

Northwest Atlantic Fisheries Organization



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

26-28 June 2011
Halifax, Nova Scotia, Canada

NAFO
Dartmouth, N.S., Canada
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**Report of the FC Working Group of Fishery Managers and Scientists
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1. Opening

Following a welcome speech by the Executive Secretary (Vladimir Shibanov), the Chair Jean-Claude Mahé (EU) opened the meeting at 1010 hrs on Sunday, 26 June 2011. He welcomed the participants from Canada, European Union, Norway, 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 with minor adjustment in the order of agenda items. It was agreed that 3LNO American Plaice should be discussed ahead of 3NO Cod (Annex 2).

4. Matters arising from the WebEx meeting (April 2011)

No substantive matters arose. It was indicated that the relevant FC requests for SC advice, as reviewed during the WebEx meeting, were addressed by the Scientific Council.

5. SC Chair presentation of scientific advice from the SC June 2011 meeting

The SC Chair (Ricardo Alpoim, EU) presented the latest scientific advice on two fish stocks currently under the *Conservation Plans and Rebuilding Strategies* programme, 3LNO American plaice and 3NO cod (Annex 3). Regarding 3LNO American plaice, the advice was formulated by the SC at its June 2011 Meeting in Braunschweig, Germany. Regarding 3NO cod, a full assessment was conducted during its June 2010 Meeting. It was monitored in 2011 and the advice was re-iterated. Reference points in the Precautionary Approach Framework for both stocks were also estimated. The comprehensive scientific advice is documented in NAFO SCS Doc 11/16.

6. Review and update of 3LNO American Plaice Conservation Plan and Rebuilding Strategy (FC Doc 10/13)

The stock 3LNO American plaice has been in moratorium since 1995. The interim 3LNO American plaice CPRS, adopted by the Fisheries Commission in 2010 and in force in 2011, was reviewed. The CPRS as contained in FC Doc 10/13 specifies an objective of attaining and maintaining the Spawning Stock Biomass (SSB) at or above Bmsy. Reference points in the framework of Precautionary Approach are identified; circumstance under which a directed fishery can occur (i.e. re-opening) is elaborated; harvest control rules (HCR) are formulated, and a strategy for stock stability is provided.

At the review, it was recognized that the objective needs to be amended to give more precision and consideration to long-term objective and interim milestone. It was also recognized that SC has provided new values in its advice to some of the reference points. The justification to re-open the fishery needs to be more rigorous. Concerning HCR which are based on the SC advice, a refinement and elaboration of risk tolerance is needed.

Concerns were raised on the high uncertainty and the lack of confidence intervals of the reference points. The WG agreed that the values of B_{isr} and B_{msy} should be further reviewed by the Scientific Council and the Fisheries Commission.

The interim CPRS was updated in consideration with the issues and concerns identified during the review. The updated CPRS has four sections: Objective(s), Reference Points, Re-opening to Directed Fishing, and Harvest Control Rules. It was decided that the updated interim CPRS, as presented in Annex 4, will be forwarded to the Fisheries Commission with a recommendation for adoption (see item 9).

7. Review and update of 3NO Cod Conservation Plan and Rebuilding Strategy (Article 9 of the NCEM)

The stock 3NO Cod has been in moratorium since 1994. The 3NO Cod CPRS, adopted by the Fisheries Commission in 2007 and in force since 2008, was reviewed. The CPRS is embodied as Article 9 in the NAFO Conservation and Enforcement Measures (NCEM).

Concerns were raised on the high uncertainty and the lack of confidence intervals of the reference points. The WG agreed that the values of *B_{isr}* and *B_{msy}* should be further reviewed by the Scientific Council and the Fisheries Commission.

At the review, it was intended that CPRS would replace the current text of Article 9 in the NCEM. The updated CPRS follows the template and language of the 3LNO American plaice CPRS. It however does not cover the bycatch issues of Articles 9.3, 9.4, and 9.7, which were duly noted. The WG concluded that this CPRS was not the place to address bycatch issues, so NCEM Articles 9.3, 9.4, and 9.7 were highlighted for possible action by the Fisheries Commission.

The updated CPRS, in a format similar to that of 3LNO American plaice and as presented in Annex 5, will be forwarded to the Fisheries Commission with a recommendation for adoption (see item 9).

8. Next Steps

The WG will report to the Fisheries Commission the results of this meeting and present its recommendations at the 2011 Annual Meeting.

The WG will seek feedback and instructions from the Fisheries Commission concerning its future work. The CPRS template that was developed and applied to 3LNO American plaice and 3NO Cod can be applied to other stocks. This WG will seek guidance from the Fisheries Commission on which other NAFO-managed fish stocks could be under a CPRS.

The WG will take into account the work of the Scientific Council particularly in the development and evaluation of HCR.

9. Recommendations to be forwarded to the Fisheries Commission

The Working Group agreed on the following recommendations:

Noting that international agreements such as the United Nations Fish Stocks Agreement (UNFSA) and the FAO Code of Conduct for Responsible Fisheries call for the rebuilding of depleted stocks through application of the precautionary approach;

Recalling the interim Conservation Plan and Rebuilding Strategy for 3LNO American plaice adopted by the Fisheries Commission in 2010;

Further Recalling that in 2007 NAFO adopted a Conservation Plan and Rebuilding Strategy for 3NO Cod that identified a limit reference point of 60,000t;

Desiring continued rebuilding and growth of these stocks to ensure their long-term sustainability and to promote associated economic opportunities; while noting rebuilt stocks may differ markedly from their status prior to depletion;

Recalling Scientific Council states that the available data for 3LNO American plaice and 3NO cod do not span the entire production curve, and that therefore large uncertainty in the estimated reference points can be expected;

Recognizing Scientific Council has advised that changes in population biology and in fishing practices can have a large impact on the estimated level of some reference points;

Noting that the Scientific Council has advised that the use of any reference points in a precautionary approach framework or rebuilding plan needs to be evaluated for any stock to which they are applied; and

Recognizing that further updates and development of the plans may be required to ensure that the long term objectives are met;

The Working Group recommends that:

- 1. The Fisheries Commission adopt the Interim 3LNO American Plaice Conservation and Rebuilding Plan (FCWG-CPRS Working Paper 11/3 Rev. 5) (Annex 4) and include it in the NCEM;**
- 2. The Fisheries Commission adopt the Interim 3NO Cod Conservation Plan and Rebuilding Strategy (FCWG-CPRS Working Paper 11/4 Rev. 3) (Annex 5) to replace current Article 9 of the NCEMs, noting the outstanding bycatch issues related to Article 9.3, 9.4 and 9.7; and**
- 3. The Fisheries Commission agree to an implementation, review and monitoring process:**

To support the effective implementation and monitoring of the Conservation Plans and Rebuilding Strategies, it is recommended that:

- a) The working group remains in place through 2014 to allow for further update and development of the plans.
- b) The Conservation Plans and Rebuilding Strategies be assessed and revised as required, taking into account the analysis of the Scientific Council, to ensure that the objective(s) of the plans are being achieved. Initial reviews should take place no later than the 36th Annual Meeting (2014), and at regular intervals subsequently agreed to by Fisheries Commission.
- c) Scientific Council be requested to provide advice for these stocks in a manner consistent with any specific parameters within the Conservation Plans and Rebuilding Strategies.

10. Others matters

Canada presented, for information purposes, its actions and programs concerning national CPRS of fish stocks in Atlantic Canada. They include, among others, the evaluation of recovery potential of cod and American plaice stocks, establishment of limit reference points for various stocks including 3Ps and 2J3KL cod, and long term projections done under various scenarios. The work was peer reviewed in Canada, and will guide the development of rebuilding plans for cod stocks.

A research project on recovery strategies for 3LNO American plaice and 3NO cod has also been funded in Canada, under the International Governance Strategy. IGS is a program within Fisheries and Oceans Canada that provides funding for Science projects focused on international fisheries, such as NAFO stocks and bluefin tuna. Project funding has been provided for 2011-2014, and the Principal Investigator is Dr. Peter Shelton, with collaboration from EU and Canadian scientists.

Recovery strategies investigated will take into account relevant PA reference points as well as performance statistics relevant to the fishery, such as average catch and variation in TAC. Several aspects of the work will require extensive discussion and collaboration with managers and industry advisors, and Scientific Council peer review of results is proposed.

11. Adoption of Report

The report was adopted prior to adjournment.

12. Adjournment

The Chair and Vice-Chair thanked the participants and the Secretariat. The meeting was adjourned at 1035 hrs on Tuesday, 28 June 2011.

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Annex 2. Agenda

1. Opening of the Meeting
2. Appointment of Rapporteur
3. Adoption of the Agenda
4. Matters arising from the WebEx meeting (April 2011)
5. SC Chair presentation of scientific advice from the SC June 2011 meeting
6. Review and update of the 3LNO American Plaice Conservation Plan and Rebuilding Strategies (FC Doc 10/13)
7. Review and update of the 3NO Cod Conservation Plan and Rebuilding Strategies (Article 9 of the NCEM)
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Annex 3. Fisheries Commission Requests and Scientific Council Responses
(FCWG-CPRS Working Paper 11/2)

For information purposes and to help facilitate discussions within the Working Group, the Secretariat has put together this working paper presenting the summary of the latest response from the Scientific Council to the FC Request for scientific advice concerning rebuilding and recovery plans and on fish stocks 3LNO American plaice and 3NO cod.

Contents:

FC Request for Advice		Scientific Advice	
FC Request	Request Item and FC Reference Document	SC Advice Formulation	SC Reference Document
Evaluation of Rebuilding and Recovery Plans	Item 6 of FC Doc 09/17	Advice formulated at the September 2010 SC Meeting.	SC Reports 2010, pp. 240-241
In 2010, advice should be provided for 2011 and 2012 for Cod Div. 3NO	Item 2 of FC Doc 09/17	Advice formulated at the June 2010 SC Meeting	SC Reports 2010, pp. 28-30
		Monitoring of Cod in Div. 3NO, undertaken at the June 2011 SC Meeting: Scientific advice was re-iterated.	SCS Doc 11/16, p.27*
In 2011, advice should be provided for 2012 and 2013 for American plaice in Div. 3LNO	Item 2 of FC Doc 10/9 Revised	Advice formulated at the June 2011 SC Meeting.	SCS Doc 11/16, pp. 10-11*
Fisheries Commission requests the Scientific Council to identify F_{msy} , identify B_{msy} and provide advice on the appropriate selection of an upper reference point for biomass (e.g. B_{buf}) for 3LNO American Plaice, 3NO cod and 3LN redfish	Item 7 of FC Doc 10/9 Revised	Advice formulated at the June 2011 SC Meeting.	SCS Doc 11/16, pp. 29-30*
Fisheries Commission requests the Scientific Council to review the stock recruit relationship for 3NO cod and the historical productivity regime used in setting the Blim value of 60 000t	Item 8 of FC Doc 10/9 Revised	Advice formulated at the June 2011 SC Meeting.	SCS Doc 11/16, p. 30*

*The SC June 2011 Meeting Report (SCS Doc 11/16) has been adopted by the Scientific Council. Pagination of the report may change due to formatting of the report document for publication.

Evaluation of Rebuilding and Recovery Plans

Fisheries Commission requested (Item 6 of FC Doc 09/17):

Many of the stocks in the NAFO Regulatory Area are well below any reasonable level of B_{lim} or B_{buf} . For these stocks, the most important task for the Scientific Council is to inform on how to rebuild the stocks. In this context and building on previous work of the Scientific Council in this area, the Scientific Council is requested to evaluate various scenarios corresponding to recovery plans with timeframes of 5 to 10 years, or longer as appropriate. This evaluation should provide the information necessary for the Fisheries Commission to consider the balance between risks and yield levels, including information on the consequences and risks of no action at all.

- a) *information on the research and monitoring required to more fully evaluate and refine the reference points described in paragraphs 1 and 3 of Annex II of the Agreement; these research requirements should be set out in the order of priority considered appropriate by the Scientific Council;*

Response: Many NAFO stocks have limit reference points (LRP) or proxies, but few have all the reference points necessary to fully delineate the NAFO PA framework (e.g. buffer RPs). In some cases, neither reference points nor proxies can be calculated (or agreed) with the data available. In other cases, proxies for biomass-based LRP have been derived from time series of survey data, but in general, some population modeling is required to produce limit reference points.

In the NAFO PA framework, there are no stocks where buffer reference points have been defined. This prevents the full application of the PA framework, in that the “Safe Zone” cannot be fully delineated. In some cases, where stocks are shown to be above B_{msy} , and F is below F_{msy} , stocks have been assumed to be in the Safe Zone. In some other jurisdictions, the buffer reference points have been replaced by points such as B_{msy} , or some fraction thereof, referred to in language such as an Upper Stock Reference. Perhaps the concept of reference points is worth revisiting for certain stocks under the NAFO PA Framework.

- b) *any other aspect of Article 6 and Annex II of the Agreement which the Scientific Council considers useful for implementation of the Agreement's provisions regarding the precautionary approach to capture fisheries;*

Response: Paragraph 2 of Annex II introduces the concept of target reference points. Few NAFO stocks have explicit target RPs, or a complete suite of pre-agreed conservation and management actions in all the PA zones.

Scientific Council considers it is important that RPs and Harvest Control Rules be properly tested, to ensure that they are compliant with the Precautionary Approach (PA). Management strategy evaluation to test harvest control rules is a good solution, recognizing that this is labor intensive and requires specialized expertise not generally available within Scientific Council. The NAFO PA framework does not explicitly deal with rebuilding scenarios, although Fisheries Commission has asked Scientific Council to consider these situations in its advice for stocks below B_{lim} . One approach would be to consider developing rebuilding strategies for any particular stocks in conjunction with Fisheries Commission.

- c) *propose criteria and harvest strategies for new and developing fisheries so as to ensure they are maintained within the Safe Zone.*

Response: In the case of reopened or new fisheries, initial TACs should be conservative enough to ensure high probability that the stock does not fall below the prescribed limit, as indicated in Paragraph 6 of Article 6. Scientific Council has followed this practice in its advice for re-opened stocks such as Div. 3LNO yellowtail, Div. 3M cod, and Div. 3LN redfish.

- d) *Provide, at its annual meeting in 2010, an overview of strategies to recover depleted fish stocks in the Northwest Atlantic, taking into account the proceedings of the NAFO co-sponsored “ICES PICES UNCOVER Symposium on Rebuilding Depleted Fish Stocks - Biology, Ecology, Social Science and Management Strategies” which is to take place November 3-6 2009 in Warnemünde, Germany.*

Response: The following are some key observations from the UNCOVER Symposium in 2009, as contained in the summary report (SCS Doc. 10/18) reviewed by Scientific Council in June 2010:

- There is a rich knowledge of stock rebuilding experiences available to draw upon. The current evidence is overwhelming that management can be effective in rebuilding of fisheries and restoring the economic and social benefits derived from sustainable fisheries.
- Stock recovery needs to be carefully considered as the end points may not be well known. While stock rebuilding may be possible, stock recovery may not. If fisheries-induced evolutionary changes have occurred, or if ecosystem and climate changes have significantly altered depleted fish stocks, restored stocks (in terms of biomass) may differ markedly from their status prior to depletion. In some cases, recovery to former biomass levels may not be possible.
- Uncertainties will always exist with respect to the stock rebuilding/stock recovery process, but these uncertainties should not undermine the development and implementation of recovery plans. A precautionary and adaptive approach may be required to avoid delays in taking effective action, not only for stocks already in dire straits, but to keep those that are beginning to show signs of reduction from becoming depleted.
- Significant investments will be required in fishery science. New assessment tools will be needed when stocks are managed at much lower rates (e.g, $F = M$). Fishery science will need to more integrated in the future and incorporate habitat, environmental, and ecosystem aspects.
- The human and economic costs of stock recovery to society need to be documented and communicated. Recognition of the considerable costs and resources involved in recovery efforts should help management to vigorously avoid stock collapses in the future. Stock recovery invariably implies significant transition costs.

It was also thought that most successful rebuilding programs have incorporated substantial, measurable reductions in fishing mortality at the onset, rather than relying on incremental small reductions over time.

In considering NAFO-managed stocks below B_{lim} and therefore in need of rebuilding, Scientific Council advises that the main strategy to consider is keeping fishing mortality as low as possible, as even when directed fisheries are closed, by-catches in other fisheries often generate fishing mortalities which hinder rebuilding. This may be necessary for extended periods. Rebuilding targets should be set so as to achieve sustainable long-term yields; one rebuilding target with well-known properties which has been agreed to in many jurisdictions is B_{msy} . Rebuilding plans should include a reasonable timeframe for stock recovery, recognizing the uncertainties involved. B_{lim} is not a rebuilding target for stocks, and rebuilding plans must include harvest strategies which have low risks of stocks again declining below B_{lim} , once fisheries are reopened. Harvest control rules should be compliant with the NAFO precautionary approach framework, and be tested through simulations where possible, rather than be chosen on an *ad hoc* basis. For stocks with a biomass below B_{buf} or fishing mortality greater than F_{buf} , yield must be balanced against stock growth by reducing F below F_{buf} , while ensuring a low probability that biomass will decline below B_{lim} .

Scientific Council further noted that most NAFO rebuilding actions for stocks below B_{lim} are related to bycatch control, which poses additional difficulties. The NAFO PA framework has not been revised since its adoption in 2004 (FC Doc. 04/17), and should be examined particularly with regard to how rebuilding could be achieved for depleted stocks - whether under bycatch or directed fishing. Again, one approach would be to consider developing rebuilding strategies for any particular stocks in conjunction with Fisheries Commission.

Cod in Div. 3NO

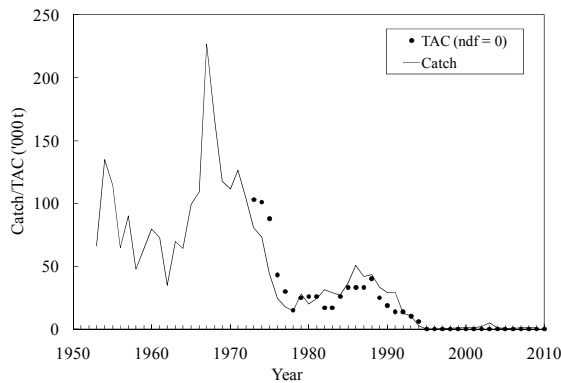
Background: This stock occupies the southern part of the Grand Bank of Newfoundland. Cod are found over the shallower parts of the bank in summer, particularly in the Southeast Shoal area (Div. 3N) and on the slopes of the bank in winter as cooling occurs.

Fishery and Catches: This stock has been under moratorium to directed fishing since February 1994. Since the moratorium catch increased from 170 t in 1995, peaked at about 4 800 t in 2003 then declined to 600 t in 2006. Since 2006 catches have increased steadily to 1 100 t in 2009.

Year	Catch ('000 t)		TAC ('000 t)	
	STACFIS	21A	Recommended	Agreed
2007	0.8	0.7	ndf	ndf
2008	0.9	0.7 ¹	ndf	ndf
2009	1.1	0.6 ¹	ndf	ndf
2010			ndf	ndf

¹ Provisional.

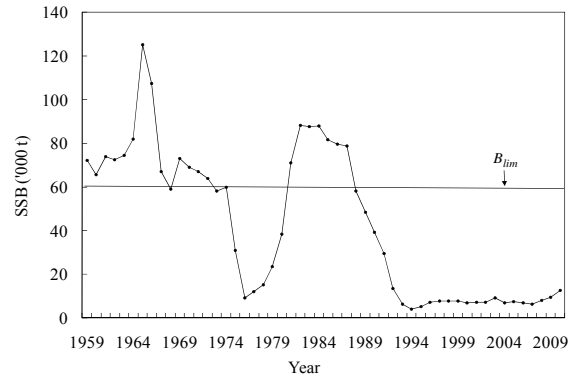
ndf No directed fishing.



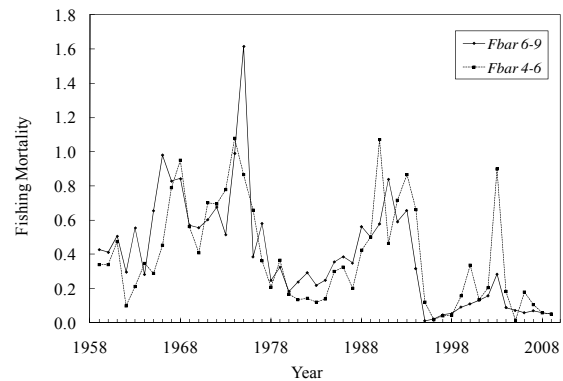
Data: Length and age composition were available from the 2007-2009 trawler fisheries to update catch at age. Canadian spring (1984-2009), autumn (1990-2009), and juvenile (1989-1994) surveys; and EU-Spain Div. 3NO May-June surveys provided abundance, biomass and size structure information.

Assessment: An analytical assessment was presented to estimate population numbers, biomass and SSB at 1 Jan in 2010.

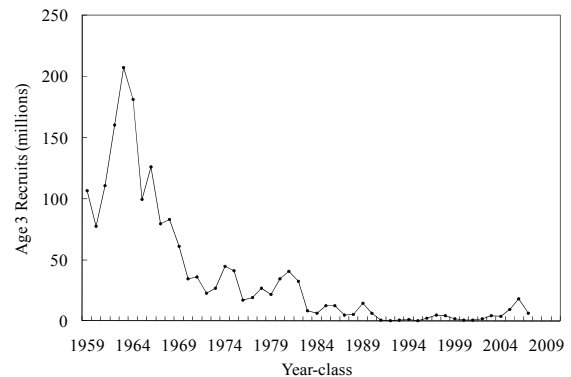
Biomass: The 2010 total biomass and spawning biomass remain low but are estimated to be at their highest levels since 1992.



Fishing Mortality: Has been declining since 2006. Estimates for ages 4-6 in 2008 and 2009 are less than 0.06 and are amongst the lowest estimated during the moratorium.

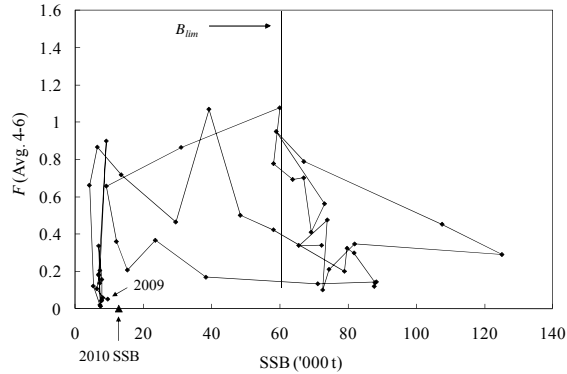


Recruitment: Remains low but has been improving in recent years with current estimates of the 2005-2007 year classes comparable to those from the mid- to late 1980s.



State of the Stock: Remains relatively low but has improved in recent years to levels just prior to the moratorium. Nevertheless, SSB is still well below B_{lim} .

Reference Points: The current best estimate of B_{lim} is 60 000 t. SSB in 2010 is estimated to be 12 700 t which is 21% of B_{lim} .



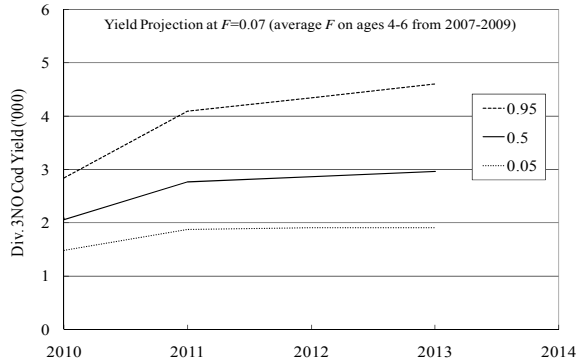
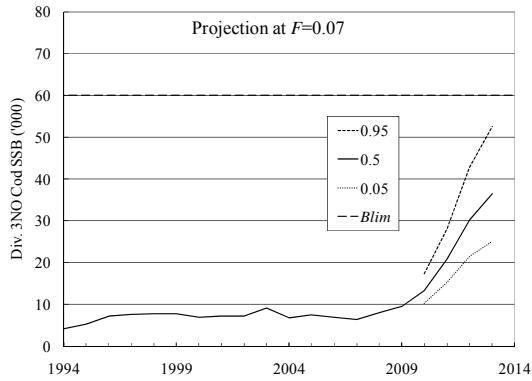
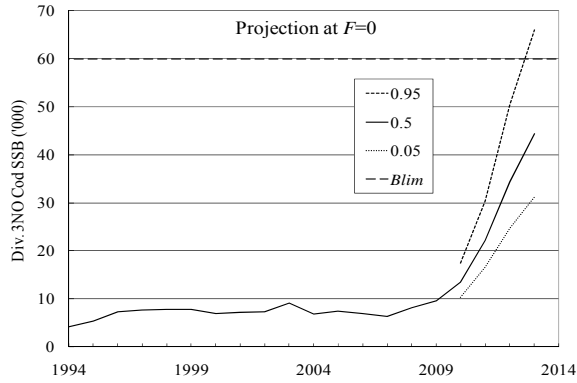
Stochastic Projection Results:

F=0 Percentile	Beginning of Year SSB			
	2010	2011	2012	2013
0.95	17456	30414	50423	66023
0.75	14963	25056	39827	51819
0.5	13498	22181	34369	44368
0.25	12150	19752	30157	38374
0.05	10283	16572	24722	31190

F=0.07 Percentile	Beginning of Year SSB			
	2010	2011	2012	2013
0.95	17358	27999	42894	52622
0.75	14853	23418	34660	42223
0.5	13388	20791	30294	36493
0.25	12028	18165	26116	31222
0.05	10261	15263	21474	25067

F=0.07 Percentile	Yield			
	2010	2011	2012	2013
0.95	2843	4092	4343	4602
0.75	2356	3237	3382	3567
0.5	2054	2765	2862	2957
0.25	1768	2351	2419	2461
0.05	1478	1877	1904	1909

Short-term considerations: Simulations were carried out to examine the trajectory of the stock under two scenarios of fishing mortality: $F=0$, $F=0.07$ (the average F on ages 4-6 from 2007-2009). Simulations were limited to a 3-year period. Given the SSB is still estimated to be well below B_{lim} , recruitment (at age 3) was only re-sampled from 1994-2009 as this represents a reasonable expectation of what has occurred under low productivity conditions. At $F = 0$ spawning stock biomass is estimated to increase and there is an 88% probability that SSB will remain under B_{lim} by 2013. At $F = 0.07$ the population is estimated to grow more slowly. If the fishing mortality in 2010-2012 remains at the average estimated in 2007-2009 then yield is estimated to increase over the 3-year time period.



Recommendation: There should be no directed fishing for cod in Div. 3N and Div. 3O in 2011-2013. Bycatches of cod should be kept to the lowest possible level and restricted to unavoidable bycatch in fisheries directed for other species.

Special Comments: The next assessment will be in 2013.

Sources of Information: SCR. Doc. 10/9, 42; SCS Doc. 10/5, 6, 7; 09/5, 09/12; 08/5, 6, 7.

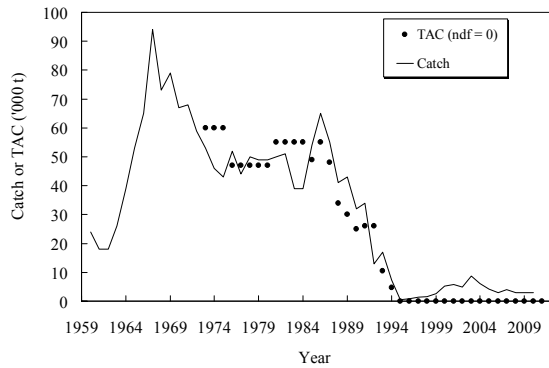
American plaice in Divisons 3LNO

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. Total catch in 2010 was 2 898 t, mainly taken in the Regulatory Area.

Year	Catch ('000 t)		TAC ('000 t)	
	STACFIS	21	Recommended	Agreed
2008	2.5	1.9	ndf	ndf
2009	3.0	1.8	ndf	ndf
2010	2.9	1.5	ndf	ndf
2011			ndf	ndf

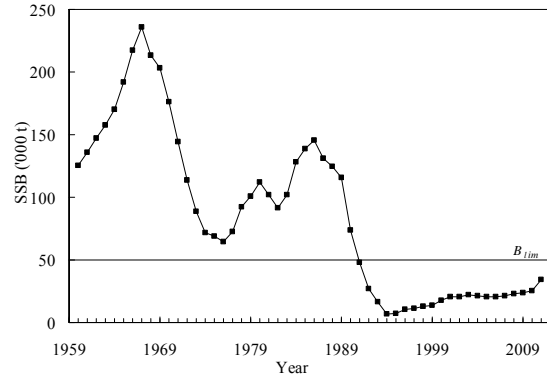
ndf No directed fishing.



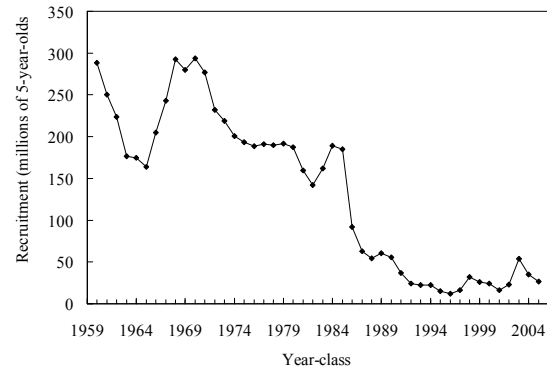
Data: Biomass and abundance data were available from: annual Canadian spring (1985-2010) and autumn (1990-2010) bottom trawl surveys; and EU-Spain surveys in the NAFO Regulatory Area of Div. 3NO (1995-2010). Age data from Canadian bycatch as well as length frequencies from EU-Portugal and EU-Spain bycatch were available for 2010.

Assessment: An analytical assessment using the ADAPTive framework tuned to the Canadian spring, Canadian autumn and the EU-Spain Div. 3NO survey was used. Natural mortality (*M*) was assumed to be 0.2 on all ages except from 1989-1996, where *M* was assumed to be 0.53 on all ages.

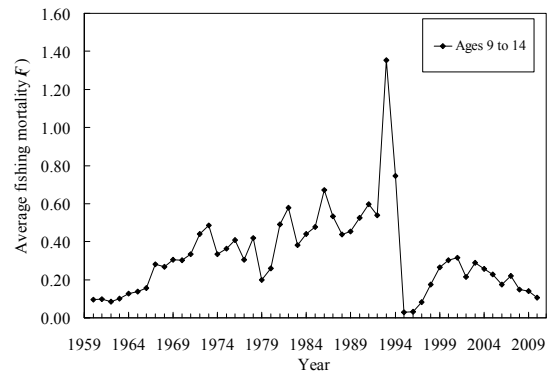
Biomass: Despite the increase in biomass since 1995, the biomass is very low compared to historic levels. SSB declined to the lowest estimated level in 1994 and 1995. SSB has been increasing since then and is currently at 34, 000 t. *B_{lim}* for this stock is 50 000 t.



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.

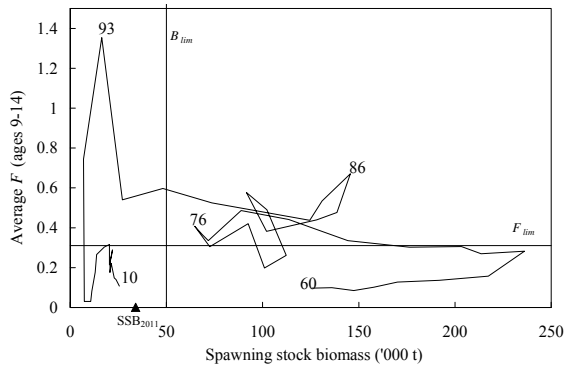
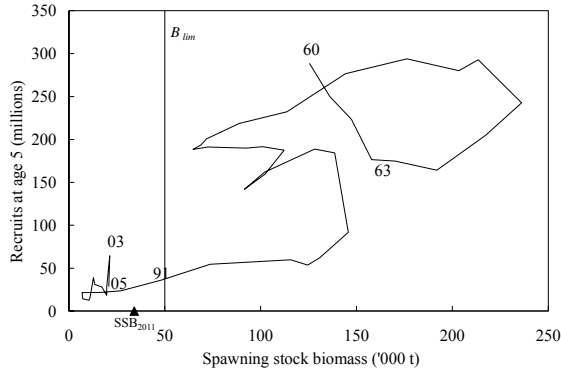


Fishing mortality: Fishing mortality on ages 9 to 14 has generally declined since 2001.



State of the Stock: 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.

Reference Points: An examination of the stock recruit scatter shows that good recruitment has rarely been observed in this stock at SSB below 50 000 tons and this is currently the best estimate of B_{lim} . In 2011 STACFIS adopted an F_{lim} of 0.31 for this stock based on F_{MSY} (see SC VII.1.d.i). The stock is currently below B_{lim} and current fishing mortality is below F_{lim} .



Short term considerations: Simulations were carried out 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). Simulations were limited to a 2-year period. Recruitment was resampled from three sections of the estimated stock recruit scatter, depending on SSB.

SSB is projected to have a 50% probability of reaching B_{lim} by the start of 2014 (i.e. end of 2013) when $F=0$. Although SSB is also projected to increase slowly with $F_{current}$ and $F_{0.1}$ the probability of reaching B_{lim} by the start of 2014 under these scenarios is less than 50%.

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			

Recommendation: There should be no directed fishing on American plaice in Div. 3LNO in 2012 and 2013. Bycatches of American plaice should be kept to the lowest possible level and restricted to unavoidable bycatch in fisheries directing for other species.

Special Comment: The next full assessment of this stock will be conducted in 2013.

Sources of Information: SCS Doc. 11/4, 5, 7, 11; SCR Doc. 11/5, 19, 32, 37, 39

d) Special Requests for Management Advice

i) Reference point for Div. 3LNO A. plaice, Div. 3NO Cod, Div. 3LN redfish (Item 7)

Fisheries Commission requests the Scientific Council to identify F_{msy} , identify B_{msy} and provide advice on the appropriate selection of an upper reference point for biomass (e.g. B_{buf}) for 3LNO American Plaice, 3NO cod and 3LN redfish.

Scientific Council responded:

Results of the last assessments of these stocks (2010) were used in the estimation of reference points. Div. 3LN redfish is assessed using a surplus production model (ASPIC) and the reference points for that stock are derived directly from the results of the ASPIC. For Div. 3NO cod and Div. 3LNO American plaice reference points were obtained through simulation by running the population to equilibrium with the dynamics determined by the spawner-recruit relationship, together with weights, maturity and partial recruitment vectors. Scientific Council notes that the available data for 3NO cod and 3LNO American plaice do not span the entire production curve and therefore large uncertainty in the estimated reference points can be expected.

	Div. 3LNO American plaice	Div. 3NO cod	Div. 3LN redfish
F_{msy}	0.31	0.30	0.13
B_{msy}	242 000 t SSB	248 000 t SSB	186 000 t

B_{buf} is a stock biomass level above B_{lim} that is required in the absence of analyses of the probability that current or projected biomass is below B_{lim} . All three of the stocks in the present request have analyses of the probability that biomass is below B_{lim} and a B_{buf} is not required. For these stocks an additional zone(s) between B_{lim} and B_{msy} in the NAFO Precautionary Approach Framework could be considered.

Changes in population biology and in fishing practices can have a large impact on the estimated level of some reference points. For example, for Div. 3LNO American plaice, although the estimate of F_{msy} of 0.31 is considered to be the most appropriate at this time, estimates of F_{msy} ranged from 0.21 to 0.47 depending on the period used to compute the input parameters. These reference points therefore need to be reevaluated on a regular basis, the frequency of which will be stock specific depending on how much change there is in biological parameters and fisheries selectivity over time.

The use of any of these reference points in a precautionary approach framework or rebuilding plan needs to be evaluated for any stock to which they are applied. There needs to be a harvest control rule (management strategy) which is mathematically explicit in order to allow formal testing. Any proposed management/rebuilding strategy should be subject to robustness testing to determine the merit of the proposed strategy. This should then be followed by full management strategy evaluation. All such analyses conducted for the Fisheries Commission should be thoroughly peer reviewed by Scientific Council.

ii) Stock recruit relationship and B_{lim} for Div. 3NO cod (Item 8)

Fisheries Commission requests the Scientific Council to review the stock recruit relationship for 3NO cod and the historical productivity regime used in setting the B_{lim} value of 60 000t.

Scientific Council responded:

The stock recruit data for Div. 3NO cod from the most recent assessment (2010) were examined. Six different stock recruit models were fit to these data. While no particular S-R approach is strongly supported by the data, the Loess smoother fitted to log recruitment provides a general description of the past response of recruitment to SSB and can be used as a basis for deriving reference points. This model gives an estimate of B_{lim} of about 60 000 t.

The Scientific Council will review in detail the biological reference points in the context of the PA framework when the SSB has reached half the current estimate of B_{lim} . In order to conduct this review a number of stock recruit pairs are required once the stock has reached and exceeded 30 000 t of SSB. The most recent estimate of SSB (from the 2010 assessment) for this stock is 12 700 t. In the most optimistic projection scenario ($F=0$) the stock will not be above 30 000 t of SSB until 2012. It will be 2015 before recruitment at age 3 produced by the 2012 SSB is observed.

There is no basis at this stage to suggest a B_{lim} lower than 60 000 t of SSB.

Annex 4. Interim 3LNO American Plaice Conservation Plan and Rebuilding Strategy
(FCWG-CPRS Working Paper 11/3, Revision 5)

1. Objective(s):

- a) Long-term Objective: The long-term objective of this Conservation Plan and Rebuilding Strategy is to achieve and to maintain the 3LNO American plaice Spawning Stock Biomass (SSB) in the ‘safe zone’, as defined by the NAFO Precautionary Approach framework, and at or near Bmsy.
- b) Interim Milestone: As an interim milestone, increase the 3LNO American plaice Spawning Stock Biomass (SSB) to a level above the Limit Reference Point (Blim). It may reasonably be expected that Blim will not be reached until after 2014.

2. Reference Points:

- a) Limit reference point for spawning stock biomass (Blim) – 50,000t
- b) An intermediate stock reference point or security margin BISR¹ – [100,000t]
- c) Limit reference point for fishing mortality (Flim = Fmsy) – 0.31
- d) Bmsy – [242,000t]

3. Re-opening to Directed Fishing:

- a) A re-opening of a directed fishery should only occur when the estimated SSB, in the year projected for opening the fishery, has a very low² probability of actually being below Blim.
- b) An annual TAC should be established at a level which is projected to result in:
 - i. continued growth in SSB,
 - ii. low³ probability of SSB declining below Blim throughout the subsequent 3-year period, and
 - iii. fishing mortality < F0.1

4. Harvest Control Rules:

Noting the desire for relative TAC stability, the projections referred to in items (a) through (d) below should consider the effect of maintaining the proposed annual TAC over 3 years. Further, in its application of the Harvest Control Rules, Fisheries Commission may, based on Scientific Council analysis, consider scenarios which either mitigate decline in SSB or limit increases in TACs as a means to balance stability and growth objectives.

- 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 between Blim and BISR:
 - i. TACs should be set at a level(s) to allow for continued growth in SSB consistent with established rebuilding objective(s),
 - ii. TACs should result in a low probability of SSB declining below Blim throughout the subsequent 3-year period, and
 - iii. Biomass projections should apply a low risk tolerance
- c) When SSB is above BISR:
 - i. TACs should be set at a level(s) to allow for growth in SSB consistent with the long term objective, and
 - ii. Biomass projections should apply a risk neutral approach (i.e. mean probabilities)

¹ A ‘buffer zone’ (Bbuf) is not required under the NAFO PA given the availability of risk analysis related to current and projected biomass values; however, SC has advised that an additional zone(s) between Blim and Bmsy could be considered. An intermediate stock reference point (BISR) is proposed to delineate this zone. The proposed value is equivalent to twice Blim.

² ‘very low’ means 10% or less

³ ‘low’ means 20% or less

- d) When SSB is above B_{msy} :
- i. TACs should be set at a level of F that has a low probability of exceeding F_{msy} , and
 - ii. Biomass projections should apply a risk neutral approach (i.e. mean probabilities)

Annex 5. Interim 3NO Cod Conservation Plan and Rebuilding Strategy
(FCWG-CPRS Working Paper 11/4, Revision 3)

1. Objective(s):

- a) Long-term Objective: The long-term objective of this Conservation Plan and Rebuilding Strategy is to achieve and to maintain the 3NO Cod Spawning Stock Biomass (SSB) in the 'safe zone', as defined by the NAFO Precautionary Approach framework, and at or near Bmsy.
- b) Interim Milestone: As an interim milestone, increase the 3NO Cod Spawning Stock Biomass (SSB) to a level above the Limit Reference Point (Blim). It may reasonably be expected that Blim will not be reached until after 2015.

2. Reference Points:

- a) Limit reference point for spawning stock biomass (Blim) – 60,000t¹
- b) An intermediate stock reference point or security margin BISR² – [120,000t]
- c) Limit reference point for fishing mortality (Flim = Fmsy) – 0.30
- d) Bmsy – [248,000t]

3. Re-opening to Directed Fishing:

- a) A re-opening of a directed fishery should only occur when the estimated SSB, in the year projected for opening the fishery, has a very low³ probability of actually being below Blim.
- b) An annual TAC should be established at a level which is projected to result in:
 - i. continued growth in SSB,
 - ii. low⁴ probability of SSB declining below Blim throughout the subsequent 3-year period, and
 - iii. fishing mortality < F0.1

4. Harvest Control Rules:

Noting the desire for relative TAC stability, the projections referred to in items (a) through (d) below should consider the effect of maintaining the proposed annual TAC over 3 years. Further, in its application of the Harvest Control Rules, Fisheries Commission may, based on Scientific Council analysis, consider scenarios which either mitigate decline in SSB or limit increases in TACs as a means to balance stability and growth objectives.

- 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

Before SSB increases above Blim, additional or alternative harvest control rules should be developed, following the Precautionary Approach, to ensure the long-term objective is met, such as:

- b) When SSB is between Blim and BISR:
 - i. TACs should be set at a level(s) to allow for continued growth in SSB consistent with established rebuilding objective(s),
 - ii. TACs should result in a low probability of SSB declining below Blim throughout the subsequent 3-year period, and
 - iii. Biomass projections should apply a low risk tolerance

¹ The Fisheries Commission shall request the Scientific Council to review in detail the limit reference point when the Spawning Stock Biomass has reached 30,000t.

² A 'buffer zone' (Bbuf) is not required under the NAFO PA given the availability of risk analysis related to current and projected biomass values; however, SC has advised that an additional zone(s) between Blim and Bmsy could be considered. An intermediate stock reference point (BISR) is proposed to delineate this zone. The proposed value is set at a level equivalent to twice Blim. Should the SC review of the limit reference point (Blim) result in a change to that value then the intermediate stock reference point (BISR) should also be re-evaluated.

³ 'very low' means 10% or less

⁴ 'low' means 20% or less

- c) When SSB is above B_{isr} :
 - i. TACs should be set at a level(s) to allow for growth in SSB consistent with the long term objective, and
 - ii. Biomass projections should apply a risk neutral approach (i.e. mean probabilities)
- d) When SSB is above B_{msy} :
 - i. TACs should be set at a level of F that has a low probability of exceeding F_{msy} , and
 - ii. Biomass projections should apply a risk neutral approach (i.e. mean probabilities)

5. Ecosystem Considerations:

Considering the importance of capelin as a food source, consistent with the ecosystem approach, the moratorium on 3NO capelin will continue until at least December 31, 2015.