PHD thesis - 2017-2020, Co-tutelle France-Australia

Title: Evaluation of harvest control rules in mixed fisheries under catch quota management

Research units

The PhD research will be carried out under a co-tutelle agreement between the University of Brest (UBO, Ecole Doctorale des Sciences de la Mer) and the University of Tasmania (UTAS, Doctoral Program in Quantitative Marine Sciences - QMS). The PhD will be hosted in:

- IFREMER, Economie Maritime & UMR AMURE, Plouzané, France (IFREMER, EM : https://wwz.ifremer.fr/Recherche-Technologie/Departements-scientifiques/Departement-Ressources-biologiques-et-environnement/Unite-d-Economie-Maritime , UMR AMURE: http://www.umr-amure.fr/index.php)
- CSIRO Oceans & Atmosphere, Marine Resources & Industries, Hobart, Austalia (https://www.csiro.au/en/Locations/Tas/Hobart)

Supervision

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Co-supervisors : Dr Claire Macher, Ifremer ; Dr Richard Lorne Little, CSIRO

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Fundings

The doctoral student will be employed by Ifremer, and the cost of the position will be shared by joint agreement between the supporting parties. Ifremer support has been confirmed. Co-funding is being sought from the Quantitative Marine Science Program, and the Centre for Marine Socio-ecology at the University of Tasmania.

Collaborations

The co-tutelle framework will ensure that the doctoral student has an opportunity to significantly interact with both the French and the Australian research groups (at least one year in each location). The PhD research will be linked to on-going research projects involving the co-supervisors, and French and Australian partners. The research will also benefit from interactions with the Mixed Fisheries Management Working Group of ICES (WGMIXFISH).

PhD project summary

In recent years, the push towards Ecosystem-Based Fisheries Management (EBFM) has led to the evolution of fisheries management towards more comprehensive catch-based systems, aimed at taking into account the entirety of fishing impacts on marine biodiversity, including targeted and non-targeted species. EBFM is also leading to the adoption of multi-criteria definitions of sustainability that include ecological, economic and social considerations. A challenge for decision-support frameworks in fisheries management is to develop operational approaches supporting such management regimes. Viability theory is particularly well suited to addressing such problems, and has successfully been applied to single species, input-based marine fisheries management problems.

The aim of the doctoral research will be to develop an ecological-economic modeling framework which can be used to evaluate alternative output-based harvest-control rules in mixed fisheries that are managed under Total Allowable Catches and individual catch shares, taking into account multiple management objectives. The framework will then be applied to a set of case studies in France and Australia, and used to compare the robustness of alternative control rules in the two different management contexts.

Keywords: Ecosystem-Based Fisheries Management, Catch shares, Ecological-economic modeling, Viability analysis, comparative research, French-Australian co-tutelle PhD.

Innovative character of the proposed research project and expected outcomes

The research will produce new approaches and tools to address one of the key contemporary challenges facing fisheries management systems under an ecosystem approach, namely the design of integrated harvest control rules that fully account for the interactions between the catch of different species and for multiple objectives of management. It is anticipated that the results of the project will both advance fisheries science in this domain (with the publication of reference articles) and provide practical tools which can be taken up in decision-making processes in Europe and other parts of the world. The project will contribute to identify and support sustainable development pathways for fisheries in the context of global change.

It is expected that the results from the doctoral research will be published in international peer-reviewed journals in resource economics and/or fisheries science. The objective will be for the PhD thesis to be based on at least three publications from the research.

Candidate Profile

Candidates should hold a degree enabling their registration as a PhD student in economics by early October 2017. They should be trained in quantitative methods, including applied mathematics and/or simulation modeling and demonstrate a strong interest in integrated ecological-economic modeling. They should be able to work in both French and English speaking research environments and willing to engage in a co-tutelle PhD program. Skills in fisheries science would be appreciated.

Application

https://theses.u-bretagneloire.fr/sml/financements-de-these-edsml-procedure-2017

Scientific context and objectives

Ecosystem-based approaches are increasingly being adopted for the management of natural resources. This is the case in the marine domain, including marine capture fisheries, with the development of ecosystem-based fisheries management (EBFM) policies (Garcia et al. 2003[1], Pikitch et al. 2004[2]). In recent years, the push towards EBFM has led to an increase in the implementation of output controls in fisheries, i.e. regulations of total catch. These regulations have increasingly been recognized as a way forward in developing sustainable fisheries, particularly if used in combination with adequately designed access rules for individual harvesters, i.e. individual catch shares. Allowing catch shares to be freely transferable between fishing operators has been argued to potentially reduce excess competition and foster economic efficiency (Grafton et al. 2006[3]), eventually increasing the ecological viability of harvested fish communities. Indeed, by eliminating the race for fish, allocating individual catch shares has been shown to limit the development of excess capacity in fisheries. Recent reviews of the experience with ITQs in fisheries show that their adoption has been associated with improved status of fisheries from both ecological and economic perspectives (Newell et al. 2005[4], Costello et al. 2008[5], Branch 2009[6], Chu 2009[7], Hamon et al. 2009[8], Essington 2010[9], Thebaud et al. 2012[10]).

The move towards EBFM has also led to the evolution of these regulatory regimes towards more comprehensive catch-based management systems, aimed at taking into account the entirety of fishing impacts on marine biodiversity, including targeted and non-targeted species. In doing so, management seeks to account for the problems of joint production, called by-catch in the fisheries literature, and the associated discards at sea of non-targeted and unwanted fish caught in the process of fishing. This is because discards may lead to increased threats on biologically vulnerable species, as well as losses in the potential economic value of fisheries (Kelleher 2005[11]). Mitigation of by-catch has thus become a worldwide pressing issue in commercial fishing (Hall and Mainprize

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2005[12]). In Europe, specific management measures, such as the recent landing obligation of species subject to Total Allowable Catch (TAC) limitations under the Common Fisheries Policy, have been implemented in an attempt to address this issue. The aim is to increase the accountability of vessels for their entire catch at sea, and to create the incentives for operators to avoid by-catch. This may lead to the issue of so-called “choke species” (Abbott and Wilen 2009[13], Schrope 2010[14]). These correspond to jointly caught species of which the TAC is reached before all catch possibilities for other commercially important species can been achieved. The existence of such “choke species” is related to the production function of a fishery, which depends both on its technological characteristics and on individual fishing strategies. A key issue which has been highlighted in recent debates about the implementation of the landing obligation in Europe is the extent to which a fishery can adjust its fishing patterns to avoid this problem.

The move towards EBFM is also leading to the adoption of multicriteria definitions of sustainability that include ecological, economic and social consideration (Charles, 1994[15]; Cochrane, 2000[16]; Pereau et al., 2012[17]). A challenge, for decision-support frameworks in fisheries management, is thus to develop approaches that meet diverse sustainability objectives. In economic theory, the usual approach is to use multi-objective optimization, which requires the identification and formalization of a function embodying all the criteria that need to be maximized. However, determining such weights may be difficult as it involves trade-offs implying normative choices regarding the relative importance of different objectives (Martinet et al., 2010[18]). An alternative is to account for conflicting management objectives using indicators, with objectives defined by thresholds. The regulation problem then becomes to avoid situations in which some indicators do not reach the thresholds representing sustainability objectives. Sustainability would then appear more as a “satisficing” problem (Krawczyk et al., 2009[19]; Simon, 1957[20]). Viability theory is particularly well suited to addressing such problems, and has successfully been applied to single species, input-based marine fisheries management (Doyen et al., 2013[21]).

In Australia, the Commonwealth Fisheries Harvest Strategy Policy and Guidelines aims for maximum economic yield: that is the maximum average catch (or corresponding level of fishing effort) that allows the fishery’s net economic returns to be maximized. Increasingly, this has been applied taking into account multi-species interactions. In Europe, the Common Fisheries policy Reform (Règlement (CE) n° 1380/2013) reaffirmed the importance of a multispecies and multi-objective management

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and stated the Maximum Sustainable Yield (MSY) as main target objective. MSY should be reached for all the stocks by 2015, or at the latest by 2020 if this is required for socio-economic considerations. The recent move towards Maximum Sustainable Yield ranges in European management plans and accounting for mixed fisheries interactions in the Australian context provide an interesting opportunity to (1) use the viability approach in an operational context, (2) provide a framework to reconcile multi-species conservation objectives and reference intervals with socio-economic considerations, also taking allocation of catch shares into consideration. Engagement of stakeholders and managers in the viability approach design (in particular in setting the thresholds) is also a key challenge for operational use of this methodology.

The aim of the doctoral research will be to develop an ecological-economic modeling framework which can be used to evaluate alternative output-based harvest-control rules in mixed fisheries that are managed under Total Allowable Catches and allocation of individual catch shares, taking into account multiple management objectives. The framework will then be applied to a set of case studies in France and Australia, and used to compare the robustness of alternative control rules in the two different management contexts.

Methods

The approach will be developed in two stages:

- In stage 1, building on prior research carried out by the co-supervisors and collaborators on the Australian South-East Trawl Fishery, a general evaluation framework for harvest control rules in a mixed fishery with ITQ management will be developed using an analytical approach. This will be based on a stylized representation of the fishery, with global biomass modeling of biologically independent but jointly caught species for which Total Allowable Catches are set separately, and individual catch shares are traded on separate lease markets. Biological, economic and social limit reference points will be identified and used in a viability analysis of the alternative control rules, considering the setting of all TACs simultaneously. The results from this first stage will emphasize the general principles which should drive the definition of harvest control rules in mixed fisheries under TAC management with individual catch shares that can be traded between operators, taking into account multiple objectives. It will lead to the preparation of a manuscript to be submitted to a high impact factor peer-reviewed journal.
- In stage 2, a numerical simulation approach will be developed and applied to selected case studies, following the general principles identified in stage 1. This will build on the IAM modeling platform (REF) which has been developed by Ifremer as an operational decision-support tool for the impact assessment of alternative fisheries management scenarios (Macher et al., 2016[22]; Merzéréaud et al., 2011[23]; Raveau et al., 2012[24], Guillen et al., 2013[25], 2014[26]). The use of IAM

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will enable the inclusion of uncertainty via the incorporation of stochastic parameter values relating to both the biological and the economic characteristics of the case study fisheries. Alternative harvest control rules identified following the general principles from stage 1 will be tested for their robustness to uncertainty and for their capacity to achieve viable outcomes, given the case-specific viability thresholds that are identified for economic, ecological and social outcomes. Candidate case studies for this second stage include the Bay of Biscay demersal mixed fishery, the Gulf of Lyon demersal mixed fishery and the Australian South-East Trawl fishery. It is anticipated that this second stage will lead to the preparation of at least two publications on (i) the presentation of the numerical simulation approach and demonstration of its application to a case study; and (ii) on a comparative analysis of the outcomes of applying this approach in different settings and with different management objectives.

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