# Risks of introducing non-indigenous species by shellfish transfer

Jeroen Wijsman, Aad Smaal

Institute for Marine Resources & Ecosystem Studies
Wageningen (IMARES), the Netherlands

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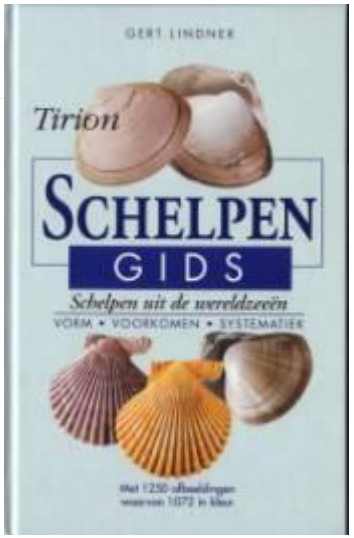
# Definitions

- Species: A group of organisms capable of interbreeding and producing fertile offspring. Described as species in taxonomical literature
- Indigenous: A species living inside its indigenous or native distributional range
- Non-indigenous: A species living outside its indigenous or native distributional range



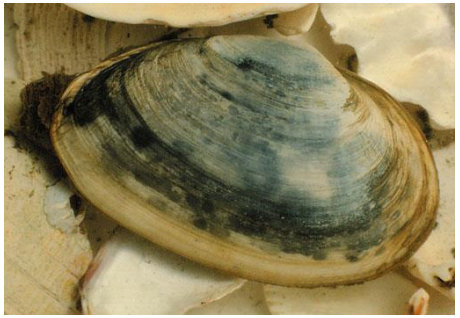

*Ensis siliqua*

*Ensis directus*

# Definitions

- Exotic species: A species introduced by human intervention outside its native distribution range
- Settled exotic species: An exotic species that reproduces sustainably within an area.


Amerikaanse oesterboorder(Stichting Anemoon)



# Definitions

- Invasive exotic species: a settled exotic species that expands outside it's area of introduction and might impact biodiversity
- Problem species: Species that, based on the state-of-the-art knowledge, might have a negative impact on the Natura-2000 goals

# Vectors of introduction exotic species

- Natural processes
  - Secondary introduction
  - Swimming/floating
- Ships hulls
  - Hard-substrate
  - Anti-fouling
- Ballast water
  - Planktonic organisms
- Shipping canals
- Shellfish transports
  - Intentional/unintentional

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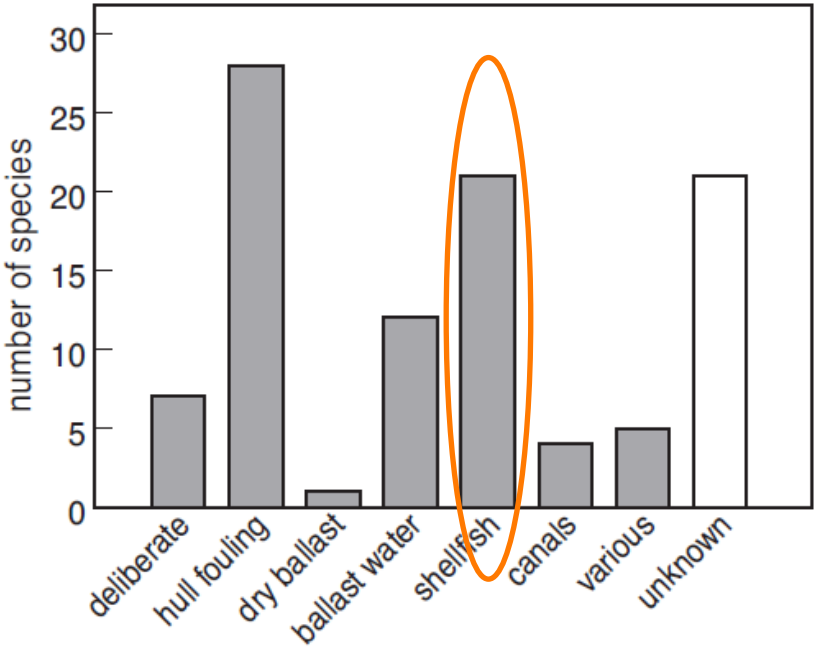
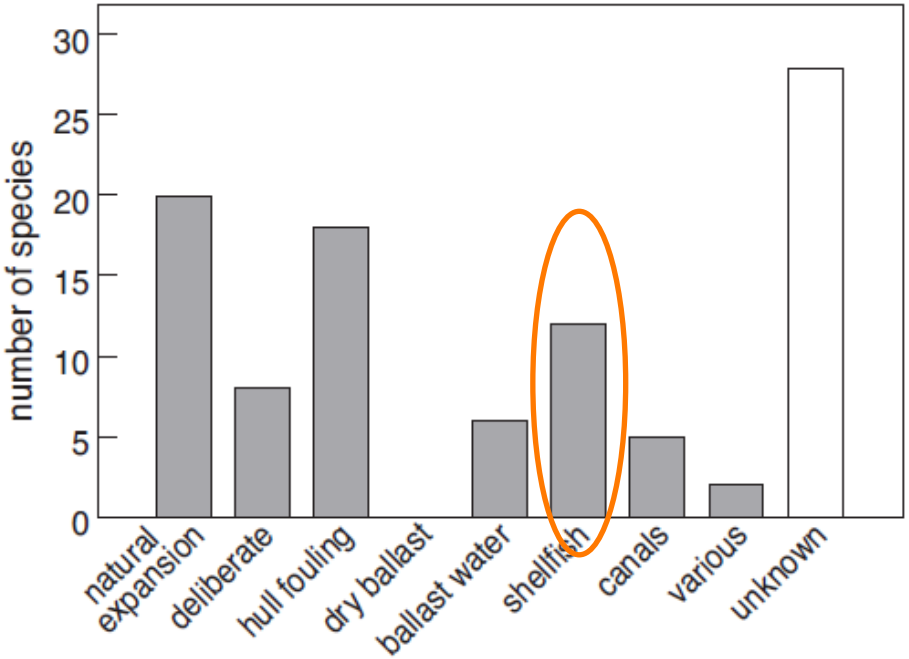
# The Netherlands

- > 100 marine exotic species reported

Most-likely vectors primary introduction




Most-likely vectors introduction into the Netherlands




Wolff (2005) Zool. Med. Leiden 79

# Shellfish culture in the Netherlands

- European flat oyster (*Ostrea edulis*) 80 tons $yr^{-1}$

- Pacific oyster (*Crassostrea gigas*) 2,500 tons $yr^{-1}$

- Mussels (*Mytilus edulis*) 60,000 tons $yr^{-1}$

# European flat oyster

- Traditional fishery Zuiderzee
- Culture in Zeeland since late 19th century
- Import from France, UK
- Decline in winter 1962/1963
- Disease *Bonamia ostrea*
- At present culture in Lake Grevelingen
- Import from Denmark, Ireland
- Export to France, Belgium
- Translocation between culture lots

# Pacific oysters

- Since 1964 introduced in Oosterschelde
- Wild since 1970
- Culture plots in Oosterschelde and Lake Grevelingen
- Export to Belgium, France
- Translocation of oysters and hard substrate between culture lots

# Mussel culture: Wild seed fishery in the Wadden Sea



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# Mussel culture: Seed Mussel Collectors (Oosterschelde and Wadden Sea)


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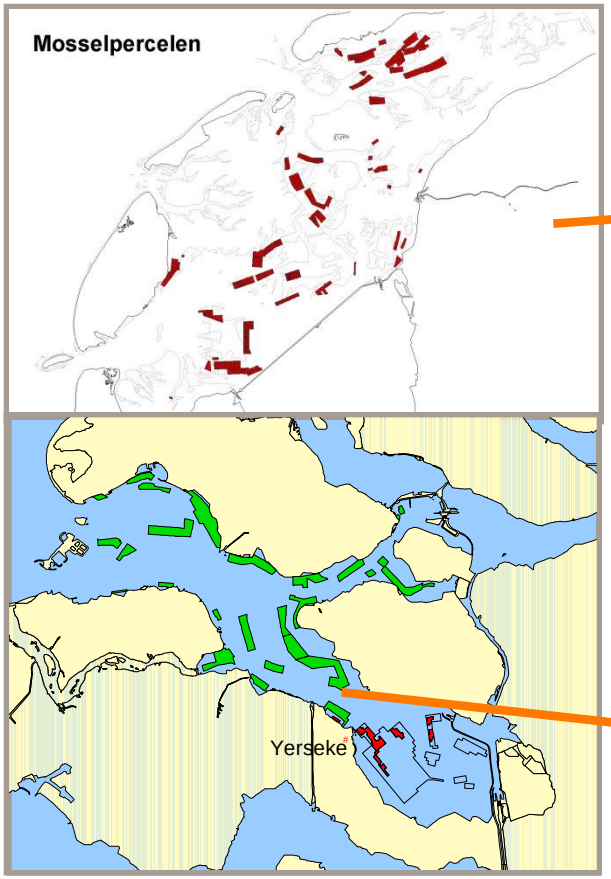
# Mussel culture: Mussel seed translocated to culture plots





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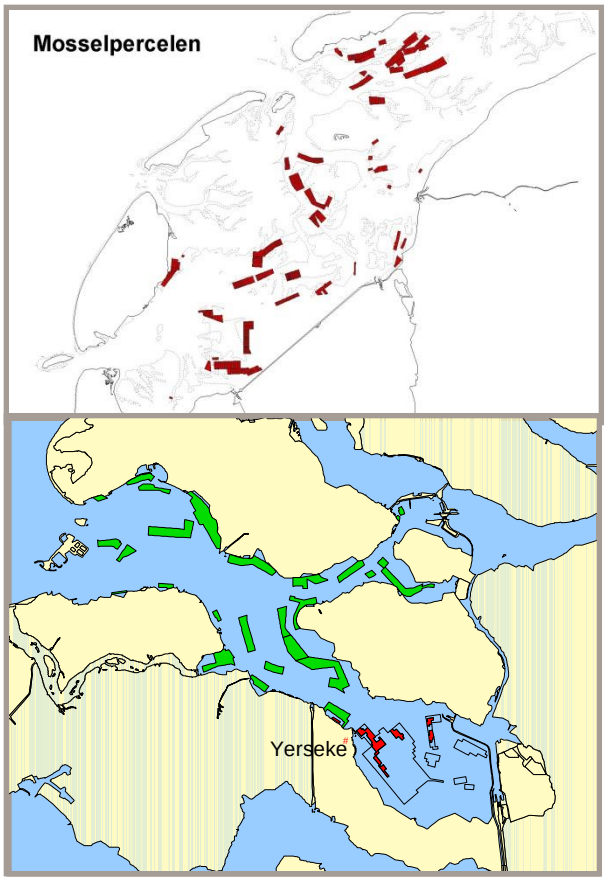
Aerial photograph of submerged culture plots

# Mussel culture: After 2-3 years sold at auction in Yerseke





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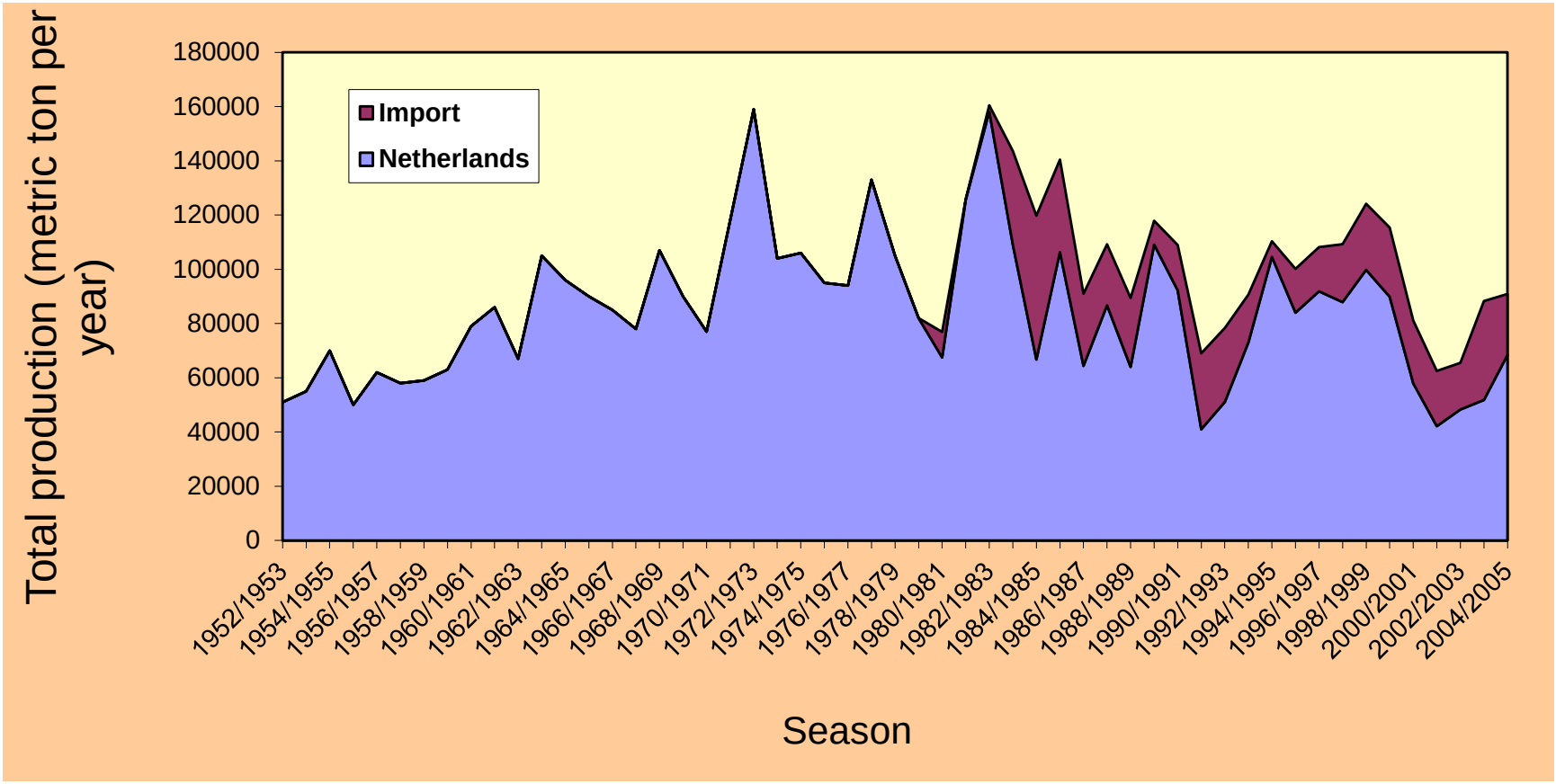
# Registered production consumption mussels

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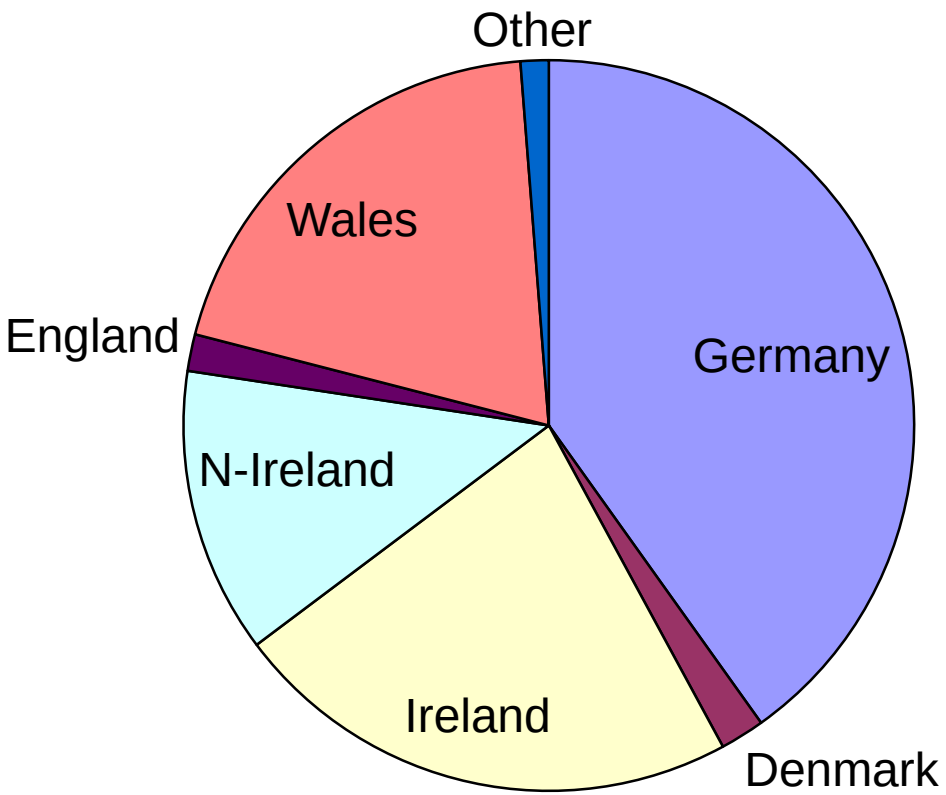
# Average import 2002 – 2006: 24.5 million kg $yr^{-1}$

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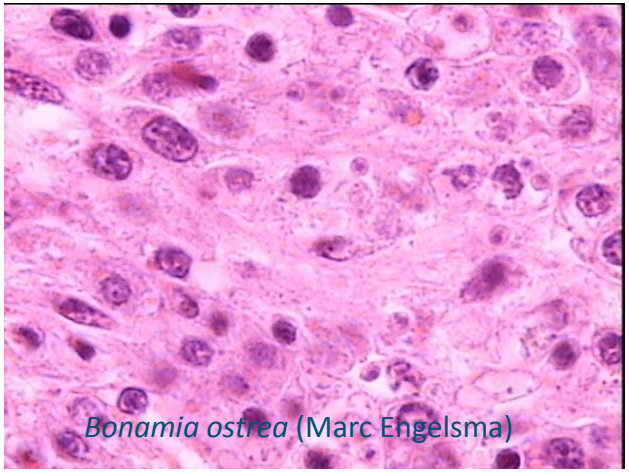
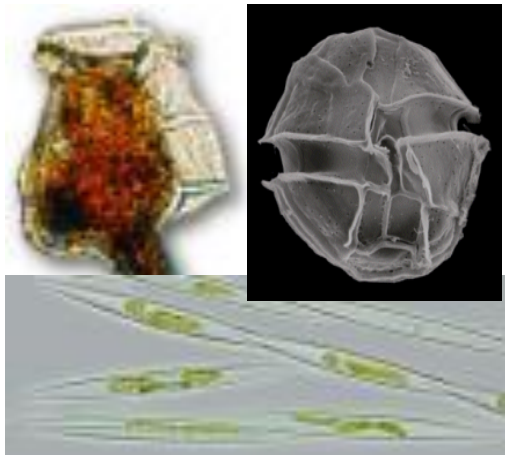
# Risks of shellfish transfer

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

- Diseases
- Harmfull algae
- Exotic (invasive) species



*Bonamia ostrea* (Marc Engelsma)



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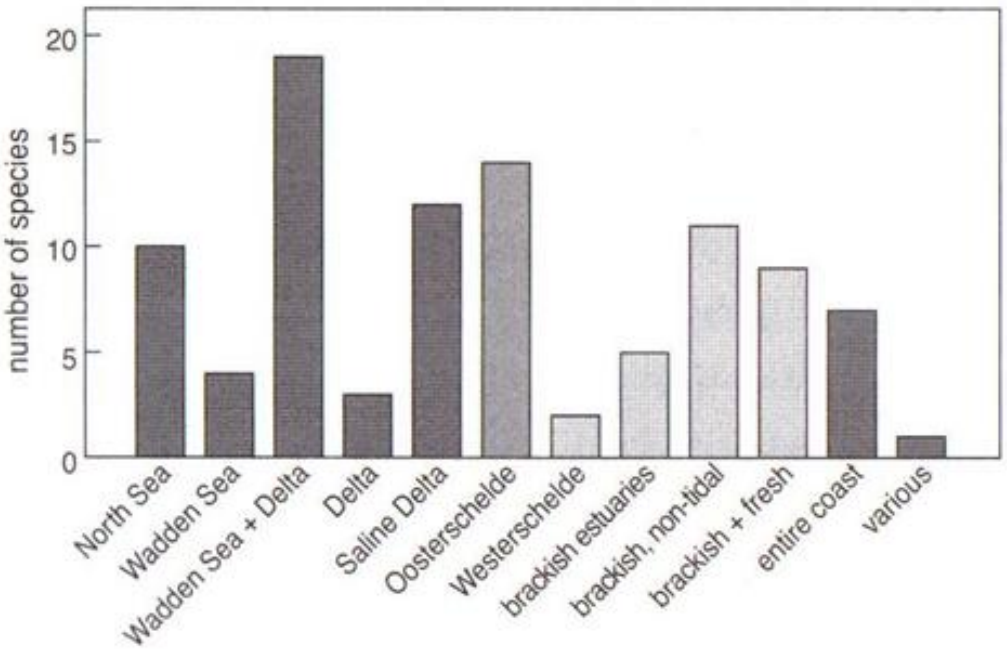
# Exotic species in Dutch waters (Wolff 2005)

- 99 exotic species
- 55% in Oosterschelde (Wadden Sea 30%)
- 14% exclusively in Oosterschelde (Wadden Sea 4%)
- Relation with shellfish Aquaculture?

Number of species exclusive for that area

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# Introductions related to shellfish aquaculture

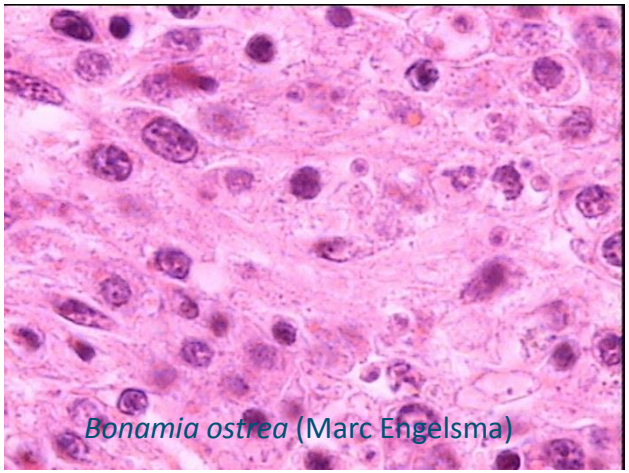
- Direct introductions
  - Pacific oysters
  - *Mercenaria mercenaria*
- Indirect introductions
  - Shellfish associated species

# *Crepidula fornicata*

- Introduced several times in UK with American oysters UK (1872-1890)
- First record in NL 1926
- Competition with other shellfish
- In 1941 4 million kg of *Crepidula* from the Oosterschelde estuary were processed for human food
- Biomasses decreased

# *Bonamia ostreae*

- Protist
- Introduced into Brittany at the end of the seventies
- Introduced in Oosterschelde with oysters from Brittany in 1980
- High mortalities *Ostrea edulis*
- Culture restricted to *Bonamia*-free zones (Lake Grevelingen)



*Bonamia ostrea* (Marc Engelsma)

# *Crasostrea gigas*

- Introduction into Portugal as *C. angulata*
- Introduction into the Oosterschelde from British Columbia (1964)
- First wild record 1970.
- Expanded intertidal mudflats
- Competition for food and habitat
- Large-scale removal in 2006 (12.5 Mkg, Wijsman et al 2008)

# *Ocinebrellus inornatus* and *Urosalpinx cinerea*

- *U. cinerea* introduced in UK 1920
- *O. inoratus* introduced Marennes Oléron 1995
- First record in the Netherlands in 2007
- Frequently found on oyster culture plots. Mortality reported
- Internal spreading due to shellfish transfer

A. Ligthart

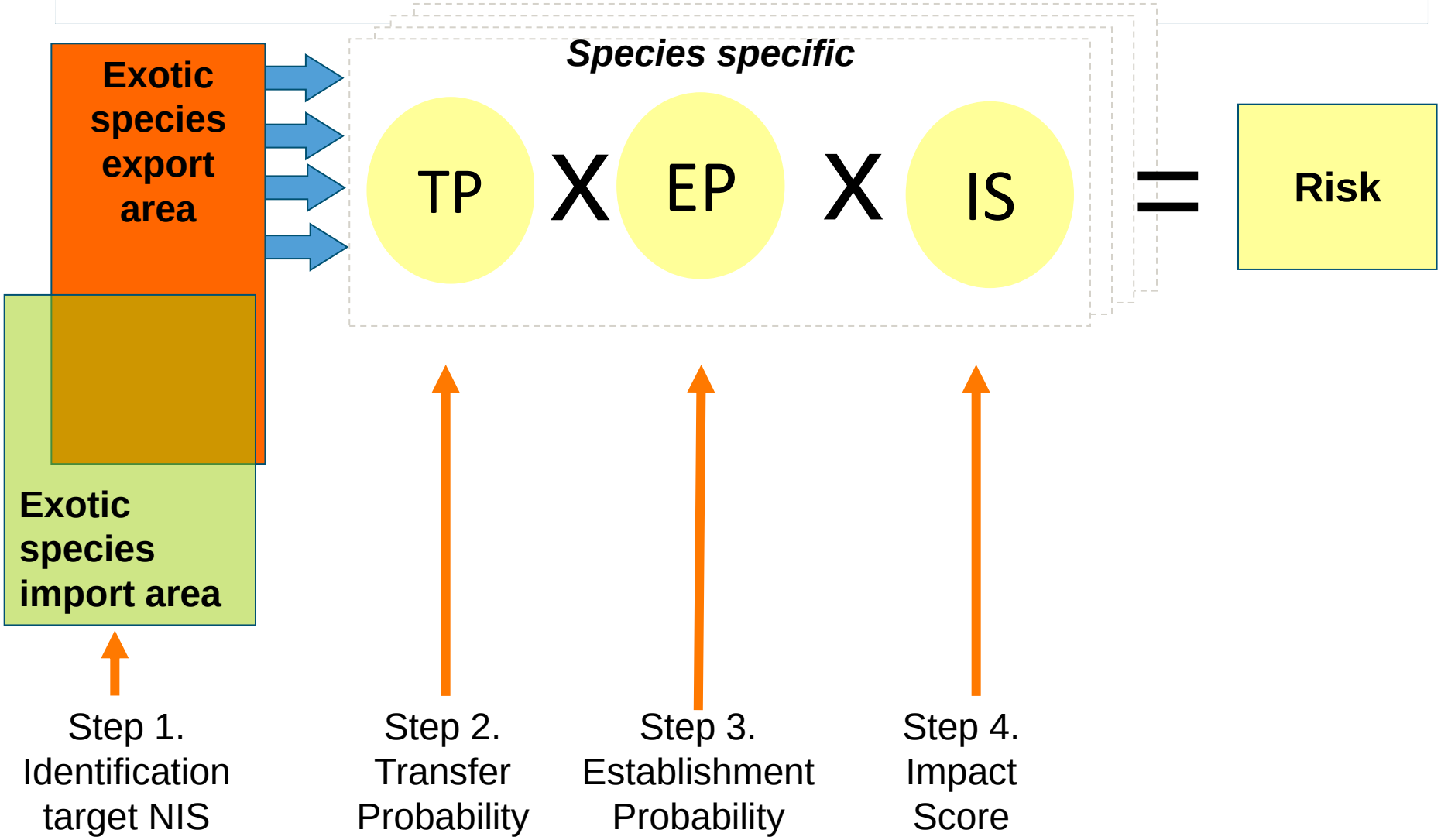
# Leglisation

- Shellfish production areas Wadden Sea, Lake Grevelingen and Oosterschelde are Natura-2000
- No permit required
  - Mussel seed to culture plots
  - SMC to culture plots
  - Translocation within system
  - Wadden Sea to Oosterschelde
- Permit required
  - Import from other countries (Ireland, UK, Germany)
  - Oosterschelde to Wadden Sea

# Risk assessment shellfish transfer

- Appropriate assessment is needed to apply for permit
- No significant effect on Natura-2000 goals
- Effect of Non-Indigenous Species (NIS) often quantified as risk
- Various risk assessment tools available for NIS.
    - ISEIA
    - Biopollution Index
    - FAO Organism risk assessment
    - ...

# Risk assessment shellfish transfer

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# Risk assessment shellfish transfer

- Overview of exotic species that could potentially be introduced with shellfish transfer (target species)
- Quantification both on literature and expert judgment
- Focus on species with highest risks
- Mitigating measures
  - Exclusion of areas or periods
  - Monitoring
  - Treatment

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# Risk management shellfish transfer

- Shellfish Import Monitoring protocol (Gittenberger 2010).
  - Shellfish-Associated Species Inventory (SASI)
  - Sampling big-bags
    - Number of species
    - NW-European NIS
    - Number of exotic species
    - Number of problem species
- Measurements
  - Intensification Big-bag inventory
  - Repeated SASI
  - Quarantine and removal

# Conclusions

- Shellfish industry is (was) an important vector for introduction of exotic species
- Translocations of shellfish within system increase spreading rate
- Risks cannot be excluded, but tools are available to manage and reduce risks

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# Thank you for your attention

jeroen.wijsman@wur.nl

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