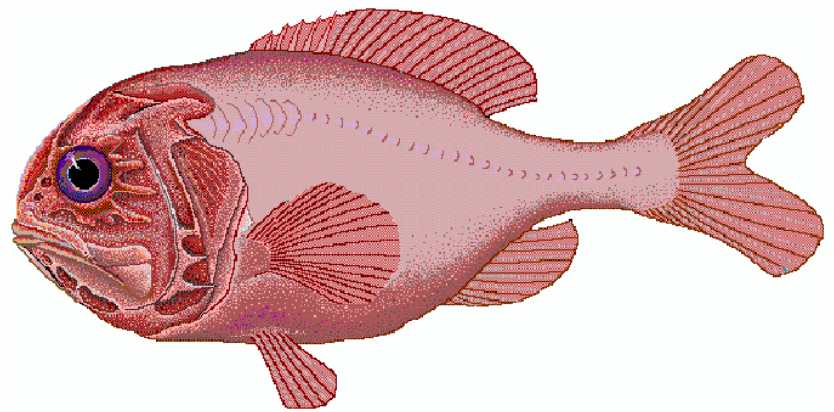




Background Document for the Orange roughy  
*Hoplostethus atlanticus*



## **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. It has been ratified by Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Sweden, Switzerland and the United Kingdom and approved by the European Community and Spain.

## **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. La Convention a été ratifiée par l'Allemagne, la Belgique, le Danemark, 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 et la Suisse et approuvée par la Communauté européenne et l'Espagne.

## **Acknowledgement**

This report has been prepared by WWF as lead party. Contributions from Francis Neat of the Fisheries Research Services UK, and national experts from Ireland and Spain are gratefully acknowledged.

### **Photo acknowledgement**

Cover page: ©John Dunn

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# Background Document for Orange roughy *Hoplostethus atlanticus*

## Executive Summary

This Background Document on the Orange roughy *Hoplostethus atlanticus* has been developed by OSPAR following the inclusion of this species on the OSPAR List of threatened and/or declining species and habitats (OSPAR Agreement 2008-6). The document provides a compilation of the reviews and assessments that have been prepared concerning this species since the agreement to include it in the OSPAR List in 2003. The original evaluation used to justify the inclusion of *H. atlanticus* in the OSPAR List is followed by an assessment of the most recent information on its status (distribution, population, condition) and key threats prepared during 2009-2010. Chapter 7 provides proposals for the actions and measures that could be taken to improve the conservation status of the species. In agreeing to the publication of this document, Contracting Parties have indicated the need to further review these proposals. Publication of this background document does not, therefore, imply any formal endorsement of these proposals by the OSPAR Commission. On the basis of the further review of these proposals, OSPAR will continue its work to ensure the protection of *H. atlanticus*, where necessary in cooperation with other competent organisations. This background document may be updated to reflect further developments or further information on the status of the species which becomes available.

## Récapitulatif

Le présent document de fond sur l'hoplostète orange a été élaboré par OSPAR à la suite de l'inclusion de cette espèce dans la liste OSPAR des espèces et habitats menacés et/ou en déclin (Accord OSPAR 2008-6). Ce document comporte une compilation des revues et des évaluations concernant cette espèce qui ont été préparées depuis qu'il a été convenu de l'inclure dans la Liste OSPAR en 2003. L'évaluation d'origine permettant de justifier l'inclusion de l'hoplostète orange dans la Liste OSPAR est suivie d'une évaluation des informations les plus récentes sur son statut (distribution, population, condition) et des menaces clés, préparée en 2009-2010. Le chapitre 7 fournit des propositions d'actions et de mesures qui pourraient être prises afin d'améliorer l'état de conservation de l'espèce. En se mettant d'accord sur la publication de ce document, les Parties contractantes ont indiqué la nécessité de réviser de nouveau ces propositions. La publication de ce document ne signifie pas, par conséquent que la Commission OSPAR entérine ces propositions de manière formelle. A partir de la nouvelle révision de ces propositions, OSPAR poursuivra ses travaux afin de s'assurer de la protection de l'hoplostète orange, le cas échéant avec la coopération d'autres organisations compétentes. Ce document de fond pourra être actualisé pour tenir compte de nouvelles avancées ou de nouvelles informations qui deviendront disponibles sur l'état de l'espèce.

## 1. Background Information

### Name of species

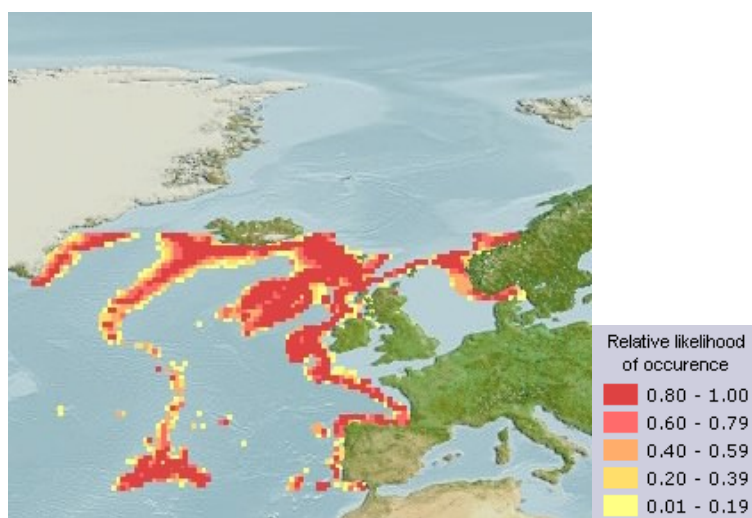
Orange roughy *Hoplostethus atlanticus* (Collett, 1889)

## 2. Original Evaluation against the Texel-Faial selection criteria

### List of OSPAR Regions and Dinter biogeographic zones where the species occurs

The OSPAR List (OSPAR agreement 2008-6) recognises that *H. atlanticus* occur in OSPAR Region Regions I and V. This document provides evidence of the occurrence of *H. atlanticus* in Region III on the Irish continental slope and Porcupine Seabight and in Region IV on the continental slope in the Bay of Biscay, and off northern Spain (Koslow *et al.*, 2000, Lorance *et al.*, 2002 Uiblein *et al.*, 2003). There are no indications that *H. atlanticus* occurs north of the Wyville Thomson and Iceland Faroes Ridges in Region I (Neat pers. Comm.).

Dinter biogeographic zones: Warm-temperate waters, Cold-temperate waters, Lusitanian-boreal, Cold-temperate pelagic waters, Seamounts and plateaus, South Iceland – Faroe Shelf; SE Greenland.



**Figure 1:** Predicted likelihood of occurrence of orange roughy (*Hoplostethus atlanticus*) in the North East Atlantic (Source: [www.fishbase.org](http://www.fishbase.org), based on GBIF OBIS).

The species occurs on the continental slope, from the Wyville Thomson ridge to the Bay of Biscay (ca. 48°N, on the offshore banks such as Rockall, Hatton and Porcupine Banks and seamounts of the north-eastern Atlantic, south of the Shetland-Faroe and Faroe-Iceland ridges, as well as along the Mid Atlantic ridge south of Iceland. Modelling of limiting environmental variables point to a high likelihood of occurrence also on the continental slope north of the Shetland-Faroe Ridge, including in the deep Skagerrak, ([www.fishbase.org](http://www.fishbase.org)), however this cannot (yet?) be supported by observations (F. Neat pers. Comm.). The actual distribution of the species is seasonally highly localised on steep slopes, pinnacles and seamounts.

**List of OSPAR Regions where the species is under threat and/or in decline**

All where it occurs.

**Original evaluation against the Texel-Faial criteria for which the species was included on the OSPAR List**

**Table 1.** Summary assessment of Orange roughy (*Hoplostethus atlanticus*) against Texel-Faial criteria.

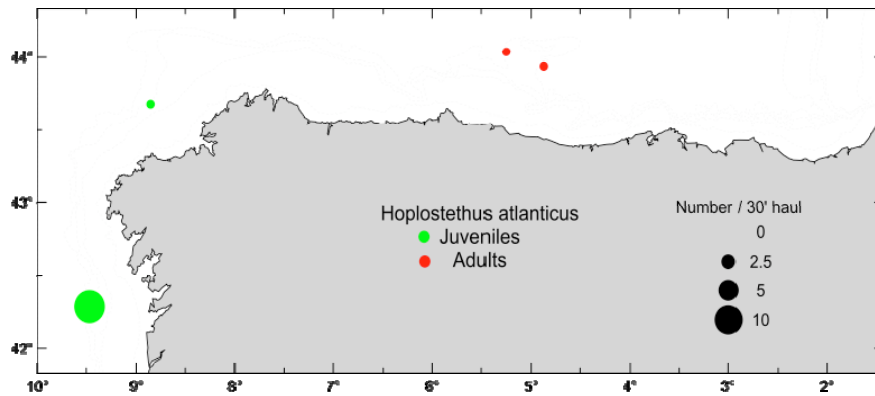
Criterion	Comments and new information	Evaluation
Global importance	Widely distributed in appropriate habitats in the temperate Atlantic, Indian and Pacific Oceans.	Does not qualify
Regional importance	There is assumed to be a single stock of <i>H. atlanticus</i> in the OSPAR Area, the genetic isolation of orange roughy populations is not well known (see ICES 2008)	Does not qualify
Rarity		Does not qualify
Sensitivity	Longevity, slow growth, late maturity, sporadic recruitment and seamount-associated discrete aggregations result in extreme vulnerability to exploitation (see ICES WGDEEP 2001 in ICES 2007)	Qualifies – very sensitive
Keystone species	No information	Unknown
Decline	ICES (2008a) considers orange roughy to be depleted in all subareas considered based on life history characteristics and the Catch per unit effort/landings data available, and recommends zero catch for the species.  Bailey et al. 2008 demonstrate the statistically highly significant historical decline of the species abundance in Porcupine Seabight between pre-commercial fishing 1977-1987 and today (1997-2002)	Qualifies

**3. Current status of the species**

**Distribution in OSPAR maritime area**

The main fishery for orange roughy in the OSPAR maritime area has been executed along the continental slope, south of the Shetland/Faroe Ridge to the west of the British Isles, and the northern Bay of Biscay up to ca. 48°N (ICES WGDEEP 2009) and the associated offshore banks and seamounts (ICES 2009a)

In northern Spain, in bottom trawl surveys carried out from 1983 to date only juveniles of orange roughy were found on deep areas (400-500 m depth) close to the break shelf of Galicia or Galicia shelf break (western area). More recently, surveys carried out on Le Danois Bank (El Cachucho), caught some adults of this species in the inner basin located between the bank and the Cantabrian Sea shelf (Figure 2).



**Figure 2.** Spatial distribution of orange roughy (*Hoplostethus atlanticus*) in the Le Danois Bank (North of Spain, Spain 2008)

### Population (current/trends/future prospects)

Due to insufficient data resolution, ICES currently considers three stock units: Subarea VI; Subarea VII; and all other areas together, mainly Subareas V, VIII and X (ICES, 2008b). These are likely to be inadequate (see below). The most recent research indicates that there may be a single genetic population of orange roughy in the North Atlantic, possibly in genetic exchange with the South East Atlantic population (White et al. (2009). The authors assume this panmixia to be based on extreme dispersal of adults which may not show any homing behaviour but aggregate for spawning at the next suitable habitat (seamount, hill, slope or bank).

### Condition (current/trends/future prospects)

Despite a general lack of knowledge on the condition of the orange roughy population in the North East Atlantic, ICES (2008) notes some evident historic sequential depletion in ICES areas Va, VI, VII, X and XII: The fisheries for orange roughy on separate aggregations west of Ireland in Subarea VII peaked in 2002 and have declined markedly since. The fishery in Subarea VI has decreased dramatically since the depletion of the main aggregation on the Hebrides Terrace Seamount in the late 1980s and early 1990s. Faroese fisheries in Subareas VI, XII, and X and the Icelandic fishery in Division Va have ceased. FAO (2008) qualifies the recent fishery for orange roughy on the Mid Atlantic ridge as sporadic with one Faroese bottom trawler being active since 2004 and one Irish trawler operating in 2003 (ICES area XII) and 2004 (ICES area X). Catches have declined substantially from 2004 to 2006.

ICES (2008) maintains its perception of the state of orange roughy spawning aggregations in Subarea VI and VII as depleted and vulnerable. The 2008 advice remains unchanged from 2006 and recommends no directed fishery for the species, as well as a by-catch in mixed fisheries which is as low as possible.

### Limitations in knowledge

The true population size and structure of orange roughy in the North-East Atlantic is unknown. Currently, ICES estimates the stock size (a fishery measure) of orange roughy mainly from landings data of the fisheries and considers the assessment of the fishery as being uncertain due to insufficient CPUE data (ICES, 2008a). Landings are spatially not adequately resolved and are based on sequential fishing in aggregation areas of the species.

Stock units currently employed by ICES are considered completely inadequate. Orange roughy forms aggregated population units which could be as small as distinct topographical features around which the units aggregate (ICES, 2008b). However, currently it is not known if different spawning units are reproductively isolated (ICES, 2008a).

Shephard et al. (2007) provide a first glimpse at the life history strategy of orange roughy, indicating an ontogenetic pattern in habitat use - for the protection/recovery of the species it would be important to deduce eventual needs for appropriate further protection measures.

No management objectives or reference points have been defined and no analytical assessment is performed due to lack of information (ICES 2008).

#### 4. Evaluation of threats and impacts

The only known threat to this species is capture in deepwater fisheries. All of the population lives within fishing depth, most abundant between 900 and 1700 m (Bailey et al. 2009). ICES considers orange roughy as highly vulnerable, due to extreme longevity and late maturity in terms of biological traits and exposure to targeted fishing practices. Natural mortality was estimated to be 0.025 in waters west of Ireland, with an estimated (standard) length at maturity between 34 and 37 cm, or approximately 40 years of age (ICES WGDEEP08). Targeted fisheries sequentially exploit discrete spawning aggregations of the species which are rapidly depleted.

For the Porcupine Seabight, Bailey et al. (2009) demonstrated a statistically highly significant reduction in abundance of orange roughy between fisheries surveys performed 1977-1989 and 1997-2002.

#### 5. Existing Management measures

Fishing in the OSPAR maritime area is managed by the national fisheries ministries of Iceland, Norway, the Faroe Islands and Greenland, the European Commission and the North-East Atlantic Fisheries Commission (NEAFC) in waters outside national jurisdiction. By 2010 almost all of the directed fisheries on orange roughy in the North East Atlantic that are exercised and managed by European member states/the European Commission and NEAFC will have ceased. However, all of the relevant measures are taken on a non-permanent basis and will be subject to review every other year.

**NEAFC Regulatory area:** The NEAFC regulatory area covers the waters beyond the 200 nm zones/EEZs of OSPAR contracting parties/the EU, or the high seas part of the OSPAR maritime area (see Figure 3). For the fishery of orange roughy this concerns ICES area XII (ridge and seamounts on and off the Mid Atlantic Ridge) and X (seamounts outside the Azores EEZ).

Resolution 61/105 of the UN General Assembly (2006) calls on states and regional fisheries management organisations such as NEAFC to vulnerable marine ecosystems, including vulnerable species like orange roughy. NEAFC has started to implement the resolution by adopting extensive bottom fisheries area closures on the Mid Atlantic Ridge, and the seamounts Altair and Antialtair (as of May 2009). Though motivated to protect vulnerable habitats from destruction, the area closures also afford protection from fisheries to the orange roughy populations known and suspected from the ridge. The measure will be in force until 31 December 2015.

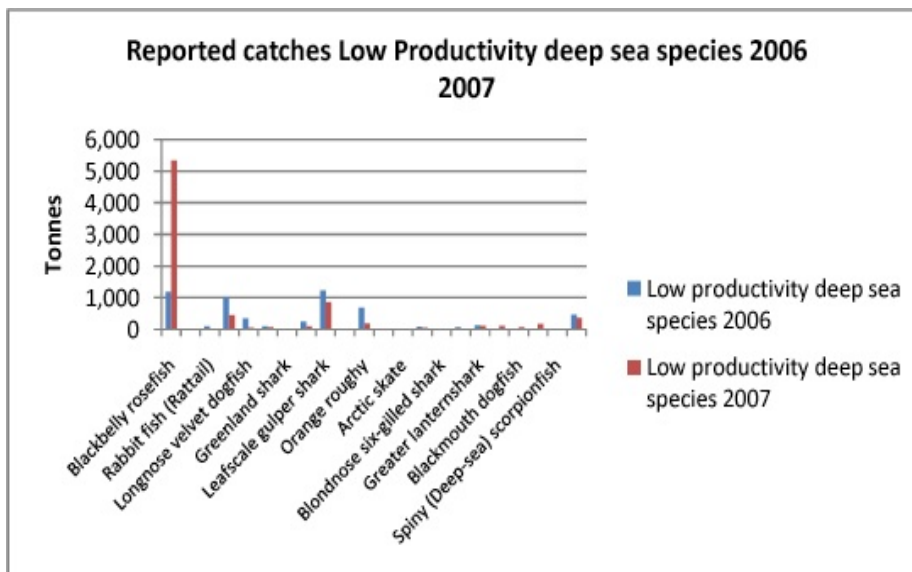
NEAFC Recommendation VII:2009 fixes the fishing effort of contracting parties to a maximum of 65 % of the highest level put into deep-sea fishing in previous years, as calculated from aggregate power, aggregate tonnage, fishing days at sea or number of participating vessels. The NEAFC catch statistic for 2007 (NEAFC AM 2008/59 rev1) states a catch of 165 t of orange roughy by EU vessels, and 20 t taken by Faroe Islands vessels. With the Council Regulation EC 1359/2008 in force, for 2010 only the Faroese fishery for orange roughy will remain.

**European waters:** Deep-water fisheries in European waters are regulated under the Common Fisheries Policy (CFP). The regulations concerning deep-sea fisheries are relatively recent. The first



TACs were introduced in 2002 for the period 2003-2004. EU Council Regulation (EC) No 2347/2002 sets maximum capacity and power (kW) ceilings on individual Member State fleets fishing for deepwater species. Council Regulation (EC) No 27/2005 limited effort (kilowatt days) at 90% of the 2003 level for 2005, and 80% for 2006. Regulation (EC) No 2270/2004 extended the TACs to species which were not yet regulated and set up three closed areas for the protection of vulnerable aggregations of orange roughy in ICES areas VI and VII (off the Irish continental shelf).

Council Regulation EC 1359/2008 fixing for 2009 and 2010 the fishing opportunities for Community fishing vessels for certain deep-sea fish stocks maintains the closed areas to orange roughy fishing in ICES areas VI and VII (Art. 7), allocates for 2009 a total TAC of 17 t in ICES area VI, 65t in ICES area VII and 15 t in all other ICES areas. France has the highest share with 70 t in total. Catch is set at zero in 2010. This applies to all European vessels no matter where they fish.



**Figure 3:** Reported catches of deepwater fish species in the NEAF Convention area 2006 and 2007 (from Hoydal 2008).

**Azores (ICES area Xa):** Within the Azores EEZ, fisheries management is based on regulations issued by the European Community, by the Portuguese government, and by the Azores regional government. Council Regulation (EC) No 1568/2005, amending Technical Regulation 850/1998, permanently prohibits the use of bottom-contacting trawls in specified boxes extending throughout the Azores, Madeira and Canary Island EEZs. In 2000 and 2001, there was an experimental trawl fishery which led to the discovery of a reproduction and possibly nursery area in the Azores EEZ (Menezes *et al.* 2009). This fishery has not been continued.

Inside a 100 nm zone from the baselines on the Azores islands established in 2003 (EC Reg. 1954/2003), fisheries are managed by the regional government of the Azores. Some technical measures were introduced by the Azores regional government since 1998 (including fishing restrictions by area, vessel type and gear, fishing licence based on landing threshold and minimum lengths), notably a prohibition of bottom trawling.

**Norway (ICES area I and II):** There is no directed orange roughy fishery, or any landings of the species (ICES WGDEEP 08)

**Iceland (ICES area Va):** Orange roughy is fished in Icelandic waters since 1991 (ICES WGDEEP 08). Landings peaked in 1993 with 717 t, decreasing very quickly and amounting to 2 and 1 t in 2006 and 2007, respectively.

**Faroe Islands (ICES area Vb):** Starting in 1995, orange roughy has been exploited in Faroese waters until at least 2007 (ICES WG DEEP08), with initially high catches (420 t in 1995) dwindling within 3 years to less than 5 t. Apart from 2000 (155 t), landings remained low ever since. Management measures are based on setting limits on fleet size (Hoydal 2008). The number of vessels that are permitted to fish for deep-sea species has been frozen at 1995 level.

**Greenland (ICES area XIV):** There is no directed orange roughy fishery in this ICES area (ICES WGDEEP08). The Greenland fleet is currently not participating in deepwater bottom fishery.

## 6. Conclusion on overall status

The orange roughy stock/population cannot support any targeted fisheries, as indicated by the rapid depletion of its population in the OSPAR Area and elsewhere. The conservation objective for this species should be to protect remaining portions of the stock in order to allow population recovery.

ICES (2008) advises that assessment and management of the orange roughy stock should be at the level of individual aggregations. At present, the spatial resolution of landings data is not sufficient to allow this. Upon cessation of the commercial exploitation, data have to come from fisheries surveys monitoring deepwater fish stocks.

In order to allow for conclusions on stock status, population development and eventual recovery, time series of sufficient spatial coverage have to be initiated.

## 7. Action to be taken by OSPAR

### Action/measures that OSPAR could take, subject to OSPAR agreement

As set out in Article 4 of Annex V of the Convention, OSPAR has agreed that no programme or measure concerning a question relating to the management of fisheries shall be adopted under this Annex. However where the Commission considers that action is desirable in relation to such a question, it shall draw that question to the attention of the authority or international body competent for that question. Where action within the competence of the Commission is desirable to complement or support action by those authorities or bodies, the Commission shall endeavour to cooperate with them.

Although OSPAR has no competence in managing the fishery (Annex V, Article 4), it is nonetheless the steward of the overall marine ecosystem, including commercially exploited fish species, and thus responsible for overseeing the conservation and recovery of the orange roughy population. In the case of orange roughy, OSPAR's role is to draw the attention of Contracting Parties and international fisheries management bodies to the concern regarding the poor conservation status and the extreme vulnerability of the species to exploitation.

**Table 2:** Summary of the key priority actions and measures which could be taken for Orange roughy (*Hoplostethus atlanticus*). Where relevant, the OSPAR Commission should draw the need for action in relation to questions of fisheries management to the attention of the competent authorities. Where action within the competence of the Commission is desirable to complement or support action by those authorities or bodies, the Commission shall endeavour to cooperate with them.

<b>Key threats</b>	Fisheries mortality (target) in deepwater fisheries. No sustainable fishery possible due to extreme vulnerability of the species - makes it subject to conservation measures under UNGA61/105	
<b>Other responsible authorities</b>	<ul style="list-style-type: none"> <li>- EC and Council of Fisheries Ministers (Common Fisheries Policy, Regulations, TACs)</li> <li>- OSPAR Contracting Parties Norway, Iceland, Denmark (on behalf of the Faroe Islands); Greenland</li> <li>- NEAFC</li> </ul>	
<b>Already protected? Measures adequate?</b>	EU: TAC, effort regulation	-
	High seas: NEAFC	-
	National waters, Contracting Parties to OSPAR	-
<b>Recommended Actions and Measures</b>	<b>OSPAR Commission</b>	<ul style="list-style-type: none"> <li>- Regularly review the progress of recovery by assessing the status based on monitoring and fisheries survey information, as well as assessments made by the ICES and bring this to the attention of CPs.</li> <li>• Coordinate with fisheries research and funding agencies to establish a long-term deepwater fisheries and ecosystem monitoring programme to track stock recoveries for a series of overexploited deepwater stocks (see ICES 2009b).</li> </ul>
	<b>Contracting Parties</b>	<ul style="list-style-type: none"> <li>- Enforce compliance of current regulations with respective nationals.</li> <li>- Provide protection under conservation legislation for the species</li> <li>- Foster deep-sea research <i>sensu lato</i></li> <li>- Coordinate JAMP assessments with fisheries surveys</li> </ul>
	<b>Research needs</b>	- Life history, biology, stock discrimination and trend data

### Brief summary of proposed monitoring system (see Annex 2)

The main progress required is fishery-independent abundance indices for deepwater fish species by establishing new and coordination of ongoing research surveys with different gear types (ICES 2009b). ICES (2008 and 2009b) suggest that a dedicated internationally coordinated trawl survey of the continental slope could be undertaken in subareas V-IX. This survey could consist of depth transects at selected reference sites, which should include the Hebridean slope, Rockall Bank, Hatton Bank, Porcupine Bank, Bay of Biscay, and the area between the canyons of Nazare and Sesimbra, Meriadzec Terrace. The key species to be surveyed are deep-sea fishes, including orange roughy. Such a survey will have to be repeated at regular time intervals to monitor eventual changes. As discussed below, trawl surveys have considerable limitations and problems with regard to the effectiveness of orange roughy catches and collateral damage to vulnerable habitats. Therefore non-invasive techniques or other mitigation measures should be used for research and survey purposes. Surveying the juvenile distribution may provide the most effective solution.

## Annex 1: Overview of data and information provided by Contracting Parties

Contracting Party	Feature occurs in CP's Maritime Area	Contribution made to the assessment (e.g. data or information provided)	National reports References or weblinks
Ireland	yes	Survey data on Orange Roughy, results of national research projects on Orange Roughy	<p>References:</p> <p>O'Donnell, C.; Macaulay, G.; Doonan, I.; Grehan, A.; Roar-Hareide, N.; Ullgren, J.; Mackey, M.; Sachetti, F. and Sheppard, S.; (2007) An acoustic survey of Orange Roughy aggregations to the west and north of the Porcupine Bank. Irish Fisheries Investigations No. 18. pp 36.</p> <p>Weblink:  <a href="http://www.marine.ie/NR/rdonlyres/2C4C7900-F989-44F0-9A27-FC4E48C7BC0D/0/FisheriesInvestigation_18.pdf">http://www.marine.ie/NR/rdonlyres/2C4C7900-F989-44F0-9A27-FC4E48C7BC0D/0/FisheriesInvestigation_18.pdf</a></p> <p>O' Hea, B.; Johnston, G.; Gerritsen, H.; Leahy, Y.; Mohn, C. and Wall, D. (2008). Deep Water Survey 2008, Celtic Explorer 9th – 22nd September 2008</p> <p>Weblink:  <a href="http://www.marine.ie/home/services/surveys/fisheries/Deepwater+Survey.htm">http://www.marine.ie/home/services/surveys/fisheries/Deepwater+Survey.htm</a></p> <p>Sheppard, S and Rogan, E. 2002. The assessment of orange roughy (<i>Hoplostethus atlanticus</i>) stocks in the deep waters off the west of Ireland using acoustic survey techniques. Final report: strategic Marine RTDI Programme 2002. Ref. N. ST/02/04.</p>
Spain	yes	Survey data on Orange Roughy, results of national research projects	MASH 08/4/Info2

Orange roughy was nominated for inclusion in the OSPAR List in 2006 by Iceland, Portugal and UK.  
 Contact person:

Mathew Carden, DEFRA, Ashdown House, 123 Victoria Street London SW1E 6DE, UK.

## Annex 2: Description of proposed monitoring and assessment strategy

### Rationale for the proposed monitoring

Monitoring is essential to provide management advice and to evaluate future trends and stock recovery following cessation of target fisheries. Monitoring should be fishery-independent and non-invasive where possible such as by use of acoustic determination techniques. Given the life history of the deepwater species, any signals in stock developments will take decades to show. Parallel ecosystem research should monitor eventual shifts in ecosystem structure and function.

### Use of existing monitoring programmes

There are currently a number of regular deepwater fisheries surveys operated by OSPAR contracting parties. The ICES planning group on the North-east Atlantic Continental Slope Survey (PGNEACS) dealing with the main aims and objectives of a proposed programme of European deep-water fisheries research surveys has recently reviewed the main deep-water fish resources in the Northeast Atlantic, summarized their spatial extent and exploitation patterns and identified what are the necessary survey attributes to produce advice on single-stocks of commercial species, non target species and advice on the affect of fishing on the deep-water ecosystem. The group also reviewed how existing survey programs meet the requirements and where there are important gaps in terms of stock and area coverage. ICES has proposed to internationally coordinate and improve the deepwater fisheries surveys and provided first proposals to future priority survey areas (ICES 2009b). These surveys are however heavily dependant on international funding and future funding is uncertain.

### Synergies with monitoring of other species or habitats

The monitoring of deepwater habitats on the OSPAR List may deliver valuable information on the habitat preferences for orange roughy. Whereas the deepwater sharks can be sampled effectively with trawl surveys, this is not the case for orange roughy (Neat pers. comm., see below)

### Assessment criteria

Abundance, CPUE, population diagnostics.

### Techniques/approaches:

Orange Roughy abundance has been monitored by acoustic techniques although there have been problems with target strengths. In addition, acoustic surveys on aggregating species are resource intensive as the whole stock needs to be covered by the survey to obtain accurate biomass estimates. Trawl surveys do not effectively sample orange roughy. In addition, there are issues with trawling in vulnerable habitats such as seamounts over which Orange Roughy aggregate. An alternative approach might be to monitor abundance trends of the population component that resides on flat grounds however the feasibility of the approach still needs to be evaluated.

## Annex 3: References

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**OSPAR's vision is of a clean, healthy and biologically diverse  
North-East Atlantic used sustainably**

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