

Workshop

08th & 09th September 2009
Brest, Salon de l'Océan, Ifremer



**INTEGRATED MODELLING APPROACHES FOR THE
MANAGEMENT OF MARINE RESOURCES**



BOOK OF ABSTRACTS



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- ◆ In partnership with "Partenariat Hubert Curien France - Australie
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Program

Tuesday 08th September 2009

09h00 09h30	-> Welcome & Introduction Olivier Thébaud, Stewart Frusher, Rich Little	14h00 14h20	Scenario templates to analyse qualitative ecosystem models Guy Fontenelle, Agrocampus, France
09h30 09h50	Modelling communities and fisheries dynamics under climate, economic and institutional constraints : approach within the CHALOUPE project Fabian Blanchard, Ifremer, France	14h20 14h40	Building from the inside out: incorporating the human and biological dimensions in fisheries models Stewart Frusher, TAFI-UTAS, Australia
09h50 10h10	Biophysical interactions, economies, ontologies and decision support models: Examples from temperate and tropical reefs Craig Johnson, TAFI-UTAS, Australia	14h40 15h00	Controlling the biological invasion of a commercial fishery by a space competitor Marjolaine Fresard, UBO, France
10h10 10h30	InVitro - Agents in a glass - a spatially explicit agent based model for regional marine ecosystems and economies Rich Little, CSIRO, Australia	15h00 15h20	Investigating the potential impact of MPAs on fisheries: what can be learnt from basic bioeconomic modelling? Jean Boncoeur, UBO, France
10h30 10h50	<i>Coffee</i>	15h20 15h40	<i>Coffee</i>
11h00 11h20	Discussion I	15h50 16h10	Tentative experiment of systematic conservation planning in the Eastern English Channel Sandrine Vaz, Ifremer, France
11h20 11h40	EcoTroph: a trophic-level based ecosystem modelling approach Didier Gascuel, Agrocampus, France	16h10 16h30	Discussion II
11h40 12h00	An ecosystem modelling for the viable management of the coastal fishery in French Guyana Sophie Gourguet, UBO, France	16h30 16h50	Allocation of TAC and fishing effort in mixed-fisheries: a bio-economic modelling approach applied to the Channel flatfish fisheries Paul Marchal, Ifremer, France
12h00 12h20	Population model assessments of fishing and other anthropogenic impacts on seabird populations Geoff Tuck, CSIRO, Australia	16h50 17h10	Economic Studies in Recreational Fishing in Tasmania Sarah Jennings, UTAS, Australia
12h20 12h40	Exploring ecological shifts using qualitative modelling: Alternative states on Tasmanian rocky-reefs Martin Marzloff, TAFI-UTAS, CSIRO, Australia	17h10 17h30	Management of Moored Fishing Aggregating Devices (FADS) in the Lesser Antilles: A Bio-Economic Approach Olivier Guyader, Ifremer, France
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Wednesday 09th September 2009

09h10 09h30	Modelling the fleet dynamics of a small-scale mixed fishery Philippe Ziegler, TAFI-UTAS, Australia	14h00 14h20	The use of bioeconomic modelling to reform management of the Tasmanian rock lobster stock Caleb Gardner, TAFI-UTAS, Australia
09h30 09h50	Modeling Non-compliance with Resource Regulation Aaron Hatcher, University of Portsmouth, UK	14h20 14h40	Sustainable Management of an Hake--Anchovy Peruvian Ecosystem Model by Viability Methods Michel De Lara, ENPC, France
09h50 10h10	Viable coalitions in the commons Luc Doyen, CNRS, France	14h40 15h00	Risk and Sustainability: Assessing Fisheries Management Procedures Vincent Martinet, INRA, France
10h10 10h30	The development of the rock lobster lease quota market Ingrid Van Putten, CSIRO, Australia	15h00 15h20	Bio-economic modelling using the métier-fleet based approach and the IFREMER Fisheries Observatory Database: application to the Bay of Biscay Hake long-term management plan Michel Bertignac, Ifremer, France
10h30 10h50	<i>Coffee</i>	15h20 15h40	<i>Coffee</i>
11h00 11h20	Modelling the effect of the introduction of Individual Transferable Quotas in fisheries : the rock lobster in Tasmania Katell Hamon, Ifremer, UBO, TAFI-UTAS, CSIRO, Australia & France	15h50 16h10	Modeling the impacts of aquaculture growth and environmental fluctuations on small pelagic fisheries with a global model Gorka Merino, PML, UK
11h20 11h40	Combining fleet dynamics and population dynamics for a volatile fishery: the example of the anchovy fishery of the Bay of Biscay Youen Vermard, Ifremer, France	16h10 16h30	Faustmann Rotation and Aquaculture in the presence of an epidemic risk Patrice Loisel, INRA, France
11h40 12h00	Integrative modelling in the coastal zone: some (early) learnings from the SPICOSA project Rémi Mongruel, Ifremer, France	16h30 16h50	Estimating the social cost of discards: the case of the Nephrops trawl fishery in the bay of Biscay Claire Macher, Ifremer, France
12h00 12h20	The Value of Water across a Catchment in Tasmania, Australia Christine Crawford, UTAS, Australia	16h50 17h10	How global sensitivity analyses can support fisheries management? Stéphanie Mahévas, Ifremer, France
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12h40 14h00	<i>Lunch</i>		



Tuesday 08th September

Modelling communities and fisheries dynamics under climate, economic and institutional constraints : approach within the CHALOUPE project

*Fabian Blanchard, Olivier Thébaud
Ifremer, France*

Abstract

From 2006 to 2009, the Chaloupe project, focused on analysing the interactions between global change, the dynamics of exploited marine biodiversity, and the viability of fisheries in three regional systems. An important outcome of the project was to reinforce collaboration between fisheries ecologists, economists, mathematicians and computer scientists to advance an integrated approach to marine ecosystem management. Different modelling approaches were developed to explore some of the key processes identified as driving changes in marine social-ecological systems at a regional scale.

We review the progress made in the course of the project in extending the social and ecological dimensions of classic single species fisheries models to better capture these processes, and the lessons learned from the diversity of modelling approaches that were undertaken.

Biophysical interactions, economies, ontologies and decision support models: Examples from temperate and tropical reefs

Craig Johnson
University of Tasmania

Abstract

Shallow marine hard-bottom benthic communities in temperate and tropical latitudes typically support significant economic activity, and provide humans with protein and a range of ecosystem services. The major trends in community dynamics of these productive and biodiverse systems are strongly influenced by a small number of species or guilds, and the nature of the interactions usually allows for multiple stable states including 'high productivity species-rich' and 'low productivity species-poor' configurations. Because these reefs are accessible to divers, key interactions can be identified and quantified using manipulative experiments and surveys. Quantitative data of this kind enable development of models as decision support tools for managers.

I will identify key interactions demonstrated to drive the dynamics of near-shore rocky reefs in sheltered and exposed waters in eastern Tasmania. On sheltered reefs, key ecological interactions include those between native sea urchins, native and introduced seaweeds, rock lobsters, abalone, crustose algae, an epilithic sediment matrix and fishers. On the open coast it is interactions between a different (and recently invading) species of sea urchin, seaweeds, rock lobster, abalone, crustose algae, the sediment matrix and fishers that are important. These same kinds of interactions, but involving different species, are important on temperate reefs world wide.

Similarly, there is a very circumscribed set of ecological interactions among guilds of tropical organisms that underpin the dynamics of coral reefs. I will introduce a multi-scale, multi-process, spatially explicit generic simulation model of the biophysical dynamics of coral reef systems that is designed (1) to be portable across different kinds of coral reef systems worldwide, and (2) to interact with regional socio-economic dynamics.

I will argue that the same kind of generic ontology that underpins the biophysical coral reef model and its interaction with human social and economic systems can be developed for and usefully applied to temperate reef systems world wide. The state of knowledge of reef dynamics and associated human systems in eastern Tasmania is at a stage where this ontology could be built and tested.

InVitro - Agents in a glass - a spatially explicit agent based model for regional marine ecosystems and economies

Rich Little

CSIRO Marine and Atmospheric Research,
Castray Esplanade, Hobart, Tasmania 7000, Australia

Abstract

Agent-based modelling is an important way of representing bio-physical and human systems and their interactions. Because these representations can be relatively fine scale, agent-based models can be used to evaluate in detail, the potential effects of a range of natural processes and human mediated activities including climate change at a regional level. We have developed an agent-based modelling framework, called InVitro, in order to evaluate prospective multiple-use management strategies for the Northwest Shelf of Australia under different hypothetical scenarios. The framework allows us to represent the bio-physical and socio-economic components of the region as either individual agents, or as a broader scale analytical model, all in a single agent based modelling structure. The model describes the ecosystem and human impacts, projecting into the future both multiple use management measures as well as the responses of the ecosystem.

Detailed representation of the ecosystem includes, benthic habitats, fish species and their potential dependence on benthic habitat, large megafauna, and ontogenic shifts in marine species behaviour. Detailed representation of human use of the marine environment includes the effects of commercial trawl and trap fishing (of prawn and scalefish, as well as bycatch and benthic effects), recreational fishing, shipping lanes, and outfalls. Simulated management measures included stock assessment and fisheries decision procedures, outfall monitoring and mitigation as well as an integrated conservation imperative. Externally forcing factors include wave and wind effects as well as climatic events such as cyclones.

Model results can show the tradeoffs between conflicting objectives, and the implications of changes to management strategies. Such changes not only have direct effects on the targeted sectors, but also indirect effects. Even in simple examples, the comprehensive model allows realistic examination of multiple-use management and the cumulative impacts of human uses on the ecosystem. The flexible level of detail and scale that can be employed in the model, and the modular structure, which can add components to the system and thus represent increasing complexity of the ecosystem, makes the InVitro modelling framework a valuable tool for examining the potential effects on regional marine systems of a broad range of scenarios, including climatic events and trends.



ECOTROPH: A TROPHIC-LEVEL BASED ECOSYSTEM MODELLING APPROACH

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ABSTRACT

EcoTroph is a modelling approach articulated around the idea that an ecosystem can be represented by its biomass distribution across trophic levels (Gascuel et al., 2009). Such an approach, wherein species as such disappear, may be regarded as the ultimate stage in the use of the trophic level metric for ecosystem modelling. By concentrating on biomass flow as a quasi-physical process, it allows aspects of ecosystem functioning to be explored which are complementary to the worldwide well known Ecopath approach. It provides users with simple tools to quantify the impacts of fishing at an ecosystem scale and a new way of looking at ecosystems. EcoTroph is available as a plug-in module of Ecopath with Ecosim (EwE Version 6) and can be used either in association with an existing Ecopath model or as a stand-alone application, especially in data-poor environments.

Here, we illustrate the usefulness of such an approach, based on the Guinean ecosystem case study. We simulated changes in fishing pressure by using multipliers of the fishing mortality ranging from 0 to 5 and applied to the whole ecosystem (Gascuel et al., 2008). We show that the current fishing effort led to a 3-fold decrease in biomass of higher trophic levels, compared to the unexploited ecosystem. The over-exploitation of these high trophic levels induces a significant decrease in the mean TL of both the total biomass and the catches. These results confirm and generalize previous single species assessments. Forecasting suggests that higher yields might be obtained by exploiting lower trophic levels, but this would result in a higher impact on ecosystem and a qualitative degradation of the ecosystem health.

We conclude that, within the EwE family of models, EcoTroph constitutes a simplified and useful caricature of the functioning of real ecosystems. It thus appears a useful complement to Ecopath.

REFERENCES

- Gascuel, D., Boyer-Tremblay, L., Pauly, D., 2009. EcoTroph: a trophic-level based software for assessing the impact of fishing on aquatic ecosystems. Fisheries Centre Research Reports, 17(1), University of British Columbia [ISSN 1198-6727], Vancouver, 83p.
- Gascuel D., Guénette S., Pauly D., 2008 - The trophic-level based ecosystem modelling approach: Theoretical overview and practical uses. *ASC-ICES CM 2008 / F:18*, Septembre 2008, Halifax (Canada), 16 p.

An ecosystem modelling for the viable management of the coastal fishery in French Guyana

Sophie Gourguet

UBO, France

Abstract

Scientists and stakeholders are more and more concerned about the viability of the fisheries and the current exploitations of marine biodiversity. Usual approaches for the management of fisheries address every exploited species separately. Multi-species and ecosystemic dimensions must be integrated for a sustainable managements and in particular, the trophic interactions between species. In the context of the Ecosystem-Based Fisheries Management (EBFM), the coastal fishery of Guyana, who targets the “white” fishes, constitutes an interesting example.

In this work, we have developed an ecosystemic multi-species multi-fleet model, integrating Lotka-Volterra trophic dynamics. After calibrating this model with 13 species and 4 fleets, we have simulated several fishing scenarios. The biological and economical viability of “exploited marine populations-fisheries” systems are considered both to preserve the biodiversity and to guarantee economic incomes for the fleets.

The different tested scenarios combine increase or decrease of fishing efforts. A reduction of the efforts is suggested to satisfy a future food demand and preserve a maximum of biodiversity. This study is a preliminary analysis which might contribute to the development of sustainable exploitations.



Population model assessments of fishing and other anthropogenic impacts on seabird populations

Geoff Tuck
CSIRO, Australia

Abstract

This talk will describe the application of quantitative impact assessments to seabirds that fully integrates information on the birds' biology and the fisheries they encounter. Two examples will be discussed: (1) The flesh-footed shearwater of Lord-Howe Island and (2) Atlantic Ocean albatrosses.

The flesh-footed shearwater is a medium-sized seabird with a single eastern Australian population breeding on Lord Howe Island. Flesh-footed shearwaters have been observed as bycatch from domestic and distant-water longline fleets in Australian waters. In addition, substantial reductions in colony size have occurred on the island due to housing development. As a consequence, concerns have been expressed about the population's sustainability.

In 2006 the International Commission for the Conservation of Atlantic Tunas (ICCAT) called for an assessment of all seabirds that breed or forage within ICCAT's jurisdiction. An international collaboration then began that developed methods to assess the extent, and potential consequence, of ICCAT longline fishing on over 60 populations of seabirds.

Exploring ecological shifts using qualitative modelling: Alternative states on Tasmanian rocky-reefs

**Martin Marzloff^{1,3}, Jeffrey Dambacher², Rich Little³,
Stewart Frusher¹, Craig R. Johnson¹**

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Abstract

Alternative stable states characterise many natural ecosystems. Subtidal rocky-reefs on the east coast of Tasmania persist in a range of different configurations, including so-called sea urchin 'barrens' and dense seaweed beds with a closed canopy. In creating and maintaining barrens habitat on temperate reefs, sea urchins induce major losses of production, biodiversity and physical structure. The invasive long-spined sea urchin (*Centrostephanus rodgersii*) is able to form barrens across its newly extended range in Tasmania. Formation of urchin barrens on the east coast has been a rising concern in recent decades, in particular because the two most valuable fisheries in the state, for blacklip abalone (*Haliotis rubra*) and southern rock lobster (*Jasus edwardsii*), are not viable on barrens. Thus, identifying triggers of barrens formation is critical in the management of these reefs. Here we explore the dynamics of Tasmanian rocky-reef communities, including testing the effects of fishing, using qualitative modelling informed by a deep empirical knowledge of interactions among species. Loop analysis offers a holistic approach to address the structure and dynamics of the system. It sacrifices precision of particular dynamics to maximize reality and generality in providing a causal understanding of complex systems. The network topology forms emergent feedback patterns that cause meta-stable properties in this rocky-reef system, and the models capture formation of urchin barrens and the mechanisms of the phase shifts. Fishing is identified as a perturbation that can reduce resilience of the system in its original highly productive seaweed-dominated state. We show that qualitative loop models can be highly valuable in identifying the kinds of system dynamics that managers need to consider in ecosystem based management, but emphasise that they are not designed to act as definitive management models for specific instantiations.

Keywords: *Subtidal rocky-reef; Tasmania; community structure; phase shifts; alternative stable states; qualitative modelling.*

Scenario templates to analyse qualitative ecosystem models

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Abstract

In this paper, we propose to transform environmental questions about future evolution of ecosystems into queries that could be submitted to a simulation model. In this work, the model is a marine ecosystem in a sheries context. When dealing with environmental problems, scenarios are widely used tools for evaluating future evolution of ecosystems given policy options, potential climatic changes or impacts of catastrophic events. If the scenarios are generally expressed in natural language, when working with a model describing the ecosystem, it is necessary to transform them into formalised queries that can be given as input to the model. In this paper, the ecosystem behavior is described by a qualitative model, defined as a discrete-event system and represented by timed automata. The scenario templates are expressed using temporal logic completed with interest variables. The ecosystem is represented as a set of interacting subsystems and the global model obtained by composition on shared events. This technique is particularly suited to representing large-scale systems such as ecosystems. This work has been applied to a simplified marine ecosystem under shing pressure. The model describes the tropho-dynamic interactions between sh trophic groups as well as interactions with the activities of a shery. Scenario templates has been defined and tested in order to check several assumptions of the model.

Building from the inside out: incorporating the human and biological dimensions in fisheries models

Stewart Frusher
TAFI-UTAS, Australia

Abstract

To address the needs of ecosystem based fisheries management (EBFM) three general approaches have been undertaken – the development of ecosystem models that capture the majority of the biological entities in the ecosystem (e.g. EwE, Atlantis), the development of qualitative frameworks (risk assessments, traffic light approaches) and the extension of the existing fishery models. While these were initially focused on the biophysical components of the system, it is increasingly being recognised that both economic and social components are also essential. As such, these approaches are now beginning to consider ways of incorporating the economic and social components of the human system. For the Tasmanian rock lobster fishery we have taken the approach of building on the existing fishery assessment model and this presentation will demonstrate the methods we are starting to use to address economic and ecosystem issues which also including climate change impacts. An advantage of this approach is that it builds on the existing knowledge and language that is understood by management and industry. This, we believe, will ensure an improved uptake of management options, assessment outcomes and subsequent co-management of the fishery.

Controlling the biological invasion of a commercial fishery by a space competitor

Marjolaine Frésard

UMR AMURE

Université de Bretagne Occidentale, Brest (France)

Abstract

This presentation deals with the control of an invasive species, void of market value, and acting as a space competitor for a native valuable harvested species. First, we present a theoretical bioeconomic model describing the interacting dynamics of the two species. Then, we use an age-structured bioeconomic model of harvesting common scallop combined with a spatial invasion model to simulate an invasion control program of the bay of Saint-Brieuc case.

Investigating the potential impact of MPAs on fisheries: what can be learnt from basic bioeconomic modelling?

Jean Boncoeur

UMR AMURE

Université de Bretagne Occidentale, Brest (France)

Abstract

This paper makes use of a simple theoretical model to investigate the possible impact of marine protected areas (MPAs) on fisheries. For the sake of the paper, we define an MPA as a permanent fishing ban in part of the area occupied by a fish stock that is targeted by fishers.

The first part of the paper describes the model. We consider a single homogeneous fish stock, with a habitat composed of two distinct zones, and a given pattern of inter-zone mobility. Each zone has its own physical and ecological characteristics. One of them is a no-take zone (NTZ), and the other is a fishing zone (FZ). Assumptions concerning natural stock dynamics, catch function, costs and earnings are standard.

In the second part of the paper, we analyse the consequences of different rates of fishing mortality on the following key-variables: FZ and NTZ fish biomasses, net biomass transfer between zones, and catches. We highlight the critical role played by the rate of inter-zone mobility, together with the intrinsic growth rate of the stock and the carrying capacity of the NTZ.

In the last part of the paper, we use the model to compare the bioeconomic performance of the fishery when one zone is a NTZ ("MPA management"), and when both zones are open to fishing (so-called "conventional management"). According to the model, though theoretically MPAs are not as good as conventional management methods for maximising sustainable yield or economic rent, they may act as a second best, both from an economic and from a biological point of view, when the stock is heavily fished and when full control of fishing effort is not practically feasible. This result does not preclude other possible benefits of MPAs in terms of ecosystem conservation, and non-extractive ecosystem uses (e.g. ecotourism).

Tentative experiment of systematic conservation planning in the Eastern English Channel

J. Delavenne(1), R.J Smith(2), S. Vaz(1)

1 IFREMER, Lab. Ressources Halieutiques, Boulogne sur Mer

2 Durrell Institute of Conservation and Ecology, University of Kent

Abstract

The marine environment of the Eastern English Channel is a significant economic resource that supports a number of human-based activities, such as tourism and recreation, international ports and shipping, and the extraction of both living and non-living resources. In addition to human use, the region supports a number of important marine biological features. Responsible and integrated management aided by information systems and tools capable of assisting decision-making is essential for the construction of policies to ensure the sustainable exploitation of these marine resources. MARXAN is a computer program that deliver decision support for reserve system design. It finds reasonably efficient solutions to the problem of selecting a system of spatially cohesive sites that meet a suite of biodiversity targets. The aim of this study is to develop a tentative conservation plan for the eastern English Channel to identify important sites for conserving biodiversity, whilst using anthropological, economic and legal data to minimize potential opportunity costs.

Allocation of TAC and fishing effort in mixed-fisheries: a bio-economic modelling approach applied to the Channel flatfish fisheries

Paul Marchal^{1,2}, Rich Little³ and Olivier Thébaud⁴

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4. IFREMER, Maritime Economy Department, Technopôle de Brest-Iroise, BP 70, 29280 Brest, France.

Abstract

The aim of this article is to assess the respective merits of management strategies building on fixed or flexible catch quota allocation and also their sensitivity to a variety of fleet behavior mechanisms, using a simulation modelling approach. The modeling framework is applied to the Channel flatfish mixed fisheries. The results are sensitive to the fleet dynamics. When fleet behavior depends on both traditions and expected economic returns, one clear advantage of a flexible quota allocation regime would be to maintain the spawning SSB of Eastern Channel sole, the main targeted stock, above safe limits in all projected years. The impact of the flexible quota allocation regime on the less targeted species is more mitigated, as TAC would be exceeded in 80% of projected years. Under the flexible quota allocation scenario, only two (out of initially four) fleets, the small and large netters, would own most of the stocks quotas, and only these two fleets would be expected to make a decent profit out of fishing in the future.

Economic Studies in Recreational Fishing in Tasmania

Dr Sarah Jennings
Head of School
Economics and Finance

Abstract

Two new studies of the economic valuation of recreational fishing opportunities in Tasmania are described. Both studies involve estimating recreational fishers' willingness to pay using the double-bounded dichotomous choice contingent valuation survey method. The first is a cross-fishery study that aims to provide estimates of the marginal value of fish caught in a range of recreational fisheries in the State. The second explores the importance of scope, time and source in determining individual's willingness to pay for current measures aimed at reducing or preventing future impacts. Individual heterogeneity in risk aversion and intergenerational attitudes are accounted for. In both studies, estimates are corrected for anchoring and the sources of anchoring explored.

Management of Moored Fishing Aggregating Devices (FADS) in the Lesser Antilles: A Bio-Economic Approach

Olivier Guyader(1), Lionel Reynal (2), Jean Boncoeur(3)

(1) UMR AMURE, Ifremer Brest

(2) Ifremer Martinique

(3) UMR AMURE, Université de Brest

Abstract

Since the 1990s, the moored FADs (Fish Aggregation Devices) have had a sharp success in the Lesser Antilles and beyond, because they make it possible for the small nondecked fishing units to reach, at low costs, offshore resources which they could do only seasonally or resources normally accessible by large scale vessels only. In these areas, the purpose of moored FADs has also been to provide small scale fishermen incentives to switch from reef fisheries often overexploited to large pelagic fisheries considered as moderately exploited. The objective of this paper is to analyse the biological and economic implications of different management and funding regimes (private, public, collective) of the moored fishing aggregating devices (FADs). To consider this issue, a simple model of the commercial exploitation of a pelagic resource in a given area is developed to illustrate the potential effects of fishermen congestion around FADs and the biological interactions between the devices. Sensitivity analysis on the control variables of the model - the number of fishing unit and the number of FADs in the fishery – provide results on the level of profit and rent for the individual fisherman and for the total fleet. It illustrates the risk of rent dissipation in the case of mismanagement of the FADs as well as overcapacity in the fleet. First empirical data are examined to discuss this issue.

Key words: Moored FADs, pelagic fisheries, rent dissipation, small scale fleet.

Modelling the fleet dynamics of a small-scale mixed fishery

By *Philippe E. Ziegler*
TAFI-UTAS, Australia

Abstract (work in progress):

The small-scale coastal scalefish fishery in Tasmania, south-eastern Australia, exhibits complex population and fishery dynamics due to a high diversity of fishing gears and target species. In addition, many fishers readily adapt their operations in response to changes in spatial and temporal species availability and the economic situation. Despite strong interactions between the different components of scalefish fishery, stock assessments and fishery management have typically dealt with the fishery at a single-species level. The aim of this study is to predict the allocation of fishing effort and understand the underlying fishers' choices. Initially, fishing tactics (characterised by fishing gear, target species, location and month) and fleets (characterised by their fishing activities) were identified through multivariate analyses of catch and effort logbook records for the 15 gear types used in the fishery. However, catches within these fleets were highly heterogeneous ranging from sporadic fishing trips to full-time operations. Fishers were stratified based on their fishing activity and effort allocations of the main fishers was further investigated in respect to choice of fishing tactic and location. The outcome of this analysis was supplemented with information from industry surveys, where fishers were interviewed about decision making and key drivers of their fishing activities, including the relative importance of fish availability, fishing tradition, management arrangements and economic factors.



Wednesday 09th September

Modeling Non-compliance with Resource Regulation

Aaron Hatcher

CEMARE, University of Portsmouth, UK

Abstract

Models of renewable resource exploitation generally assume compliance with regulations designed to control harvest rates or harvesting effort. A degree of regulatory non-compliance is probably the norm, however, and in some cases may be considerable. The paper considers the incentive structure of non-compliance and how it can be incorporated into economic models of resource exploitation. Estimating rates of non-compliance is inherently problematic and an heuristic approach is called for.

Viable coalitions in the commons

Luc Doyen
CNRS, France

Abstract

It is well known that the non-cooperation among agents harvesting a renewable resource is critical for its sustainable management. The present paper gives insights on the complex balance between coalitions structure, resource state or dynamics and agents' heterogeneity to avoid bio-economic collapses. A model bringing together coalition games and a viability approach is proposed to focus on the compatibility between bio-economic constraints and an exploited common stock dynamics. It is examined to what extent cooperation promotes sustainability. Based on the Shapley value, an original measure of the marginal contribution of the users to the sustainability of the resource is proposed.

The development of the rock lobster lease quota market - what does it mean for the fisher and for the industry.

Ingrid Van Putten

CSIRO, Australia

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Abstract (work in progress)

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ITQ introduction has had several effects on fisheries in terms of, for example, changes in the composition of the fishing fleet and fishing efficiency gains. ITQ introduction may also have changed the social fabric of fishing communities. After ITQ introduction in the Tasmanian rock lobster industry in 1998, an increasing number of fishers have become dependent on quota leasing to catch fish. The increase in lease quota dependent fishers has developed in parallel with an increase in lease quota trading. At the same time quota owners who lease out their entire quota, increasingly characterises the fishery.

It is becoming progressively more recognised that economic activity occurs within a context of social relations. Personal relationships play a role in the way some markets operate. These relationships may be particularly pertinent in industries with strong social connections - such as fisheries. The effect of social networks, in ITQ managed fisheries that are increasingly characterised by 'investors', is of particular interest. It is expected that the development of fishing industries that are more dependent on a lease quota trade market may also contribute to social changes in fishing industry associated communities.

Tracking the development of lease quota markets and the interactions that take place in those markets reveals information about changing social interactions between participants. A network analysis of the lease quota market for Tasmanian rock lobster reveals a trend from a market that was dependent on internal networks towards a market that more closely resembles a 'free market' 10 years after ITQ introduction.

Modelling the effect of the introduction of Individual Transferable Quotas in fisheries : the rock lobster in Tasmania

K. Hamon, R. Little, S. Frusher and O. Thébaud

Abstract

The Tasmanian rock lobster fishery was brought under individual transferable quotas (ITQ) in 1998 following the decline of the resource. After the implementation of the new management system the number of vessels in the rock lobster fishing fleet decreased and the remaining fishers changed their fishing practices in order to increase the profit they made from their allocation of the resource. The models currently used for stock assessment and projection already combine a fairly complex population dynamic model of the rock lobster stock with an effort allocation model based on linear regressions. However the current effort allocation model does not allow for feedback loops or external perturbation that can dynamically change the initial fishing plan. Currently this limits the potential to assess economic perturbations on the fishery.

The project dealt with in this presentation aims at incorporating individual fishing behaviour in response to external factors like operating costs or rock lobster beach-prices. In addition, one of the main features of ITQ which has been little studied in fisheries, the transfer of quota between individual fishers and/or investors, will be incorporated into the model. A quota market model will be linked to the fleet dynamics that accounts for quota allocation amongst participants, influencing their fishing effort distribution and probably the impact on the stock.

The initial structure of the model including the spatial and temporal scales at which events take place will be presented with particular emphasis on the fishing effort allocation component of the model. This representation of the system is still in the design phase and discussion and suggestions are highly encouraged.

Combining fleet dynamics and population dynamics for a volatile fishery: the example of the anchovy fishery of the Bay of Biscay.

*Youen Vermard, Sigrid Lehuta, Stéphanie Mahévas,
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Abstract

It is increasingly recognized that fisher's behavior should be taken into account to understand and predict fishery dynamics, in particular in response to management. ISIS-Fish is a spatially and seasonally explicit modeling framework especially designed to couple populations and fleets dynamics and explore the impact of various management measures on mixed fisheries. It has already been set up using a static fishing effort allocation (corresponding to an average historical pattern) between the various métiers to simulate the pelagic fishery in the Bay of Biscay. We present here the integration of a fleet dynamics model. This model is derived from a Random Utility Model simulating métiers choice using as explanatory variables the past value per unit effort of the main species caught and the past percentage of effort spent in the different métiers. We assess the contribution of the fleet dynamics module in the evaluation of management strategies building on TAC and Marine Protected Area, in the case of the Bay of Biscay pelagic fishery. Simulation results while applying the mean observed pattern or the dynamic effort allocation are compared with observations over the period 2000-2004. The simulated effort allocation fits observations for some métiers, but not for the most variable ones. Simulated anchovy biomass and catches fit observations reasonably well using either mean observed or dynamic effort allocation. More than the implemented MPA, we show that fisher's behavior and spatial fish distribution have a strong impact on the performances of management scenarios.

Integrative modelling in the coastal zone: some (early) learnings from the SPICOSA project

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Abstract

The European project SPICOSA (Science and Policy integration for coastal systems assessment) develops a “system approach framework” which aims at supporting the development of integrative modelling. This approach seeks to include the ecological, economic and social dimensions of a coastal system into a dynamic representation which will be used in order to simulate scenarios regarding one particular policy issue. Such models will be developed by two French study sites: Pertuis charentais and Thau lagoon. In these study sites, the socio-economic sub-models will be built following various economic approaches (sectoral damage assessment, cost-effectiveness analysis, multi-criteria analysis and input-output matrix) and they will also generate some basic management decisions (application of the rules which limit the uses in response to pre-defined ecological thresholds).

The Value of Water across a Catchment in Tasmania, Australia

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Abstract

Water is an increasingly scarce resource across Australia as the population expands. Demands for water, both quality and quantity, are growing and this can lead to conflict over water allocation. We investigated the social, ecological and economic value of water in a small rural catchment in Tasmania, in particular to the agricultural community in the upper catchment and to the shellfish farmers in the estuary. In the estuary a nutrient budget and a dynamic ecosystem model, in conjunction with field observations, were developed to assess the importance of environmental flows to the estuary. Of significance was the model prediction of a non-linear response of the estuary to increasing river flow, leading to greater benefits per megalitre of river flow at low than at high flow regimes. Thus harvesting water for irrigation in dry years is more likely to have an effect on the estuary, particularly in summer months

We also developed a set of economic accounts and an economic water evaluation framework to assess the value of freshwater to various users across the catchment. The water accounts attempted mass water balance but this was difficult because of insufficient data; instead we investigated the value of water to farmers from a loss of income during drought years. From the loss of productivity, preventative expenditure and replacement costs, it was estimated that the overall reduction in income to the catchment was approximately one-third of its normal economic state.

The use of bioeconomic modelling to reform management of the Tasmanian rock lobster stock

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Abstract

The commercial Tasmanian rock lobster fishery has been managed for a decade with ITQs, which have been reasonably successful in improving the status of stocks and associated harvests. The implementation of ITQ management was associated with the relaxation of some of the input controls, in particular larger trap holdings per vessel and longer open seasons. The relaxation of these regulated inefficiencies, plus higher catch rates from rebuilt biomass, has resulted in fleet rationalisation (reduced by a third), higher capitalisation of units, and increased resource rent. These positive developments have occurred without targets for management, and this opportunity to extend gains by better targeting of management is currently being pursued through bioeconomic modelling with support and direction from the fishing industry. Commercial fishers, researchers and managers have worked together to develop a range of possible options for further extending gains made over the last decade. These include reducing the TAC to target MEY (either stepwise or gradually); using quota based incentives to move effort away from areas with more depleted stock; regional size limit changes; translocation of stock between regions; and changes to trading systems for quota units. The objectives of all the proposals are to increase the stock, lower costs of harvesting, rationalise the fleet, reduce business exposure to recruitment risk (including from climate change), reduce ecosystem effects of fishing, and increase egg production. The Tasmania lobster industry intends to finalise their proposed changes in October 2009 through an industry vote. Industry leaders who are driving the changes have identified the following threats to implementing proposed stock rebuilding, higher resource rent and reduced ecosystem impact: lack of understanding by many fishers that profits can increase with lower catches, a recreational fishery management policy that prevents commensurate reduction in catches by both sectors, and a commonwealth government drive for expanded MPAs.

Sustainable Management of an Hake--Anchovy Peruvian Ecosystem Model by Viability Methods

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Abstract

We consider sustainable management issues formulated within the framework of control theory. The problem is one of controlling a discrete--time dynamical system (e.g. population model) in the presence of state and control constraints, representing conflicting economic and ecological issues for instance. The viability kernel is known to play a basic role for the analysis of such problems and the design of viable control feedbacks, but its computation is not an easy task in general. We study the viability of nonlinear generic ecosystem models under preservation and production constraints. Under simple conditions on the growth rates at the boundary constraints, we provide an explicit description of the viability kernel. A numerical illustration is given for the hake--anchovy couple in the Peruvian upwelling ecosystem.

Risk and Sustainability: Assessing Fisheries Management Procedures

Vincent Martinet,
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Abstract

This paper develops a theoretical framework to assess resources management procedures from a sustainability perspective, when resource dynamics is marked by uncertainty. Using stochastic viability, management procedures are ranked according to their probability to achieve economic and ecological constraints over time. This framework is applied to a fishery case-study, facing El Niño uncertainty. We study the viability of constant effort and constant quota strategies, when a minimal catch level and a minimal biomass are required. Conditions on the sustainability objectives are derived for the superiority of each of the two management methods.

Modeling the impacts of aquaculture growth and environmental fluctuations on small pelagic fisheries with a global model

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The sustainability of aquaculture and the environmentally affected ecosystems on which it depends is explored in this work. Aquaculture has contributed to the global food supply, as the human population has grown its demand for marine products, increasing its production since the last decades and establishing a highly globalized trade system. Such production and associated demand of fishmeal increase to produce aquafed has raised some concern on the higher fishing pressure on the species targeted as the main source of fishmeal. Small pelagic fish are highly affected by climate induced fluctuations and particularly, Peruvian anchoveta, the species on which half of the traded fishmeal is obtained is modulated by El Niño events, which are followed by declines in fish biomass, catches and fish condition. We investigate the conditions on which aquaculture may endanger the environmentally affected marine resources. In this paper we explore the synergism between the impacts of regional climate-driven fluctuations, aquaculture growth and economic globalization by modeling the dynamics and trades associated to global small pelagic fisheries. Two market expansion scenarios are quantified and compared to independent observations of Oceanic Niño Index, fishmeal used in aquaculture, small pelagic fish production and fishmeal price. Our analysis show how regional stocks recover from climate-driven fluctuations unless these act simultaneously to an expansion on international fishmeal markets demands. Furthermore, in our simulations, a sequential pattern of collapses emerges as an endogenous property at the levels of price response to demand and climatic fluctuations explored. Our work pioneers the quantification of the double exposure created by climate and globalisation on particular natural resources and explains the stakes involved in the development of fishmeal trade for global aquaculture expansion on marine fish populations. We suggest that the expected spread of globalisation may overwhelm local management efforts unless adaptive and multi-scaled management measures are developed to ensure the sustainability of regional production systems in the face of increasing climate change and global demanding markets.

Faustmann Rotation and Aquaculture in the presence of an epidemic risk

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Abstract

For the management of natural resources, the first question that arises is : what is the optimal duration of cycle production. This is the case both in forestry, aquaculture, production of renewable resources. In the case where a calculation method to predict earnings for various terms of the cycle is available, Faustmann [2] proposed a formalism based on the expected discounted yield. Many authors have successively improved or reformulated the method, Ohlin [7], Pearse [8]. Clark [1] has applied this method to natural resources, in the absence of risk of destructive events. The risk of destruction has been introduced to forest stands by Martell [6] and Routledge [10] in discrete time. Thereafter, Reed [9] has studied the optimal forest rotation in continuous time with the risk of fire. Most of the work on Faustmann rotation and in particular the study of Reed [9] are developed in the context of forestry but are not specific to forestry and can be applied to the production of renewable resources. In the context of random prices in aquaculture Guttormsen [3] studies a method based on dynamic programming. For the absence of risk of destructive events, epidemic events all the production cycles are carried out to the same term. When the risk of destructive event exists and is taken into account, the authors cited above assume that the operator systematically decides to interrupt the current cycle and begin a new cycle. This is fully justified in the case of severe epidemic. In the case of an epidemic of limited impact on mortality, to the first question about the optimal term a second question is added : should we interrupt the current cycle and begin a new cycle or is it better to continue the current cycle ? If there are alternatives, what is the criterion to choose ? To fulfil this goal in a framework of not too restrictive assumptions, first we define a criterion for choice and secondly we use a dynamic model population that allows us to follow the evolution of individuals of the system. We consider a simplified model of averaged individual type, inspired by the models of Hannesson [4] and Heaps [5], to facilitate the presentation of the proposed method and to focus the analysis on the influence of an epidemic risk. The expected discounted yield is obtained via the resolution of a quasi-linear integrodifference equation. For specific decisions and thus specific criteria, we study two particular cases. In the first case, the operator systematically interrupts the cycle in case of a destructive event, we generalize the results obtained by Reed [9] under less restrictive assumptions. We show that the results obtained in [9] are valid under the assumption that the operator does not harvest during the production cycle and that the cleaning costs in the case of epidemic event be fixed. The proposed method takes into account intermediate harvesting and cleaning costs depending on the severity of epidemic event. In the second case, the operator continues the cycle even in case of epidemic events (which makes sense if the epidemic is minor) and we deduce the corresponding expected discounted yield. Once the criterion set, in the general case for a test choice based on the number of individuals we show the

existence of a unique solution to the integrodifference equation and we provide a numerical algorithm to solve it. Finally we show that the proposed formalism allows to integrate in a single optimization problem, the two levels of decision-making : the tactic level, with regard to harvesting and the strategic level in case of epidemic events with regard to the choice between two alternatives : to continue or to interrupt the cycle.

Références

- [1] Clark C.W. (1976) *Mathematical Bioeconomics*, Wiley, New York.
- [2] Faustmann M. (1849) Berechnung des Wertes welchen Waldboden sowie noch nicht haubare Holzbestände für die Weldwirtschaft besitzen. *Allgemeine Forst-und Jagd-Zeitung*, 25, pp 441-445.
- [3] Guttormsen A.G. (2001) Faustmann in the Sea - Optimal Rotation Time in Aquaculture. XIII EAFE Conference, 18-20 April 2001.
- [4] Hannesson R. (1986) Optimal thinning of a year-class with density-dependent growth. *Canadian Journal of Fisheries and Aquatic Sciences*. Vol 43, N°4, pp 889-892.
- [5] Heaps T., (1993). The optimal feeding of farmed fish. *Marine Resource Economics*, 8, pp. 89-99.
- [6] Martell D.L. (1980) The optimal rotation of a flammable forest stand, *Canadian Journal of Forest Research*, 10 (1), pp. 30-34.
- [7] Ohlin B. (1921) Concerning the question of the rotation period in forestry. *Journal of forest economics*, vol.1, n°1-1995, pp. 89-114.
- [8] Pearse P.H. (1967) The optimal forest rotation. *Forest Chron.*, 43 pp 178-195.
- [9] Reed W.J. (1984) The Effects of the Risk of Fire on the Optimal rotation of a Forest. *JEEM* 11, pp 180-190.
- [10] Routledge, R.D. (1980) Effect of potential catastrophic mortality and other unpredictable events on optimal forest rotation policy . *Forest science*, 26, pp 386-399.

Estimating the social cost of discards: the case of the *Nephrops* trawl fishery in the bay of Biscay

Claire MACHER, Olivier GUYADER,
Olivier THEBAUD and Jean BONCOEUR

Abstract

The *Nephrops* trawl fishery in the bay of Biscay is characterized by high levels of undesired catches of many species that are discarded with high mortality rates. 60% of the *Nephrops* caught in number and more than 90% of the hake catches are thus discarded, mainly because the small individuals caught by low selective bottom trawlers do not reach the minimum landing size implemented in this fishery. This is a waste for the stocks as well as for the fleets depending on these resources, for the consumers and for the State. The estimation of the social cost generated by the *Nephrops* trawler fleet through *Nephrops* and hake discards under the minimum landing size is based on a bio-economic simulation model of the interactions in the fisheries. Costs and benefits of a selective scenario with no under-sized *Nephrops* and hake discards are compared to status quo to estimate this social cost. Surplus variations are estimated for the *Nephrops* fleet, the other fleets, the state and the consumers under several assumptions. It highlights high social cost generated by *Nephrops* bottom trawlers but the difficulties to implement right based solutions and the need to find alternatives to reduce external effects.

How global sensitivity analyses can support fisheries management?

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Abstract

Fisheries management requires quantitative diagnostic of the impact of management measures. ISIS-Fish is a flexible simulation tool of fisheries dynamics. The model ISIS-Fish was designed through a « law driven » approach integrating a description of process dynamics of fisheries to predict fishery behaviour, to assess marine resources and more specifically the impact of management measures and fishing regulations on the fishery. Its originality is link to 1) an explicit description of spatial and seasonal dynamics, 2) an independent definition of populations and fleets dynamics, 3) the account for fishermen behaviour in reaction to management and 4) a “supply” of the model using traditional fisheries data. This model is appropriate to address the assessment of spatial and seasonal management measures as Marine Protected Area (MPA). As soon as ISIS-Fish is parameterised, running simulations is easy. To prevent from an incorrect use of simulations outputs we provided a guideline for simulation tools, mainly based on simulation designs.

An abundant literature is available on simulation designs to assess the robustness of model and to investigate uncertainties propagation delivering confidence intervals of outputs. Nevertheless, in fisheries science, few analyses are performed to jointly address these issues. Most of the sensitivity analyses published are reduced to one parameter by one parameter analysis (also commonly called elasticity). However this approach does not suit the exploration or validation of a model. We present a simulation guideline to integrate different sources of uncertainties (modelling, data, parameters) in forecasts of management impact on fisheries. We propose some illustrations of these techniques for several European fisheries modelled using Isis-Fish.

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