Report

Optimizing sustainable fishing yields - ecosystem and management perspectives

A scientific symposium organised by the F_{MSY} project group

10-11 October 2018, DGI-byen, Tietgensgade 65, 1704 Copenhagen, Denmark

Ministry of Environment and Food of Denmark

European Union
European Maritime and Fisheries Fund

Nordic Council of Ministers

INSTITUTE OF MARINE RESEARCH

The Fmsy project.

A 2 year project under the Nordic Marine Think Tank (NMTT) and funded by: The European Maritime and Fisheries Fund & the Danish Ministry of Environment and Food (1.372 mio DKK), the Norwegian Fisheries Research Fund via IMR Norway (0.5 mio DKK) and from the Nordic Council of Ministers (0.5 mio DKK). The total budget for the project is therefore 3.057 mio DKK.

Contents

1 Introduction

Fish stocks in the North Atlantic are rebuilding and it is time to revisit what the optimal fishing pressure is. The technical basis are the so-called FMSY reference points. The Symposium was held to discuss ways of revising these.

The Symposium was organized by the Fmsy-project – a 2 year project organized by the Nordic Marine Think Tank (NMTT) running from February 2017 to April 2019 (see www.fmsyproject.com).

The objective of the Fmsy-project is to come up with FMSY values, which are based on ecosystem functioning, for each of ICES data rich fish stocks and some relevant stocks from the sea off North America. These FMSY values can be applied directly by ICES and other management bodies, in their current fisheries management. The aim is to bridge the gap between the science available and management.

The current FMSY values used by ICES are based on traditional single species consideration that ignores aspects of ecosystem functioning in terms of density dependent population dynamics in growth, sexual maturity and mortality as well as species interactions.

Not bridging the gap between the science on ecosystem functioning available and management has the unfortunate consequence MSY is not reached, because the current FMSY values used are biased.

Meta-analysis and ecosystem/multispecies modeling in several ICES eco-regions, indicate that the foregone yield will be substantial if not applying ecosystem based FMSY values (see e.g. Gislason 1999, Collie et al. 2003, Sparholt and Cook 2009, Fernandez and Cook, 2013, ICES 1989, 2008, 2012, 2013) and that forage species like sprat and capelin might be predated heavily and only allow for very low if any, fishery.

There are four density dependent mechanisms in fish population dynamics that are important for Fmsy calculations. These are:

- Density dependent recruitment
- Density dependent individual fish growth
- Density dependent mortality
- Density dependent maturity.

Currently, only the first one is taken into account in the Fmsy calculations.

The approach suggested in the Fmsy-project is not a full multispecies approach, but focus on adding mainly density dependent growth, maturity and (mainly for cod) cannibalism, to the current single species way of estimating FMSY. Thus, managers need not consider the balance between species for using the proposed set of FMSY values.

The interaction between species need not be an integrated part of the calculations, if the new FMSY values are regarded as valid for only a limited time period, say 5 years. This is because the stock sizes can be considered reasonable constant within such a limited time period. However, if say, a predator stock increases quickly, as has been seen in the past for some cod stocks when fishing mortality is substantially reduced, new FMSY values might need to be calculated for its prey stocks before the end of the 5 year period, using a new set of natural mortality by age values.

The alternative set of FMSY values calculated by the Fmsy-project are based on a meta-analysis of the very extensive amount of published science work on FMSY in multi-species and ecosystem models, including population dynamic characteristics of each stock in terms of growth, maturity and longevity parameters. The scientists in the North Atlantic area (including the Baltic) are world leaders in this research field based on four decades of intensive research, where more than 200 peer review papers has been published, more than 1.5 million fish stomachs analyzed, expensive laboratory facilities have been build, hundreds of science person-years spend on fish evacuation experiments, and a multitude of models developed. Surplus production models will be applied to some selected data rich stocks, using estimated F time series as effort. The selection will be based on the dynamic range of F, so that only the best suited stocks for surplus production models will be analyzed. Surplus production models will give FMSY (and BMSY) as an integral part of the model. These are based on actual realizations over the past history of the stock and therefore implicitly includes ecosystem functioning in their FMSY (and BMSY) calculations. Ricard et al. (2011) and Thorson et al. (2012) are the most prominent studies of this kind. Dynamic Pool modelling like PROST (Åsnes and Bogstad 2014) and Non_P (ICES 2017) were applied for a handful of stocks where density dependent kmowledge on growth, maturity and cannibalism were available.

GLMM models including e.g. life history parameters like Linf and K from the von Bertalanffy growth equation important for stock productivity (see e.g. Patrick et al., 2010), will been applied, in order to "expand" information from multispecies, SPMs, and Dynamic Pool estimated Fmsy values to other stocks.

The purpose of the symposium is to present the Fmsy-project results and discuss these in public.

2. Symposium programme

The symposium was held over two days with the following structure.

Day 1 – October 10, 2018

12:30 – Open for registration

Chair Carl Christian Schmidt

13:00 – Opening of Symposium. Carl Christian Schmidt, NMTT Chair.
13:10 – Opening speeches, Eva Kjer Hansen (Danish Minister of Fisheries) (by video), Ernesto Peñas Lado (EU), Yimin Ye (Branch Head of FAO Marine and Inland Fisheries), and Anne Christine Brusendorff (ICES General Secretary).

Chair: Jeremy Collie

13:40 – Setting the Scene. (Henrik Sparholt)
14:05 – Density dependence in fish populations. (Jan Horbowy)
14:25 – The multispecies and ecosystem knowledge. (Daniel Howell)

14:50 – Coffee and Networking
15:20 – The cod in Barents Sea and Icelandic Waters experience and ways forward. (Bjarte Bogstad)
15:50 – Surplus production models and F_{MSY} estimation. (Rob van Gemert and Henrik Sparholt)
16:20 – Surplus production models: RAM Legacy, Froese et al. and resulting F_{MSY}. (Mike Melnychuk)
16:50 – Results from SPiCT. (Rob van Gemert)
17:20 – "Exporting" the F_{MSY} to other stocks. (Mike Melnychuck and Henrik Gislason)

17:50 – Closing for the day – chair

18:00 – 21:30 Symposium Networking Buffet, hosted by the F_{MSY} project – DGI Byen

Day 2 – October 11, 2018
08:00 – Breakfast and networking hosted by the F_{MSY} project

Chair: Villy Christensen

09:00 – Historical catch data improvements (Claus Redtz Sparrevohn/Søren Anker Pedersen)
09:20 – Case studies with specific Density Dependent calculations (PROST-type calculations) (Henrik Sparholt/ Rob van Gemert)
09:40 – Varying population productivity, FMSY, and implications for sustainable levels of fishing. (Joanne Morgan, DFO Canada)
10:00 – Trade off in management and MSY. (Ken H. Andersen, DTU AQUA)
10:20 – Views on how to "bridge the gap" between the science available on these issues and the scientific advice/management. (Anna Rindorf, DTU AQUA)

10:40 – Coffee and Networking

11:10 – Roundtable discussion – Should these new F_{MSY} be implemented in advice and management and if so how? Moderator: Villy Christensen. Participants: Martin Pastoors (Former ACOM Chair, now Dutch Pelagic Fishers), Ernesto Peñas Lado (EU), Anna Rindorf (DTU AQUA), and Henrik Sparholt (F_{MSY} project.
12.15 – Participant poll: Are we ready for implementation of updated F_{MSY} values? (Søren Anker Pedersen)
12:30 – Reflections on the symposium from the science-policy interface perspective. (Poul Degnbol)
12:40 – Conclusion from the Fmsy project and what it could mean for fisheries management (Henrik Sparholt)

13:00 – 14:00 Lunch and networking hosted by the "F_{MSY} project".

3. Attendance

The symposium was attended by 88 participants which represented mostly scientists, managers, stakeholders from the fishing industry and from "green" NGOs. Students and PhD students were also present. Participants came from Belgium, Canada, Denmark, Faroe Islands, Germany, Greece, Iceland, Indonesia, Ireland, Italy, The Netherlands, Norway, Russia, Sweden, UK England, UK Scotland, and USA.

The VIP group was especially strong with Eva Kjer Hansen (Danish Minister of Fisheries) (by video), Anne Christine Brusendorff (ICES General Secretary), Ernesto Peñas Lado (senior scientist at DG Mare the EU), Yimin Ye (Branch Head of FAO Marine and Inland Fisheries), and Carl Christian Schmidt (President of the Nordic Marine Think Tank).

4. Presentations

There were 10 presentations by the Fmsy-project scientists and 3 presentations from external scientists. The presentations can be found on the Fmsy- projects homepage www.fmsyproject.com.

5. Roundtable discussion

The overall theme of the Roundtable discussion was "**Should the new F_{MSY} be implemented in advice and management, and if so how?".**

Villy Christensen was moderator and the members of the Panel were:

- Martin Pastoors (Former ACOM Chair, Pelagic Freezer Trawler Association)
- Ernesto Peñas Lado (DG Mare)
- Anna Rindorf (DTU Aqua)
- Henrik Sparholt (F_{MSY} project)

After a short in introduction by the Chair of each member, each member was allowed a short statement.

The panel was briefed beforehand on possible questions. The questions marked (*) are those the Chair beforehand prioritized (8 of 12 Q's).

The questions focused on the "should" in the title of the panel discussion, but the Panel was also invited to address the "how", including addressing the hurdles that there will be.

Questions

1. You've heard the F_{MSY} WG's findings and conclusions, including finding a gap between the science available with regards to F_{MSY} and the scientific advice/management. How big do you find the gap?

2. * The F_{MSY} values currently in use by ICES are based on single-species approaches that do not consider notably density-dependent growth, maturity, and mortality (incl. cannibalism). Including each of these factors, according to the WG, results in higher estimates of FMSY, do you find that this has been convincingly demonstrated?

3. * The F_{MSY} WG proposes to use the set of ecosystem-F_{MSY} values for five years before re-evaluating, as populations, food webs, and environmental conditions change over time. Is that a viable approach, or how do we best go about addressing these issues?

4. The F_{MSY} WG did not aim for a full multispecies approach, but opted for small steps. Yet, ecosystem-based approaches has been underway for 40 years. Is the research available, and are ICES, member states and the EU ready for that step?

5. * ICES Strategic Plan: “Bridging the gap between science available and fisheries advice/management, with the use of ”...unbiased...” and ”... available science ...” The currently used F_{MSY} values are likely to be downward biased. The resulting low fishing pressure helps with rebuilding, maintains high SSB, and lowers the risk of stock collapse, but there are economic consequences. In essence, it may be considered a hidden precautionary approach – is that OK?

6. * Higher F_{MSY} means lower B_{MSY}, and this may impact predators, notably marine mammals and birds. Does there need to be an explicit share for the predators?

7. * From a precautionary perspective, the use of a “pretty good yield” *sensu* Hilborn (2010), set at, e.g., 80% of F_{MSY}, has been advocated. Is PGY the way to go, and if so, how should it be set?

8. Rindorf et al. (ICES JMS 2017) found that fishing at a PGY of 95% (of current) F_{MSY} by and large didn’t impact recruitment for larger species, but might for smaller and medium sized fish. Does this indicate that PGY needs to be group specific?

9. * The F_{MSY} WG has analysed F_{MSY} for a limited portion of the managed stocks, and are suggesting the use of multi-variate statistical approaches to estimate ecosystem-F_{MSY} for other managed stocks. Do you find this sufficient, or should ecosystem-F_{MSY} be explicitly estimated for all stocks?

10. * If the new F_{MSY}’s are adopted and TACs based on these, the TACs will be larger, but vary more. What objectives should be considered to strike a balance between average yield and variability?

11. * Has the time come to implement the F_{MSY} values estimated by the WG? If No to above, should an ad-hoc ICES WG be tasked with evaluating the F_{MSY} estimation, or will this just be a way of ensuring that nothing happens?

12. Are there lessons from this symposium that are relevant beyond the areas with strong management, e.g., in the tropics?

13. Similar to for DD factors, the environment is included in the current F_{MSY} calculations by setting the impact to zero. That’s a problem when the environment changes – we call that regime shifts when it’s so drastic that we notice it. There is major progress in observation capabilities (think, satellites) for environment changes, and time series fitting of ecosystem modelling shows environmental impacts propagating through the food web. So, shouldn’t environmental factors be integrated in estimating of reference points?

14. Density dependent Fmsy check list:
    - Can we statistically detect DD in the stock?

- Is it a large enough effect to matter?
- Is the stock currently at high stock size?
- Have we evaluated the proposed HCR to be precautionary?
- Do we understand the process?

6. Conclusions

There were no attempt to reach a formally agreed conclusion, but the following summing up by two external (to the Fmsy-project) scientists and managers, probably reflects well the general flavour of the opinion in the audience, (which was monitored by a Kahoot questionnaire session where 40 particiants took part with their smart phones):

> *"- The symposium demonstrated the full scale of variability of Fmsy estimates, not just on methodology but fundamentally on whether ecosystem considerations are taken into account.*
> *- There is an emerging challenge in Fmsy-based management: that emphasis on single-stock Fmsy objectives without ecosystem considerations will lead to 'too little fishing' in some cases and thus to foregone yields.*
> *- Fmsy is not stable and the management system must recognize this by avoiding that legislation be too deterministic, when the leading parameter is so highly unstable.*
> *- The same applies to the effects of regime change in the estimation of Fmsy. This regime change is being exacerbated by global warming, and thus the management system should provide for flexibility to allow parameters, and particularly biomass-related parameters, to be quickly adaptable to the emerging evidence.*
> *- The higher Fmsy values obtained when considering density dependence and other ecosystem factors can have a low risk of stock depletion, provided that biomass-related thresholds (Bpa or MSY Btrigger) are applied.*
> *- There is very promising research on the 'transfer' of Fmsy estimates from data-rich stocks to data-poor ones through correlation based on life story parameters of the stocks. This could be a good solution to the lack of Fmsy estimates in stocks where extra investment seems unlikely."*
>
> …and…

"As stated at the start of this conference, years ago science advisors could state that for policy action there was no uncertainty in stock assessments, we knew the direction with great certainty although current numbers might be technically quite uncertain. This created some complacency and may have fostered ground for not working sufficiently on incorporating density dependence for instance in assessments and thus not prepare for today.

This conference has highlighted a number of issues:

1 *Change is necessary* as new knowledge is coming and stock sizes are increasing. Inclusion of density dependence is now more important than before because populations are larger and for many stocks we need to be much more accurate about direction of management.

But the combination of uncertainty and strong political interest makes it even more important to ensure that we are unbiased and are even sharper on what we consider knowledge which is robust enough to use.

2 This conference has highlighted that the way forward in this situation is *gradual adaptive change*. Focus initially on healthy stocks, pin down the responsibility for inclusion of robust knowledge while opening for change.

However, this approach is still based on history with delay and does thus not in itself prepare for a future which may be completely different – as highlighted in this conference by talks about regime shifts and trends.

3 *The future will be different from the past*, for reasons beyond fisheries management control. There will be regime shifts and there are trends for instance in productivity as highlighted in this conference. Predictability based on historical experiences is therefore a problem. It is therefore necessary to

- ensure that reference points are seen as dynamic, also in management plans.

- adjust on an ongoing basis reference points for productivity and stock size.

One approach which has been suggested at this conference is to incorporate possible regime shifts and trends by taking a risk-based approach and look at options for the future under different assumptions about future regime shifts and trends.

4 Hardwiring reference points in management plans makes a dynamic and adaptive approach difficult. It is in this context important to *decouple reference points from action decision parameters in management plans*. Action decision parameters may initially be numerically identical to reference points, but should then specifically be termed differently. It is perfectly possible – as is done in other jurisdictions – to have a management plan with action decision parameters which is something completely different from reference points, such as a survey index, but which has been found to deliver in relation to reference points in a MSE.

5 The discussions at this conference have highlighted the need to clarify whether reference points are seen as a scientific technical issue which can be addressed in a traditional stock assessment framework or are seen as the result of a management strategy evaluation. *MSY related reference*

points should be seen as linked to a specific management strategy and should thus be determined within a MSE framework.

6 *Interactions* between stakeholders, scientists and decision makers – such as at this conference - are important, even crucial, but it is my impression that this has been diminishing in substance in recent years. Inclusion of density dependence has important consequences for all and necessitates that interactions are intensified if anything. A legitimate inclusion of wider ecological aspects in reference points will only work if dialogue, transparency and cooperation is up to it.

7 It is necessary to *focus on what is implementable on the short term while pushing for next longer term steps*. Therefore initially:

- focus on issues which involves minimal trade offs between different stakeholders. Handling trade offs has proven to be one of the most difficult tasks for fisheries management decision bodies in Europe;
- but it is at the same time necessary to push the limits for the future, to inclusion of those trade offs which exist out there and are important;
- there are presently two elephants in the fisheries management room: handling trade off between fish stocks (and thus between stakeholders) and real integration of environmental concerns in fisheries policy;
- addressing these two elephants will be difficult and takes long time; it is therefore necessary to push now.

A condition for this to succeed is that we defend the good aspects of European fisheries management, in this context that science based advice continues to be seen as legitimate and not speaking to specific interests:

- Maintain an international approach to the science basis for fisheries policy, without governments or intergovernmental bodies coediting;
- Maintain that scientific advice nationally or internationally is not subject to market forces."

7. Further issues to be explored

The following points for further issues to be explored came from the audience:

1. Confidence intervals around Fmsy from PROST should be possible to calculate.
2. The confidence intervals around SPiCT Fmsy values seems very wide – are they overestimated?
3. Only apply the new Fmsy vales to healthy stocks, i.e. stocks with SSB above MSYBtrigger or Bpa.

4. A two-step HCR like for NEA cod with the upper level of F at the new Fmsy values could be a way forward given the benefit of the new Fmsy values and no foregone catch and the benefit of the current low risk for impaired recruitment due to low stock sizes, with current MSY Btrigger (in the ICES terminology).
5. The risk is of the most concern to scientists in ICES and maybe also managers. An unchanged 5% risk can be obtained in many ways also with the new Fmsy values.
6. Individual stock Fmsy values should be scrutinized carefully. Some seem strange like one sole stock have a high Fmsy values while all others rather similar and much lower values – maybe the GLMM type analysis linking Fmsy to life history parameters could be a way forward.

The Fmsy-project agreed to try to address those points which fall inside the tasks of Fmsy-project after the Symposium.

8. Symposium flyer

A flyer was produced in due time before the Symposium, send around to potential participants, distributed at various events, and posted on the Fmsy-project home page www.fmsyproject.com.

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