

# Non-indigenous species from a scientific point of view

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Among scientists semantic misunderstandings are not uncommon when discussing non-indigenous species. Taxonomists, ecologists, molecular biologists and geologists can have different views on how the species concept should be defined. The NE Atlantic mussel *Mytilus edulis* is an example where scientists tend to use different species definitions. As a result mussels that are considered indigenous according to some, are considered to be non-indigenous by others under the same circumstances. Taking semantics into account, it remains important that scientists of multiple disciplines join forces while studying the dynamics of species' distributions. Population genetics may prove valuable for identifying distribution pathways, but it is still necessary to study additionally the taxonomy, physiology, ecology and/or the geological history of non-indigenous species. As the environment is always changing, regions that used to be unsuitable for the settlement of species may become suitable or vice versa. In recent years several molluscs and cnidarians have expanded their ranges into the North Sea, most probably by their natural distribution capacities. Although such natural range expansions usually take place gradually, volcanic eruptions, extreme storms, sea water level changes, continental shifts and fluctuating temperatures (ice ages), have also caused more abrupt range expansions of species, over relatively large distances. At present, the number of introductions has mainly raised because of human activities. In the marine environment one should hereby acknowledge that most marine species have a pelagic stage during which they can disperse over relatively large distances, along with the sea currents. Therefore, both the main oceanic and tidal currents and the pelagic larval stages of non-indigenous species should be studied to understand their potential future impacts. Such studies have been conducted in western Europe mostly for only a small number of species, like the Japanese oyster *Crassostrea gigas*, the American razor shell *Ensis directus*, and *Sargassum muticum*, i.e. species that have been wide-spread and present in western Europe for decades. From a scientific point of view relatively little is known, however, about species that have expanded their populations in more recent years like the invasive Dripping sea squirt *Didemnum vexillum* and the Oriental shrimp *Palaemon macrodactylus*. Another lack in scientific knowledge concerns the distribution patterns of non-indigenous species as recent rapid species assessments in the Wadden Sea have shown. Furthermore the transport vectors and stepping-stones for non-indigenous species within the NE Atlantic are understudied. Much is hypothesized about the role of pleasure crafts and shellfish transports, but little is known on a western European scale. The value of stepping stones like shipwrecks also appears underestimated. A recent series of expeditions to the central North Sea illustrate their importance for at least some invasive species. In conclusion, from a scientific point of view, much has been hypothesized but much remains to be studied about non-indigenous species in the NE Atlantic.