxon National Park Administration (Wilhelmshaven). Additionally, the Institute for Marine Resources & Ecosystem Studies (IMARES, Texel), the Danish Fisheries Research Institute and the Alfred-Wegener-Institute (AWI, List/Sylt) provided recent data on oyster distribution.

The report was the starting point for a discussion at a trilateral workshop on 22 March 2007 in Wilhelmshaven with scientists and managers from the Wadden Sea and England to discuss the recent status and possible consequences of the Pacific oyster spreading in the Wadden Sea and to prepare recommendations regarding follow up-activities in the fields of research, monitoring and management. The workshop program is in Annex 1 and the list of participants is in Annex 2.

Conclusions:

Sporadic occurrence of the Pacific oyster in some parts of the Wadden Sea is known for over 20 years, but a rapid increase in the entire area has been documented only for the last 5 years. Areas populated by the Pacific oyster (blue mussel beds, hard substrates) increased significantly in the past years, also including formerly soft sediments. The Pacific oysters form massive reefs in all parts of the Wadden Sea. The total oyster biomass in the intertidal area of the entire Wadden Sea has increased to about 61,000 tons fresh weight in 2006 (The Netherlands: 20,510, Lower Saxony: 22,747, Schleswig-Holstein: 14,481; Denmark: 3289). In many places Pacific oysters have overgrown former blue mussel beds to form dense and solid reefs. Abundance in dense reefs is about 1000 oysters m$^{-2}$ with a mean biomass 30 to 50 kg m$^{-2}$ live wet weight.

1. Factors influencing oyster distribution

Abiotic factors:

As a main abiotic factor the substrate availability must be pointed out. Pacific oysters settle on hard substrates which are of limited occurrence in the Wadden See. They often settle initially upon barnacles, blue mussels and dead bivalve shells. Further on Pacific oysters create their own substrate and as oyster larvae prefer conspecifics to settle, they initiate massive clumps which grow further as more oyster larvae settle on top.
Salinity does not seem to significantly influence the distribution of the Pacific oyster in the Wadden Sea.

The reproduction of the Pacific Oyster in the Wadden Sea is highly correlated to summer temperatures. The high summer temperatures in the last 10-12 years have been identified as a main factor causing the recent increase of the Pacific oyster. A few days in July and August with water temperatures above 18-20 °C may already trigger the reproduction of the oyster. On the other hand, the Pacific oyster is able to survive cold winters better than previously expected.

Mass mortality among Pacific oysters was observed occasionally in shallow bays and harbours in late summer after spatfall (when condition of oysters is low). This is probably caused by local factors such as limited water exchange.

**Biotic Factors**

The Pacific oyster has almost no natural predators in the Wadden Sea. But predation by birds like oystercatchers and herring gulls has been observed. So far neither starfish, shore crabs, birds nor parasites induce high mortality that could stop or reduce the oyster’s population growth.

The observed population development is considered to have been promoted by an extension of phytoplankton blooms in late summer which enhance especially successful settling of oyster larvae.

On the other hand, phytoplankton spring blooms have developed later in the year (due to increased grazing pressure during mild winters) providing less food for blue mussels, cockles and Baltic tellins during their reproductive period.

**2. Future development**

From experiences in the Dutch Delta region (Oosterschelde), where the Pacific oyster showed a continuous increase over the last 30 years, it can be assumed that the spread in the Wadden Sea will continue further. Total biomass (life wet weight) of Pacific oysters in Wadden Sea is still less than half of that known from the Oosterschelde.

Climate change will further enhance the spread of the Pacific oyster. Warmer winters are assumed to have a negative influence on reproduction of blue mussels and other bivalves, because predators like shore crabs and shrimps return earlier in spring to the tidal flats reducing bivalve spat significantly. On the other hand, proliferation of oysters is facilitated by warm summers. The warm summer of 2006 lead to a strong oyster spatfall in the entire Wadden Sea and further spread and increasing abundances and biomass are to be expected.

The questions whether or not native blue mussel beds will disappear from the Wadden Sea due to the invasive nature of the Pacific oyster or whether a coexistence of Pacific oysters and blue mussels is possible cannot be answered so far. In future, all three types of beds might occur: blue mussel beds, oyster reefs and mixed beds.

There are several examples of co-existence of blue mussels and oysters in mixed beds. In the Dutch Wadden Sea, blue mussels have successfully re-established a strong population in the last years. If sufficient blue mussel recruits manage to settle, new beds may develop and blue mussels may co-exist with oyster reefs.
To evaluate the further development of the Pacific Oyster in the Wadden Sea annual monitoring should be carried out, accompanied with investigations on ecology and development in other coastal waters of our globe.

3. Consequences for the ecosystem

Until now the species composition of the associated fauna of oyster reefs compared to that of blue mussel beds does not differ significantly. Negative effects on the biodiversity have not been detected, but the dominance structure of the associated fauna has changed.

Most bird species seem to be able to adapt to the appearance of oyster reefs because they feed mainly on the associated fauna, such as worms and shore crabs. Birds with food preference for blue mussels, like Eider and Oystercatcher, are not able to use oysters as food resource.

In the Oosterschelde (SW Netherlands) a management experiment was carried out consisting of the removal of 50 ha of oyster reefs in March 2006. Effects on sedimentation and benthic infauna community at the oyster plots and reference areas were also investigated. The interim report (Wijsman et al. 2006) stated that the removal is effective. Oyster beds exhibit muddy sediments with higher organic carbon content which becomes apparent in the associated community (higher diversity, characterized by polychaetes, decapods and amphipods). Oyster removal might lead to sandy sediments with a less diverse community (more molluscs). A negative side effect may occur through suffocation of the benthic fauna living in areas where the removed oyster bed is dumped.

4. Human use

Negative effects on recreational activities can be expected because oyster shells are sharp and swimmers and surfers may be hurt; however, this will be restricted to few areas only.

The spread of the Pacific oyster may have some effects on the blue mussel fishery because mixed beds with blue mussels and oysters can no longer be exploited. At present no specific data on this issue are available.

At present there is only limited interest in fisheries for Pacific oysters as the wild Pacific oysters are of little commercial value.

Positive effects of developing oyster reefs on coastal protection issues are not considered to be of significance.

5. Monitoring

The spread of the Pacific oyster is a major change in the Wadden Sea ecosystem and should therefore be properly documented to assess future changes. A higher effort is therefore necessary to gather the required data.

The ongoing national monitoring programs in the TMAP document the location of blue mussel beds and in this context also the occurrence of Pacific oyster. However, no information on oysters is available for areas which are not surveyed in the mussel monitoring. There is a gap in the monitoring in the Netherlands in 2007 (only few beds are monitored regularly in connection with blue mussel fishery).

Apart from the monitoring program, more research is urgently needed to investigate and assess the changes of the Wadden Sea ecosystem which may be induced by the change of a key ecological community. Such data are also needed against the background of the Habitat Directive.
Methods of the Trilateral Monitoring must be standardized with respect to the adequate monitoring of oyster reefs.

6. Management

There are no successful management options available for removal of the Pacific oyster from the Wadden Sea. Therefore, these oysters have to be considered as permanent members of the Wadden Sea ecosystem. The ecosystem has been always changing and interference by severe management measure should be avoided. This would be in line with the guiding principle that natural processes in the Wadden Sea should proceed as undisturbed as possible.

In order to control, or reduce the occurrence of the Pacific oyster in the Wadden Sea, no viruses or diseases should be introduced because of their unforeseeable and uncontrollable effects.

Local management / removal may be possible as already discussed for the Oosterschelde. In any case a better scientific basis has to be established to assess the impact of such a management measure on the ecosystem and its processes.

Recommendations

1. Research

The workshop underlined the urgency of further ecological research in order to better assess the consequences of the Pacific oyster invasion for the Wadden Sea ecosystem. A good scientific foundation has to be prepared now and in this phase of oyster spreading, to be able to better assess future changes.

In general there is a need for more basic knowledge on ecosystem effects in order to support management decisions. Experiences from other coastal waters of the world should be used.

Cooperation of research institutes in the Wadden Sea and other countries (F, UK, Asia) and exchange of knowledge is recommended. The CWSS is asked to coordinate research activities and future initiatives, and to investigate possible funding from the EU (such as COST, FP7).

2. Monitoring

The present, the monitoring of Pacific oysters in the Wadden Sea is not done in a harmonized way. For example, no monitoring takes places in the Dutch Wadden Sea in 2007, whereas further assessments in Niedersachsen and Schleswig-Holstein are guaranteed until 2008. Pacific oyster monitoring cannot be simply included in the existing monitoring of blue mussel beds, and therefore requires extra funding.

The further developments of the Pacific oyster and its effects on the ecosystem should be part of the harmonized assessment of the data for the entire Wadden Sea. The Trilateral Monitoring and Assessment Program (TMAP) is the instrument to provide Wadden Sea wide data in a harmonized and effective way.

The present gaps in monitoring of the Pacific oyster should be filled as soon as possible by establishing a regular monitoring within the framework of the TMAP starting already in spring

3. Management

The spread of the Pacific oyster in the Wadden Sea has to be regarded as the consequence of a careless introduction of an alien species to a sensitive and protected ecosystem. This underlines that the introduction of alien species in an ecosystems has to be avoided as much as possible.

The judgement on possible removal of Pacific oyster beds as a management option needs more supporting scientific knowledge and must be based on thorough impact assessment. The first trial has been done in the Oosterschelde in March 2006 (Wijsman et al. 2006) and more results have to be awaited.
ANNEX 1 Final Workshop Program

Trilateral Workshop on
Pacific Oyster Invasion in the Wadden Sea
Consequences for Ecology, Monitoring and Management
22 March 2007
Senckenberg Research Institute,
Südstrand 40, Wilhelmshaven

Organized by the Common Wadden Sea Secretariat in the framework of the HARBASINS project

Program

11.00 Welcome and introduction (Chair: Karel Essink)

11:10 Distribution of the Pacific Oyster in the Netherlands, Germany and Denmark: Temporal and spatial trends (Georg Nehls, BioConsult SH)

11.40 Distribution of the Pacific Oyster in South-west England (Gemma Couzens, Natural England, UK)

11.50 Distribution of Pacific Oyster in the Danish Limfjord (Helle Torp Christensen, Danish Technical University)

12:00: Topical presentations

- 12:00 Associated fauna (Heike Büttger, BioConsult SH, Husum)
- 12:10: Filtration experiments (Achim Wehrmann, Research Institute Senckenberg, Wilhelmshaven)

12:20– 13:15 Lunch

- 13:15 Field experiments on artificial oyster reefs (Karsten Reise, Alfred-Wegener-Institute, Sylt)
- 13:30 Larviphagy by oysters, mussels and cockles (Wim Wolff / Karin Troost, Uni Groningen)
- 13:45 Consequences for birds (Bruno Ens, SOVON, NL / Gregor Scheiffarth, Inst. Avian Research, Wilhelmshaven)
- 14:00 Oyster monitoring in the TMAP (Georg Nehls, BioConsult SH, Husum)

14:15 – 14:30 Break

14:30 Plenary Discussion

Topics
- Oyster distribution in the Wadden Sea: main factors, future developments;
- Consequences for the ecosystem,
- Consequences for human use (recreation, fisheries, coastal protection);
- Adaptation of monitoring and management,

15:45 Conclusions

- Main findings and recommendations
- Follow up (research projects, monitoring proposals)

16:00 Closing

Further information on the workshop website:
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