Northern shrimp in Subareas 0 and 1

Background: The shrimp stock off West Greenland is distributed in Subarea 1 and Div. 0A east of 60°30'W. A small-scale inshore fishery began in SA 1 in the 1930s. Since 1969 an offshore fishery has developed.

Fishery and Catches: The fishery is prosecuted mostly by Greenland in SA 1 and Canada in Div. 0A. Canada did not fish in 2008 and fished little in 2009, but has since resumed fishing. Recent catches are:

Year	Catch ('000 t)		TAC ('000 t)	
	NIPAG	STATLANT 21	Advised	Actual[2]
2008	152.9	148.6	130	145.7
2009	135.5	133.5[1]	110	133.0
2010	134.0	134.0[1]	110	133.0
2011	126.0[3]		120	142.6

[1] Provisional.
[2] Total of TACs set by Greenland and Canada.
[3] Predicted to year end by industry observers.
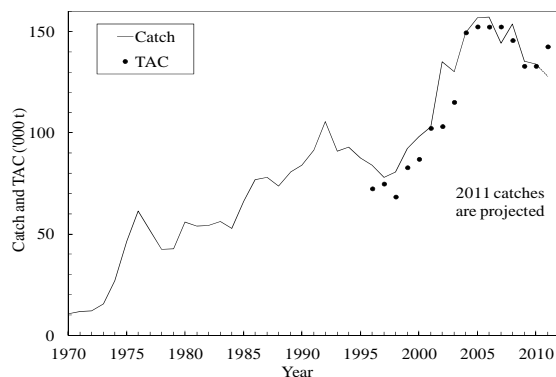
Data: Catch, effort, and position data were available from all vessels. Series of biomass and recruitment indices and size- and sex-composition data were available from research surveys. Series of cod biomass and cod consumption were also available.

Assessment: An analytical assessment framework was used to describe stock dynamics in terms of biomass (B) and mortality (Z) relative to biological reference points.

The model used was a stochastic version of a surplus production model including an explicit term for predation by Atlantic cod, stated in a state-space framework and fitted by Bayesian methods. *MSY* (Maximum Sustainable Yield) defines maximum production, and B_{msy} is the biomass level giving *MSY*.

A precautionary limit reference point for stock biomass (B_{lim}) is 30% of B_{msy} and the limit reference point for mortality (Z_{lim}) is Z_{msy}. Recent CPUE values have stayed high, while the area fished has contracted and survey biomass indices have decreased, and the index is now considered to be of questionable reliability. Therefore in the 2011 assessment, the model accepted was modified from that used in foregoing years to give equal weight to CPUE and survey indices of biomass. The resulting median estimate of *MSY* was 135 000 t/yr.

Indices of how widely the stock and the fishery were distributed were calculated from catch positions in the fishery and the survey.
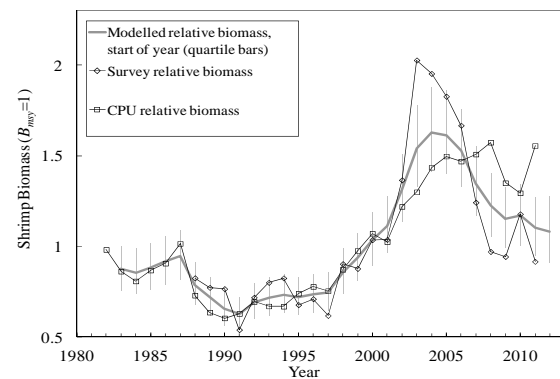

Biomass. A stock-dynamic model showed a maximum biomass at the end of 2003, with a continuing decline since; the probability that biomass will be below B_{msy} at the end of 2011 with projected catches at 126 000 t was estimated at 38% and risk of its being below B_{lim} at less than 1%.

Mortality. The mortality caused by fishing and cod predation (Z) is estimated to have stayed below the upper limit reference (Z_{msy}) from 1996 to 2005, but is now estimated to have averaged 6% over the limit value since 2006. With catches projected at 126 000 t the risk that total mortality in 2011 would exceed Z_{msy} was estimated at about 59%. Atlantic cod is widely distributed on the West Greenland shrimp grounds in 2011 and predation is expected to remain high
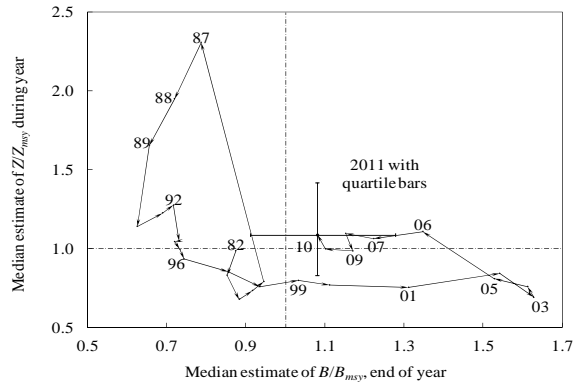
Recruitment. The stock structure in 2011 is deficient in shrimps of intermediate size 15–22 mm CPL, presaging poor short-term recruitment to both the fishable and spawning stocks; numbers at age 2 in 2011 are at 55% of the series mean, so medium-term recruitment is also expected to be poor.
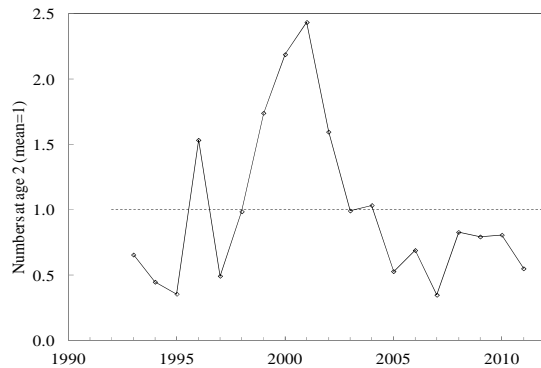

State of the Stock. Modelled biomass is estimated to have been declining since 2004. At the end of 2011 biomass is projected to remain slightly above B_{msy}. Total mortality for the year is projected to exceed Z_{msy}. Recruitment to the fishable stock, in both the short and the medium term, is expected to be low.

Short-term predictions: Estimated risks for 2012 with an "effective" (the amount of cod biomass overlapping the shrimp biomass) 20 000 t cod stock are:

20 000 t cod	Catch option ('000 t)						
Risk of end 2012 (%)	60	70	80	90	100	110	120
falling below B_{msy}	33.1	34.4	35.5	37.5	38.1	40.2	41.3
falling below B_{lim}	<1	<1	<1	<1	<1	<1	<1
exceeding Z_{msy}	13.4	17.0	22.7	30.7	38.7	47.8	55.1

Medium-term Predictions: Predicted probabilities of transgressing precautionary limits after 3 years in the fishery for Northern Shrimp on the West Greenland shelf with 'effective' cod stocks assumed at 20 000 t (20kt) and 30 000 t(30kt) were estimated at:

	Prob. biomass $< B_{MSY}$ (%)		Prob. biomass $<B_{lim}$ (%)		Prob. mort. $> Z_{msy}$ (%)	
Catch (Kt/yr)	20 Kt	30 Kt	20 Kt	30 Kt	20 Kt	30 Kt
60	27.4	29.2	1.6	2.0	14.0	18.4
70	30.0	31.9	1.5	2.1	17.7	22.7
80	32.2	34.9	1.6	2.2	22.7	29.0
90	36.1	38.8	1.8	2.3	30.7	37.2
100	38.0	41.3	1.8	2.4	38.8	45.8
110	42.2	44.5	1.8	2.4	48.3	54.8
120	44.6	47.8	1.8	2.6	56.2	61.8
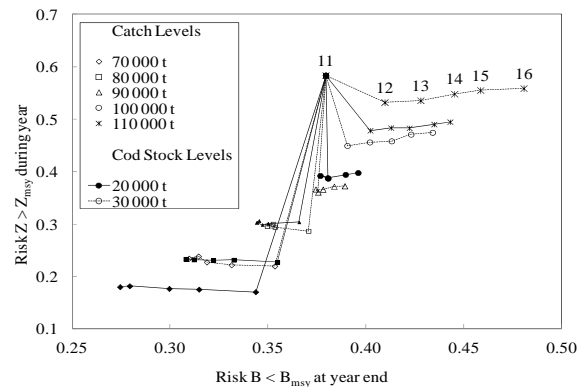
Recommendation: Recent catch levels are not estimated to be sustainable. Scientific Council therefore recommends that catches in 2012 should be reduced substantially.

The risk of exceeding Z_{msy} at a catch level of 90 000 t with an effective cod stock at the 2011 level in 2012 is estimated to be around 31%. Scientific Council notes that this risk is higher than was recommended in previous assessments. This is because model results indicate a stationary stock above B_{msy} at this risk level of exceeding Z_{msy}. Scientific Council therefore recommends that catches in 2012 should not exceed 90 000 t.

Special Comments: Scientific Council were not in a position to predict the cod stock so assumed that the cod stock in 2012 would be at the same level as 2011 in its analysis. Should the cod stock increase beyond

this assumption catches may have to be decreased further.

Sources of Information: SCR Docs 04/75, 04/76, 08/62, 11/50, 11/51, 11/52, 11/55, 11/57, 11/58, SCS Doc. 04/12