Orange Roughy

**Scientific name:** *Hoplostethus atlanticus*

**Territorial/Offshore waters:** Offshore

Orange roughy (*Hoplostethus atlanticus*) is a benthopelagic species, inhabiting continental slopes and seamounts at depths below 600m but mostly between 900 and 1700m (Bailey *et al.* 2009). This fish, which commonly reaches 60 cm in length, is bright brick red in colour when caught, however this colour fades to a yellowish orange after death (hence its name). It has a deep and compressed body and a large head with an oblique mouth and large eyes. This species has been commercially exploited in the past but Total Allowable Catch has now been reduced to zero across the North-east Atlantic.

**Functional Links and Connectivity**

**Functional links and associations with Priority Marine Features**

- *Seamounts and seamount communities*: Populations of orange roughy are often concentrated around topographical features such as seamounts where they are known to aggregate to feed and spawn (OSPAR, 2010)

- *Continental slope*: Outside of spawning aggregations, orange roughy are widely distributed at low densities across the Hebridean continental slope where juveniles have been caught in fishing surveys.

**Functional links with wider Scottish marine ecosystem**

The ecology of this species in the North Atlantic is poorly understood but studies of the Rockall Trough by Mauchline & Gordon (1984) between 1973 and 1981 showed that orange roughy exploit the benthopelagic fauna for prey, especially mysids and decapod crustaceans. Using this and additional data, Howell *et al.* (2009) showed that the total diet for orange roughy likely consists of: prawns and shrimp (~40%) mesopelagic fish (~33.4%), benthopelagic fish, other benthic invertebrates cephalopods as well as a small amount of zooplankton. There is no information to suggest that orange roughy play a specific role as a keystone species or habitat modifier, although its position as an opportunistic predator is likely to influence the structure of mesopelagic and benthopelagic community composition.
Connectivity

Orange roughy has a widespread distribution on the continental slope, banks and seamounts to the west of Scotland. They aggregate to spawn around seamounts (OSPAR 2010). The main site of spawning aggregations in Scottish waters is believed to be the Hebrides Terrace Seamount which was the location of a target fishery for the species in the early 1990s (ICES, 2011). Catches from this area declined to low levels in 1993 following depletion of the stock. There is also some evidence for aggregation sites on Rosemary Bank and Anton Dohrn (eg. Bridger 1978). MSS surveys have recorded juvenile orange roughy on the Scottish continental slope, mainly south of 58°N.

White et al. (2009) found North East Atlantic populations of orange roughy to be typically K-selected\(^1\), exhibiting panmixia, or random mating. The data suggests that adult orange roughy are migrating large distances (~200miles) and mating with different populations. The long distance migration is considered to be the most likely reason for the genetic mixing on such a wide geographical scale, the alternative being sufficient dispersal of eggs/larvae, which is discounted by Zeldis et al. (1995 cited in White et al., 2009) who suggest that eggs could travel no more than 50km, with observed displacement being 18km from the spawning area.

Coherence

Population structure

Orange roughy has a widespread distribution on the continental slope, banks and seamounts to the west of Scotland. They aggregate to spawn around seamounts between January and April. Known spawning aggregation sites in Scottish waters include the Hebrides Terrace Seamount and possibly Anton Dohrn and Rosemary Bank Seamounts but this has not been confirmed.

Orange roughy is a very slow-growing species with a longevity of around 130 years (Allain & Lorance, 2000). They do not reach sexual maturity until around 28 years and have relatively low fecundity (Minto & Nolan 2006). It also is likely that all orange roughy do not spawn every year (Annala et al., 2003). All this leads to the conclusion of very low productivity and high vulnerability to depletion by fisheries exploitation.

Ecological variation across Scottish waters

There is insufficient evidence to determine whether individual spawning aggregations constitute discrete populations. Genetic evidence suggests that there is no population structure across the North Atlantic (White et al. 2009). However, studies on populations in the southern hemisphere have produced equivocal results; genetic studies have generally failed to discriminate between stocks while those that have focused on variation in the environmental characteristics experienced by the fish during its life (e.g. otolith microchemistry, otolith structure, morphometric differences and parasite analysis) have generally shown that adult orange roughy are relatively sedentary and that stocks are fairly isolated from one another (ICES 2002).

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\(^1\)In the K-selected strategy, populations tend to remain near the carrying capacity (K), the maximum number of individuals that the environment can sustain. Individuals in a K-selected population.
Viability

It is uncertain whether separate spawning locations of orange roughy constitute discrete populations. It has been suggested that individual orange roughy may choose to spawn in any suitable location rather than displaying fidelity to a particular aggregation site (White et al., 2009). Orange roughy are most vulnerable to exploitation when aggregating to spawn and so protected areas should be focused on aggregation sites. In the absence of precise information on small scale location of aggregations within the seamount features, adequate protection could be achieved by protecting all waters of suitable depth (600-1700m) on the seamount. Protected areas are unlikely to be a suitable management measure for orange roughy outside spawning aggregation sites due to their widely dispersed distribution.

Indicators of Least Damaged/More Natural

The sensitivity of orange roughy to pressures associated with human activities is included in the Features, Activities, Sensitivities Tool (FeAST; Marine Scotland, 2013). Information on indicators of orange roughy being least damaged or more natural in Scottish waters has been taken from the OSPAR Case Reports for Threatened and/or Declining Species and Habitats (OSPAR, 2010) (Table 1).

<table>
<thead>
<tr>
<th>Indicator of Naturalness</th>
<th>Indicator of Damage</th>
<th>Potential Sources of Damage</th>
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<td>Maintenance of catch per unit effort (CPUE) over time</td>
<td>Reductions in CPUE indicating a decrease in population size (OSPAR, 2010)</td>
<td>Extraction (fishing; OSPAR 2010)</td>
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<tr>
<td>Maintenance of catch size distribution over time</td>
<td>Reductions in the size distribution of individuals caught indicating the removal of the higher age classes within the population (OSPAR, 2010)</td>
<td>Extraction (OSPAR 2010)</td>
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Risk Assessment

The details of the assessment of risk for each MPA search feature is addressed in a separate report (Chaniotis et al., 2014).

Recovery Potential

Extraction

The slow growth rate and longevity of orange roughy means that recovery of depleted populations is likely to be very slow.
Geographical Variation

Orange roughy has a range that extends across the Far West MPA region, with records along the continental slope and on the Rosemary Bank, Anton Dohrn and Hebrides Terrace seamounts. Commercial landings are also reported at very low levels from the southern part of the North Scottish MPA region (ICES 2011) but there are no spawning aggregations in this area and it can probably be considered as an extension of the range in the Far West region.

Geographical context

H. atlanticus is recorded from deep water habitats in the Atlantic, Pacific and Indian oceans. The fishery in New Zealand is the world’s largest (OSPAR, 2008).
References

Allain, V. & Lorance P. 2000. Age estimation and growth of some deep-sea fish from the Northeast Atlantic ocean. Cybium 24(3 suppl.), 7-16


Bridger J. P. 1978. New deep-water trawling grounds to the west of Britain. Ministry of agriculture Fisheries and Food directorate of fisheries research laboratory leaflet No. 41. Lowestoft.


