



## International Conference on Ecological Sciences



October 22-25 2018, Rennes (France) – Couvent des Jacobins

### **SYMPOSIA – Sfecologie 2018, International conference on Ecological Sciences**

#### **Title of symposium**

*Ecological Models in Fisheries Sciences: From Knowledge to Management*

#### **Main organizer of the symposium**

**GASCUEL Didier**, Université Bretagne Loire, Agrocampus Ouest, UMR 985 Ecologie et Santé des Ecosystèmes (ESE), 65 rue de Saint Brieuc, CS 84215, 35042 RENNES Cedex, France  
Didier.Gascuel@agrocampus-ouest.fr

#### **Co-organizers of the symposium**

**DROUINEAU Hilaire**, IRSTEA, UR EABX, Research Unit Aquatic Ecosystems and Global Changes, 50 avenue de Verdun, Gazinet Cestas, F-33612 Cestas, France  
Hilaire.Drouineau@irstea.fr

**HERNVANN Pierre-Yves**, IFREMER, Laboratoire de Technologies et de Biologie Halieutiques (LTBH), 8 rue François Toullec, CS 60012, 56325 LORIENT Cedex, France  
Pierre.Yves.Hervann@ifremer.fr

#### **Session description**

Over the last century, fisheries have impacted marine and freshwater natural resources and ecosystems on a global scale, pushing fisheries scientists - maybe earlier than others - to develop modelling tools. In this field, models have long been considered the major experimental way to analyse human impacts on large fish populations, on communities and on the whole ecosystems, in both a theoretical context and for very operational purposes. Thus, models aim to understand ecological functionings, while keeping in mind the constraint to manage fisheries. Now that global change is coming, and particularly climate change, the objectives of modelling approaches are enlarged. New challenges have to be taken up by working at multiple scales, and being complementary in understanding the impact of fishing and other anthropogenic pressures on aquatic ecosystems.

Built on a selection of key presentations by scientific leaders in their field, this symposium aims to provide an overview of the variety of models used in aquatic and fisheries ecology, and how they can be used to inform fisheries management in the perspective of an ecosystem approach. Presentations will be organized according to the various biological

scales considered in models, from the organism to the whole ecosystem. Evolutionary ecology uses Individual Based Models to give an insight on organisms and populations capacities to adapt to environmental changes. At the scale of population, modeling approaches such as life-cycle models are developed to identify sensitive stages of fish development, from larvae to spawners. At the community level, models allow informing on the indirect impact of fishing on non-target species and assemblages, notably through competition for resources. At the ecosystem scale, trophic models enable studying the propagation of anthropogenic impact through the food-web, and highlight how fishing pressures and climate change are modifying the functioning of marine food webs. Lastly, because fishermen are obviously part of the system, models are key to analyse fishers' adaptation and to couple representations of ecological, economic and social processes.

### **Speakers**

**Talk 1. DROUINEAU Hilaire**, IRSTEA, UR EABX, Research Unit Aquatic Ecosystems and Global Changes, 50 avenue de Verdun, Gazinet Cestas, F-33612 Cestas, France  
Hilaire.Drouineau@irstea.fr

#### **“Using Individual Based modeling to explore adaptation capacity of temperate eels to global change”**

Since 15 million years, temperate eels have displayed amazing adaptation capacities: they have survived to various ice ages and are currently able to grow in very contrasted environments despite their panmixia. Individual-based model based on the life history theories were used to explore how these adaptation capacities are based on an original combination of adaptive phenotypic plasticity and genetic polyphormism, and how they are altered by the different components of global change, overfishing, climate change, contamination, ecosystem fragmentation and alien species. This synergy among components of global change may explain the dramatic collapses of those species observed since the early 80s. The IBM also shows that phenotypic capacity can act as a compensatory mechanism that mitigates the direct mortality induced by some anthropogenic pressure. In view of this, managers should move beyond a simple “quantity of eels based management” towards a management that also assess and preserve eel diversity.

**Talk 2. OLMOS Maxime**, UMR 985 Ecologie et Santé des Ecosystèmes (ESE), 65 rue de Saint Briec, CS 84215, 35042 Rennes Cedex, France  
Maxime.Olmos@agrocampus-ouest.fr

#### **“Using life cycle model to assess fish stocks in a complex environment: the Atlantic Salmon case study”**

For many single species fisheries, one of the most efficient ways to improve fisheries management policies in the context of multiple environmental stressors is to develop life cycle models with a comprehensive representation of the spatial and temporal heterogeneities of the demographical mechanisms. Here, we illustrate this approach using a life cycle model to study the especially complex dynamics of Atlantic salmon population (*Salmo salar*) over the North Atlantic area. The model is structured by biological stages and is

used to forecast the returns of adult to their homewaters. It allows assessing the compliance of spawning escapement to conservation limits and provides a framework to investigate the drivers of changes in Atlantic salmon population dynamics including disentangling the effects of fishing from those of environmental factors.

**Talk 3. GREMILLET David**, Centre d'Ecologie Fonctionnelle et Evolutive, UMR 5175, CNRS - Université de Montpellier - Université Paul-Valéry Montpellier - EPHE, Montpellier, France and FitzPatrick Institute, DST-NRF Centre of Excellence at the University of Cape Town, Rondebosch 7701, South Africa  
David.Gremillet@cefe.cnrs.fr

**“Using energetics to inform conservation of seabirds facing global change”**

Energetics of seabirds, the most threatened avian group, is a powerful tool to inform conservation, as I will illustrate using selected recent studies. Notably, I will report on the first validation of energetic fitness as a complement to conventional fitness metrics. To this aim, 3D accelerometry was used to estimate Adélie penguin (*Pygoscelis adeliae*) field metabolic rates, which were significantly linked to bird body condition and multiyear reproductive performance. Further, I will illustrate how mechanistic models allow forecasting energyscapes in wintering little auks (*Alle alle*), as well as the impact climate change on their migratory strategies. Also, using the energy balance of Cape gannets (*Morus capensis*) as determined with multiple bird-borne data loggers, I will show that this species performs unprofitable foraging when competing with industrial fisheries, pointing to unsustainable harvesting practices. Finally, I will present a worldwide assessment of food competition between seabirds and fisheries, on the basis of modeled energy requirements for 276 seabird species in 1482 populations belonging to all seabird families. Through these case studies, I hope to be able to demonstrate that avian energetics do not only serve the purpose of understanding the ecophysiology and evolution of birds in their natural environment, but also function as operational metrics for rating the fitness of wild animals in a rapidly changing world.

**Talk 4. GASCUEL Didier**, Université Bretagne Loire, Agrocampus Ouest, UMR 985 Ecologie et Santé des Ecosystèmes (ESE), 65 rue de Saint Briec, CS 84215, 35042 RENNES Cedex, France  
Didier.Gascuel@agrocampus-ouest.fr

**“Using trophic models to assess fishery and climate change impacts on food-webs functioning”**

In the field of marine ecology, trophic models rapidly developed over the last two decades. In this presentation, principles, aims and limits of three main modelling tools (Ecopath with Ecosim, Osmose and EcoTroph) will be reviewed. Based on case studies, we will show how they are used to analyze the propagation of the fishing impact on the whole food web, to draw diagnoses on ecosystem health, to assess fishing management scenarios and their ability to reach conservation objectives, or to analyze the effects of Marine Protected Area at the scale of the whole food web. Models are also and increasingly used to understand

other human impacts than fishing and especially those of climate change on ecosystems functioning. They can especially highlight how changes of species assemblages expected from the Ocean warming would modify the efficiency and the kinetics of biomass transfers through the food web. Thus, a current challenge is to build model-based realistic scenarios of the coming impact of global change on the productivity of marine ecosystems and fisheries, and more generally on ecosystems services.

**Talk 5. THEBAUD Olivier**, IFREMER, Univ Brest, CNRS, UMR 6308, AMURE, Unité d'Economie Maritime, IUEM, F-29280, Plouzane, France  
Olivier.Thebaud@ifremer.fr

**“Incorporating human dimensions in models of marine ecosystems: selected examples and key challenges”**

As part of the ecosystem approach to managing fisheries and other uses of marine ecosystems, there has been a growing call for the development of integrated assessment tools to support the provision of both tactical and strategic management advice. Of particular importance in this domain is the development of models that capture the dynamic interactions between social and economic systems, and marine ecosystems, allowing identification of scenarios for the future, and evaluation of potential responses to alternative management strategies. This presentation will use selected examples to illustrate progress made in this domain, and highlight the key challenges ahead in developing these modelling approaches and their application to actual management decision problems. Challenges relate in particular to the evaluation of trade-offs associated with managing marine resource systems, process understanding of marine ecosystem uses, the growing complexity of models that seek to couple representations of ecological, economic and social processes, and requirements if models are expected to be used in decision-support processes involving multiple stakeholders.

**Talk 6. LEHUTA Sigrid**, IFREMER, Ecologie et Modèles pour l’Halieutique (EMH), Rue de l’Ile d’Yeu, BP 21105, 44311 Nantes Cedex 03  
Sigrid.Lehuta@ifremer.fr

**“Models for fisheries management: methodological tools and examples”**

Models of increasing complexity are required to address the ever more ambitious challenges of fisheries and marine ecosystem management. In the last decade the inclusion of the human dimension in models and particularly fishers’ adaptation to the ecological, economic and management context emerged as critical to strengthen the robustness of management strategies evaluations. The efficient transfer of these tools from the academic spheres to operational management instances faces hurdles associated with their time-demanding development and inherent complexity and uncertainty. Mathematical and communication tools are necessary to establish benchmark standards and improve the reliability, credibility and appropriation by managers and stakeholders of fishery science models.

## Flash debate

Presentations will be followed by a discussion on the topic: “Using models to move from science to management”

**THIS PROPOSAL FOR SYMPOSIUM IS MADE ON BEHALF OF THE “ASSOCIATION FRANCAISE D’HALIEUTIQUE” (AFH).** The AFH gathers about 200 researchers in aquatic and fisheries sciences from various French institutes and promotes dissemination of scientific knowledge for a sustainable exploitation of living aquatic resources, respecting both men and ecosystems.

**Association Française  
d’Halieutique**

65 rue de Saint Briec  
CS 84215, 35042 RENNES CEDEX  
Tél. : 02 23 48 55 36

Email : [afh@agrocampus-ouest.fr](mailto:afh@agrocampus-ouest.fr)

Web : <https://www.association-francaise-halieuatique.fr/>

Twitter : <https://twitter.com/AFHalieuatique>

