11. Fan mussel (*Atrina fragilis*)

Irish name: Cleiteog

Figure A10.11.1. A fan mussel (*Atrina fragilis*) shell. © Raymond Huet

Background

The fan mussel (*Atrina fragilis*) is a large pinnid bivalve mollusc with a depth range from the sublittoral fringe to beyond the shelf edge, and a distribution range stretching from Northern Scotland to the Mediterranean interface (Stirling et al., 2016, Tyler-Walters & Wilding, 2022). Fan mussels are large (shell length to 48 cm) and triangular and embed themselves in sediments (mud, sand, or gravel), the pointed tapered end down, with at least a third of their shell exposed above the sediment interface (Stirling et al., 2016, Tyler-Walters & Wilding, 2022). Fan mussels can be solitary or occur in aggregations (Stirling et al., 2016). The morphologically and ecologically similar species *Pinna nobilis* is considered an ecosystem-engineering species as their exposed shells provide substrate for epifaunal species, increasing macrobenthic diversity (Rabaoui et al., 2009). *Atrina fragilis* also provides substratum for a variety of epifauna e.g., barnacles, sponges, hydroids, and anemones (Tyler-Walters & Wilding, 2022i), therefore aggregations should provide the same ecological-engineering services as *Pinna nobilis*. Limited data suggest a life span of between 12 and 32 years (Tyler-Walters & Wilding, 2022) and slow growth (3-4 cm a year in Valentia Bay, Kerry; Anon, 1999). Fan mussels have a pelagic larval stage, estimated to last at least four months, which is longer than in other pinnids (Stirling et al., 2018).

The fragile nature of their shells, coupled with their protrusion from the sediment, means fan mussels are susceptible to destruction by beam trawls and dredges (Solandt, 2003). They were

commonly encountered by trawlers in the Celtic Sea up until the 1970s (Solandt, 2003). Industrialised benthic fishing practices are assumed to have had a large impact on the present-day distribution of fan mussels (Hall-Spencer et al., 1999; Fryganiotis et al., 2013). The UK Joint Nature Conservation Committee estimated that without protection fan mussels would become extinct in UK waters (JNCC, 2010. Historic records suggest that fan mussels were common within the Celtic Sea until the 1970s (Nichols, 1900; Went, 1962; Solandt, 2003). There have been just two records within the Celtic Sea in the last 12 years (OBIS, 2024). As ecosystem-engineering species, any disturbance or destruction of fan mussel populations will have a cascading effect on their epifaunal associates, lowering macrobenthic diversity (Rabaoui et al., 2009, Tyler-Walters & Wilding, 2022).

Rationale for spatial protection in the Celtic Sea

As ecosystem engineers, fan mussels increase the diversity of macrobenthic species in areas where they form and are thus ecologically important. Given that fan mussels are relatively long-lived sessile invertebrates, recruitment and recovery after disturbance is likely to be slow, so spatial protection would be beneficial. Additionally, given past records of their distribution within the Celtic Sea, fan mussels have restoration potential.

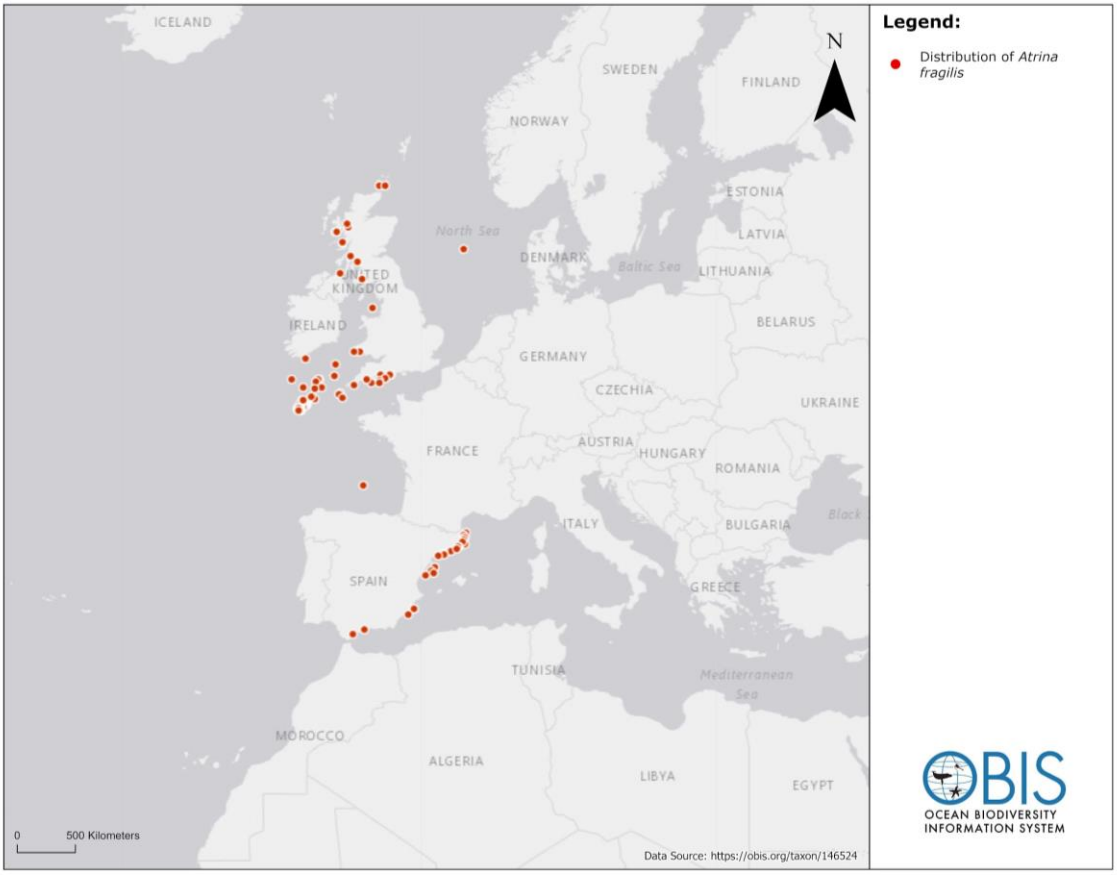

Figure A10.11.2. The global distribution of the fan mussel (*Atrina fragilis*). Source: Ocean Biogeographic Information System, www.obis.org (https://obis.org/taxon/146524)

Sensitivity assessment

Fan mussels are highly sensitive to seven of the pressures associated with the construction and operation of offshore wind farms. All marine habitats and benthic species are considered to have a high sensitivity to physical loss to land or freshwater. A change of seabed type from sediment to hard substratum, would result in loss of viable habitat for this species, and, because resilience is very low, fan mussels are highly sensitive to this pressure. Removal of the substratum would likely remove the whole population of fan mussels in the affected area meaning a resistance of none and, with a very low resistance, sensitivity for this pressure is high. Similarly, penetration or disturbance of the subsurface is likely to remove, destroy, or dislodge fan mussels, to which they have no resistance and very low resilience, meaning they are highly sensitive to this pressure. A heavy deposition of >30 cm of sediment would result in burial of the whole animal. As they cannot burrow upwards (Yonge, 1953), smothering and death would result, thus sensitivity to this pressure is high. Based on limited evidence (Šimunović et al., 2010, Masato et al., 2017 Nagasoe et al., 2020) that mainly comes from similar species, fan mussels are likely to suffer significant mortality under conditions where the dissolved oxygen concentration is ≤ 2 mg/l for one week. This means they have low resistance, and probably low resilience, making them highly sensitive to deoxygenation. Fan mussels have a high sensitivity to abrasion/disturbance of the surface of the substratum or seabed, a pressure associated with both ORE and fishing practices. Fan mussels can survive low levels of abrasion by withdrawing their mantle and ctenidia into the remaining part of the shell buried in the sediment and can repair its shell. However high impact abrasion from fishing practices or legs of jack-up barges, is likely to result in mortality (Hall-Spencer et al., 1999, Fryganiotis et al., 2013).

Fan mussels are highly sensitive to four of the pressures associated with the fishing sector. Three of these pressures are also associated with ORE, Physical change (to another seabed type), abrasion/disturbance of substratum surface or seabed, and penetration or disturbance of substratum subsurface, and are discussed above. Removal of non-target species via dredging and demersal trawling have been associated with declines in pinnid abundance and extent (Anon, 1999; Hall-spencer et al., 1999; Šimunović et al., 2001; Solandt, 2003; Fryganiotis et al., 2013; Chavaz-Villabla et al., 2022). Fan mussels are thus highly sensitive to removal of non-target species, as they have no resistance and probably very low resilience.

Fan mussels could not be assessed for their sensitivity to pressures associated with shipping. The available evidence was either insufficient to support an assessment of the pressures (e.g., chemical pressures), or the pressure was not relevant to fan mussels (e.g., underwater noise).

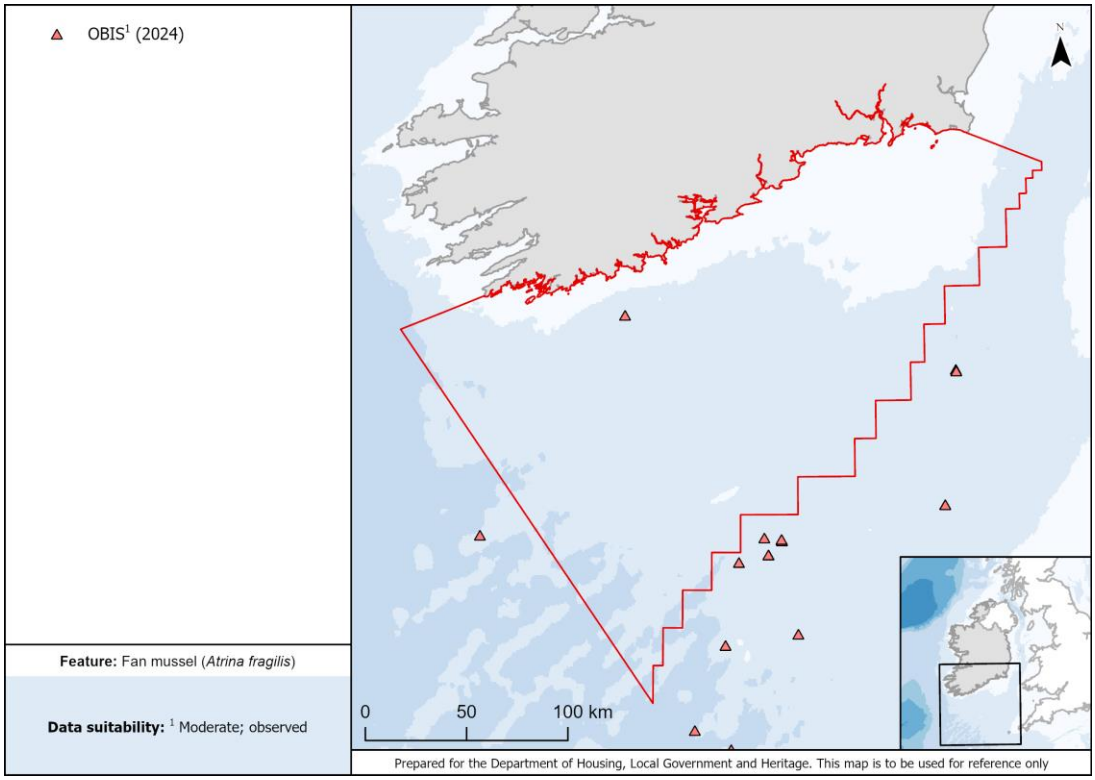

Figure A10.11.3. Data available for the fan mussel (*Atrina fragilis*) in the Celtic Sea.

Data sources available

Data sources for the fan mussel in the Celtic Sea AOI that were available to the MPA Advisory Group, and the quality / suitability of those data for conservation prioritization analyses (See Table 3.2.1 Main Report), are shown in Figure A10.11.3. Data were not considered suitable for inclusion in prioritization analyses: data are too sparse.

Further research needs

There is a lack of knowledge on the distribution and persistence of the fan mussel in the Celtic Sea and in Irish waters in general. More focused research is needed into the potential impacts of the pressures transition elements and organo-metal contamination, hydrocarbon and PAH contamination, synthetic compound contamination, introduction of other substances, introduction or spread of invasive non-indigenous species, electromagnetic energy, and organic enrichment on the fan mussel as no evidence was found to support conclusive assessments for these pressures.

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