Addendum

Report of the Working Group of Fishery Managers and Scientists on Conservation Plans and Rebuilding Strategies (WGFMS-CPRS)

(FC Doc. 12/5)

4 September 2012
via WebEx teleconference

Contents

Report of the Fisheries Commission Working Group of Fishery Managers and Scientists on Conservation Plans and Rebuilding Strategies (WGFMS-CPRS)

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1. Opening

The Chair Jean-Claude Mahé (EU) opened the meeting at 0920 hrs (Eastern Canadian time) on Tuesday, 4 September 2012. He welcomed the participants from Canada, European Union, France (in respect of St. Pierre et Miquelon), the Russian Federation, and the USA, as well as the Scientific Council (SC) Chair (Annex 1).

2. Appointment of Rapporteur

The Fisheries Commission Coordinator (Ricardo Federizon) was appointed rapporteur.

3. Adoption of Agenda

The provisional agenda as previously circulated was adopted (Annex 2).

4. Review and update of 3NO Cod and 3LNO American plaice CPRS

a. Presentation of Scientific Council Advice

The SC Chair, Carsten Hvingel (Norway) presented the scientific advice regarding CPRS including the stock status of fish stocks currently under it. The advice was formulated at the SC June 2012 meeting in response to the FC request. The advice is documented in SCS Doc 12/19. The FC request and SC response are compiled in Annex 3. Among the highlights of the SC advice:

- For both stocks, Spawning Stock Biomass and recruitment are low. B_{lim} is not expected to be reached in the short term and the fisheries should remain closed.
- Reference points B_{msy} and F_{msy} provided in 2011 for both stocks were reviewed. For 3NO cod, the yield-per recruit (YPR) and spawner per recruit (SPR) approach was used for estimating the proxy reference points. The values were similar to F_{msy} estimated last year and to the current B_{lim}. The YPR-estimated B_{msy} was different from the B_{msy} estimated last year but it was noted that the YPR-estimated value depends on assumptions about the level of recruitment. On 3LNO American plaice, the Bayesian surplus production models were used and the results support the MSY reference points derived by SC in 2011.
- The alternative Harvest Control Rule (HCR) (as elaborated in item 8 of the FC request) was tested on 3LNO American plaice by simulation and the results support that this rule works reasonably well as a management strategy and meets most of the requirement that are laid out in the interim conservation and rebuilding plan for this stock. SC advised that this HCR be considered for adoption for 3LNO American Plaice. However it would take a long time to reach the various reference points/milestones: B_{lim} in 2022, B_{isr} in 2036 and B_{msy} in 2060.

b. Consideration of updates to Conservation Plan and Rebuilding Strategy (CPRS) for 3NO cod and 3LNO American plaice

The WG took note of the SC advice and discussed the possibility of updating the current 3NO cod and 3LNO American plaice CPRS by including the option of adopting a more simplified HCR for 3LNO American plaice. It was however realized that an update based on these possible changes would not have short-term consequence. In consideration that a face-to-face meeting in 2013 would be needed (see item 7) to elaborate among others the management objectives, framework and performance statistics of the CPRS as well as further consideration of other fish stocks as CPRS candidates, it was decided that no updates are necessary, i.e. the current CPRS on the 3NO cod and 3LNO American plaice, as reflected in Article 7.6-7.11 and Article 8 of the 2012 NCEM, respectively, remain as they are at this time.

5. Consideration of Scientific Council Advice as it relates to B_{msy} and appropriate HCR consistent with the NAFO PA Approach for 3M Cod

It was noted that SC did not make considerable progress in its work on 3M cod in the context of estimation of reference points (e.g. B_{msy}) and appropriate HCR consistent with the Precautionary Approach. Therefore the WG could not have adequate scientific basis in continuing the discussion. It was suggested that further discussion should occur at the next WG meeting.

6. Discussion on a CPRS for 3NO Witch flounder

The attempts of SC to establish reference point proxies were not successful. A number of complicating factors has made it difficult to do in particular, the survey series that provide biomass estimates cover different time periods and areas, and are highly variable, with trends in biomass that are not clear. It was noted that SC has indicated that there are some areas which should be investigated further, in particular, the approach that was used for. 2J3KL witch flounder to estimate B_{lim}. It was suggested that SC should be requested to pursue this area of study at its June 2013 to allow for further discussion at the next meeting of this Working Group.

7. Discussion and Establishment of Priorities for Future Developments of CPRS

Priorities for further development of CPRS were discussed with acknowledgement that there are limits to the capacity and expertise of SC and the WG. The need for the WG to have a face-to-face meeting was recognized. Ideally the meeting should be held sometime in July 2013 when the SC June 2013 meeting results become available. The WG considers as priorities the development of a general CPRS framework for stocks managed by NAFO, on-going development of CPRS for 3LNO American plaice and 3NO cod, continued efforts to develop a CPRS for 3NO witch flounder, and initial development of CPRS for both 3LN redfish and 3M cod. The recommendations to be forwarded to the Fisheries Commission reflect the priorities for future development of CPRS (see item 8).

8. Recommendations to be forwarded to the Fisheries Commission

1. The WG **recommends** that the Fisheries Commission considers as priorities the development of a general CPRS framework for stocks managed by NAFO, on-going development of CPRS for 3LNO American plaice and 3NO cod, continued efforts to develop a CPRS for other stocks including 3NO witch flounder, and initial development of CPRS for both 3LN redfish and 3M cod.

2. The WG **recommends** that the Fisheries Commission endorses the following work items for the next meeting of the working group:
   - the elaboration of a general framework including management objectives and performance statistics;
   - the development of alternate strategies for stocks that may not be suited to formulaic rules and/or for stocks where reference points do not exist or cannot be developed.

3. The WG **recommends** that the Fisheries Commission requests the Scientific Council to
   - as a short term priority, develop Limit Reference Points (LRP) Proxy for 3NO witch flounder, e.g. investigate further the approach that was used for 2J3KL witch flounder to estimate B_{lim};
   - as an intermediate priority, continue its research on the 3NO Cod productivity, particularly MSY reference points.

9. Other Matters

There was no other matter to discuss.

10. Adoption of Report

The report was adopted though correspondence after the meeting.

11. Adjournment

The Chair thanked the participants for their input and the Secretariat for the technical support and assistance. The meeting was adjourned at 1100 hrs.

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Annex 2. Agenda

1. Opening of the Meeting

2. Appointment of Rapporteur

3. Adoption of Agenda

4. Review and update of 3NO Cod and 3LNO American plaice CPRS

    a. Presentation of Scientific Council Advice

    b. Consideration of updates to Conservation Plan and Rebuilding Strategy (CPRS) for 3NO cod and 3LNO American Plaice

5. Consideration of Scientific Council Advice as it relates to B_{msy} and appropriate HCR consistent with the NAFO PA Approach for 3M Cod

6. Discussion of a CPRS for 3NO Witch Flounder

7. Discussion and Establishment of Priorities for Future Developments of CPRS

8. Recommendations to be forwarded to the Fisheries Commission.

9. Other matters

10. Adoption of Report

11. Adjournment

Annex 3. FC Request and SC Response

Review and Update Reference points and intermediate reference point. (Item 6 of FC Doc 11/9 Rev)

Fisheries Commission requested:

The Fisheries Commission adopted in September 2011, conservation plans and rebuilding strategies for 3NO cod and 3 LNO American plaice and "recognizing that further updates and development of the plans may be required to ensure that the long term objectives are met". The Fisheries Commission requests the Scientific Council to:

a) Provide advice on the addition of a new intermediate reference point (i.e. Bisr) in the NAFO precautionary approach framework to delineate an additional zone between Blim and Bmsy as proposed by the working group

b) Taking into consideration the new reference point Bisr, provide advice on an updating NAFO PA framework and provide a description for each zone.

c) Provide advice on an appropriate selection of the Bisr value for Div. 3NO cod and Div. 3 LNO American plaice.

Scientific Council responded:

In 2011 Scientific Council had advised that B_{buf} was not required because both Div. 3LNO American plaice and Div. 3NO cod have analyses of the probability that biomass is below B_{lim}. However an additional zone between B_{lim} and B_{msy} in the NAFO Precautionary Approach Framework could be considered.

Providing advice on a new intermediate reference point and selecting an appropriate level depends on the purpose and on the properties that such a reference point would have. The purpose of the proposed B_{isr} is not clear to Scientific Council. If the purpose is to serve as a 'milestone' for the Fisheries Commission to track rebuilding, then the reference point can have any value that the Fisheries Commission wishes. If the purpose of the B_{isr} is to mark the beginning of the safe zone, or to mark an SSB above which h there is a high probability of being above Blim, or if the purpose is to mark any zone for which there would be some change in an HCR, then analyses as to the appropriate level would need to be conducted. Scientific Council can not advise on particular levels until it is clear as to the purpose of B_{isr}.

Scientific Council also can not advise on updating the NAFO PA framework as it also depends on the purpose of the B_{isr}. Scientific Council recommends that this exercise be conducted jointly with the Fisheries Commission. Therefore, the Scientific Council chair will contact the Fisheries Commission chair about the possibility of forming a joint working group to re-evaluate the NAFO PA framework. Scientific Council members of this group would bring work peer reviewed by Scientific Council to the discussions.

d) Review B_{msy} and F_{msy} provided in 2011 for both stocks and quantify uncertainty surrounding these estimates.

Scientific Council responded that for Div. 3NO cod:

Scientific Council notes that the approach used in estimation of the maximum sustainable yield (MSY) reference points approved last year may not be advisable in the case of Div. 3NO cod due to the high uncertainty in the stock-recruit relationship for this stock. Scientific Council recommends the use of proxies based on the yield per recruit (YPR) and spawner per recruit (SPR) to estimate the reference points for cod in Div. 3NO.

Using this approach Scientific Council estimated the YPR and SPR reference points with uncertainty for Div. 3NO cod. The proxies for the limit references points estimated through YPR were very similar to the F_{msy} estimated last year based on Loess smoother applied to log-transformed recruitment values from the VPA and the current B_{lim}. However, the B_{msy} estimated based on the YPR was different to the B_{msy} estimated last year.

Scientific Council noted that the level of B_{msy} estimated from YPR-SPR depends on assumptions about the level of recruitment. Scientific Council concluded that more research about the possibility of changes in productivity is needed to better estimate this reference point. Scientific Council noted that the actual biomass level of the Div. 3NO cod is far below any reasonable level of B_{msy}.

For Div. 3LNO American plaice:

For Div. 3LNO American plaice Bayesian surplus production models were fit to catch and research survey data and the results compared to the results for MSY reference points derived from Loess smoother applied to log-transformed recruitment values from the American plaice VPA assessment. Although the absolute values of F_{msy} and B_{msy} derived from these two different methods are not directly comparable the ratio of Biomass to B_{msy} (B_{ratio}) and Fishing mortality to F_{msy} (F_{ratio}) can be compared. Trends in these metrics from the different models were very similar over time, particularly B_{ratio}. All models show that current biomass is well below B_{msy}. The results of the Bayesian surplus production models support the MSY reference points derived by Scientific Council in 2011.

Review of rebuilding plans for 3LNO A. plaice and 3NO Cod (Item 7)

Fisheries Commission requested:

Fisheries Commission requests the Scientific Council to review the conservation and rebuilding plans of 3LNO American Plaice (NAFO/FC Doc. 11/4, Annex 4) and 3NO Cod (NAFO/FC Doc. 11/4, Annex 5). Through projections and a risk based approach, evaluate the performance of the present rebuilding plans in terms of expected time frames (5 / 10 / 15 years) and associated probabilities to reach indicated limit and target biomass levels and catches. Projections should assume appropriate levels of recruitment and the status quo fishing mortality (3-year average scaled and unscaled) until reaching biomass levels above B_{lim}.

Scientific Council responded to this request in conjunction with the following request [Item 8].

Evaluation of the proposed harvest control rule for 3LNO A. plaice and 3NO Cod. (Item 8)

Fisheries Commission requested:

Fisheries Commission requests the Scientific Council to evaluate the Harvest Control Rule (HCR) indicated below as an alternative to the HCR of the 3LNO American Plaice (NAFO/FC Doc. 11/4, Annex 4, item 4) and 3NO Cod (NAFO/FC Doc. 11/4, Annex 5, item 4) Conservation Plans and Rebuilding Strategies. Through projections and a risk based approach, evaluate the performance of this HCR in terms probabilities associated with maintaining Biomass above B_{lim} and ensuring continuous SSB growth. SC should provide SSB and associated catch trajectories for 5 / 10 / 15 years. Projections should assume appropriate levels of recruitment and the status quo fishing mortality (3-year average scaled and unscaled) until reaching biomass levels above B_{lim}.

Harvest Control Rule:

a) When SSB is below Blim:

i. no directed fishing, and

ii. by-catch should be restricted to unavoidable by-catch in fisheries directing for other species

b) When SSB is above Blim:

*If P y+1 > 0.9 Then Fy+1 = F0.1 * Py+1*

Else

Fy+1 = 0

*TACy+1 = B y+1 * Fy+1*

Where:

Fy+1 = Fishing mortality to project catches for the following year.

Py+1 = Probability of projected Spawning Stock Biomass to be above Blim.

B y+1 = Exploitable biomass projected for the following year.

Scientific Council responded to item 7 and 8 together.

For Div. 3NO cod:

Scientific Council notes that testing of the rebuilding plan and alternative HCR for Div. 3NO cod was not possible at this time. The stock recruit relationship of Div. 3NO is poorly defined and the use of parametric relationships is not warranted. The MSY reference points may be revised in the near future. The current stock status of Div. 3NO cod is such that it is well below B_{lim} and very far from any reasonable level of B_{msy}.

For Div. 3LNO American plaice:

The alternative HCR for Div. 3LNO American plaice was tested by simulation. This testing did not constitute a full management strategy evaluation and Scientific Council advises that such a process should be conducted. The simulation testing that was done indicates that this rule works reasonably well as a management strategy, although the time to reach the various reference points/milestones is long. The median time to reach B_{lim} is 2022, to reach the proposed value of B_{isr} is 2036 and to reach B_{msy} is greater than 2060.

Results of simulations testing the alternative HCR for Div. 3LNO American plaice

	5 years	10 years	15 years
SSB growth	$pSSB_{5years}>SSB_{1year}$ =0.80	$pSSB_{10years}>SSB_{5years}$=0.80	$pSSB_{15years}>SSB_{10years}$=0.93
p SSB > B_{lim}	0	0.25	0.79
Median SSB	38 340	43 712	56 507
Median catch	4 446	4 991	8 221

Scientific Council notes that for Div. 3LNO American plaice the alternative HCR described in the Fisheries Commission request item 8 meets most of the requirements that are laid out in the conservation and rebuilding plan for that stock. It is a much simpler rule that is easier to apply than the current rebuilding plan. The rules described in the current rebuilding plan often mix performance statistics with HCR. In addition some of the rules are complicated and performance statistics vague. Therefore Scientific Council advises that the alternative HCR described in item 8 be considered for adoption for Div. 3LNO American Plaice.

For both Div. 3LNO American plaice and 3NO cod, Scientific Council responded:

It is not expected that Div. 3LNO American plaice and 3NO cod will reach B_{lim} in the short term. This gives time for the Scientific Council to cooperate with the Fisheries Commission and perform a full management strategy evaluation before the opening of any directed fisheries. Scientific Council highlights that such a process entails substantial workload and will require close dialogue between Scientific Council and Fisheries Commission.

Full Assessment of 3LNO A. plaice in accordance with the rebuilding plan (Item 9)

Fisheries Commission requested:

The Fisheries Commission requests the Scientific Council to conduct a full assessment of 3LNO American Plaice and provide advice in accordance to the rebuilding plan currently in place.

Scientific Council responded:

American plaice in Div. 3LNO

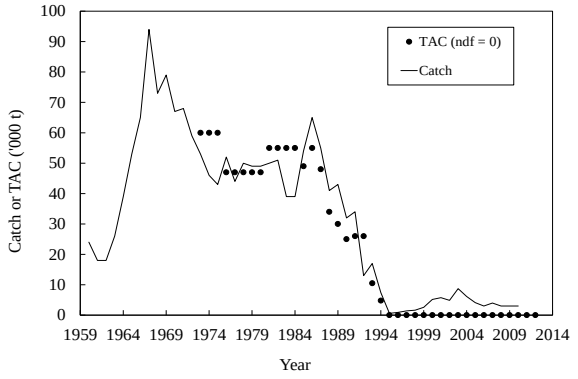
Recommendation: SSB was projected to have a <5% probability of reaching B_{lim} by the start of 2014 when $F = F_{2010}$ (0.11). Scientific Council therefore recommends that in accordance with the rebuilding plan, there should be no directed fishing on American plaice in Div. 3LNO in 2013 and 2014. Bycatches of American plaice should be kept to the lowest possible level and restricted to unavoidable bycatch in fisheries directing for other species.

Background: Historically, American plaice in Div. 3LNO has comprised the largest flatfish fishery in the Northwest Atlantic.

Fishery and Catches: In most years the majority of the catch has been taken by offshore otter trawlers. There was no directed fishing in 1994 and there has been a moratorium since 1995. Catches increased after the moratorium until 2003 after which they began to decline. This year, STACFIS only had STATLANT 21A available as estimates of catches in 2011. The inconsistency between the information available to produce catch figures used in the previous years' assessments and that available for the 2011 catches has made it impossible for STACFIS to provide the best assessment for this stock.

	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21	Recommended	Agreed
2009	3.0	1.8	ndf	ndf
2010	2.9	2.0	ndf	ndf
2011	na	1.2	ndf	ndf
2012			ndf	ndf

ndf No directed fishing; na Not available.



Data: Biomass and abundance data were available from: annual Canadian spring (1985-2011) and autumn (1990-2011) bottom trawl surveys; and EU-Spain surveys in the NAFO Regulatory Area of Div. 3NO (1995-2011). Age data from Canadian bycatch as well as length frequencies from EU-Portugal and EU-Spain bycatch were available for 2011.

Assessment: Since STACFIS was not able to estimate total catch, the analytical assessment using the ADAPTive framework could not be updated in 2012.

During the previous assessment in 2011, Scientific Council concluded that:

Biomass: Despite the increase in biomass since 1995, the biomass is very low compared to historic levels. SSB declined to the lowest estimated level in 1994 and 1995. SSB has been increasing since then and at the start of 2011 was 34, 000 t. B_{lim} for this stock is 50 000 t.

Recruitment: Estimated recruitment at age 5 indicates that the 2003 year class is comparable to the 1987-1990 year classes but well below the long-term average.

Fishing mortality: Fishing mortality on ages 9 to 14 has generally declined since 2001.

State of the Stock: During the previous assessment in 2011, Scientific Council concluded that: the stock remains low compared to historic levels and, although SSB is increasing, it is still estimated to be below B_{lim}. Estimated recruitment at age 5 indicates that the 2003 year class is comparable to the 1987-1990 year classes but well below the long-term average. The 2012 assessment does not indicate a change in the status of the stock, based on last year's analytical model and the 2011 survey results.

Reference Points: Based on the 2011 assessment the biomass for this stock is estimated to be below B_{lim} (50 000 t) and fishing mortality in 2010 was below F_{lim} (0.3).

Short Term Considerations: Simulations were carried out in 2011 to examine the trajectory of the stock under 3 scenarios of fishing mortality: F = 0, $F = F_{2010}$ (0.11), and $F_{0.1}$ (0.16).

SSB was projected to have a <5% probability of reaching B_{lim} by the start of 2014 when $F = F_{2010}$ (0.11).

	F = 0		
	SSB ('000 t)		
	p5	p50	p95
2011	29	33	38
2012	36	41	47
2013	42	48	56
2014	46	53	64

	F_{2010} = 0.11					
	SSB ('000 t)			Yield ('000 t)		
	p5	p50	p95	p5	p50	p95
2011	29	33	37	3.2	3.6	4.1
2012	33	37	43	3.7	4.1	4.7
2013	36	41	47	3.9	4.3	4.9
2014	37	42	49			

	$F_{0.1}$ = 0.16					
	SSB ('000 t)			Yield ('000 t)		
	p5	p50	p95	p5	p50	p95
2011	29	33	37	4.5	5.1	5.8
2012	32	36	42	5.0	5.7	6.5
2013	33	38	44	5.1	5.7	6.5
2014	33	38	45			

Special Comment: Given the low probability of reaching B_{lim} in the short term, Scientific Council plans to conduct the next full assessment of this stock in 2014.

Sources of Information: SCS Doc. 12/4, 5, 8, 9, 14; SCR Doc. 12/6, 12, 17, 33, 34.

Definition of MSY reference points and a prospective harvest control rule for cod in Div. 3M (Item 11)

Fisheries Commission requested:

Fisheries Commission requests the Scientific Council to define Bmsy for cod in Division 3M and to propose a Harvest Control Rule (HCR) consistent with the NAFO Precautionary Approach Framework. It also requests the Scientific Council to define the estimated timeframe to reach Bmsy under different scenarios, consistent with the proposed HCR.

Scientific Council responded:

Scientific Council has been unable to make any progress towards answering this request at this time.

Variability in indicators of stock status and recruitment for 3NO witch flounder (Item 14)

Fisheries Commission requested:

Taking note that recent point estimates for Div. 3NO Witch flounder of the Canadian autumn survey are 2-3 times higher than in 1994 when the moratorium was first implemented and are among the highest in the times series, and while more variable, the recent point estimates of the Canadian spring survey are about 50% higher than in 1994.

Scientific Council responded:

Scientific Council notes that the biomass index from the 2011 Canadian autumn survey was lower than the 2008-10 values and in the range of the 2004-06 values. There is no trend in the Canadian spring survey data since 2004.

a) What are the relative strengths and weaknesses of all the indices of abundance of witch?

For the Canadian spring surveys, depths greater than 731 m are not surveyed, and there is evidence that at least some witch are in deep water in the early spring, related to spawning. So it is possible that these fish would not be found in the spring survey in some years. The Canadian autumn survey has covered 731-1462 m in some years, but a high proportion of witch flounder is not found at those depths at that time of year. Ideally, there would be some deep coverage in the spring survey rather than the autumn. The EU-Spanish survey of the NRA does cover greater depths, but only surveys part of the witch distribution, and very little of Div. 3O. The Canadian autumn survey probably has the best chance of being an index of total stock abundance or biomass, particularly in years where deep sets are done, although even those deep sets are probably not critical to the index, at least in recent years.

b) What are plausible reasons for different abundance trends in the spring and autumn surveys of the SAME STRATA, and what are the rationales to support either set of results over the other?

This is most likely to be due to different distribution of witch in spring vs autumn, for biological reasons (i.e. spawning). Witch flounder are not likely to be distributed in the same areas in all seasons, for a number of reasons, including environmental. Scientific Council considered the issue of depth distribution of this stock in its 2008 and 2011 assessments, and has noted on several previous occasions that some variation in survey indices is likely due to distributional shifts between deeper smaller strata and larger shallower strata. It appears that more witch flounder are in shallow water in fall compared to spring, and more are in deeper water in spring, likely related to spawning

c) How might the confidence intervals around the point estimates over the time series affect the interpretations of stock trend and current status?

If the same population is sampled on numerous occasions and interval estimates are made on each occasion the resulting intervals would bracket the true population parameter in approximately 95% of the cases. Confidence intervals consist of a range of values (interval) that act as good estimates of the unknown population parameter. Therefore when variance in the survey results is large, the confidence intervals are wide, and the "statistical confidence" in the mean value and related trend is reduced. Very wide CI's are caused by 1 or more large catches, much larger than mean values, which greatly increase the variance around the estimates of abundance and biomass, and may obscure the trend in the mean values.

d) What evidence exists (if any) to indicate whether any changes in natural mortality have occurred since the early 1990's, e.g. condition of the fish?

Relative body condition was calculated for each year to determine if there have been any trends over time. Data were available for 1979, 1984, 1990, 1993, 1994 and 1997-2011. A length vs. body weight regression was fit using all data. The condition index is then the observed body weight of a fish divided by the body weight predicted from the length weight regression for a fish of that length. Relative body condition for each year was estimated using a generalized linear model with an identity link and a gamma error, with year as a class variable. Multiple comparisons were also conducted.

There was significant interannual variation in relative condition (χ^2=132.2, df=18, p<0.001). In general condition was higher in the first 3 years of the time series, lower in 1993-1994 and 1997-2003 and low again from 2009-2011 (Fig. 1). Relative condition was not significantly different among 1979, 1984 and 1990. Condition in these three years was significantly higher than most years until 2004. Condition in 2004 and in most years until 2008 was not significantly different from the first 3 years of the time series. Condition in 2008-2011 was significantly lower than these first 3 years (except for 2011 and 1979).

Condition was lower in most years for which data were available after 1990, except for 1997 and 2004-2008. The lack of data in years prior to 1990 means that there is limited information on condition in the period prior to the decline in stock size. Decreases in condition can be associated with stock decline if natural mortality has increased due to poor condition. However, the opposite can be true if there is a density dependent effect. Lower population size can lead to an increase in resources available to the remaining individuals and therefore an increase in condition.

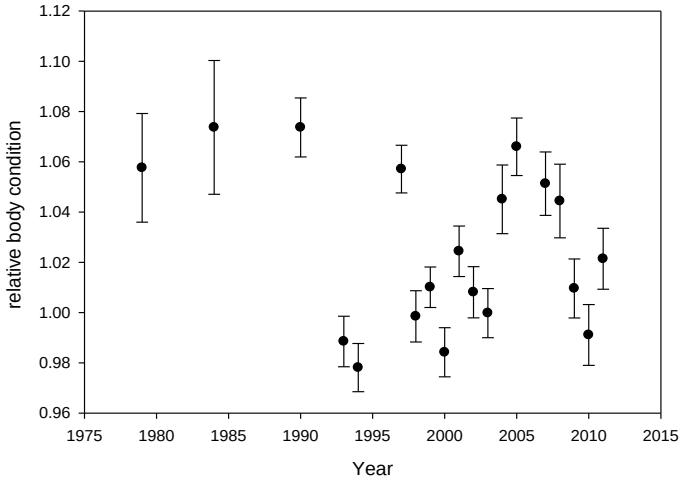


Fig. 1. Relative condition (+ standard error) from spring research vessel survey data for witch flounder in NAFO Div. 3NO.

No other analyses of changes in natural mortality have been carried out at this time. Scientific Council is unable to determine if changes in natural mortality have occurred.

e) Is it plausible there may be a different survey catchability for younger/smaller fish relative to older/larger fish (applicable to witch flounder), and how might this affect our interpretation of stock trends and status?

Scientific Council expects there to be size-dependent catchability. But overall, within a survey series, this should not be a factor, i.e. there are no expectations that size-dependent catchability has changed in the years after the introduction to the Canadian survey series of the Campelen trawl in 1995. The same trawl gear is used in spring and fall surveys, so there should be no gear related differences in size-dependent catchability between these two surveys.

Scientific Council noted there is a recommendation for additional work related to this issue: "STACFIS **recommends** *further investigation of recruitment trends for witch flounder in Div. 3NO.* This should include analysis of trends in abundance in the survey series, as well as examination of areal distribution of small witch flounder, particularly in years where deeper strata are covered by surveys. STACFIS noted that analyses of recruitment will rely on length frequency data, as no ageing has been conducted on this stock since the early 1990s." Analysis has begun on this, but there is no progress to report yet.

f) What might be reasonable options for reference point proxies, with associated rationale, including those based on one or a combination of survey indices?

Scientific Council has made some attempts in the past at producing limit reference points. In 1998, Scientific Council looked at some analyses based on a Schaefer model and also on yield- and spawner per recruit, but did not establish any reference points based on this work. More recently, Scientific Council reviewed some analyses to see if proxies for B_{lim} could be established. The conclusions were that it was difficult to do because the survey series that provide biomass estimates cover different time periods and areas, and are highly variable, with trends in biomass or abundance that are less clear than for other stocks (e.g. Div. 2J3KL witch). As well, the highest observed biomass estimates are in the early part of the longer time series, when the survey covered less of the entire stock area. As a result, B_{lim} may be underestimated using a method that ties B_{lim} to a percentage of the maximum survey value (e.g. the 85% decline proxy used for some stocks), and therefore using this proxy for B_{lim} may not be appropriate for Div. 3NO witch. It is not clear that the same approach used for Div. 2J3KL witch flounder to estimate B_{lim} from survey data, by adjusting the older values in the time series, can be applied to Div. 3NO witch, but this should be investigated further, as should other proxies.