OSPAR COMMISSION

Case report for *Haploops* habitat

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OSPAR Convention

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the "OSPAR Convention") was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. The Contracting Parties are Belgium, Denmark, the European Union, Finland, France, Germany, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Convention OSPAR

La Convention pour la protection du milieu marin de l´Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d´Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998. Les Parties contractantes sont l´Allemagne, la Belgique, le Danemark, l´Espagne, la Finlande, la France, l´Irlande, l´Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume- Uni de Grande Bretagne et d´Irlande du Nord, la Suède, la Suisse et l´Union européenne.

Contents

Nomination

Muddy sediment dominated by *Haploops* species ("*Haploops* habitat")

Figure 1: Photo of *Haploops* habitat in Kattegat, Denmark. Photo taken by ROV (Oceana, 2011)

Figure 2: A bottom sample of *Haploops* spp. tubes from Kattegat (OCEANA/Carlos Minguell. 2012)

Reason for review

Haploops habitat is proposed for addition to the OSPAR list of threatened and/or declining species because there is clear evidence of decline in the Kattegat area of OSPAR region II.

The *Haploops* habitat is built by small crustacean amphipods living in muddy substrates. They live in small, self-built tubes that rise a few centimeters above the seafloor and these can form dense mats. Soft-bottom habitats dominated by one or several of these species are called *Haploops* spp. communities or habitats, depending on the density of individuals. The *Haploops* habitat is in general characterised by high alpha-diversity of macroinvertebrates (tube worms, sea urchins, brittle stars) and is important as feeding grounds for many species of fish such as cod and flatfish.

The genus *Haploops* (Crustacea: Amphipoda: Ampeliscidae) comprises 27 species (2018) (Bellan-Santini & Dauvin 2008; Kaïm-Malka *et al*., 2016; Dauvin *et al*., 2017; Peart, 2017; Bellan-Santini *et al*., 2018), of which 19 are found in the OSPAR maritime area (*H. abyssorum, H. antennata, H. bjarnii, H. carinata, H. dellavallei, H. dauvini, H. gascogni, H. islandica, H. kaimmalkai, H. laevis, H. lodo, H. longiseta, H. nirae, H. proxima, H. setosa, H. similis, H. tenuis, H. tubicola* and *H. vallifera*). *Haploops* species occur at varying depths ranging from 15 to 3000 m, but most of them are deep-water species.

In the Kattegat of OSPAR Region II, the habitat regularly occurs below the halocline in conditions with relatively high salinity and low temperature. There are two species known to form the habitat in the Kattegat: *Haploops tenuis* and *Haploops tubicola*. This habitat is further described in OSPAR Agreement 2008-7. To qualify as '*Haploops* habitat', the habitat created by dense occurrence of *Haploops* needs to display a different structure compared to the surrounding homogenous

muddy/fine sand or sediment habitat. The number of *Haploops* individuals should be 400 ind./m-2 or more, although with lower densities expert judgement should be sought to assess whether the qualification of *Haploops* spp. habitat is justified considering the regional/local context. For occurrence and possible patchiness of the habitat, expert judgement should be used to estimate whether the habitat has been present historically and later declined. When identifying a *Haploops* habitat the important factor is how the habitat structurally differs from the surrounding area.

Densities and abundance of individual crustaceans in *Haploops* spp. habitat vary significantly according to species, locations and seasons. Temporal variations in densities of *Haploops* spp. follow patterns of seasonal variations in environmental factors and food availability. Strong variations in densities between successive sampling dates can also relate to the high spatial heterogeneity in *Haploops* distribution at a local scale. *Haploops* spp. are nevertheless capable of colonizing large areas of the seabed. They have been reported to cover extensive surface of soft sediment bottoms with densities of several thousand individuals/tubes per square meter (e.g. Bellan-Santini and Dauvin, 1989).

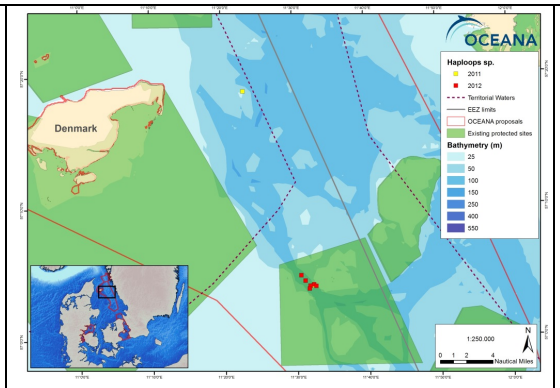
Geographic extent

Habitats formed by *Haploops* spp is principally found in OSPAR regions II and IV, although species occurrence and prevalence is variable. They are found in the following Dinter biogeographic zones - Lusitanian-Boreal, and Boreal. In Region IV (Bay of Biscay and the Iberian Coast) particularly off the coast of Brittany the *Haploops* habitat is dominated by the species *H. nirae*.

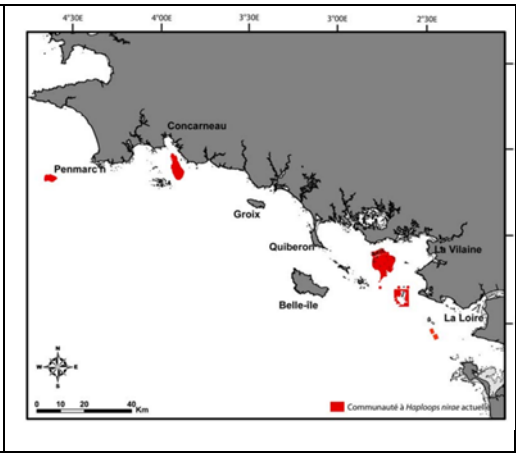
In Region II (the North Sea, particularly in the area of Kattegat), there are two species known to form the habitat: *Haploops tenuis* and *Haploops tubicola.* The Recommendation applies to Region II.

Outside of the OSPAR maritime area, very high densities of *Haploops* spp have been recorded historically from the Great Belt. More recent data from the Sound, Danish-Swedish border (1993-2006) points to more than 400 ind/m2 (sum *H. tenuis*, *H. tubicola*), at lower densities brittle stars *Amphiura* spp dominate on soft bottoms below halocline. Rich *Haploops* communities here are always followed by the brittle star Ophiura robusta and the ostracode *Philomedes brenda*. In the past (Petersen 1913, Thorson 1968) also the bivalves *Nuculana pernula*, *Nuculana minuta* and *Pseudamussium peslutrae* accompanied the *Haploops* habitat in the Sound/southeastern Kattegat.

a)



b)



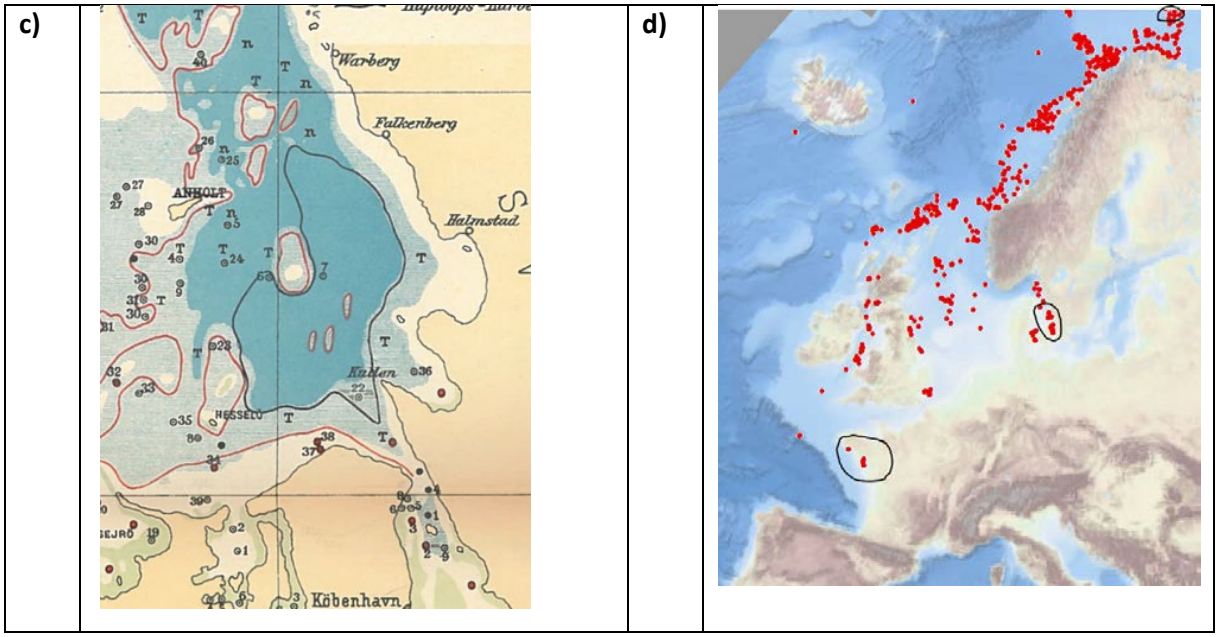


Figure 3: Distribution of *Haploops* habitat in OSPAR regions II and IV: a) *Haploops* habitat in the Kattegat, Denmark, Region II (Oceana 2014); b) *Haploops* habitat in South Brittany, France, Region IV (from Rigolet 2013); c) Mapping of the *Haploops* habitat in southern Kattegat by Petersen (1913). Community distribution encircled with black line; d) Map of occurrence of the *Haploops* genus from EMODnet Data Portal (checked on 8 November 2018). The areas of *Haploops* habitat covered by the case report are circled.

Application of the Texel-Faial criteria

Global importance

A significant proportion of key *Haploops* habitat, with the highest known densities of individuals in the world, are or have been found in the OSPAR maritime area (as circled in Figure 3d). *Haploops* habitat, with densities equal to or greater than one thousand individuals per square metre, are only found in a few locations globally (Bellan-Santini and Dauvin 1989);in the North-East Atlantic such as the Kattegat (Denmark and Sweden, OSPAR Region II), several bays in South Brittany (France, OSPAR Region IV), as well as the Bay of Fundy (Canada), and the East Siberian Sea (Russia) (Rigolet et al. 2013; Gukov, 2011).

Regional importance

The known distribution of *Haploops* habitats is restricted to locations in OSPAR region II (Kattegat), and Region IV (South Brittany France). In region IV, *Haploops* habitats have a larger distribution range, from the coast of South Brittany (France) to Morocco where expansion is occurring (Rigolet et al. 2012).

Rarity

The distribution of *Haploops* habitat is patchy, both globally and in the OSPAR maritime area. Lower densities of *Haploops* individuals can also be found in shallow muddy areas of OSPAR Regions I, III and V but these are often insufficiently documented to determine presence of the habitat.

Sensitivity

Haploops habitat may be sensitive to human activity, but there is a lack of direct evidence of impacts. *Haploops* habitat is considered sensitive to direct physical impacts and disturbances of the seafloor, as well as to eutrophication, hypoxia and turbidity (Göransson et al. 2002; Tillin et al. 2006), and to oil pollution (Dauvin, 1987). For instance bottom-fishing activities, dredging, mining, sand and gravel extraction and offshore installations remove, disturb and stir up the sea bottom, with direct impacts on benthic animals. Evidence from Region II suggests that *Haploops* habitat face difficulties in re-establishing in areas that are regularly trawled (Olesen et al. 2011). See further information under 'Threats'.

Ecological significance

Haploops are bioengineering species, which build small tubes in soft sediments. *Haploops* habitat with high tube densities increase the complexity and heterogeneity of the sea bottom, in comparison with adjacent, more homogeneous areas and potentially play significant roles in different ecosystem processes. As a result, the *Haploops* habitat improves the diversity and composition of invertebrates living in areas where it is found (Rigolet et al. 2014), for instance, it attracts various species of tubeworms, sea urchins and brittle stars.

Haploops species are an important link in the food chain, as they are food sources for demersal fishes such as flatfish (Rigolet et al. 2014). Also, because of their biological activity, these engineering species strongly affect the food web, especially by promoting microphytobenthic production (Rigolet et al. 2014; Rigolet et al. 2015).

Dense tube mats of the *Haploops* habitat can also improve the quality of benthos by processing particulate organic matter and oxygenating sediments (Diaz et al. 2008). The *Haploops* habitat is characterized by an enriched sediment, as the amount of organic carbon and nitrogen are significantly higher, with the lowest C:N ratio, and the highest chlorophyll a and phaeopigment concentrations. As a result, the organic matter is more abundant and of better quality (higher digestibility correlates with lower C:N ratio) when the sediment is colonized by *Haploops* (Rigolet 2013). The *Haploops* habitat also helps stabilise sediments by minimising the transport of silt and facilitating the colonisation and the development of suspension-feeding species (Mackenzie et al. 2006).

Status of Decline

Based on the available information, and applying the precautionary principle, the decline should be categorised as follows:

Region II: Significantly declined in the Kattegat (Boreal Dinter Province)

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Haploops habitat has declined significantly in a small part of OSPAR Region II. There are long historical records of the occurrence of the habitat in the Kattegat within Region II since the first half of the 1900s. The researcher Carl Georg Johannes Petersen (1860-1928) studied benthic fauna, including *Haploops*, in the Kattegat. This study showed that the *Haploops* habitat was found on bottoms below 25 metres depth in a large area of south-eastern Kattegat, (Göransson 1999). When systematic monitoring was resumed in the 1980s and 1990s these habitats were mostly gone. (Pers com. Jörgen Hansen). The exact cause of this decline in *Haploops* habitat remains unknown.

Region IV: Not Declining

(Regions I,III, and V: Little evidence of presence of *Haploops* habitat in these OSPAR regions.)

Threat

Region II: Potentially threatened

Fishing with bottom contacting mobile fishing gears(e.g. dredging, trawling) is a potential threat to *Haploops* habitat. These fishing methods can have a direct impact on the structure of the seafloor and can cause physical damage and disturbance to benthic habitats and species (Olesen et al. 2011; HELCOM 2013,b,c; Tillin et al. 2006; De Juan et al. 2007). Other major potential threats are hazardous substances and eutrophication, where oxygen deficiency can affect the benthic life (HELCOM 2013,b,c). Hazardous substances accumulate in muddy bottoms and therefore *Haploops* habitat can be exposed to pollution. Other threats include climate change where increased temperatures are expected to have an impact on artic-boreal habitats (Blæsbjerg et al. 2012; Oceana 2011; HELCOM 2013a, b, Göransson 2017). However, the whole picture appears to be more complex, given that in some other areas, like Region IV, the corresponding *Haploops* habitat (built by the species *H nirae*) appear to have benefited from increased nutrients, sediment resuspension and increase of offshore bottom-trawling activities, resulting in increased turbidity in nearshore waters (LeBris & Glemarec 1995; Hily et al. 2008).

Relevant additional considerations

Sufficiency of data

Haploops habitat have been studied in past decades in the Kattegat, where there has been a significant decline. The status of corresponding *Haploops* habitats are also well-known south of Brittany, where they have been increasing in recent years. The dynamics of the *Haploops* habitat, their decline in some areas and increase in others is not fully understood. A number of uncertainties remain, and more information is needed, for instance, on the effects of bottom trawling, eutrophication, climate change etc. in order to be able to efficiently protect and potentially restore the declined habitats. The *Haploops* habitat is not as prevalent in other parts of the OSPAR maritime area and therefore little data on presence and condition trends is available.

Changes in relation to natural variability

The extent of *Haploops* habitat can vary as a response to nutrient availability, currents, turbidity, temperature, benthic substrate etc.

Expert judgement

During the process to develop the HELCOM Red List (Helcom 2013a), *Haploops* communities, and the two *Haploops* species present in the Sound and Kattegat (*H. tenuis* and *H. tubicola*) were assessed against the Red List criteria of the International Union for Conservation of Nature (IUCN). Both species were found to be in danger of becoming extinct (Endangered status for *H. tenuis*, and Vulnerable status for *H. tubicola*) and the biotope 'Baltic aphotic muddy sediment dominated by *Haploops* spp' was found to be Endangered.

Trends and prospects on the status of the habitat

In the Kattegat (OSPAR Region II) prospects of recovery of the *Haploops* habitat is unlikely to occur without management action to reduce or remove pressure. Off the Britanny coast the corresponding (OSPAR Region IV) *Haploops* habitat appears to be increasing in extent. There is insufficient information regarding presence of the *Haploops* habitat elsewhere in the OSPAR maritime area.

Conclusion on overall status

Haploops habitat is potentially under threat and in decline in OSPAR region II. The decline is focused in the Kattegat, but that is a key location for this habitat in the OSPAR maritime area.

Overview of data and information provided by Contracting Parties

No information available. Not clear if Contracting Parties have reported absence.

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Our vision is a clean, healthy and biologically diverse North-East Atlantic Ocean, which is productive, used sustainably and resilient to climate change and ocean acidification.

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