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Risk evaluation and management of introducing exotic species with mussel transports

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- Dutch mussel culture and mussel transports
- Exotic species
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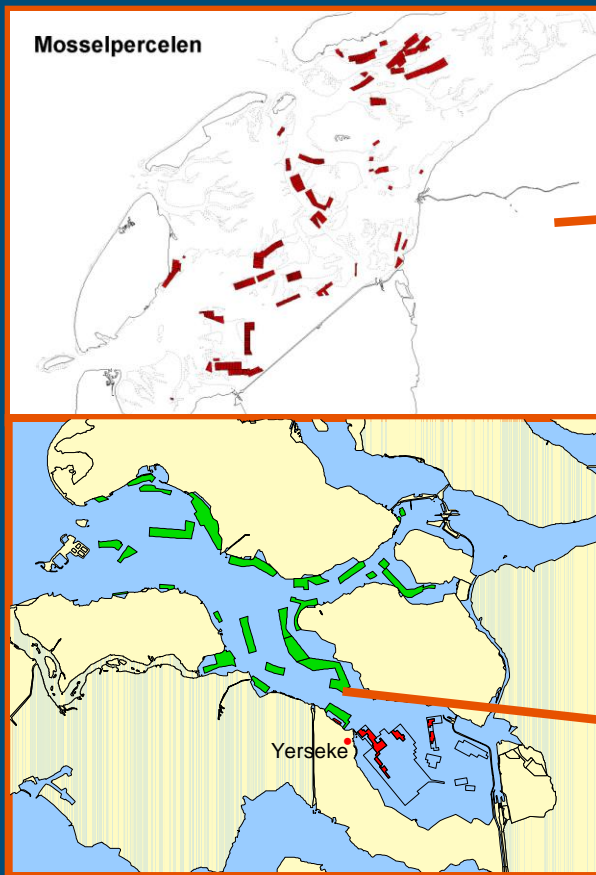
Dutch mussel culture: mainly bottom culture



Seed fishery



Mussel culture: seed translocated to culture plots



Culture plots



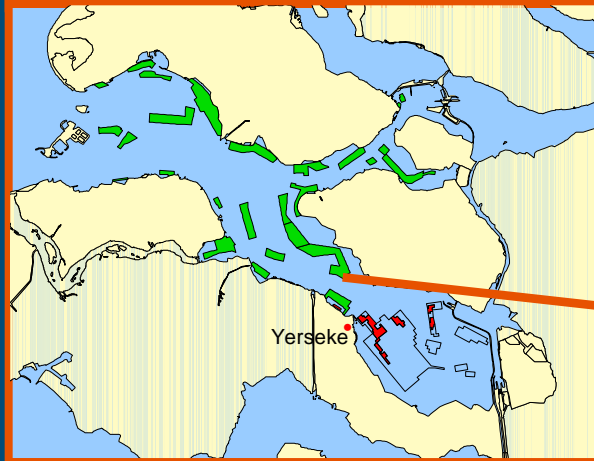
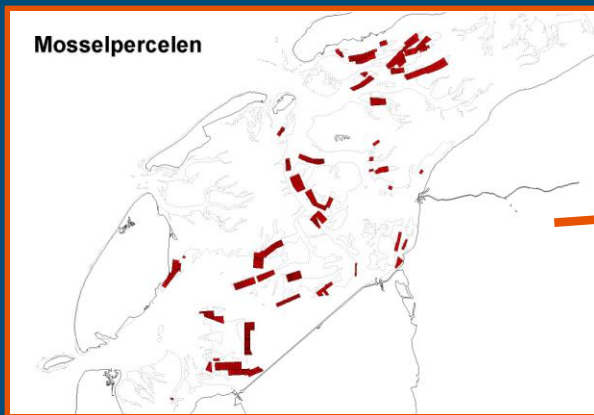


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Mussel culture: seed translocated to culture plots

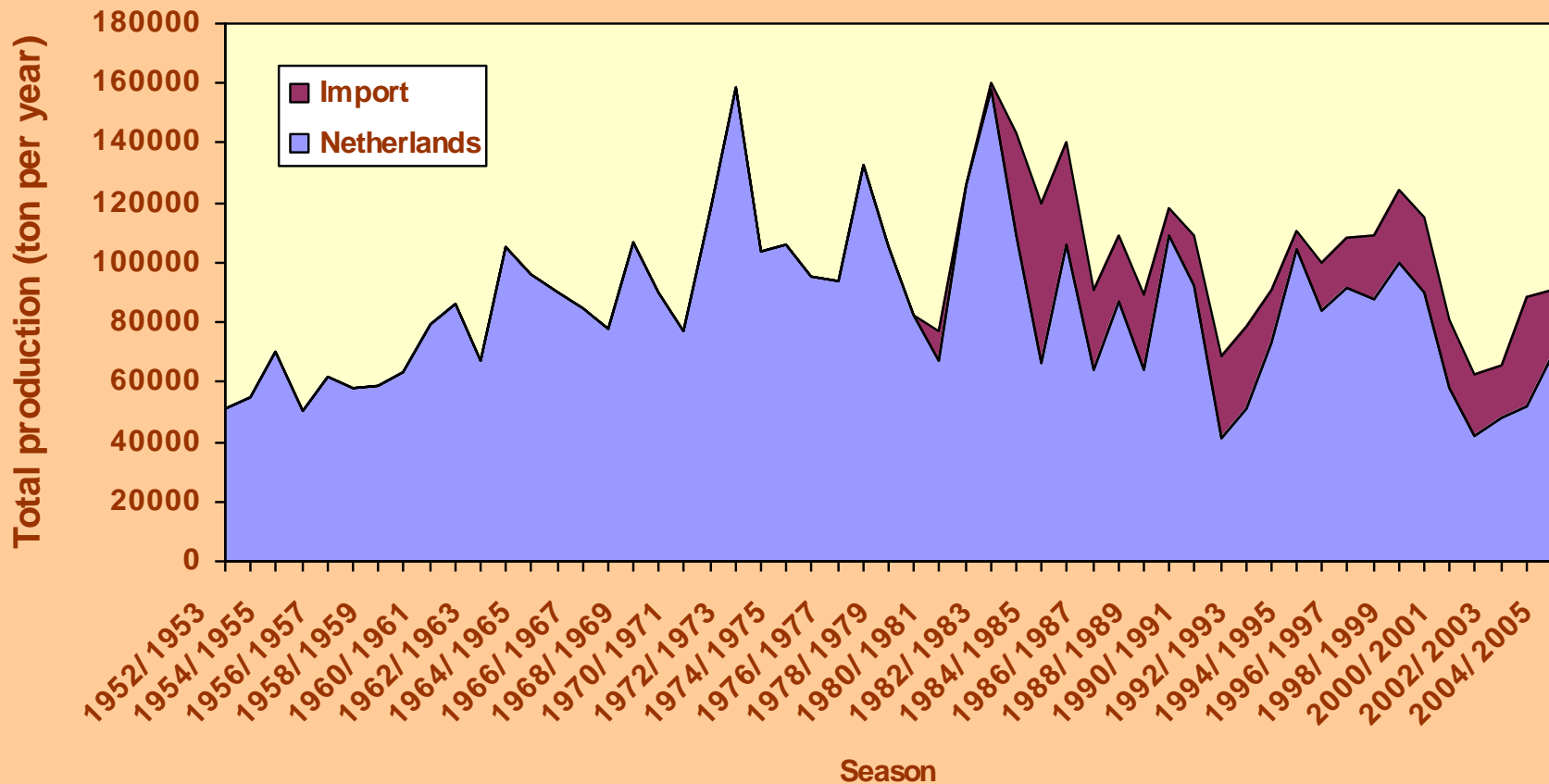


Transition in Dutch mussel culture

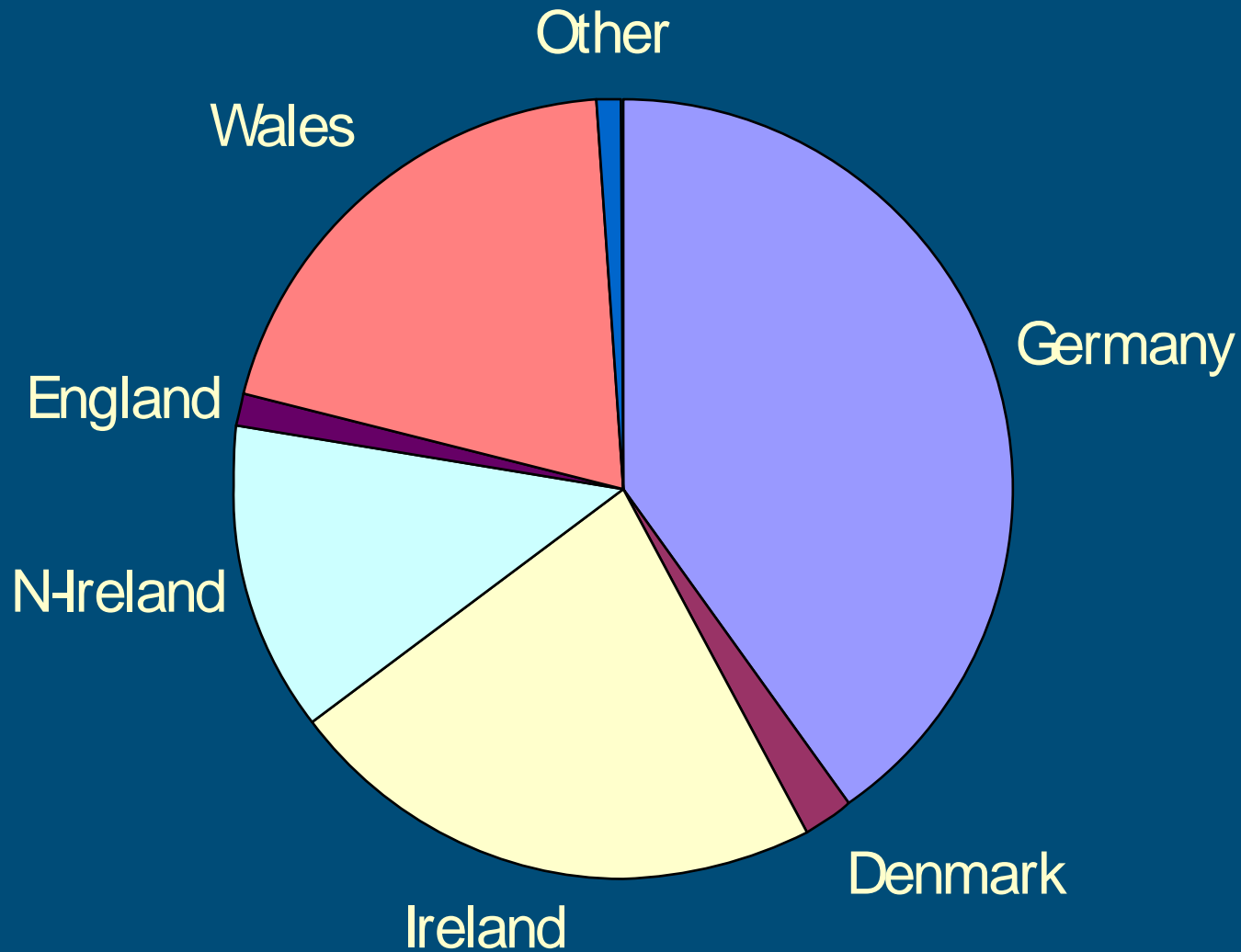
- Varying and unpredictable seed resources Wadden Sea
- Conflicts mussel fishery ↔ natural values of Wadden Sea
→ shortage of seed mussels
- Import mussels from other countries
 - Consumption mussels
 - Seed mussels
- Seed Mussel Capture devices



Registered import consumption mussels



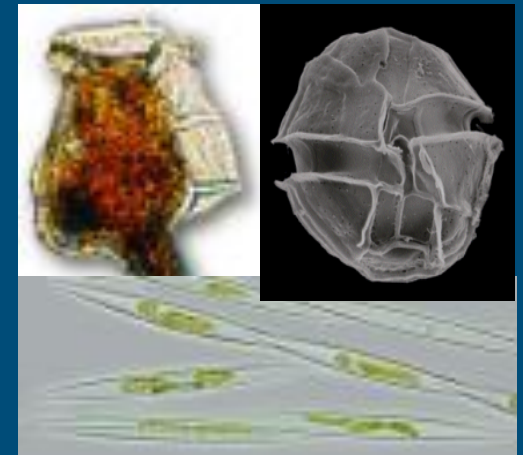
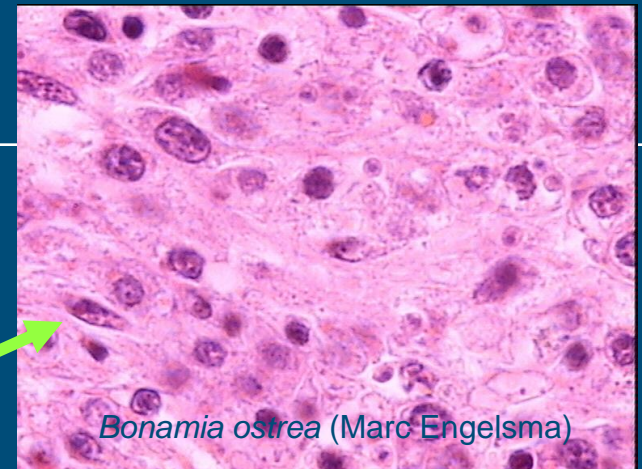
Average import 2002 – 2006: 24 500 ton yr⁻¹



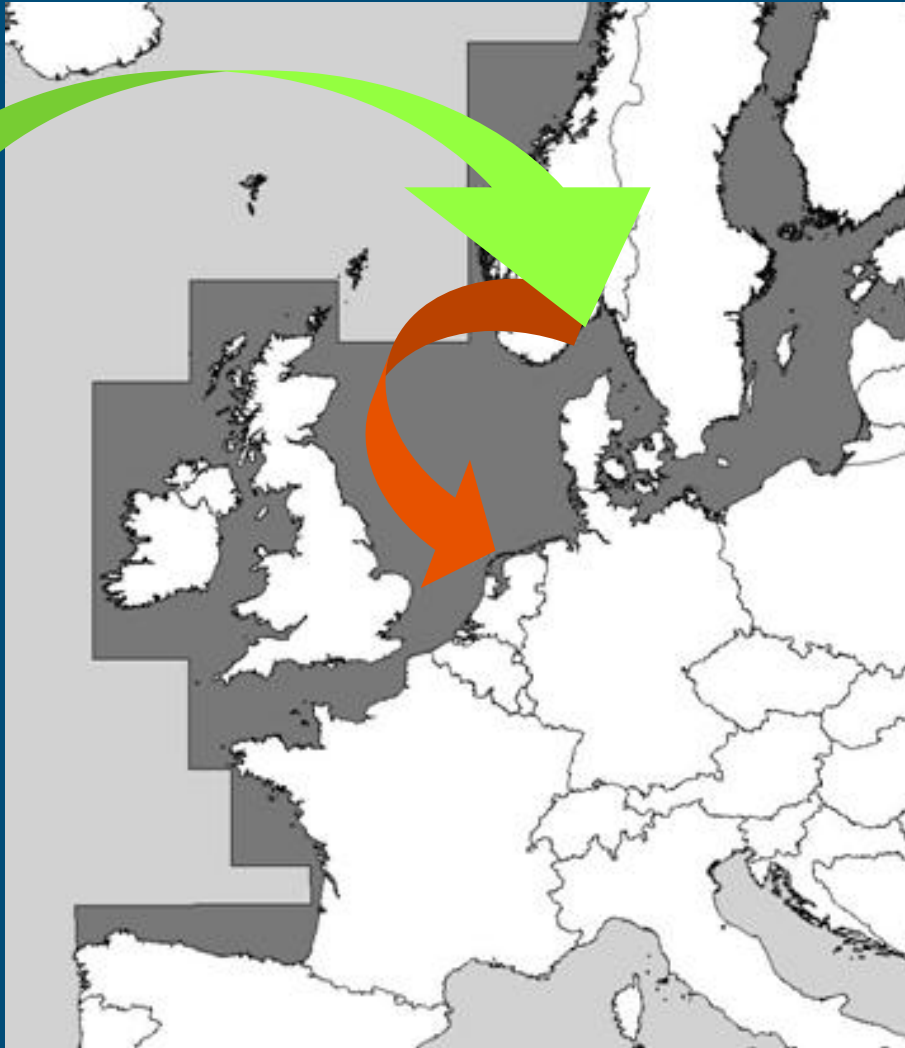
Risks of shellfish transfer

With the transfer of mussels also other (non-target) organisms could be transferred

- Diseases
- Harmful algae
- Invasive (exotic) species

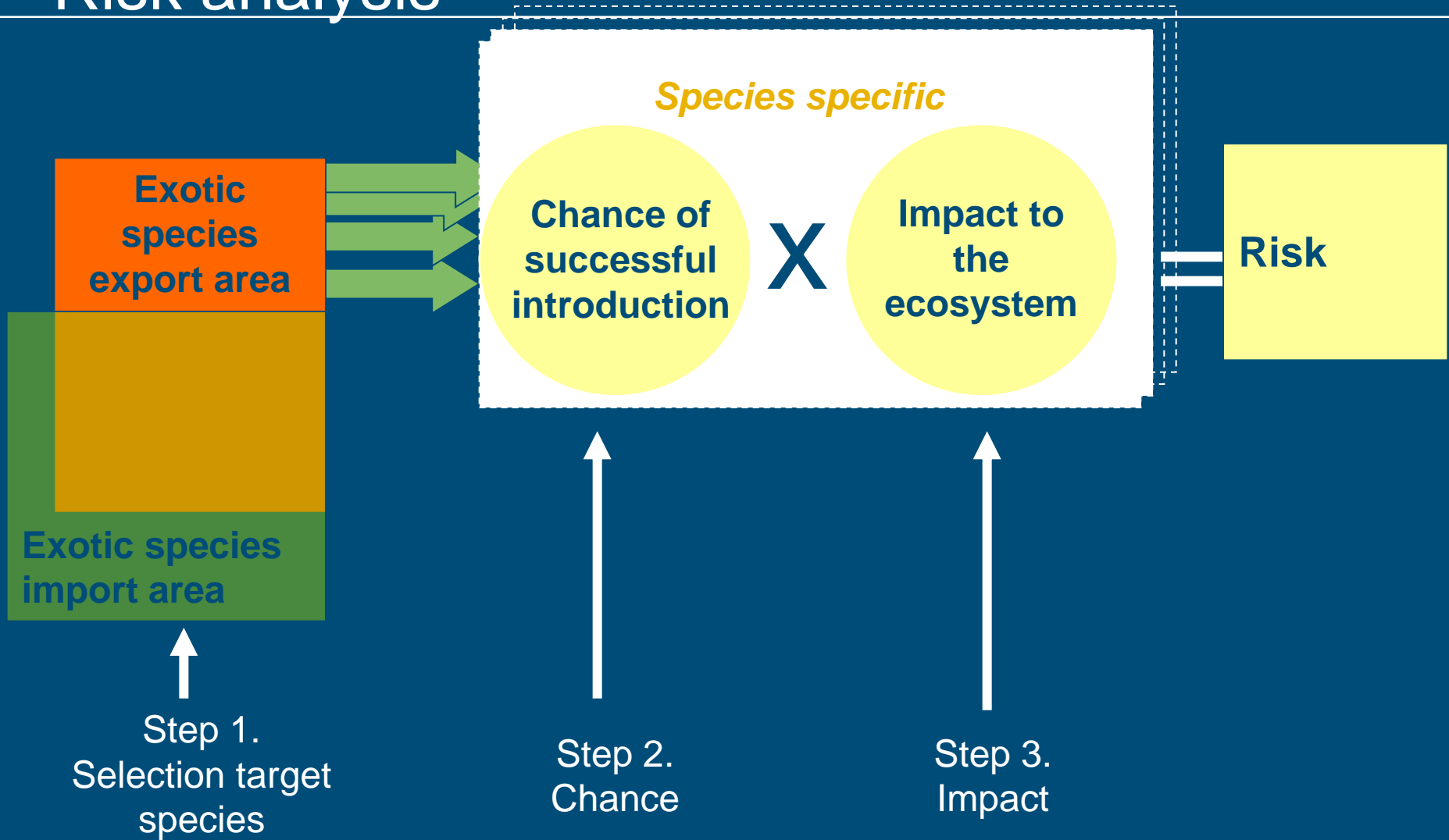


Exotic species



- Originate from other biogeographic region (e.g. US, Japan)
- Were not able to reach Wadden Sea by natural transport
- Are introduced in NW Atlantic by human activities
- Could reach Wadden Sea by natural transport or human activities
- Might establish permanently and could result in ecological problems if environmental conditions are suitable

Risk analysis



Characteristics of successful invaders

- Abundant over a large native range
- Diverse diet and habitat preferences
- Wide physiological tolerance
- High genetic variability
- Short generation time
- High reproductive capacity
- Large dispersal capacity

Typically invaded habitats

- Climate similar to the source area of the invading species
- Recently disturbed
- Low natural diversity
- Relatively simple food web
- No likely predators on invading species
- Absence of native species morphologically similar to the invading species

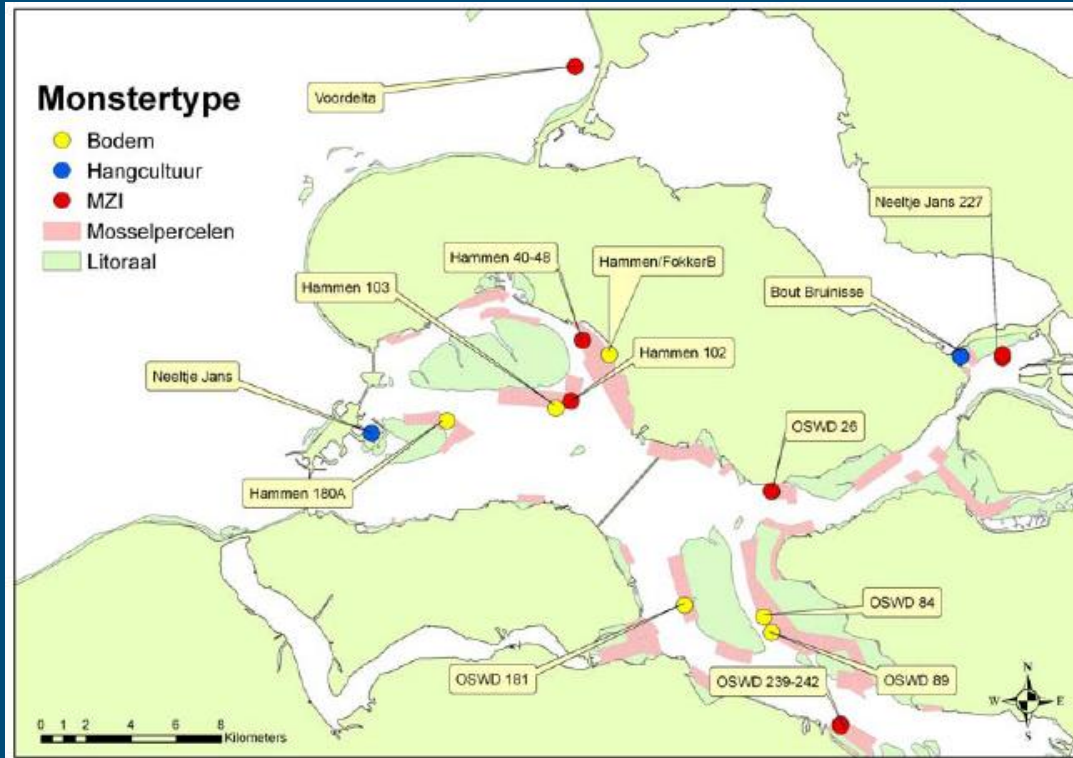
Risk management shellfish transfer

(1) Prevention, (2) removal, (3) isolation, (4) control

Tools for prevention

- Monitoring (know what is where and when)
- Treatment (mechanical, chemical, ...)
- Zonation (space and time)

Monitoring: know what is where and when



Monitoring: know what is where and when

Typical bottom culture species



Hemigrapsus penicillatus



Crassostrea gigas

Typical rope culture species



Styela clava

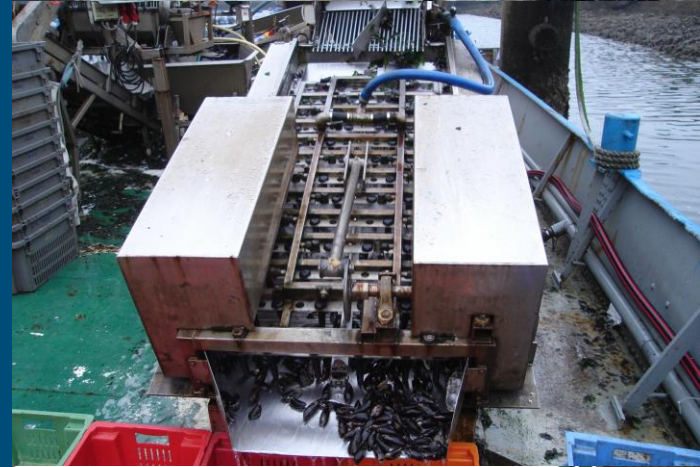


Undaria pinnatifida

- Other species associated with suspended culture
- Not less exotic species on SMC's
- About 13 % of identified species on mussels were exotic

Treatment

- No effect on mussels
- Effective for other organisms
 - Exposure to air
 - Mechanical
 - Chemical (e.g. freshwater, salt)
 - Combination



Freshwater immersion experiments oyster drills

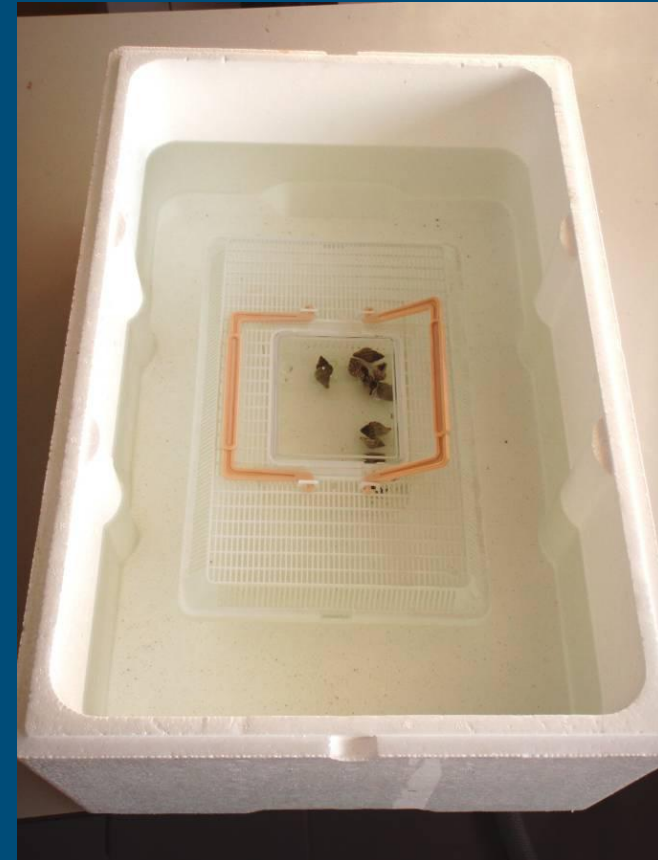
- American oyster drill (*Urosalpinx cinerea*), Japanese oyster drill (*Ocenebrellus inornatus*)
- Survived treatment up to 24 hrs
- Detached from substrate
 - **Freshwater treatment not effective for oyster drills**



American oyster drill (Stichting Anemoon)



Japanese oyster drill (IFREMER)



Conclusions

- Shellfish transfer is essential for mussel culture
- Risks associated with shellfish transfer → introduction of invasive species
- Risk = chance x potential impact
- Risk management should focus primarily on prevention
- Other, but not less exotic species associated with Seed Mussel Collectors
- Freshwater treatment not effective for oyster drills
- Mitigation possible: tailor-made approach



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Thank you for your attention!!!

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