# Non-native aquatic animals introductions have driven disease emergence in Europe

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# Introduction

 $\label{largenumber} A \, large \, number \, of \, aquatic \, animal \, species \, have \, been \, translocated \, outside \, of \, their \, natural \,$ geographic ranges over many years. Aquaculture and trade in ornamental species have been the main drivers; accidental introductions have also occurred. Non-native species (NNS) introductions have severely damaged many aquatic ecosystems through predation, competition for food, introduction of disease etc.. Emerging diseases may

be new diseases but are more often known pathogens in a new host, occurring in a new geographical area or presenting with increased virulence. Introductions of NNS to Europe illustrate how translocation of a species outside of its natural geographic range drives all types of emerging diseases.





#### Introduction of non-native species



Introduction of exotic disease



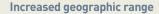
Overspill of disease from farmed to wild populations





Signal crayfish [*Pacifastacus leniusculus*) native to N. Ameri introduced to Europe to be farmed, established in the wi carrier of crayfish plague (which has eliminated nati

## **Host-switching**





Koi herpesvirus (KHV) emerged in carp production in Israel in the early 1990s and has spread worldwide through the movement of carp (Cyprinus carpio) for the ornamental pet trade. The wide distribution of carp, outside their original range, allowed the parasite to establish across the world. KHV can cause high levels of mortality in carp in farms, fisheries and ponds

New disease



Bonamia ostreae, a protist parasite, emerged in the native European oysters (Ostrae edulis) during the late 1970s and early 1980s. Later the parasite was discovered to originate in Californian from where it was introduced into France and Spain with spat of *O. edulis.* Thus the parasite was introduced into Europe through the reintroduction of a native species from outside its natural geographic range. *B. ostreae* has resulted in the decimation of native oysters in Europe.





Anguillicoides crassus (a nematode infection) which was introduced to Europe through the importation of Asian eels (*Anguilla japonica*) from Japan to Germany for fattening and consumption. Whilst the exotic eels did not escape the parasite succeeded in infecting wild European eels Anguilla anguilla. The parasite has contributed to the dramatic decline in eel populations across Europe.





1970s in Norway. The parasite was introduced from Sweden with imports of Atlantic salmon smolts from the Baltic destined for aquaculture. The switch from its original host, a Baltic strain of Atlantic salmon to Atlantic strains of Atlantic salmon resulted in dramatically increased virulence due to a lack of immunity in the new host, leading to losses of over 90% of salmon in affected rivers.

## Conclusions

- The most severe disease events in wild European aquatic animal population in recent vears are attributable to the introduction of NNS
- The introduction of a non-native aquatic animal allows their disease agents to switch
- · Parasites and pathogens with low host specificity are most likely to emerge
- Impact of the disease in the new host is often severe due to a lack of innate immunity
- Current ex-ante import risk assessment methods will not identify emerging diseases hazards
- Alternative approaches to assessing disease risks associated with the introduction of NNS and generic risk mitigation measures (e.g. restriction on the sources and number of species traded, movement of eggs in the place of adults) are needed