Stock Annex

Stock specific documentation of standard assessment procedures used by ICES.

Stock Roundnose grenadier *(Coryphaenoides rupestris*) in Division IIIa

Working Group: WGDEEP

Date: March/2011

Revised by WGDEEP/

A. General

A.1. Stock definition

Roundnose grenadier (*Coryphaenoides rupestris*) in Division IIIa is treated as one stock separated from three other stocks within the distribution area in Northeast Atlantic.

The current perception is based on what is believed to be natural restrictions to the dispersal of all life stages. The stock in Skagerrak (Division IIIa) is thought to be separated from the other stocks through the Wyville-Thomson Sill.

In 2007, WGDEEP examined the available evidence of stock discrimination in this species but, on the available evidence, was not able to make further progress in discriminating stocks. On this basis WGDEEP concluded there was no basis on which to change current practice.

Recent genetic analyzes have brought forward new information regarding the issue of stock discrimination in the roundnose grenadier. White et al. (2010), investigating a limited geographic area in the central and easternNorth Atlantic, found evidence for population substructure and local adaptation to depth. An ongoing study, to be published soon (Knutsen et al. in prep), covers a larger geographic range and finds indication for population structure throughout the species' distribution range. More specifically, they found that stock structure is clearly evident in the outskirts of the distribution range (Canada and Norway) however, significant but weaker structure, is found among some pairwise samples in the central distribution areas like MAR, west of UK and Greenland (Oral presentation by Knutsen et al. 2010 ICELAND DSBS).

A.2. Fishery

For many years the grenadier was only taken as by-catch in bottom trawl fisheries for *Pandalus borealis* and perhaps *Nephrops,* and it is uncertain if all catches were landed. The interest in marketing by-catches and developing targeted fisheries grew in the 1980s, probably stimulated by the new fisheries to the west of the British Isles and marketing opportunities in e.g. France. The potential for landing and marketing grenadier for human consumption was explored and exploratory surveys were conducted, but a major sustained fishery never developed in this area.

The stock of roundnose grenadier found in the deep parts of Skagerrak (IIIa) was then the basis for commercial exploitation by a few Danish vessels from the late 1980s until 2006, in some years mainly by a single vessel. This directed fishery began in 1987 as an exploratory fishery. Up to 2003 landings increased

gradually, from around 1000 t to 4000 t with fluctuations. However, in 2004 and 2005 exceptionally high catches were reported. The catches were landed mainly for reduction. The fishery and catches were both mainly conducted in the Norwegian economic zone of Skagerrak. This directed fishery stopped in 2006 due to implementation of new agreed regulations between EU and Norway concerning this fishery (Bergstad 2006). Roundnose grenadier is also taken as bycatch in the Danish fisheries for *Pandalus*, in IIIa. However, the landings of this bycatch (also for reduction) are generally insignificant.

Other countries by-catches of roundnose grenadier in IIIa, from such as the Norwegian *Pandalus borealis* fishery, is minor due to a introducion of sorting grid in this fishery since the mid 1990s.

Only Denmark has contributed significantly to this fishery and since 2007 landings have been negligible.

A.3. Ecosystem aspects

B. Data

B.1. Commercial catch

Landings have been reported to WGDEEP since 1988. Prior to 1988 landings were small or at the level observed in the early 1990s. Danish landings were always dominant, and Norway and Sweden and all other nations reported very minor landings. Until 2000 the landings were mostly below 2500 tonnes per year. Subsequently, the Danish fishery expanded, and in 2005 the landings reported to WGDEEP reached almost 12 000 tonnes. The landings declined again in 2006 to very low levels and have since been stable reflecting only by-catches from other fisheries.

The total Danish landings of this species split in landings for H.C. and for reduction is shown in Table 10.3.1. These landings figures have been estimated on basis of reported logbook records combined with samples of the landed catches for reduction. They differ slightly from the logbook recorded catches, which generally overestimate the true landings. For the period 2001–2006 peak landings within a year were recorded in March–April.

Data is given on the geographical distribution of this fishery from 2006 (Figure 10.3.1). This fishery had a very small geographical distribution and landings was mainly from a very few rectangles in Norwegian zone of Skagerrak.

Table 10.3.1. Danish landings, 1996–2006 of roundnose grenadier split into H.C. landings and landings for reduction.

	LANDINGS OF ROUNDNOSE GRENADIER (KG)		TOTAL LANDINGS
year	H. C.	Reduction	(tons)
1996	6493	2 207 000	2213
1997		1 356 280	1356
1998	635	1 489 000	1490
1999		3 113 000	3113
2000	315	2 400 000	2400
2001	6401	3 061 000	3067
2002	4	4 195 738	4196
2003	7	4 301 661	4302

2004	3129	9 870 664	9874
2005	17 056	1 904 545	11922
2006	2448	2 259 000	2261

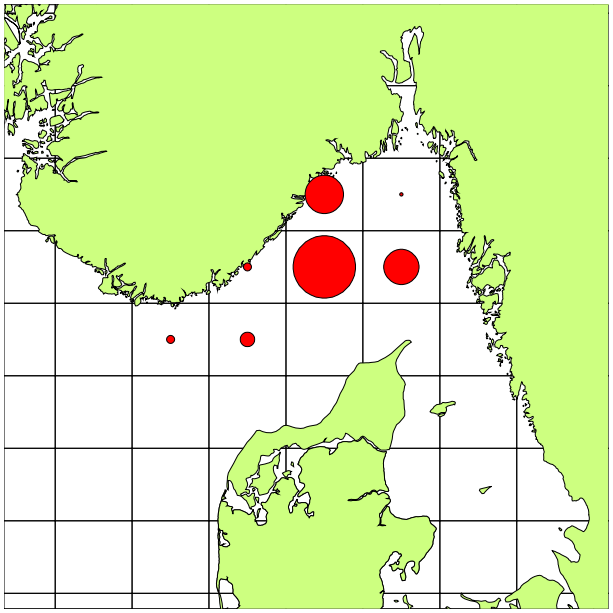
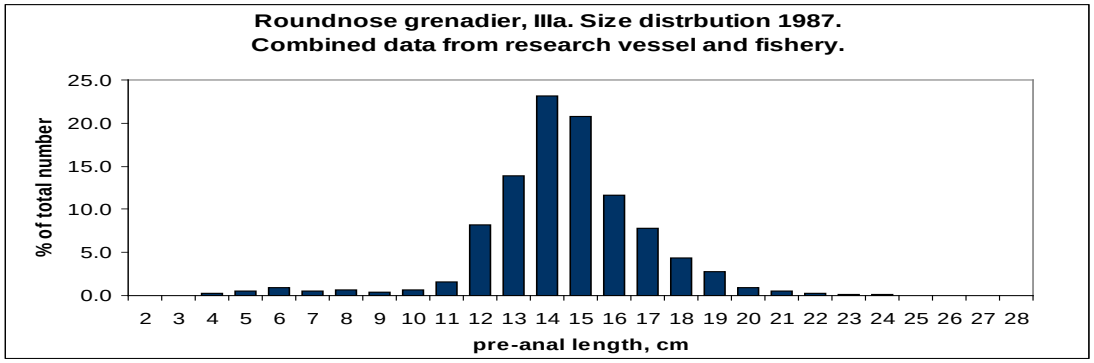
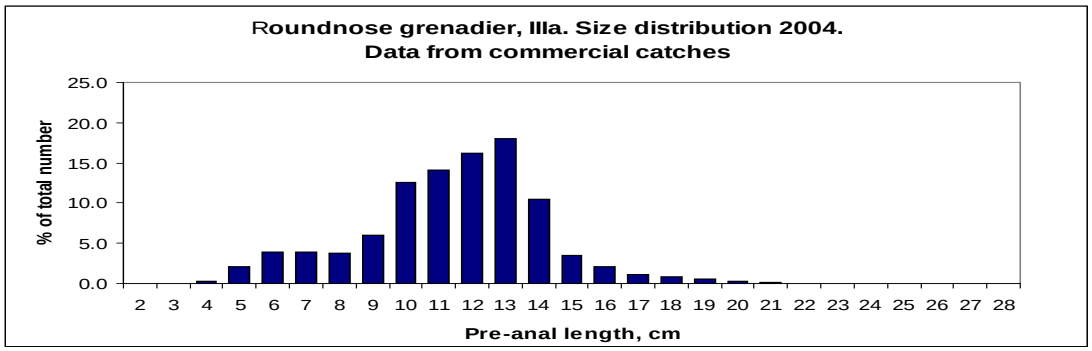


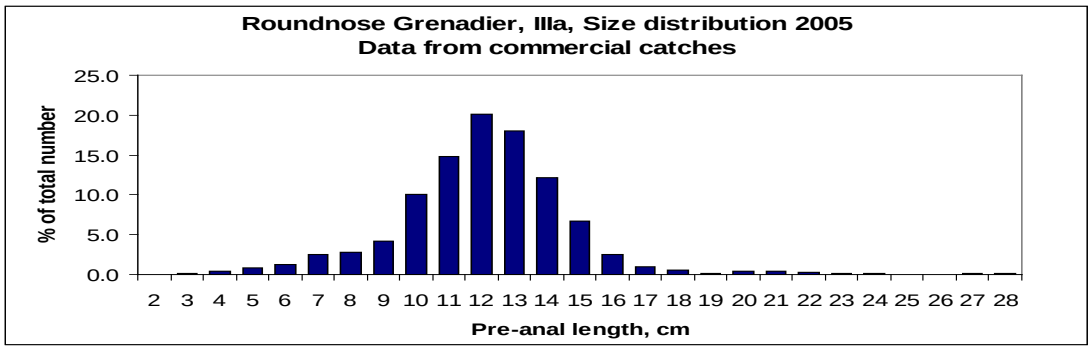
Figure 10.3.1. Geographical distribution of the fishery for roundnose grenadier in IIIa in 2006.

B.2. Biological

Length frequency data for roundnose grenadier in IIIa are available from a 1987 survey by the Danish research vessel and an experimental Danish fishery in the same year. Samples of the Danish landings 2004–2006 have provided information of the size composition in landings during the major expansion of the fishery, see Figure 10.3.2.







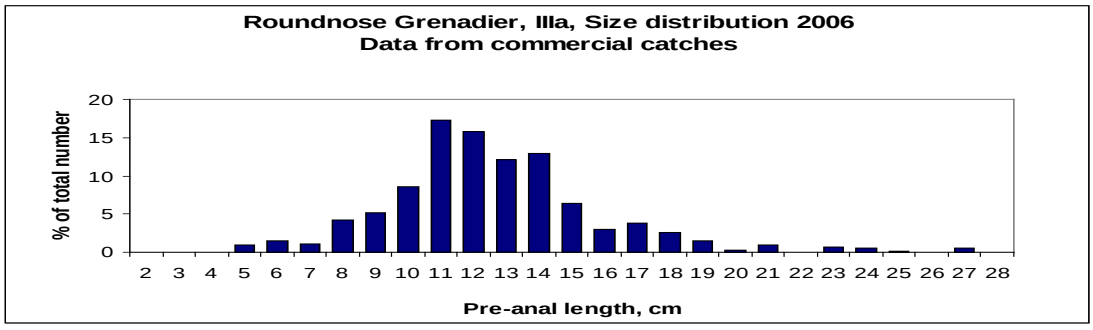


Figure 10.3.2. Size compositions from Danish commercial catches in 1987, 2004-06.

B.3. Surveys (use the ICES surveys acronym)

B.3.1. Pandalus borealis survey

An annual *Pandalus borealis* shrimp survey performed by the Institute of Marine Research have been conducted in the area since 1984. The survey is a depth stratified research survey with approximately 25% of the stations deeper than 300 m (depth range 110-520 m). The stations are placed at random within strata and subareas, and the same sites area sampled every year. The survey is thought to have a representative sampling for roundnose grenadier although the survey originally was designed primarilly for sampling shrimp. Although some changes occurred over the years, the overall standardization was maintained throughout the time series (Bergstad *et al.* 2009 and 2011, WD's to WGDEEP). At present, data from this survey is the only fishery independent information on this stock from this area.

Biomass and abundance was calculated as mean of all stations at depths>300m including the stations with zero catches (Figure 10.3.3). Percentage length distributions were standardized to catch size and trawling distance for all stations >300m with positive catches (Figure 10.3.4).

B.3.2. Other survey data

Investigations by Bergstad (1990) based on data from 1987 in Skagerrak suggest very slow growth and consequently the age distributions in catches could span over 20–30 years.

B.4. Commercial CPUE

The overall trends in logbook recorded catch, effort and cpue for the Danish directed fishery on this stock for the period 1996–2006 is showed in Table 10.3.2. A-C. A number of different mesh sizes were used in the fishery. The evaluation of the Danish cpue data is presented in ICES (2007) together with suggestive comments. Here it suffices to state, that these cpue figures (Tables 10.3.2 A–C) do not provide any clear indications of stock development and status for that period (Figure 10.3.5).

Table 10.3.2 A–C. The Danish fishery for roundnose grenadier in IIIa. Trends in catch, effort and cpue by major ICES rectangle, see text.

(A) Total catch (tons) by ICES rectangle						
year	44F8	44F9	45F8	45F9	46F9	Total
1996	80	40	25	709	98	951
1997	28	0	115	1088	163	1393
1998	238	235	180	1483	1112	3248
1999	0	25	61	704	1353	2143
2000	0	0	40	893	854	1787
2001	105	11	65	862	956	1999
2002	165	79	0	928	1531	2702
2003	0	120	545	1223	1769	3657
2004	1104	5786	215	1704	1721	10 529
2005	518	4073	682	4739	2823	12 834
2006	26	517	40	1067	487	2136

(B) TOTAL EFFORT (DAYS) BY ICES RECTANGLE

year	44F8	44F9	45F8	45F9	46F9	Total
1996	5	23	2	59	6	95
1997	3		7	67	5	82
1998	7	9	4	54	32	106
1999		2	4	43	65	114
2000		2	4	57	48	111
2001	5	8	3	49	65	130
2002	11	7		42	70	130
2003		5	17	70	96	188
2004	99	391	9	74	65	638
2005	47	178	9	107	77	418
2006	2	19	2	24	20	67

(C) TOTAL CPUE (TONS/DAY) BY ICES RECTANGLE

year	44F8	44F9	45F8	45F9	46F9	Average
1996	16.0	1.7	12.5	12.0	16.3	10.0
1997	9.2		16.4	16.2	32.5	17.0
1998	34.0	26.1	45.0	27.5	34.8	30.6
1999		12.5	15.3	16.4	20.8	18.8
2000		0.0	10.0	15.7	17.8	16.1
2001	21.0	1.4	21.7	17.6	14.7	15.4
2002	15.0	11.3		22.1	21.9	20.8
2003		24.0	32.1	17.5	18.4	19.5
2004	11.2	14.8	23.9	23.0	26.5	16.5
2005	11.0	22.9	75.7	44.3	36.7	30.7
2006	12.8	27.2	20.0	44.5	24.3	31.9

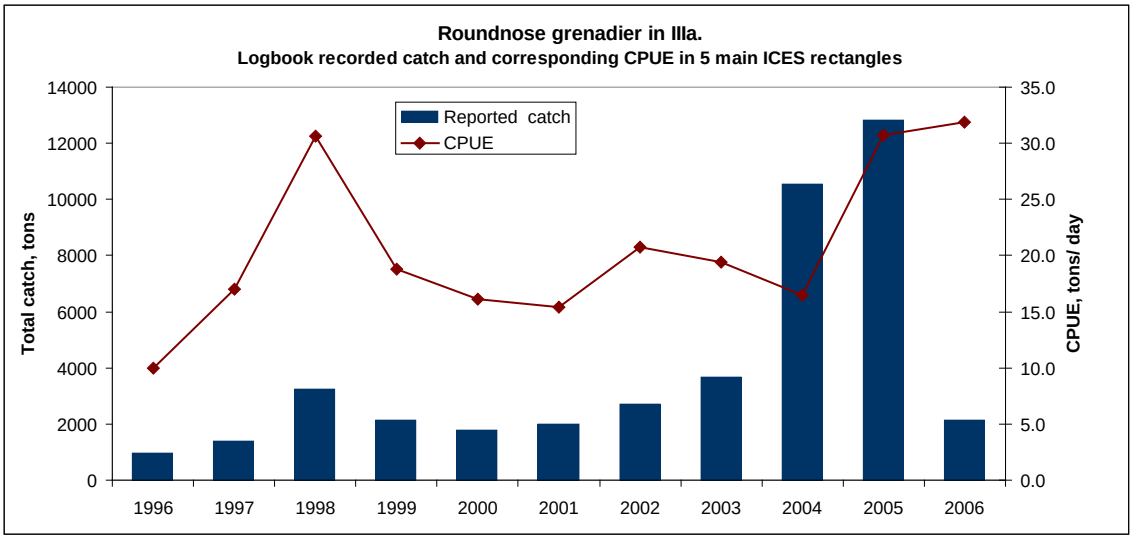


Figure 10.3.5. Danish catches and cpue by main ICES rectangle. Based on logbook records.

B.5. Other relevant data

C. Assessment: data and method

Model used: Survey trends, landings and size distribution from landings during directed fishery.
Software used:

Model Options chosen:

Input data types and characteristics:

Type	Name	Year range	Split on countries	Variable from year to year Yes/No
Landings	Catches in tonnes	1988-2010	Yes	No
Danish CPUE commercial catches	Tonnes/day	1996-2006	Danish only	No
Danish commercial length compositions	% of total number	1987 and 2004-06	Danish only	Yes
Survey catch rate	Kg/hour	1984-2010	Norwegian only	No
Survey length compositions	% of total number	1984-2010	Norwegian only	No
West	Weight at age of the spawning stock at spawning time.			
Mprop	Proportion of natural mortality before spawning			

Fprop	Proportion of fishing mortality before spawning			
Matprop	Proportion mature at age			
Natmor	Natural mortality			

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1			
Tuning fleet 2			
Tuning fleet 3			
….			

D. Short-Term Projection

Model used:

Software used:

Initial stock size:

Maturity:

F and M before spawning:

Weight at age in the stock:

Weight at age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock recruitment model used:

Procedures used for splitting projected catches:

E. Medium-Term Projections

Model used:

Software used:

Initial stock size:

Natural mortality:

Maturity:

F and M before spawning:

Weight at age in the stock:

Weight at age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock recruitment model used:

Uncertainty models used:

1. Initial stock size:
2. Natural mortality:
3. Maturity:
4. F and M before spawning:
5. Weight at age in the stock:
6. Weight at age in the catch:
7. Exploitation pattern:
8. Intermediate year assumptions:
9. Stock recruitment model used:

F. Long-Term Projections

Model used:

Software used:

Maturity:

F and M before spawning:

Weight at age in the stock:

Weight at age in the catch:

Exploitation pattern:

Procedures used for splitting projected catches:

G. Biological Reference Points

	Type	*Value*	*Technical basis*
MSY Approach	**MSY $B_{trigger}$**	**xxx t**	**Explain**
	F_{MSY}	**Xxx**	**Explain**
Precautionary Approach	**B_{lim}**	**xxx t**	**Explain**
	B_{pa}	**xxx t**	**Explain**
	F_{lim}	**Xxx**	**Explain**
	F_{pa}	**Xxx**	**Explain**

No biological reference points have been set.

H. Other Issues

H.1. Historical overview of previous assessment methods (this subsection is optional. See example below.)

Summary of data ranges used in recent assessments:

Data	2006 assessment	2007 assessment	2008 assessment	2009 assessment
Catch data	Years: 1978–(AY-1) Ages: 1–8+	Years: 1978–(AY-1) Ages: 1–8+	Years: 1978–(AY-1) Ages: 1–8+	Years: 1978–(AY-1) Ages: 1–8+
Survey: A_Q1	Years: 1985–AY Ages: 1–7	Years: 1985–AY Ages 1–7	Years: 1985– AY Ages 1–7	Years: 1985– AY Ages 1–7
Survey: B_Q4	Years: 1996–(AY-1) Ages: 1–5	Years: 1996– AY-1) Ages 1–7	Years: 1996– AY-1) Ages 1–7	Years: 1996– AY-1) Ages 1–7
Survey: C	Not used	Not used	Not used	Not used

AY – Assessment year

(The historic perspective, as well as all the other section on the stock annex, should only update in a benchmark workshop. If there is any reason to deviate from the stocks annex, this should be explain in the Working Group report and only update this deviation in the historic perspective after consultation with ICES Secretariat and WG Chair).

I. References

Bergstad, O.A., H.Ø. Hansen, and T. Jørgensen. 2009. Fisheries-independent information on temporal variation in abundance, size structure, recruitment and distribution of the roundnose grenadier *Coryphaenoides rupestris*, 1984-2009. Working Document for ICES WGDEEP, Copenhagen 2009.

Bergstad, O.A., H.Ø. Hansen and T. Jørgensen. 2011. Update on Norwegian fishery independent information on roundnose grenadier (Coryphaenoides rupestris) in the Skagerrak and north-eastern North Sea (ICES Division IIIa and Iva). Working Document 12 for ICES WGDEEP, Copenhagen 2010.

Bergstad, O.A. 1990a. Ecology of the fishes of the Norwegian Deeps: Distribution and species assemblages. *Netherlands Journal of Sea Research* 25(1/2): 237-266.

Bergstad, O.A. 2006. Exploitation and advice options for roundnose grenadier in the Skagerrak (IIIa). Working Document for ICES WGDEEP, Vigo, 2006. 8 p.

Bergstad, O.A. 1990b. Distribution, population structure, growth and reproduction of the roundnose grenadier *Coryphaenoides rupestris* (Pisces:Macrouridae) in the deep waters of the Skagerrak. *Marine Biology* 107: 25 - 39.

ICES 2007. Report of the Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP). ICES CM 2007/ACOM:??.

Knutsen *et al*. 2010 ICELAND DSBS. Oral presentation.

White, T.A., J. Stamford, and A.R. Hoelzel, 2010. Local selection and population structure in a deep-seafish, the roundnose grenadier (*Coryphaenoides rupestris*). Molecular Ecology 19: 216-226