FishSource Scores

How they're calculated and what they represent

Jim Cannon

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A programme of the **Sustainable Fisheries Partnership** (http://www.sustainablefisheries.eu/)
For further information please email support@fishsource.org

FishSource Scores: Introduction

Executive Summary

This report describes the FishSource scores reported in the ***FishSource Scores*** section of FishSource.

FishSource scores provide a rough guide to how a fishery stacks up against existing definitions and measures of sustainabilty. The FishSource scores currently only cover five criteria of sustainability, whereas a full assessment – such as that by the MSC – will typically cover over sixty. As such, the FishSource scores are not a firm guide to how a fishery will perform overall. Nonetheless, the FishSource scores do capture the main outcome-based measures of sustainability.

FishSource scores are based on common measures of sustainability, as used by ICES, NMFS, and the MSC, among others (e.g., current fishing mortality relative to the fishing mortality target reference point, or current adult fish biomass relative to B_{msy}). These ratios provide critical information about the sustainability of a fishery. However, interpreting this "raw" data correctly requires some expertise in fisheries science and a detailed knowledge of one more of the common definitions of sustainability.

FishSource helps lay-people by translating these raw measures into simple scores out of 10. This scoring system is designed to communicate to a lay person what different value of the ratios mean in terms of fisheries sustainability used by existing leading fisheries management agencies and independent certification systems such as the MSC.

If existing measures of sustainability consider a fishery to be relatively well managed, then it will typically score 8 or more out of 10 on FishSource. If the fishery is judged to be doing ok, but requires improvement, then it will typically score between 6 and 8 on FishSource. Fisheries falling short of minimum requirements of existing measures of sustainability are scored 6 or below, with the score declining as the condition of the fishery deteriorates.

FishSource scores provide readers with a "quick and dirty" picture of how "unsustainable" a fishery, according to the sub-set of quantitative criteria covered. FishSource tracks the scores over time, giving readers an insight into how fast a fishery is improving, and when it might be judged sustainable – at least as far as the criteria scored are concerned.

FishSource Scores include the following:

Score 1: Is the management strategy precautionary? A fishery scores 10 out of 10 if fishing mortality is reduced to zero at biomass levels below the limit reference point. Reducing fishing mortality to zero is preferable because it is the fastest possible way to rebuild the stock above the level at which it may be of risk of collapse. A fishery scores 8 out of 10 if fishing mortality is reduced to 50% of the target reference point for fishing mortality. A fishery scores 6 out of 10 if the fishing mortality is held at the target reference point level.

Score 2: Do managers follow scientific advice? A fishery scores 10 out of 10 if managers always set the TAC equal to or below the scientific advice. The score drops to 8 out of 10 if the managers set the TAC 12.5% above the advised level, and drops to 6 out of 10 if they set the level 25% higher than advised.

Score 3: Do fishers comply with managers decisions? A fishery scores 10 out of 10 if the estimated total actual catches are always at or below the quota level set by managers. The score drops to 8 out of 10 if catches exceed the quota by 12.5%, and drop to 6 out 10 if catches exceed the quota by 25%.

Score 4: Is the fish stock healthy? A fishery scores 10 out of 10 if current spawning biomass is 50% above the target reference point (typically B_{msy} or some variation). A fishery at B_{msy} scores an 8, while a fishery at $0.5B_{msy}$ scores a 6 and a fishery below that level scores below 6.

Score 5: Will the fish stock be healthy in future? A fishery scores 10 out of 10 if F is 50% below F_{msy}. A fishery where the fishing mortality is at the target reference point scores an 8, while a fishery with fishing mortality 50% higher than F_{msy} scores

a 6 and a fishery with even higher F scores below 6.

Issue	Measure	Underlying ratio
Is the management strategy precautionary?	Determine whether harvest rates are reduced at low stock levels.	$F_{advised}/F_{target\ reference\ point}$ or $F_{actual}/F_{target\ reference\ point}$
Do managers follow scientific advice?	Determine whether the catch limits set by managers are in line with the advice in the stock assessment.	Set TAC / Advised TAC
Do fishers comply?	Determine whether the actual catches are in line with the catch limits set by managers.	Actual Catch / Set TAC
Is the fish stock healthy?	Determine if current biomass is at long-term target levels.	SSB/B_{40} (or equivalent)
Will the fish stock be healthy in future?	Determine if current fishing mortality is at the long term target level.	$F/F_{target\ reference\ point}$

Table 1: Summary of the FishSource scores

These indices have been developed in discussion with various experts and are continually adapted to reflect current consensus on which metrics are applicable for the relevant issue. If you have any feedback to add, then please email us at support@fishsource.org.

Anomalies in the FishSource Scores

Note that in some fisheries TACs are set very high, far above what the fishers can actually catch. In such cases the fishery will typically score low on “do managers follow scientific advice”, but could earn a high score for “Do fishers comply with managers decisions.” A high score in such cases is meaningless as an indicator of compliance in the fishery.

MSC Assessments and Current FishSource Scores

The initial fisheries included in FishSource are primarily whitefish fisheries. Hence we have used information made public by the MSC on certified whitefish fisheries to determine how MSC scores of 60 and 80 relate to available quantitative data.

The MSC has 3 principles, each of which divide into several criteria, which divide into sub-criteria, each of which in turn divide into several performance indicators. Together these form the “assessment tree”. A fishery is deemed sustainable by the MSC if it scores 60 or more in every performance indicator, and an average of 80 or more at the principle level. The MSC requires certified fisheries to take corrective actions to improve any areas of the fishery that scored between 60 and 80, with the intention of achieving a score of 80 or above in every area of the fishery.

The MSC has certified five whitefish fisheries: New Zealand hoki, BSAI Alaskan pollock, Gulf of Alaska pollock, South African hake and BSAI longline Pacific cod. The number of indicators used in each assessment are summarized in the Table below.

Fishery	Number of Indicators used			
	P1 (target stock)	P2 (ecosystem)	P3 (management)	Total
NZ hoki (Apr 2006)	23	20	19	62
BSAI Alaskan pollock (June 2004)	28	21	45	94
Gulf of Alaska pollock (April 2005)	28	21	45	94
South African hake	25	23	34	82
Pacific cod – longline (Jan 2006)	25	22	28	75

Table 2: Number of indicators for each of the MSC certified whitefish fisheries

Disclaimers and Cautions

FishSource does not define sustainability itself. Instead FishSource uses the definitions drawn from existing sustainability rating schemes. At the current time, the FishSource scores rely primarily on the MSC definition of sustainability for whitefish, as defined by the way in which whitefish fisheries have been assessed as sustainable to date. The FishSource scores do not reflect any ongoing efforts to refine the MSC, but are based purely on past assessments of whitefish fisheries. The MSC system provides a high degree of transparency over how and why fisheries are determined to be sustainable, and the MSC standard reflects a broad expert-based consensus.

Note that FishSource is fully independent of the MSC. The FishSource scores are provided in good faith, based on data generally derived directly from formal / government stock assessment reports and applying the understanding of MSC scoring history presented in this report. However, FishSource provides no guarantee what-so-ever of how a Certification Body might actually score a fishery against the MSC standard.

The scores provided depend on publicly available quantitative information, and are therefore only a partial picture of the status of the fishery (MSC assessments typically score over ten times more indicators).

The actual points awarded by an MSC assessment for a particular indicator may vary considerably from that suggested by a FishSource score, because the MSC assessment typically takes other factors into account.

The scores are currently based only on an analysis of the MSC assessments for whitefish fisheries, and are likely to be modified as more MSC assessments are analyzed or more whiteifish fisheries become certified.

FishSource scores 1, 2 and 3 are all measures of management quality. Note that these specific measures all generally appear under MSC Principle 1 (P1: target stock) of the MSC standard. Under the MSC system, Principle 3 (P3: management) has focused on broader governance and participation questions. Few of the MSC performance indicators for P3 for MSC certified whitefish fisheries have been scored used quantitative information.

Developing and Adding FishSource Scores

The intent of the *FishSource Scores* section of FishSource is to provide a snapshot of the condition of the fishery. The snapshot depends on publicly available quantitative information, and is therefore only a partial picture of the status of the fishery.

The most obvious omission from FishSource today is any score for environment and biodiversity issues. This reflects the lack of standard measures, and a general lack of information. For instance, even the MSC Alaskan pollock certification does not use quantitative measures in scoring the performance indicators. Instead the focus is on the level of knowledge, whether

limits have been set for impacts, and whether management responses have been appropriate or not. Bycatch percentages, numbers of PET species caught, trends in PET species populations, habitat mapping etc are all referred to, but are not the basis of scoring. Likewise for New Zealand hoki, none of the MSC performance indicators use quantitative information as the basis for scoring. However, several of the indicators do refer to different quantitative measures as relevant to the scoring, though the size of bycatch as a percentage of the total catch is not used.

NZ Hoki Indicator	**Use of quantitative data**
2.1.2.1	Percentage (by number of species, and weight of bycatch) of bycatch species which are target species in their own right, and for which management targets and assessments are available
2.1.4.1	Discards, expressed as a percentage of the catch
2.1.4.2	MPAs, expressed as a percentage of the EEZ closed to trawl fishing
2.1.5.2	Biomass reference points, and biomass as a percentage of B_0, but only for bycatch species that are managed under New Zealand's Quota Management System for which such data is available
2.2.1.2	Catches/deaths (expressed as number of individuals, and number of individuals per tow) and mortality rates for PET species Trends in the population size of PET species

Table 3: The quantitative measures used for some of the MSC performance indicators for New Zealand Hoki

FishSource is prioritizing developing FishSource Scores for environment and biodiversity aspects of fisheries sustainability, and welcomes any suggestions on how to proceed.

The core indicators used are common to most measures of sustainability. The current indicators used in FishSource are drawn from the set used by the MSC for which quantitative data is often publicly available. In future we intend to add – where ever the publicly available data allows us to do so - additional indicators used by one or more sustainability evaluations. The MSC is also working to standardize the way it scores fisheries, as part of its “Quality and Consistency” project. It is anticipated that the results of this work will enable FishSource to broaden the range of sustainability statistics, to include criteria measured on a more subjective or non-quantitative basis.

FishSource scores currently rely on quantitative stock assessment data being available. Such information is often available for the world's largest sources of seafood, and hence FishSource can provide critical information on much of the seafood being bought and sold by large retailers and suppliers. However, this quantitative approach does mean FishSource scores cannot be prepared for fisheries with limited available quantitative information. FishSource will incorporate additional approaches to scoring fisheries as alternative non-quantitative approaches to judging sustainability are tested and proven.

Glossary

FishSource strives to use standard fisheries management terms, as agreed and described by the Fisheries Department of the United Nations Food and Agriculture Organization: http://www.fao.org/fi/glossary/default.asp. If readers note any different usage of terms please let us know.

FishSource Score 1: Is the management strategy precautionary?

Introduction

A wide range of measures are used to assess whether scientific advice and management decisions are precautionary. No single measure is widely applied, and full formal tests are complex and still relatively rare, even amongst fisheries that are MSC certified or deemed "green" by other commentators.

The main focus for scientific advice is on whether the advice provided is precautionary given the uncertainty in the assessment. New Zealand hoki Indicator 1.1.3.3 asks "does the stock assessment take into account the implications of uncertainty in data and model structure". The fishery scored 88 because "this fishery examines assessment uncertainty to a greater degree than is the case for for most well-managed fisheries".

In terms of management advice, the BSAI pollock fishery Indicator 1.1.1.5 asks whether "the harvest strategy can be shown to be precautionary." The fishery scored 75 because " there has been no comprehensive simulation testing of the harvest strategies used for pollock management, nor attempts to test their robustness to a wide range of uncertainties and assumptions inherent in stock assessment and management". In the New Zealand hoki reassessment of 2007, indicator 1.1.3.4 asks "are assessment uncertainties and assumption reflected in the management advice?" The fishery was scored 95, because "the management advice includes the important sources of uncertainty in the assessment and their implications for management within a quantitative framework."

Pacific cod features several well-structured Indicators on these points:

Indicator	**Summary**
1.1.5.1	"the assessment has been tested for robustness using simulation"
1.1.5.2	"the assessment takes sufficient account of major uncertainties in data (including evaluation of assumptions) to provide a robust assessment of the stock"
1.1.5.3	"uncertainties and assumptions are reflected in management advice"
1.1.5.5	"the assessment model is used to evaluate the consequences of current harvest strategies"

Table 4: Indicators for Pacific cod

However, these measures are scored according to the presence of specific attributes in the stock assessment and preparation of advice and management decisions. Quantitative information is not used, and hence these indicators cannot be scored using publicly available quantitative information.

There does not appear to be a single simple measure of either how precautionary scientific advice is, or how precautionary management strategies are. However, an alternative indicative proxy for how precautionary management strategies are, that could be used in many fisheries, is ***whether harvest rates are reduced at low stock levels***.

The Underlying Measure

This question can be answered by assessing the level of fishing mortality at low biomass levels relative to the long-term target fishing mortality level. A precautionary management strategy reduces fishing mortality as biomass declines, in order to give the fish stock a chance to recover.

How the FishSource indices are calculated

If biomass levels are above the limit reference point for biomass (typically $B_{20\%}$ or proxy), then we use the fishing mortality proposed or mandated under the management strategy ($F_{\text{advised at low biomass levels}}/F_{\text{target}}$). If biomass levels are at or below the limit reference point, then we use the actual fishing mortality as estimated by the stock assessment ($F_{\text{current}}/F_{\text{target}}$).

How the MSC Has Scored Fisheries Using This Measure

Summary Findings: The MSC historically has given fisheries a maximum 100 points if the management system sets fishing mortality to zero at or below the limit reference point (and hence the ratio = 0). If F is equal to $F_{msy}/2$ (i.e., a cut of 50% from long-term target level) then the MSC has generally scored the fishery at the 80 level. If F is at F_{msy} then the MSC score has generally scored the fishery at the 60 level.

Alaskan Pollock: Indicator 1.1.1.1 states "the harvest control rule is well defined". A limit reference point (LRP)of Minimum Stock Size Threshold (MSST) is set at 50% of B_{msy}, the target reference point (TRP). A limit reference point for fishing mortality is also set as the Over Fishing Level (OFL), corresponding to F_{msy}. Allowable Biological Catches (ABCs) are set below the OFL, and Total Allowable Catches set at or below the ABC. The ABC for the East Bering Sea pollock is set to zero if B drops below $B_{20\%}$, due to concerns about the impacts of depletion of pollock on Steller sea lions. Indicator 1.1.1.3 specifically asks whether fishing mortality was reduced at low stock sizes.

1.1.1.3 harvest control rule results in appropriate reductions in exploitation rate at low stock sizes	
Score	**Requirement**
60	"Exploitation rate is not reduced as stock levels decline."
80	"Exploitation rate is reduced as stocks decline below threshold levels, sufficient to promote rapid stock recovery. Threshold levels are selected in relation to internationally recognized limit reference points for target species (such as B_{MSY})."
100	"Exploitation rate is set to zero if stocks are assessed to be below threshold minimum stock sizes. The threshold minimum stock size is selected to take account of ecological as well as target species impacts."

Table 5: MSC Score definitions for Indicator 1.1.1.3

It was noted for the East Bering Sea (EBS) portion of the BSAI (Bering Sea and Aleutian Islands) fishery that "since the "zero TAC below 20% of unfished levels" explicitly addresses broader ecological impacts of harvest, the EBS stock by itself clearly exceeds the 80 scoring guidepost." The assessment went on to note that the Aleutian Islands, despite being closed to directed pollock fishing in recent years, is formally managed under a system that does not require exploitation levels to decline, and hence scored below 80 "because the current [management] arrangements are ad hoc." The combined fisheries were scored 79.

New Zealand hoki: New Zealand hoki Indicator 1.2.1.1 asks "are measures in place to rebuild a stock if it is found to be below a target or limit reference point". The western stock was below target and possibly limit reference points, and fishing mortality had been reduced. However, fishing was continuing, and the timeline to recover biomass back above B_{msy} was not known, so the fishery was scored 73.

South African hake: South African hake Indicator 1.2.1 asks "if the stock is below the precautionary reference point, are measures to rebuild the stock specified".

1.2.1 if stock is below the precautionary level, are measures to rebuild the stock specified	
Score	**Requirement**
60	"Appropriate rebuilding measures through reduction in exploitation exist and are being implemented. Measures have not been tested."
80	"Appropriate rebuilding measures are being implemented to promote recovery within reasonable time frames. Measures have been tested and can be shown to be rebuilding the stock."
100	"Appropriate rebuilding measures are being implemented to promote recovery as quickly as is possible. Additional measures are being implemented to prevent problems in the future."

Table 6: MSC Score definitions for indicator 1.2.1

Here the 60 score requires a reduction in F, though unspecified. The 80 score requires F is set low enough to rebuild the stock on an agreed timescale (and in the scoring refers to a 10 year plan). The 100 score is for "recovery as quickly as is possible", which implies F = 0. The South African hake west coast stock was below B_{msy} at the time of certification, but a 10 year rebuilding plan was in place and recovery underway, so the indicator scored 95.

Pacific cod: Pacific cod Indicator 1.1.4.1 asks if "there is a harvest strategy in place to adjust harvest as required for the management of the stock." The fishery scored a 95, because fishing mortality was reduced as biomass dropped below B_{msy}. However, Pacific cod Indicator 1.2.1 asks "when the stock is below the target point, there are measures to rebuild the stock specified and implemented for recovery and rebuilding of the stock". The fishery scored an 80 on this point, because "the control rule does not reduce fishing mortality to near zero when the stock falls below the limit reference point".

The FishSource Score

The FishSource score closely reflects the MSC scoring, as reflected in the summary findings above. Reducing F to 0 earns a score of 10. Reducing F to 50% of $F_{target\ reference\ point}$ earns an 8. Keeping F at $F_{target\ reference\ point}$ earns a 6. The FishSource score is then extrapolated linearly until the score drops to zero.

The figure below illustrates the relationship between the FishSource score and the underlying ratio:

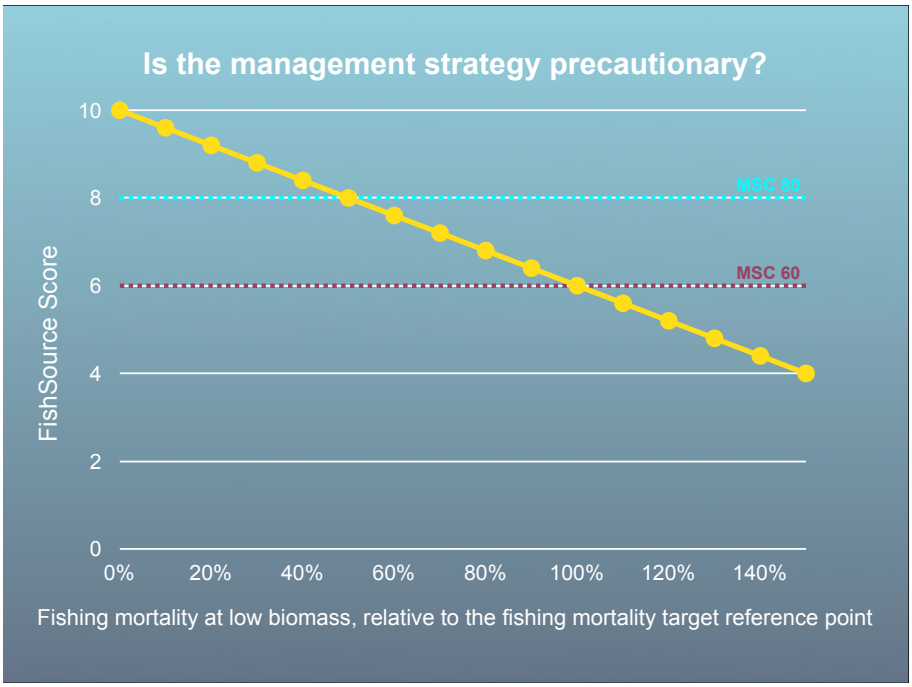

Illustration 1: FishSource Score 1 vs relative fishing mortality

FishSource Score 2: Do Managers Follow Scientific Advice?

Introduction

Several different measures may be used to judge whether managers follow scientific advice.

One simple measure used in many fisheries is ***whether managers set quotas in accordance with scientific advice.***

The Underlying Measure

This question can be answered by assessing the level of the set quota or "Total Allowable Catch" (TAC) relative to the TAC advised by the stock assessment scientists, based on the stock assessment.

In general stock assessment scientists are providing advice on how to maintain a fishery at or above agreed minimum levels, with a pre-defined high degree of confidence. The limits and confidence requirements placed on the scientists are generally defined in harvest control rules, formal stock assessment guidance or other fisheries policy or regulations. It is generally considered best practices that managers follow the scientific advice they are given. In many fisheries this is a mandatory requirement.

How the MSC Has Scored Fisheries Using This Measure

Summary Findings: The managers in all MSC certified whitefish fisheries generally follow the scientific advice, and the fisheries have all scored well above 80. Since none of the certified whitefish fisheries report managers regularly setting TACs significantly in excess of scientific advice, there is no guidance on what level of consistency between managers decisions and scientific advice might result in a score of 80 or 60.

Alaskan pollock: BSAI Alaskan pollock Indicator 1.1.1.6 asks if "the harvest strategy is properly applied."

1.1.1.6 the harvest strategy is properly applied	
Score	**Requirement**
60	"The harvest strategy is not applied consistently, or is regularly over-ridden in ways that result in less precautionary outcomes."
80	"Decisions about catch limits follow the agreed strategy."
100	"The agreed harvest strategy is applied without exception."

Table 7: MSC Score defintions for indicator 1.1.1.6

The BSAI fishery scored 95 on this indicator, reflecting that the managers "almost always adhere to the recommendations" of the scientists.

New Zealand hoki: New Zealand hoki Indicator 3.2.2.1 asks whether management implements measures to maintain the target stock.

3.2.2.1 Does the management system implement management measures to maintain the target species	
Score	**Requirement**
60	"Management measures reflect the intent of any strategies."
80	"Management measures are based on the best available information and are consistent with any strategies."
100	"Management measures reflect the outcomes of the precautionary application of any strategies."

Table 8: MSC Score defintions for indicator 3.2.2.1

The fishery scored 87, because the management decisions reflected the scientific advice received and "were clearly linked to the results of the stock assessment".

South African hake: South African hake Indicator 1.1.4.2 asks "are clear, tested decision rules set out".

1.1.4.2 Are clear, tested decision rules set out	
Score	**Requirement**
60	"It can be demonstrated that decision making, though not documented, is logical and appropriate. Rules have not been tested."
80	"Clear decision making rules exist, are fully documented, but have not been fully tested. Decision rules are reconciled with reference points and with data and assessment limitations."
100	"Clear, documented and tested decision rules are fully implemented and have been fully reconciled with reference points, and the data and assessment limitations, and have been periodically evaluated."

Table 9: MSC Score defintions for indicator 1.1.4.2

The fishery scored 90, reflecting the management plan is clear, and is implemented effectively.

Pacific cod: Pacific cod Indicator 3.2.2.1 asks whether "catch levels are set to maintain high productivity of the target population and ecosystem.

3.2.2.1 Catch levels are set to maintain high productivity of the target population and ecosystem	
Score	**Requirement**
60	"Catch levels are varied in relation to target specific population goals, but setting of goals and the degree of conformity with such goals is variable."
80	"Catch levels.... are regularly set in a precautionary manner directly tied to, and limited by, target species population goals" and "no clear-cut indications of substantial declines in productivity of the target species"
100	"Catch levels.... are regularly set in a precautionary manner directly tied to, and limited by, target species population goals" and "no evidence that the productivity of the target populations, including population subcomponents, is declining as a consequence of harvest levels"

Table 10: MSC Score defintions for indicator 3.2.2.1

The fishery scored 95, because "NMFS use harvest control rules that meet or exceed international standards and are precautionary", and the Allowable Biological catch usually exceeds the Total Allowable Catch, which usually exceeds the

actual catch.

Pacific cod Indicator 3.2.1.5 asks if “the management system presents managers with clear, useful, relevant information including advice”. The scoring includes judging whether the managers followed the advice or not:

3.2.1.5 The management system presents managers with clear, useful, relevant information including advice	
Score	**Requirement**
60	“Decision makers do not consistently rely on the information presented to them”
80	“The management system's decision makers show evidence of relying consistently upon the information provided to them”
100	“The management system shows evidence of a pattern of behavior by decision makers that reveals that they have found the information provided to them to be useful”

Table 11: MSC Score defintions for indicator 3.2.1.5

The fishery scored a 90, in part because “the council... does not set the ABC above that recommended by its scientific advisors” and “NMFS sets TAC below that ABC.”

The FishSource Score

If managers always set the TAC equal to or below the scientific advice then the fishery gets a rating of 10. The high scores of MSC certified fisheries against this criteria means there is no information on how the MSC might score less well-managed fisheries. For the moment, we propose that TACs set 12.5% above scientific advice, or set above scientific advice 12.5% of the time, would earn a score of 8, while those 25% above would earn a score of 6. These numbers will be adjusted if/when more information becomes available.

The figure below illustrates the relationship between the FishSource score and the underlying ratio:

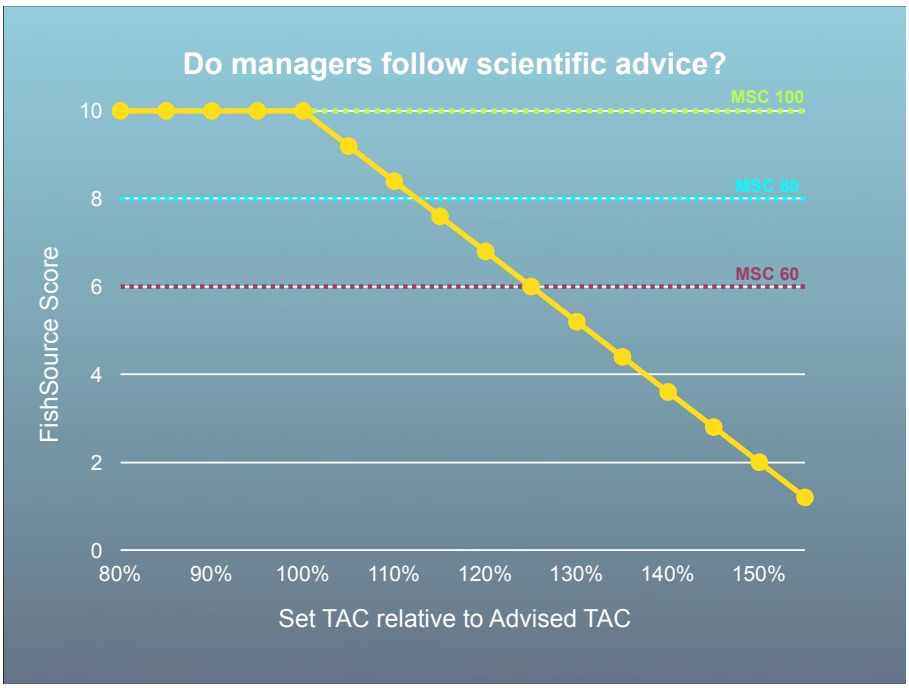

Illustration 2: FishSource Score 2 vs relative Set TAC

FishSource Score 3: Do Fishers Comply With Managers Decisions?

Introduction

Several different measures may be used to judge whether fishers comply with the rules and policies set by management. Ideally fisheries would report comprehensive enforcement statistics that showed the number of detected infringements of different regulations, and some estimate of the likely total number of infringements. These include the number of incursions into prohibited zones, the use of banned fishing gears or practices and failure to report to authorities as required. Unfortunately such information is rarely available.

One simple alternative measure used in many fisheries is ***whether fishers catch fish over the quota set by the managers.***

The Underlying Measure

This question can be answered by assessing the level of the actual catch relative to the quota or "Total Allowable Catch" (TAC) set by managers.

Determining this ratio requires a good estimate of actual total catch. Estimates for actual catch are often generated by stock assessment scientists, who require a good estimate of total catch to accurately scale their estimates of fish abundance. Enforcement agencies, customs and tax authorities, and veterinarian and health and safety inspectors may also provide estimates.

Minimizing over-quota fishing is important from sustainability and responsible sourcing perspectives. In general fisheries managers assume effective implementation of the rules when they set quotas. If implementation is poor, then managers decisions will fail to achieve their intent, with potentially significant repercussions for sustainability. Over-quota fishing will also typically be illegal, which is clearly a challenge for any responsible sourcing policy.

How the MSC Has Scored Fisheries Using This Measure

Summary Findings: The MSC system has typically scored fisheries with good compliance in the 90-100 range (with the exception of South African hake). None of the MSC certified whitefish fisheries report significant over-quota fishing, hence there is no guidance on what level of over-quota catch might result in a score of 80 or 60.

Alaskan pollock: BSAI Alaskan pollock Indicator 1.1.2.3.5.1 refers to the measurement of fishing mortality:

1.1.2.3.5.1 All major sources of fishing mortality for the stocks are measured and accounted for.	
Score	**Requirement**
60	"Catch monitoring is inadequate to estimate significant sources of mortality due to fishing. Catches from outside the management area that impact significantly on the stocks are largely ignored."
80	"Catches from the target fishery and significant by-catch fisheries are recorded through an at sea observer program with adequate statistical coverage. Catches from outside the management area of the target fishery that impact on the target stocks are available, and are used in the assessment."
100	"All sources of fishing mortality, including catches from all fleets, by-catch from other targeted fisheries, and catches outside the management area that impact on the stocks, are measured accurately using a comprehensive at sea observer program."

Table 12: Measurement of fishing mortality for BSAI Alaskan Pollock

The assessment noted that "the fishery scores very high on this indicator as far as monitoring of domestic US catches is concerned. However the overall score is less than 80 because, although Russian catch levels are available, they are not currently used in the assessment of the EBS stock."

BSAI pollock Indicator 3.4.3 (p 225 of full assessment report) asks whether "the management system provides for monitoring". The fishery scored 90, because it "is carefully monitored through a comprehensive federal fishery observer program as well as requirements for flow scales, VMS units and extensive record keeping and logbook reporting". The assessment goes on to note that "this observer program is the only one of its kind in any U.S. fishery. But improvements could be made related to coverage and the hiring process", and that a "review cited a high likelihood of differences in vessel behavior between observed and non-observed vessel days, both in terms of fishing patterns and compliance with management measures." Nonetheless, the fishery "benefit from extensive, useful, and reliable monitoring. The Bering Sea and Aleutian Islands fisheries would have received a higher score, except that the assessment team received evidence that significant, but mostly un-quantified catch of stocks from these areas are being harvested in Russian waters."

New Zealand hoki: The New Zealand hoki reassessment refers to good compliance in Indicator 1.1.4.1, which asks "are there appropriate management tools...to implement decisions and hence constrain harvests". The fishery scored 95 against this indicator in part because "catches have been at or below the TACCs since 1997-98". Indicator 3.2.4.1 asks "does the management system determine the extent of compliance and include an enforcement component". The fishery scored only 78 against this indicator, because although compliance with government regulations was high, the certification also depended on compliance with a industry code of conduct, for which compliance levels were less clear.

South African hake: South African hake Indicator 3B.5.2directly asks whether fishers comply or not:

3B.5.2 do fishers comply with management system, legal and administrative requirements	
Score	**Requirement**
60	"Fishers comply with some, but not all, requirements."
80	"Fishers are fully compliant with relevant management measures."
100	"Fishers are fully compliant with, and fully supportive of, a code of conduct which incorporates legal, and administrative requirements."

Table 13: Fishers compliance determination for South African Hake

The fishery scores 75 because “compliance is considered generally good, and there have been very few prosecutions in the hake trawling sector. However....compliance offshore is...difficult to monitor and some transgressions are reported, such that it cannot be said that fishers are fully compliant.” It is unclear what “fully supportive” means, and why a fully compliant fishery should not score 100. But this assessment scored full compliance only as an 80 score.

Pacific cod: Pacific cod fishery scored 95 on Indicator 1.1.2.1, which asks whether “fishing related mortality is measured/estimated...” The fishery scored highly because of extensive observer coverage (e.g., observers monitored 52% of the longline catch in 2001). Pacific cod Indicator 1.1.4.3 asks whether “there are appropriate management tools specified to implement decisions... for management of the stock.” The fishery was scored 95, in large part because “since 1995 the catch has not exceeded the TAC.” Indicator 3.2.5.1 asks directly whether “fishing operations are fully compliant with regulations and directives regarding fishing practices developed by the management system.” The fishery scored 90, because detected violations were very low, penalties were significant (up to $100,000 and/or 6 months in jail), and observer coverage was high.

The FishSource Score

A fishery that has no over-quota catches earns a FishSource score of 10. The high scores of MSC certified fisheries against this criteria means there is no information on how the MSC might score less well-managed fisheries. For the moment, we propose that catches 12.5% over-quota would earn a score of 8, while those 25% over quota would earn a score of 6.

The figure below illustrates the relationship between the FishSource score and the underlying ratio:

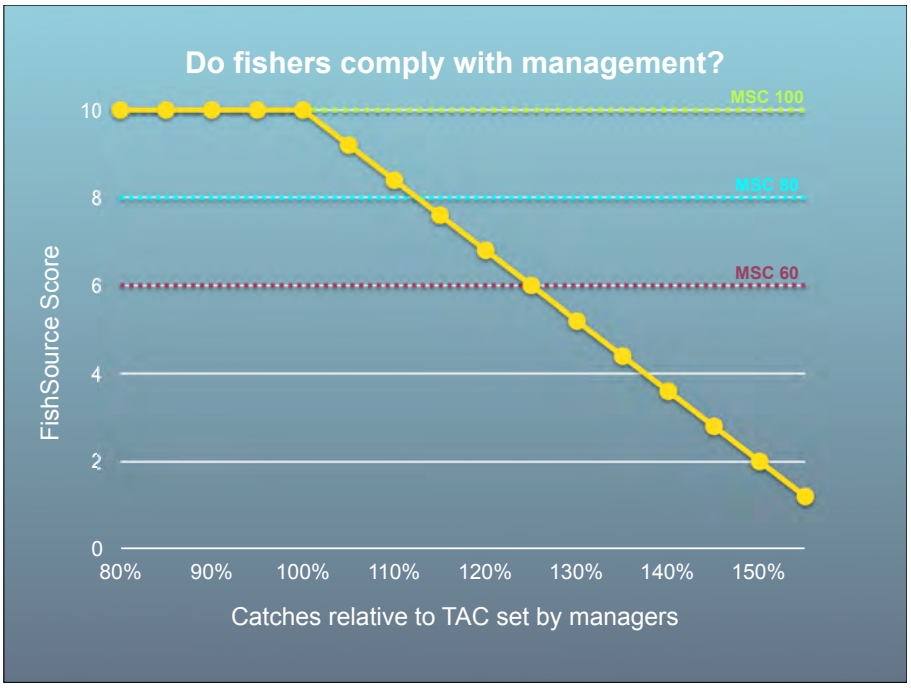

Illustration 3: FishSource Score 3 vs catches relative to set TAC

FishSource Score 4: Is the Fish Stock Healthy?

Introduction

The core measure of fish stock health used in many fisheries is ***whether the biomass is at or above the target reference point set for the fishery?***

The Underlying Measure

Answering this question requires that an appropriate definition of "healthy" exists for the fishery, and that the stock is assessed to be above that level. MSC assessments, for instance, have typically scored fisheries both for the management levels set for the fishery, and for the current status of the fishery relative to those levels.

The underlying measure then becomes the current size of the spawning biomass relative to the spawning biomass target reference point (typically B_{msy} or some variant).

How the MSC Has Scored Fisheries Using This Measure

Summary Findings: There is significant variation in how fisheries have been scored against this criteria, making it difficult to identify scoring levels. In general, the MSC scheme scored certified whitefish fisheries at 80 or above if the spawning stock biomass was at or above B_{msy}. A 100 score was given if the target reference point (TRP) also included and addressed ecosystem concerns (which was judged not to be the case in any of the fisheries). A 60 score was typically awarded if the fishery was below the TRP but above the limit reference point (LRP) and recovering. Typically the LRP was of the order of 50% of the TRP (with the notable exception of Pacific cod).

Alaskan pollock: BSAI Alaskan pollock Indicator 1.1.2.1 measures the size of the stock relative to reference points.

1.1.2.1 Current stock sizes are assessed to be above appropriate limit reference points.	
Score	**Requirement**
60	"Stock assessments show that there is a reasonable chance that the stock is at or above B_{MSY} or its equivalent."
80	"Stock assessments show the stock to be above the reference biomass with greater than 70% probability. The reference biomass is B_{MSY} or its equivalent and takes into account the natural variability of the stock."
100	"Stock assessments show the stock to be above the reference biomass with greater than 90% probability. The reference biomass is above B_{MSY} and takes into account the needs of predators."

Table 14: BSAI Alaskan Pollock Indicator 1.1.2.1

Controversially, the BSAI assessment team decided B_{msy} was a limit reference point. This decision was taken in part because the importance of pollock in the broader ecosystem (as a source of food for other sea life) meant that a limit reference point of $B_{msy}/2$ (or approximately 17% of B_0) was too low.

New Zealand hoki: New Zealand hoki Indicator 1.1.4.2 asks "are appropriate target and limit reference points used" and refers to $B_{20\%}$ as the defacto limit reference point (LRP) and $B_{40\%}$ as the defacto target reference point (TRP) used in the assessment forecasts, and notes that "[t]hese reference points are typical of those used for well-managed fisheries."

New Zealand hoki Indicator 1.1.5.1 asks "are the stocks at or above the reference points?". The scoring guideposts are summarized in the table below:

1.1.5.1 Are stocks at or above the reference points? [LRP is $B_{20\%}$, TRP is $B_{40\%}$]	
Score	**Requirement**
60	"stocks are likely above their limit reference points or a rebuilding program is in place so that recovery to above the limit reference points will likely not be delayed by more than one generation"
80	"stocks are being maintained above their limit reference points and are likely currently, and in the future, to be around their target reference points"
100	"there is a very high probability that all stock are above their target reference points, and are likely, currently and in the future, to be around their target reference points"

Table 15: New Zealand Hoki indicator 1.1.5.1

At the time of NZ hoki recertification, the eastern stock was at $B_{40\%}$ and the western stock was deemed likely below $B_{20\%}$ ("The Western stock was estimated in 2004 to be 13-22% of its unfished level. The stock is likely therefore below 0.2 B_0, the *defacto* limit reference point for the stock"). The two stocks together earned a score of 67 (though the recovery trajectory for the western stock was only evaluated under criteria 1.2, which applied when stocks were depleted).

South African hake: South African hake Indicator 1.1.3.1 asks "are there appropriate limit and precautionary reference points". The fishery has a target of spawning stock of B_{msy}. Indicator 1.1.6.1 asks "Is the stock(s) at or above reference points", but the fishery was not scored against the indicator because the western stock was considered depleted, noting "spawning biomass is about 22% of the initial (unexploited) spawning biomass". Instead the fishery was scored against Indicator 1.2.1, which asks "if the stock is below the precautionary reference point, are measures to rebuild the stock specified". The fishery score 95, because recovery measures had been implemented to rebuild the fishery within 10 years.

Pacific cod: Pacific cod 1.1.6.1 asks if the stock is at or above appropriate reference levels.

1.1.6.1 the stock is at or above appropriate reference levels [LRP is $B_{35\%}$, TRP is $B_{40\%}$]	
Score	**Requirement**
60	"Assessments show the stock is likely above the limit reference point. However, the probability is undefined"
80	"Assessments show the stock has a greater than 50% probability of being above the limit reference point"
100	"Assessments show the stock is above the target reference point more than 50% of the time in recent years"

Table 16: Pacific Cod 1.1.6.1 Indicator

The fishery scored 80 because the spawning stock was below the TRP but above the LRP and expected to increase above TRP in a few years.

The FishSource Score

There is significant variation in how fisheries have been scored against this MSC criteria, making it difficult to identify scoring levels. However, other fisheries experts such as ICES have provided guidance that fisheries above the target reference points be considered “green”, those between the limit and target reference points be considered “yellow”, while those below the limit reference points be considered “red”.

FishSource scores a fishery a 10 if current biomass is 50% above B_{msy}. A fishery at B_{msy} scores an 8, while a fishery at $0.5B_{msy}$ scores a 6 and a fishery below that level scores below 6.

One wrinkle is that although B_{msy} or $B_{40\%}$ is estimated for the majority of jurisdictions where assessments are available, these parameters are not provided by ICES for European stocks. Instead ICES and the EU use a TRP of B_{pa}, and and LRP of B_{lim}. A common definition of B_{lim} is the level at which recruitment is likely lower, while B_{pa} is the biomass level above which there is little risk that the real biomass level is below B_{lim}. However, the terms are used inconsistently.

However, until ICES produces estimates of B_{msy} and $B_{40\%}$ as a matter of course, our statistic will treat B_{pa} as the TRP. Hence for ICES assessed stocks, our statistic scores 10 if B is 50% above B_{pa}, 8 if B equals B_{pa}, 6 if B equals $B_{pa}/2$, and below 6 if the biomass is lower.

The figure below illustrates the relationship between the FishSource score and the underlying ratio:

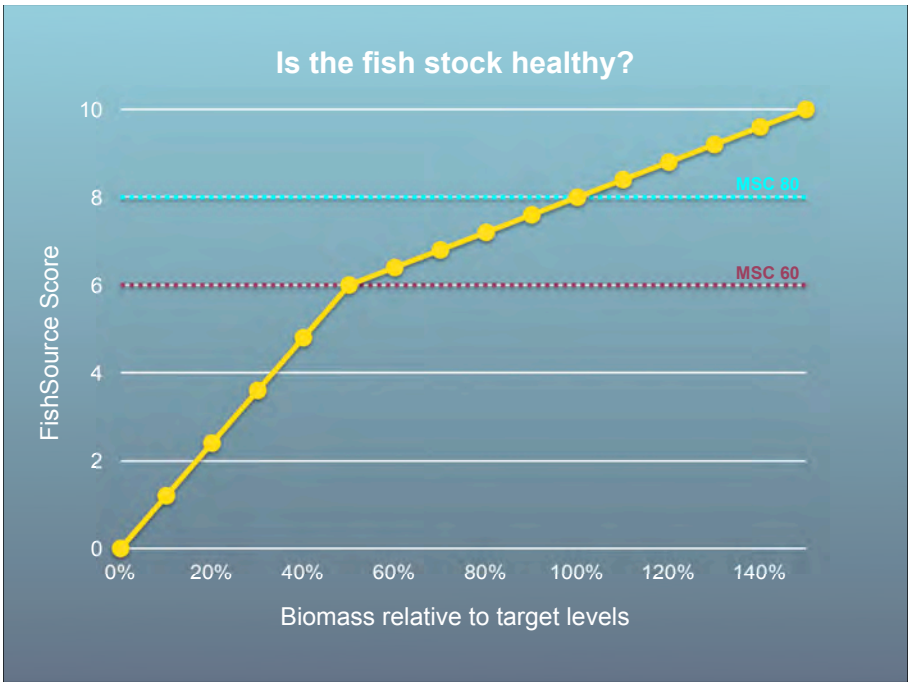

Illustration 4: FishSource Score 4 vs relative biomass

FishSource Score 5: Will the Fish Stock be Healthy in Future?

Introduction

A wide range of measures can be used to judge whether a fish stock will be healthy in future. A common quantitative measure is ***whether fishing mortality is below the target reference point for the fishery?***

The Underlying Measure

The core underlying measure is the ratio of current fishing mortality to the set target reference point for fishing mortality (e.g., F/F_{msy}).

If fishing mortality is below the target reference point, then it is expected that a stock below the target biomass level would be able to recover. The lower the fishing mortality, the speedier the recovery.

How the MSC Has Scored Fisheries Using This Measure

Summary Findings: There is significant variation in how fisheries have been scored against this criteria. For instance, in order to earn 100, the Alaska pollock fishing mortality was required to be below a target reference point that included ecosystem management targets, whereas Pacific cod simply required F be below F_{msy}. In order to earn 80, Alaska pollock F was required to be below F_{msy} with a high degree of certainty, while Pacific cod required F to be below the limit reference point with a high degree of certainty (noting though that the certifiers of the Pacific cod fishery identified $F_{35\%}$ as the LRP, rather than a more typical higher figure, so the discrepancy is not as great as it first appears).

Alaskan pollock: BSAI Alaskan pollock Indicator 1.1.1.2 asks if the "harvest control rule is based on appropriate limits to the maximum exploitation rate". A score of 100 is awarded if the harvest level is defined on a precautionary basis with respect to impacts on target *and* associated species, 80 if it is defined on the basis of internationally recognized LRPs (referring to F_{msy}), and 60 if F_{msy} is used as a TRP. The fishery scored 85 on this indicator, because "although the maximum exploitation rates.... do not explicitly take into account of impacts on associated species, several features of the [management plan] effectively constrain harvest rates further and do so to (in part) protect associated species."

BSAI Alaskan pollock indicator 1.1.2.2 determines where current F is relative to reference points.

1.1.2.2 Current exploitation rates are below appropriate limit reference points.	
Score	**Requirement**
60	"Stock assessments show the current exploitation rate to be at or below F_{MSY} or its equivalent."
80	"Stock assessments show the current exploitation rate to be below the limit reference point with greater than 70% probability. The limit reference point is set at F_{MSY} or equivalent."
100	"Stock assessments show the current exploitation rate to be below the limit reference point with greater than 90% probability. The limit reference point is below F_{MSY} and takes account of needs of predators."

Table 17: BSAI Alaskan Pollock indicator 1.1.2.2

The AI portion of the fishery scored 100, because pollock was only being taken as bycatch in other fisheries and thus the fishing mortality was very low. The EBS portion of the fishery scored "between 80 and 100" because the limit reference point was set at F_{msy}, but actual F was below F_{msy} with a high degree of probability.

New Zealand hoki: New Zealand hoki Indicator 1.1.5.2 asks "is fishing mortality below reference points?". However, no fishing mortality reference points are estimated for the fishery, so the scoring guideposts were phrased in terms of future trends in biomass likely given current fishing mortality. The scoring guideposts were:

1.1.5.2 Is fishing mortality below reference points?	
Score	**Requirement**
60	"the current level of fishing mortality is expected to keep stocks above their ***limit*** reference points"
80	"there is a low probability that the current level of fishing mortality will cause the stocks to drop below their ***limit*** reference points"
100	"there is a only a very low probability that the current level of fishing mortality will cause the stocks to drop below their ***target*** reference points"

Table 18: New Zealand Hoki indicator 1.1.5.2

The fishery scored 80, because although the western biomass was currently below the limit reference point ($B_{20\%}$), the current fishing mortality was low and expected to allow the stock to rebuild above $B_{20\%}$.

South African hake: The South African hake assessment does not include an Indicator asking specifically about fishing mortality, although Indicator 1.1.6.1 asks "is the stock above reference levels", and notes "the South coast sector .... fishing mortality rates are below F_{msy}."

Pacific cod: Pacific cod Indicator 1.1.6.2 asks if "the fishing mortality rate is below the appropriate limit reference point".

1.1.6.2 The fishing mortality is below the appropriate limit reference point	
Score	**Requirement**
60	"Assessments show the fishing mortality rate is likely below the limit reference point most of the time in recent years"
80	"Assessments show the fishing mortality rate is very likely below the limit reference point most of the time in recent years"
100	"Assessments show the fishing mortality rate is very likely below the limit reference point consistently for several years"

Table 19: Pacific Cod indicator 1.1.6.2

The fishery scored 100, because "there is a high probability of the stock being below the target exploitation rate [F35%] and very high probability of it being below the limit reference point [F40%]".

The FishSource Score

There is significant variation in how fisheries have been scored against this MSC criteria, making it difficult to identify scoring levels. However, other fisheries experts such as ICES have provided guidance that fisheries with a fishing mortality level below the target reference points be considered "green", those between the limit and target reference points be considered "yellow", while those above the limit reference points be considered "red".

How the FishSource indices are calculated

FishSource scores a fishery a 10 if F is 50% below F_{msy}. A fishery where the fishing mortality is at the target reference point scores an 8, while a fishery with fishing mortality 50% higher than F_{msy} scores a 6 and a fishery with even higher F scores below 6.

The figure below illustrates the relationship between the FishSource score and the underlying ratio:

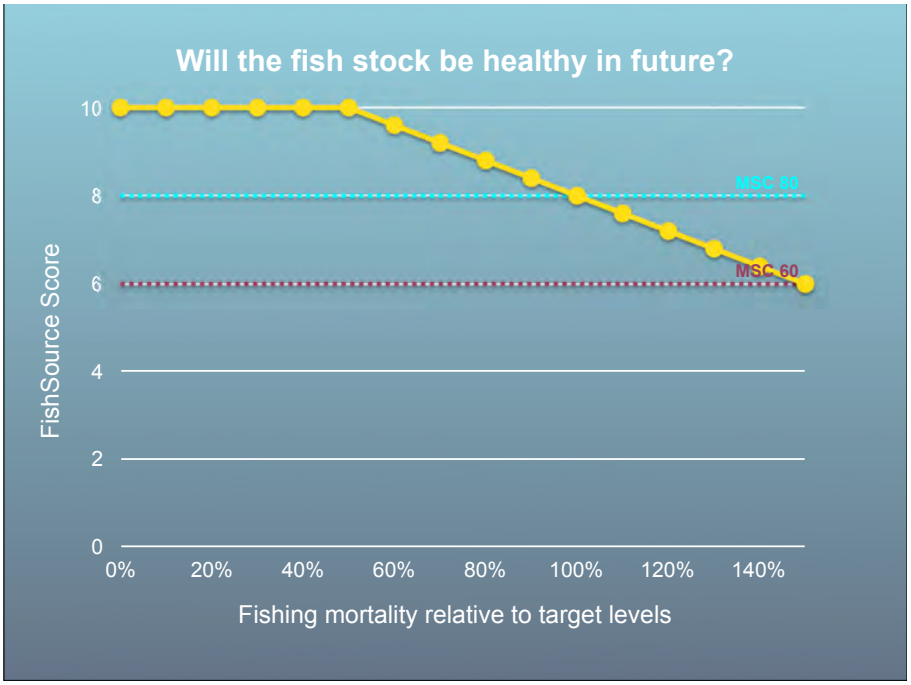

Illustration 5: FishSource Score 5 vs relative fishing mortality