A QUALITATIVE REVIEW OF THE COMPLIANCE OF THE TAC DECISION RULES FOR COD IN THE SOUTHERN GULF OF ST. LAWRENCE (MARCH 7, 2005) AND IN THE NORTHERN GULF OF ST. LAWRENCE (JANUARY 28, 2005) TO THE PRECAUTIONARY APPROACH

Context

The directed cod fisheries in the southern (NAFO 4T-Vn (November-April)) and northern (3Pn, 4RS) Gulf of St. Lawrence were closed in September 1993 and January 1994, respectively, due to stock collapse. The directed cod fisheries were re-opened in 1997 in the northern Gulf and in 1998 in the southern Gulf. These fisheries were closed again in 2003 because stock assessments indicated that abundance was at historically low levels, below the level where serious harm had been done, and showed no signs of imminent recovery despite a decade of reduced landings. In 2003, cod catches from surveys and by-catches in other fisheries amounted to 288 t and 406 t in the southern and northern Gulf respectively. In 2004, the fisheries were re-opened with Total Allowable Catches (TACs) of 3,000 t in the southern Gulf and 3,500 t in the northern Gulf and industry were required '….to agree, prior to the fishery opening, to procedures to determine quotas for 2005 and beyond' (DFO News Release, May 4, 2004). These procedures were called 'TAC Decision Rules' and were required to be developed for both stocks in an approach of shared stewardship with industry. An iterative process led by DFO Fisheries and Aquaculture Management (FAM) and involving industry and DFO Science in an advisory role led to the development of draft TAC Decision Rules in early 2005 (Appendix I (southern Gulf) and II (northern Gulf)). While the Precautionary Approach was a guiding principle in the development of the rules, it was not mandatory. At the end of this consultative process, these TAC Decision Rules were not fully endorsed and were set aside in both 2005 and 2006 and not used for TAC determination. For the southern Gulf cod, the TAC was set at 4,000 t for both years. For the northern Gulf cod, the TAC was set at 5,000 t in 2005 and 6,000 t in 2006. On September 27, 2006, DFO Science was asked by FAM to conduct 'an internal Science review of the strength and weaknesses of the existing rules in relation to the compliance with (the) Precautionary Approach', as outlined in CSAS SAR 2006/023, in preparation for further discussions with industry to be held later in fall 2006. The current review pertains to the Draft TAC Decision Rules of March 7, 2005 and January 28, 2005 for the southern and northern Gulf of St. Lawrence cod respectively. The review examined the form of the rules and whether or not they conform to the minimum requirements of the Precautionary Approach.

Background

The Precautionary Approach (PA) is a general philosophy to managing threats of serious or irreversible harm where there is scientific uncertainty. Good risk management compels us to use caution and to take uncertainty into account when making decisions. The application of precaution requires increased risk avoidance where there is risk of serious harm and uncertainty is great. Canada signed the United Nations Fish Stock Agreement (UNFSA - also commonly referred to as UNFA) in 1995 and ratified it in 1999. The Agreement came into effect

in December 2001, and amongst other things, it compels countries to use the PA in the management of fisheries. A harvest strategy is an essential component of fishery management plans. A harvest strategy compliant with the PA includes a Removal Reference for three stock status zones (Critical; Cautious; Healthy) delineated by a Limit Reference Point and an Upper Stock Reference as defined below (CSAS SAR 2006/023):

- The *Upper stock reference point* is the stock level threshold below which the removal rate is reduced. As such it applies to exploited populations. This reference point is determined by productivity objectives for the fishery. These objectives will vary among species and fisheries and include biological, social and economic factors. The stock status zone above the Upper stock reference is called the *Healthy* zone.
- The *Limit reference point* is the stock level below which productivity is sufficiently impaired to cause serious harm but above the level where the risk of extinction becomes a concern. In this context, serious harm could be due to over-fishing, other human induced mortality, or changes in population dynamics not related to fishing. The stock status zone above the Limit reference point but below the Upper stock reference is called the *Cautious* zone. The zone below the Limit reference point is called the *Critical* zone.
- *The Removal reference* is the maximum acceptable removal rate. The removal rate is the ratio of all human induced removals and total exploitable stock size. To comply with the UNFSA, it must be less than or equal to the removal rate associated with maximum sustainable yield. The Removal Reference includes all human-induced mortality.

The Stock references and Removal reference are defined for “normal” conditions and may be adjusted to reflect changes in stock dynamics. The reference points will be determined by the best available science.

In addition to taking uncertainty into account and exercising increased risk avoidance when there is risk of serious harm, the minimal requirements of a PA compliant harvest strategy are as follows:

- In the Healthy zone, the stock status is considered to be good. In this zone, the removal rate should not exceed the Removal reference.
- In the Cautious zone, fisheries management actions should promote stock rebuilding towards the Healthy zone. The removal rate should not exceed the Removal reference. The Removal reference should progressively decrease as the stock level approaches the Critical zone. Any progressively decreasing removal reference in the Cautious zone is permissible.
- In the Critical zone, the status of the stock has declined to such a low level that it is considered to be in a precarious state. In this zone, fishery management actions must promote stock growth. Removals by all human sources must be kept to the lowest possible level.

Evaluation of the form of the Draft TAC Decision Rules

The form of the TAC decision rules was compared qualitatively to the requirements of a harvest strategy compliant with the precautionary approach. The review did not examine the validity of the individual indicators and overall stock index, or the basis for the reference points. The following conclusions regarding the compliance of the procedure to the PA were arrived at:

Southern Gulf of St. Lawrence Cod

- Compliant aspects
  - Use of a three- zone framework and reference points that correspond to those described in CSAS SAR 2006/023.
  - The limit reference point of 80,000 t (LRP) has been established on the basis of peer-reviewed science.
  - The stated goals are for the stock to rebuild to and remain in the Healthy zone.

- Partially compliant aspects
  - The best estimate of the LRP provided by Science is 80,000 t. The framework allows for a range between 70,000 and 90,000 t. This means that under certain conditions the range of biomass between 70,000 and 80,000 may be considered to be in the Cautious zone. Revising the lower bound of the zone to 80,000 t would make this rule fully compliant with the PA.
  - The TAC Decision Rules for southern Gulf of St. Lawrence propose a proxy for an index of population size called the Overall Adult Stock Indicator (OASI). The OASI is the average of various normalized abundance indicators for the stock. The peer-reviewed Science Advisory Report (SAR) derives a best estimate of population size that differs from the OASI. Until the performance of the proxy OASI has been evaluated, use of the peer-reviewed estimate of population size from the stock assessment would be preferable.

- Non-compliant aspects
  - Catches in the Critical zone are not set to the lowest possible in order to promote stock growth.
  - The use of a default 'starting' TAC in the Critical zone is not compliant with the Precautionary Approach.
  - Uncertainties are not explicitly taken into account and risk aversion is not specified.
  - The suggested maximum removal reference of 23% is not based on current stock productivity and would be higher than the removal rate associated with maximum sustainable yield given the current high natural mortality.
  - The Upper Stock Reference does not correspond to the peer reviewed estimate that considered only conservation objectives. Deviations from the conservation-based estimate to account for social and economic objectives should be documented.

- Suggested improvements to the TAC Decision Rules
  - There needs to be a more formal description of how uncertainties and risk aversion are taken into account in the framework.
  - Given the current depressed status of the stock, it would be important to first concentrate on making the rules for the Critical zone compliant with the PA.
    - During the period of the moratorium when the directed fishery was closed, catches averaged 1,273 t per year. In 2003, the fishery was closed again and by-catches

were closely controlled resulting in a total catch of 288 t. A catch of 300 t is considered to be the lowest possible (= practicable) catch level.

- In addition, it is suggested that the lowest possible catch be set to attain a high probability of growth in SSB. If this goal cannot be attained, then efforts to further reduce the lowest possible catch (for example, more stringent rules on by-catch in other fisheries) should be made. In the Critical zone fisheries management actions must promote stock growth.

- It is recommended that the best possible peer-reviewed estimates of stock status be used to guide TAC Decision Rules until the performance of the OASI is evaluated.
- Procedures for varying the removal reference in the Cautious zone should ensure that the removal reference is progressively decreasing as stock status declines.
- Given the current high natural mortality, the reference removal rate in the Healthy zone is too high and should be calculated taking into account stock productivity. Recent analyses indicate that even a low exploitation rate would not be sustainable if current conditions persist.

Northern Gulf of St. Lawrence Cod

- Compliant aspects
  - The rules in their present form appear to have been developed outside of a precautionary context and, accordingly, do not conform to any of the elements normally found in a Precautionary Approach framework.

- Partially compliant aspects
  - The TAC Decision Rules for northern Gulf of St. Lawrence propose a proxy for an index of population size called the Overall Adult Stock Indicator (OASI). The OASI is the average of various normalized abundance indicators for the stock. The peer-reviewed Science Advisory Report (SAR) derives a best estimate of population size that differs from the OASI. Until the performance of the proxy OASI has been evaluated, use of the peer-reviewed estimate of population size from the stock assessment would be preferable.

- Non-compliant aspects
  - The TAC Decision Rules for the northern Gulf of St. Lawrence cod do not use a three zone framework (Critical:Cautious:Healthy) and a removal reference is not specified.
  - Catches are not set to the lowest possible when stock status is considered to be below the Limit Reference Point.
  - There is no provision to reduce the harvest rate as the stock status becomes worse.
  - Uncertainties are not explicitly taken into account and risk aversion is not specified.

- Suggested improvements to the TAC Decision Rules
  - Adopt a three zone framework and establish a removal reference.
  - The most recent assessment of this stock (DFO SAR 2006/010), indicates that SSB is well below the limit reference point and hence in the Critical zone. When in the Critical

zone, the current rules do not imply that catches be set at the lowest possible level. A catch of 400 t is considered to be the lowest possible catch level for this stock.

- o There needs to be a more formal description of how uncertainties and risk aversion are taken into account in the framework.
- o It is recommended that the best possible peer-reviewed estimates of stock status be used to guide TAC Decision Rules until the performance of the OASI is evaluated.
- o Specific rules for varying the harvest rate in the Cautious zone should be developed and evaluated for compliance with the PA.

Conclusions

A number of revisions to the southern and northern Gulf of St. Lawrence cod TAC Decision Rules are required to make them compliant with the minimum requirements of the precautionary approach. The introduction of TAC Decision Rules compliant with the PA is a positive development in terms of achieving sustainable fisheries management. However, the performance of alternative TAC decision rules needs to be evaluated through interpretation of the information regarding stock status, including uncertainties. This requires management objectives to be stated and related to strategies, tactics and performance measures.

Contributors

Participant	Affiliation	Contributed to review of:
Martin Castonguay	DFO, Science, Québec Region	Southern and northern Gulf cod
Ghislain Chouinard	DFO, Science, National Capital Region	Southern and northern Gulf cod
Daniel Duplisea	DFO, Science, Québec Region	Southern and northern Gulf cod
Alain Fréchet	DFO, Science, Québec Region	Northern Gulf cod
Johanne Gauthier	DFO, Science, Québec Region	Northern Gulf cod
Stratis Gavaris	DFO, Science, Maritimes Region	Southern and northern Gulf cod
David Gillis	DFO, Science, National Capital Region	Northern Gulf cod
Luc Légère	DFO, Fisheries and Aquaculture Management, Gulf Region	Southern Gulf cod
Gloria Poirier	DFO, Oceans and Science, Gulf Region	Southern Gulf cod
Denis Rivard	DFO, Science, National Capital Region	Southern and northern Gulf cod
Peter Shelton	DFO, Science, Newfoundland Region	Southern and northern Gulf cod
Alan Sinclair	DFO Science, Pacific Region	Southern and northern Gulf cod
Doug Swain	DFO, Oceans and Science, Gulf Region	Southern Gulf cod
Ross Tallman	DFO, Science, Central and Arctic Region	Northern Gulf cod

Approved by

Northern Gulf Cod TAC Decision Rules
Denis Rivard
Chairperson
Rules Review

Ariane Plourde
Regional Director, Science Branch
Québec Region

Southern Gulf Cod TAC Decision Rules
Ghislain Chouinard
Chairperson
Rules Review

E.M.P. Chadwick
Regional Director, Oceans and Science Branch
Gulf Region

Sources of Information

DFO, 2006. A Harvest Strategy Compliant with the Precautionary Approach. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2006/023.

This Report is Available from the:

Centre for Science Advice,
Maritimes Region and Gulf Region
Department of Fisheries and Oceans
P.O. Box 1006, Stn. B203
Dartmouth, Nova Scotia
Canada B2Y 4A2

Telephone: (902) 426-7070
Fax: (902) 426-5435
e-mail : XMARMRAP@mar.dfo-mpo.gc.ca

Centre for Science Advice,
Quebec Region
Department of Fisheries and Oceans
Maurice Lamontagne Institute, P.O. Box 1000
Mont-Joli, Quebec
Canada G5H 3Z4

Telephone: (418) 775-0825
Fax: (418) 775-0740
E-Mail: Bras@dfo-mpo.gc.ca

Internet address: www.dfo-mpo.gc.ca/csas

La version française est disponible à l'adresse ci-dessus.

Correct Citation for this Publication:

DFO, 2006. A qualitative review of the compliance of the TAC Decision Rules for cod in the southern Gulf of St. Lawrence cod (March 7, 2005) and in the northern Gulf of St. Lawrence (January 28, 2005) to the Precautionary Approach. DFO Can. Sci. Advis. Sec. Sci. Resp. 2006/001.

Appendices

Appendix I:
A strategy to determine annual TACs for the Southern Gulf cod stock (4TVn)

Draft Decision Rules

TABLE OF CONTENTS

PREAMBLE

In May 2004, the Minister of Fisheries and Oceans invited government and industry representatives to jointly establish TAC Decision Rules beginning in 2005. It was apparent from the outset of Working Group discussions that there were some differences of view on the base level of the TAC from which increases or decreases would be implemented. Despite these differences the Working Group decided to proceed with the development of TAC Decision Rules.

The industry feels very strongly that seal predation is the major cause of poor stock performance in 4TVn cod, and that any other measures will be largely futile unless and until strong action is taken to curb the predation by seals on this stock. They believe that TAC rules are very unlikely to lead to increased quotas or even maintenance of the current fishery and as a result industry members expressed muted enthusiasm for this process. Nevertheless, on the provision they could put a strong statement about the effects of seals in the front of any document produced, their consensus was to continue with these discussions. The 2003 Stock Status Report indicates changes in natural mortality of cod (observed in this stock) are consistent with changes in the abundance of grey seals in this area.

This approach has been developed in a spirit of shared stewardship and a joint desire to eventually share a single cohesive view of this important stock and fishery.

Although this annual exercise for proposing TAC Decision Rules has been completed, some work remains to be done to establish a formal accountability accord between DFO and industry. This remains to be carried out in 2005 and should provide the framework for formalizing shared stewardship for this cod stock.

STRATEGY

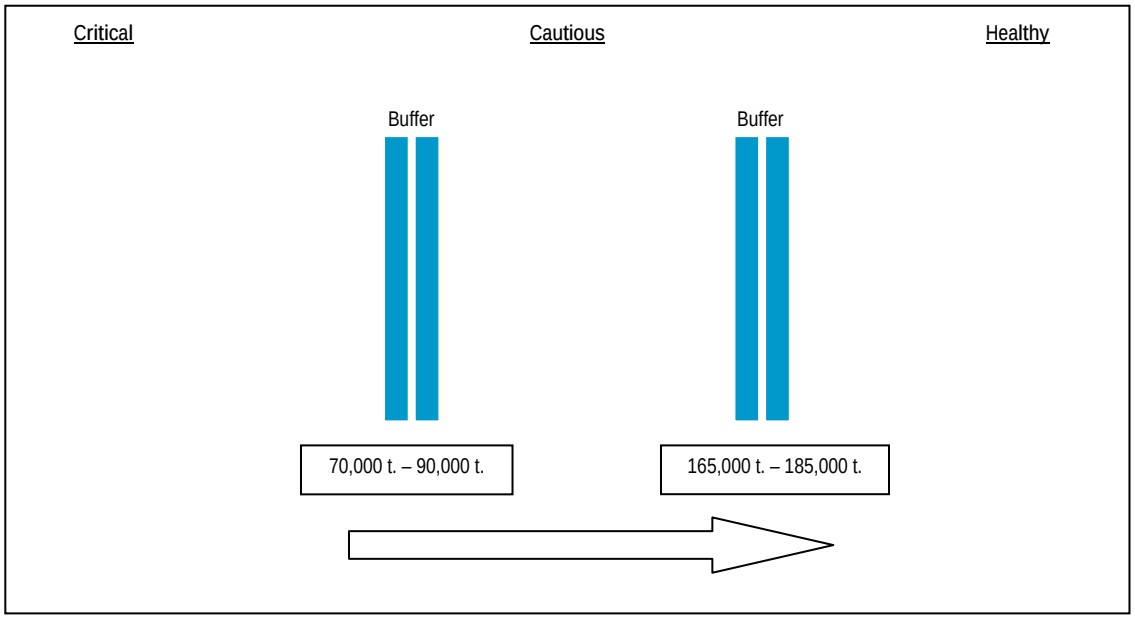
The agreed strategy is to test the state of the stock by adjusting the TAC in response to recent changes in stock condition as monitored by a suite of stock abundance indicators and also considering stock productivity. For the decision-making process in 2005, the consolidated signals from these indicators (termed the Overall Adult Stock Indicator (OASI), see appendix III) are to be based on the trend of indicators for the period 1995 to 2004. However, future decisions may incorporate relative trends in indices covering a different period, e.g. fishery catch rates since the re-opening of the fishery relative to those experienced when the stock was in a healthy condition. The percent change in the OASI from 2002 to 2004 will be used for the establishment of the TAC for 2005-2006 and 2006-2007. To establish the TAC for 2007-2008 and 2008-2009, the consolidated signal from these indicators would be based on the trend of indicators for the period between 2005 and 2006. On this basis, it is agreed that the OASI will be used to monitor changes in stock condition during the coming test period.

The process to implement the approved TAC Decision Rules for 2005 involves a formal meeting of the Working Group as soon as possible following the Regional Assessment Process (RAP) for this cod stock. At this meeting, the Working Group will consider all relevant information that was provided by RAP, as it applies to the implementation of the decision rules by making a specific recommendation on the setting of TAC of the applicable 2-year period. A

report of the results of the deliberations of the Working Group will be forwarded to the Gulf Groundfish Advisory Committee for comments. Prior to the 2006 RAP for this cod stock the Gulf Groundfish Advisory Committee will be tasked to review the overall process for implementing the approved TAC Decision Rules for the remaining of the trial period (2006 – 2007).

Notwithstanding the above, the Working Group will meet after the RAP yearly, to review all information tabled at the RAP to consider any adjustments to the initial TAC that is derived from the Decision Rules.

The rules are based on the three-zoned approach being developed as a framework for the application of the Precautionary Approach in the Canadian fishery. While these rules has not been formally evaluated it is believed that they would prevent much further harm from occurring if the index declines and would secure stock growth before permitting TAC increases until the stock clears the critical and cautious zones.



GENERAL

1. The boundary between the Critical and Cautious Zones for Stock Status is a zone generally represented by the range of 70,000 to 90,000t of the 'Overall Adult stock Biomass (OASB) described herein – see Appendix I for definitions and Appendix III for detailed explanation.

2. The boundary between Cautious and Healthy Zones for Stock Status is a zone generally represented by the range of 165,000 to 185,000t of the 'Overall Adult Stock Biomass (OASB) described herein - see Appendix I for definitions and Appendix III for detailed explanation. This designated range is preliminary, subject to confirmation based on further scientific review.

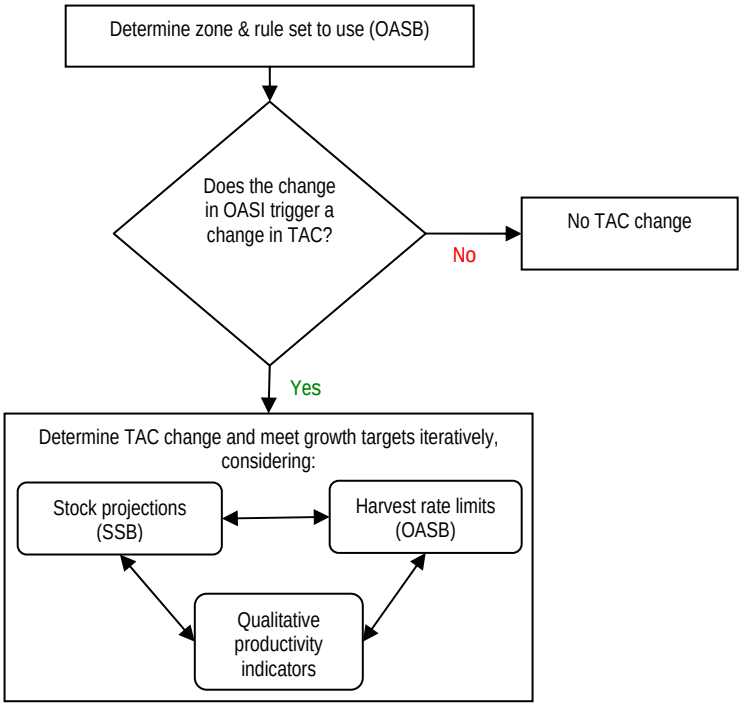
3. The general goal is for the stock to rebuild to and remain in the Healthy Zone.

4. The TAC is to be set at a level to promote arresting a decline in stock status within a 2-3 year period, and/or promote rebuilding towards the Healthy Zone, and/or maintaining the stock within the Healthy Zone. It is understood that the ability to achieve these objectives can be strongly influenced by non-fishing mortality.

5. This suite of decision rules is to remain in effect for an initial trial period of 3 years, subject to there being agreement among industry, and between industry and DFO that an adjustment is required within that period. At the end of this trial period, this framework will be reviewed in terms of its functionality and the overall stock re-building objective.

6. In each year during the 3-year trial period, a working group of DFO/Industry representatives will review information provided by the Regional Assessment Process (RAP), and consider proposing options and/or recommendations consistent with these TAC Decision Rules to be considered by the Gulf Groundfish Advisory Committee. Decisions and/or recommendations of the GGAC will be forwarded to the Minister.

7. Decisions are to be based on a suite of Abundance/Biomass Indicators summarized in an index called the Overall Adult Stock Indicator (OASI - see Appendix I for definitions and Appendix III for calculations) and the OASB (Overall Adult Stock Biomass), Productivity Indicators and Environmental Indicators (see Appendix II) . Especially when the OASB is within the Critical and Cautious Zones, decisions based on Abundance Indicators are to be evaluated and modified as appropriate to reflect circumstance with respect to both Productivity Indicators and Environmental Indicators. The order of rule application, indicating the primary measure involved, will be as followed:



8. The starting TAC for the purpose of these rules shall be the 2004 TAC of 3,000 t. The TACs for the trial period 2005-2007 may be adjusted based on rules which respond to incremental changes in the OASI. In future, the base TAC to which these rules shall be applied will be the TAC in effect at that time.

9. The use of 2-year periods for TACs will be implemented and is intended to enhance stability and reduce the impact of year-to-year fluctuations in indicators on the TAC.

10. If the OASB is within the buffer of a boundary, then the zone will be determined by the direction of the OASI. If the OASI is declining then the zone will be determined to be the one where management action is more prudent (e.g. in the critical/cautious buffer with OASI declining then zone = critical). If the OASI is increasing then the zone will be determined to be the one where management action is relatively more liberal (e.g. critical/cautious with OASI increasing then zone=cautious).

Critical Zone

1. Harvest and conservation-related decisions will reflect extreme caution, particularly if the stock is declining.

2. Beginning with the 2005-06 season, the TAC will be set for 2-year periods, unless it is reduced by the interim year rule (#5)

3. If the OASI declines by >10% over the most recent 2 years, (e.g. for 2005-2006, the change from 2002 to 2004) and a two year projection does not show a subsequent reversal in the decline without a reduction in fishing mortality, then the TAC will be reduced.

4. An increase in the TAC may be contemplated if the OASI has increased by at least 10% over the most recent 2 years, and productivity indicators project an overall growth of the assessment SSB greater than 15% within the following 2 years of the increase.

5. In the interim year of a 2-year TAC period, a TAC reduction could result from one of two situations:

    a. If, over the previous 2-year period, consecutive declines in the OASI total 15% or greater, and a 2-year projection does not show a subsequent reversal in the decline without a reduction in fishing mortality, then the TAC will be reduced.

    b. If, over the previous 2-year period, an increase in the OASI followed by a decrease produce a net decline over 2-years totalling 15% or greater, the Working Group will consider whether a reduction in the TAC is warranted.

6. Harvest rate to be set no greater than 7% of the OASB.

7. Any increase in the TAC will be at minimum increments or multiples of 1,000t.

8. If the OASB is below 70,000t and stable or declining, the application of rules 6 and 7 above would limit TAC options for total removals to be either 3000t, 2000t, 1000t, or as close to zero as possible.

Cautious Zone

There are two key factors to guide decisions on the harvest rate to be employed (up to 19%) when the OASB is in this zone, i.e. the position/level of the OASB within the zone, and the dynamic/direction of change in the OASI. Conceptually, the harvest rate would be at the higher part of the range when the OASB is near the Healthy zone and is increasing, but much lower when the OASB is near the Critical zone and the OASI is decreasing.

1. Harvest and conservation-related decisions will reflect caution, particularly if the stock is declining.

2. A reduction in the TAC is to be initiated even if the current OASI has not actually declined, if a decline projected 3 years in the future is again projected for 2 years in the future in the following year's assessment. Management action to reduce the TAC is to be relatively more aggressive if the OASB is closer to the Critical Zone.

3. In the cautious zone, the maximum harvest rate is to be set at a maximum level of 19% with the rate being must lower as the OASB nears the Critical Zone.

4. When the OASI is increasing, the harvest rate to be set at a level that promotes continued rebuilding of the OASB towards the Healthy Zone at a rate of >10% over the 2-year period, with the maximum harvest rate not to exceed 19% of the OASB.

5. TAC to be set for 2-year periods.

6. The TAC will not change if the current change in the OASI is less than 10% over the 2-year period, unless the projections identified in item 2 above indicate a reduction in the TAC is warranted to arrest an anticipated decline in the OASB.

7. Any change in the TAC will be at increments or multiples of 1,000t.

Healthy Zone

1. TAC to be set for 2-year periods.

2. Maximum harvest rate not to exceed 23% of the OASB, or the equivalent of $F_{0.1}$ converted to the percentage harvest rate of the OASB. Selection of the harvest rate is to promote rebuilding/maintaining a healthy age structure of the OASB.

3. Any change in the TAC will be at increments or multiples of 1,000t

SPECIES AT RISK ACT (SARA)

Notwithstanding all of the above, if this cod population is listed under SARA during the trial period, the Working Group will meet to consider the situation related to the impact on the decision rules. All parties recognize that the Minister is bound by the *Species at Risk Act* which would override the above decision rules subject to related listing.

APPENDIX I - DEFINITIONS

SSB (Spawning Stock Biomass): refers to the estimate of spawning stock biomass contained in the DFO stock status and based on the assessment of the resource. For this stock, the SSB is usually obtained by calibration of an age structured population model.

OASI (Overall Adult Stock Indicator): refers to the indicator of adult stock derived from the abundance indicators (see Appendix III for calculation details).

OASB (Overall Adult Stock Biomass): refers to the equivalent of the OASI in terms of biomass (see Appendix III for calculation details).

APPENDIX II - LIST OF INDICATORS (IN NO ORDER OF PRIORITY)

Abundance:

- Age 5+ weight per tow for cod from the September Southern Gulf survey conducted by DFO (1971-2002, 2004)
- Sentinel longline standardized catch rate (kg/1000 hooks) (1995 – 2004)
- Spawning stock biomass from the analytical assessments (1950 – 2004)
- Fishermen Views Index derived from the telephone survey of about 25% of the active groundfish fishers (1997 – 2002, 2004)
- Age 5+ weight per tow from the August sentinel mobile gear survey (2003 – 2004)
- Fishery catch rates since the re-opening of the fishery relative to those experienced when the stock was in a healthy condition (1999-2002, 2004, details to be reviewed at RAP in 2005).

Productivity:

- Number of predators (grey seals, 1970 – most recent levels available)
- Recruitment index (1950-2004)
- Weight at age (fishery and survey) (1950 – 2004)

- Biomass of pelagics (mackerel and herring) (1970- most recent levels available)

Environment:

- Area of the bottom with temperatures less than 1^{o} C (1971 – 2004)

Note: The years in bracket indicate the period for which data are available in January 2005. It is intended that these series would be continued.

APPENDIX III - DETAILS ON THE CALCULATION AND USE OF THE OVERALL ADULT STOCK INDICATOR (OASI) AND OVERALL ADULT STOCK BIOMASS (OASB) FOR TAC DECISION RULES OF SOUTHERN GULF OF ST. LAWRENCE COD

One of the components of the TAC Decision Rules for Southern Gulf of St. Lawrence cod is the calculation of an Overall Adult Stock Indicator (OASI). The following describes how the OASI would be calculated. The status and the rate of change of the OASI would be used in the TAC Decision Rules. Because the TAC is for the exploitable portion of the population, the OASI should be representative of that part of the stock. The exploitable portion of the stock is approximately equivalent to the spawning stock biomass.

The OASI will be based on the following six indicators, weighted equally subject to further consideration if a significant outlier is produced by any of the indicators in a given year.

1. Age 5+ weight per tow for cod from the September Southern Gulf survey conducted by DFO (1971-2002, 2004)

2. Sentinel longline standardized catch rate (kg/1000 hooks) (1995 – 2004)

3. Spawning stock biomass from the analytical assessments (1950 – 2003)

4. Fishermen Views Index derived from the telephone survey of about 25% of the active groundfish fishers (1996 – 2002, 2004)

5. Age 5+ weight per tow from the August sentinel mobile gear survey (2003 – 2004)

6. Fishery catch rates since the re-opening of the fishery relative to those experienced when the stock was in a healthy condition (1999-2004, details to be reviewed at RAP in 2005).

The OASI would be calculated in the following manner:

1. Each individual indicator will be normalized to a common reference period. This is achieved by dividing each value of the indicator by the average for the common reference period for that indicator. The common reference could be the average of a set of years (for example: 1996-2002) or an individual year. Because the sentinel mobile gear survey only starts in 2003, the common reference for all indices would be the year 2004 (Note that there are some difficulties with the 2003 RV survey).

2. The un-weighted average of the normalized indicators would be calculated. This average would be considered the OASI. It is understood that in some years some of the indicators may not be available but there should be a minimum of 4 indicators to calculate the OASI.

Rate of Change of the OASI:

For the purpose of the TAC Decision Rules, a one year and a two year rate of change in the OASI will be calculated. This will be calculated as follows

$$\text{One year} = \{(OASI_{Year\ 2} - OASI_{Year\ 1})/ OASI_{Year\ 1}\} \text{ X } 100$$

$$\text{Two year} = \{(OASI_{Year\ 3} - OASI_{Year\ 1})/ OASI_{Year\ 1}\} \text{ X } 100$$

It should be noted that the rates of change of the OASI depend to some extent on the common reference used to normalize the indices. However differences are usually small providing several indices are used to arrive at the OASI.

Overall Adult Stock Indicator and the Critical/Cautious and Cautious/Healthy boundaries:

Because the boundaries of the Critical/Cautious and Cautious/Healthy boundaries have been derived from the stock assessment SSB, these boundaries would be translated in units of the OASI by dividing the boundary (and buffer) values by the average of the SSB for the common reference period. For example, if the average of the common reference period for SSB is 70,000, then the estimates of the boundaries (C/C =80,000 and C/H = 175,000) would be divided by 70,000 and plotted with the OASI.

Uses of the Overall Adult Stock Indicator:

1. The OASI will be used to calculate the OASB to determine the zone that the stock is considered to be in (critical, cautious or healthy). If the OASB is within the buffer of a boundary, then the zone will be determined by the direction of the OASI. If the OASI is declining then the zone will be determined to be the one where management action is more prudent (e.g. in the critical/cautious buffer with OASI declining then zone = critical). If the OASI is increasing then the zone will be determined to be the one where management action is less prudent (e.g. critical/cautious with OASI increasing then zone=cautious).

2. The rate of change in the OASI (over one or two years) will be used in the decision to increase or reduce the harvest rates (see the decision rules).

3. If the rate of change in the OASI suggests that an increase in the TAC may be appropriate, a 3-year projection using SSB from the assessment will be done. Projections will be done using the most realistic values for growth, recruitment and natural mortality given current information and trends. Projections will be done for the current harvest rates and for higher harvest rates resulting in steps of 1,000 t in catch biomass or steps of 1% of harvest rate. If projections at higher harvest rates indicate that a 15% increase in the assessment SSB is possible then the 'working group' would need to make a decision on the harvest rate to use. The harvest rate would not exceed those specified in the rules for the zone.

4. Once a harvest rate has been decided (combination of decision rule and judgment based on indicators of productivity, environment, etc), the TAC would be determined by converting the OASI in biomass and applying the harvest rate. The conversion of the OASI to biomass would be done by multiplying the OASI by the average SSB for the common reference period. This quantity is called the Overall Adult Stock Biomass (OASB) for the purpose of the TAC decision rules.

APPENDIX IV - INCORPORATING NON-ABUNDANCE INDICATORS INTO DECISION RULE FRAMEWORK

In the TAC decision rules for Southern Gulf of St. Lawrence cod, the decision regarding the harvest rate to be applied would be based on the decision rules and judgment of suite of indicators relating to productivity and environment. For Southern Gulf of St. Lawrence, the indicators of productivity would include recruitment estimates based on SPA, weights-at-age (age 6) from research surveys (indicator of growth), the number of grey seals (indicator of M) and estimates of pelagic biomass (indicator of conditions for egg and larvae survival). Currently, the indicator of the environment incorporates the bottom area with temperatures less than 1 C. Other indicators may be added to each of these categories.

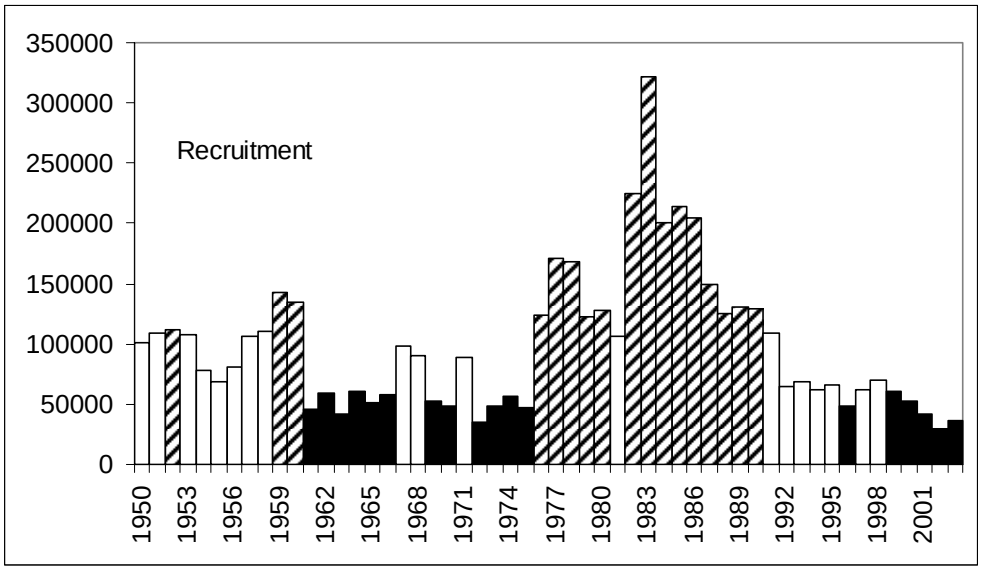
Given that each of these indicators extend over long periods (30+ to 50+ years), they can regarded to cover the range of potential values for these indicators. In this context, the lowest third of the observations can be considered as poor (red, black in the figure below), the middle third as average (or neutral - white) and the upper third as good (green, hatched in the figure). For indicators where a negative effect is postulated (e.g. high area of cold water (< 1) having likely negative effects, high number of seals causing increases in M (a negative), etc), the zones would be reversed (lowest third –green and upper third –red).

To classify each observation in the appropriate zone, the observations are first ranked and the value of the observation at the 33 percentile would correspond to one boundary and that of the 66 percentile corresponds to the other. For example, if there are 30 observations, the values are first ranked from the lowest to the highest. The values of the 10^{th} and 20^{th} observations would thus correspond to the boundaries to classify the observations.

For each indicator, a graph showing the time series of values and their different colours corresponding to each zone would be presented. For the most recent year, a composite (e.g. a pie chart) could show the colors for each indicator of productivity. The Working Group would use judgment in determining the harvest rate but, in general, if indicators are predominantly poor (red), a lower harvest rate would be suggested while a higher harvest rate could be used if indicators are predominantly good (green).

Recruitment

Example of poor (black), neutral (white) and good (hatched) values for recruitment.



January 28, 2005

Appendix II:
A strategy to determine annual TACs for the northern Gulf cod stock (3Pn, 4RS)
2005 - 2007
Draft Decision Rules

Preamble:

In May 2004, the Minister of Fisheries and Oceans invited government and industry representatives to jointly establish TAC Decision Rules beginning in 2005. It became clear from the Working Group discussions that differences of view would forestall joint agreement on any rule, if it was to be based on a common understanding of the current stock condition. Despite these differences the Working Group decided to proceed with the development of TAC Decision Rules.

This approach has been developed in a spirit of shared stewardship and a joint desire to eventually share a single cohesive view of this important stock and fishery. Industry and government would agree to be jointly accountable for the operation of the rule and to adhere to agreed actions as necessary.

The industry believes this stock is in substantively better condition than the DFO assessment indicates, and feels strongly that the current TAC of 3,500t is too low. This view is based on the magnitude, broad distribution and quality of commercial catches; other increasing indications of stock abundance since 1997, stock production that has exceeded expectations since 1997, stable recruitment, and uncertainty about analytical approaches used on this stock.

The DFO assessment for this stock continues to indicate that the stock is in a serious condition, based on the fact that SSB is currently well below the established limit reference point (85,000 t. – 110,000 t.), that recent removals have been sufficient to crop any significant growth in SSB, and that natural mortality is high and recruitment remains low in historical terms.

These disparate views have produced ongoing stakeholder dissatisfaction and concern with current management approaches. TACs have fluctuated between zero and 7,500t since 1997, with no apparent objective. This fishery has been a source of ongoing disagreement between government, industry and community officials, and among politicians throughout this period.

Strategy:

The agreed strategy is to test the state of the stock by adjusting the TAC in response to recent changes in stock condition, as monitored by a suite of stock abundance indicators and considering stock productivity. The consolidated signal from these indicators (termed the Overall Adult Stock Indicator (OASI), see next section) currently describes a general improving trend in this stock from 1995 to 2004, with a total relative increase of about 3-fold over that period. This

trend agrees generally with how fishermen feel the stock has improved over that time period, and with the trend in the DFO assessment. On this basis, it is agreed that the OASI will be used to monitor changes in stock condition during the coming test period.

The recommended TAC will be established in 2005 for 2 years and again in 2007[1] for 2 years based on the recent performance of the OASI, and by applying the agreed to TAC decision rules.

This approach endorses neither view (above) on the state of the stock. It is based on the premise, referenced by the FRCC in its 2004 report to the Minister, that a conservative management rule driven by a suite of abundance indicators will eventually guide decision-making in the appropriate direction. There is a risk to the stock that parties must be willing to accept during the trial but this strategy should provide further insight that may help establish a more considered stock management strategy in the period following.

Decision Rules:

1. The Overall Adult Stock Index (OASI), composed of the separate indices listed below and weighted equally, will be used to monitor stock response.
    i. Sentinel longline catch rates (CPUE)
    ii. Sentinel gillnet catch rates (CPUE)
    iii. July mobile gear sentinel survey
    iv. August DFO research vessel survey
    v. Commercial CPUE (gears consolidated)
    vi. Spatio-temporal distribution gillnet (pending review)
    vii. Spatio-temporal distribution longline (pending review)
    viii. Fishermen's telephone questionnaires
    ix. Spawning stock biomass

    Note: missing indicator values or potentially faulty values (outliers) shall be discussed by the Working Group.
2. From the current level of 3,500t, TACs will be reconsidered in 2005 and again in 2007 in response to scaled changes in the OASI.
3. If the OASI increases by ≥ 10% total change over the previous 2 years, the TAC is eligible to be increased by a maximum of 2,000t for the following 2 year period.
4. If the OASI declines by ≥10% total change over the previous 2 years, the TAC is eligible to be reduced by a minimum of 2,000t, for the following 2 year period.
5. If the OASI changes (increase) by ≥ 25% total change over the previous 2 years, the level of change to the TAC for the following 2-year period shall be discussed by the Working Group. Note: if, the OASI increase from 2002 to 2004 exceeds 25%, the Working group agrees the TAC increase for the 2-year period commencing with 2005-06 shall be a maximum of 2,500t.
6. If the OASI changes (decreases) by ≥ 25% total change over the previous 2 years, the level of change to the TAC for the following 2-year period shall be discussed by the Working Group. Note: if, the OASI decrease from 2002 to 2004 exceeds 25%, the Working group agrees the TAC decrease for the 2-year period commencing with 2005-06

[1] (Subject to review of 3 year pilot)

shall be a minimum of ? *(Amount not previously discussed with working group – need to be addressed prior to finalizing of decision rules)*

7. In all the above circumstances, key stock productivity factors listed below (not to exclude others) shall be considered in the decision. If significant changes are detected in these indicators, they may temper or cancel a TAC increase or suggest a further TAC decline if immediate prospects for stock growth are sufficiently low that such increase or decrease is unlikely to be sustainable. If immediate prospects for growth are sufficiently favorable they may also temper a TAC decline. However, no action will be taken prior to a meeting with all members of the Working group to define more precisely how rule no 7 will be applied.
    i. Recruitment
    ii. Growth (length at age)
    iii. Condition (spring K)
    iv. Portion of older fish

8. These rules would be in effect for 3 years, subject to there being an agreement among industry, and between industry and DFO, that an adjustment is necessary. If these cod populations are listed under SARA during the trial period, these rules would need to be reviewed to ensure any additional management considerations resulting from SARA are being respected.

Important notes:

1. The approaches adopted for this 3 year trial shall not limit future approaches that may be considered for this stock.
2. DFO will continue to conduct its scientific assessment of this stock in the established manner, with the addition of any agreed products that may be required to meet the needs of these rules.
3. The Precautionary Framework could not be used for this 3-year trial because the Working Group could not come to any consensus on which of the zones the stock is currently situated. This does not signal any rejection of the PA framework itself, nor its possible utility in future decision-making on this stock, nor on other stocks in the meantime.
4. For reference purposes, the harvest rate will be calculated on the Overall Adult Stock biomass (OASB). It is expected to be initially in the 7% to 10% range.
5. The current stock condition is felt to be heavily influenced by natural mortality. Should M change significantly in the term of this trial, the Working Group shall discuss the implications of that change on the decision rules.
6. At a conceptual level, the Working Group remains interested in the role a traffic light approach could play in future management of this stock, and wishes to continue discussion and development of such an approach.
7. The role that a one-time acoustic survey of the cod population, or other techniques, may play in helping resolve the abundance question concerning this stock should be explicitly considered.