Post-doctoral position, 18 month

Modeling of marine food webs functioning,

to improve the Ecosystem approach to fisheries management, in the context of climate change

Skills

. Trophic modelling (experience in using EwE approaches would be appreciated)
. R programming,
. Marine ecology and fisheries science

. Applicants should have stayed at least 12 month outside France, over the last 3 years

Application

Application deadline: **12 May 2018**

Starting date: as soon as possible
Duration: 18 months
Location: Fisheries Ecology research unit, UMR Ecology and ecosystems health, Agrocampus Ouest, Rennes (France)
Net salary: around 2000 €/month depending on experience
Supervision: Didier Gascuel (Agrocampus Ouest), co-supervision William Cheung (Changing Ocean Research Unit, UBC, Vancouver, Canada)

This Postdoc work is part of the international program NEREUS "Predicting future Oceans", led by the University of British Columbia (Director William Cheung). It is co-funded by the Region Bretagne.

To apply, send CV, covering letter and supporting information to: Didier.Gascuel@agrocampus-ouest.fr (For more information also contact D. Gascuel)

Scientific context

Over the last decades, the development of fisheries in the global ocean has led to changes in species abundance, assemblages, food webs functioning, and ultimately in the productivity and stability of marine ecosystems. Climate change is now coming and also modifies ecosystems structure and functions, especially as ocean warming affects species' size, growth, distribution and interactions. These stressors may act in synergy to modify biomass (or energy) flows from low to high trophic levels of the food web. Thus, fisheries, but also the fisheries management system, have to adapt.

Trophic modelling is a key approach to analyze and predict these interactive effects of fisheries and climate change on the global functioning of marine food webs, and to test the efficiency of various fisheries management strategies. In particular, the EcoTroph model (Gascuel and Pauly 2009) is a quasi-physical approach focusing on the distribution of the ecosystem biomass by trophic level, and analyzing how this distribution and biomass flows are affected by fisheries in a given state of the environment. This approach is particularly well suited to simulate the emergent effects of climate change (on primary

production, biomass flows kinetics, and trophic transfer efficiencies) and to assess the overall ecosystem impacts of fishing, associated to a given climate change scenarios. It appears complementary to the worldwide well-known Ecopath with Ecosim (EwE) standard of modelling, providing a synthetic overview of ecosystems functioning.

The Rennes team (research unit "Fisheries Ecology", at Agrocampus Ouest) joined in 2016 the international program Nereus, led by the University of British Columbia (UBC, Vancouver, Canada) and funded by the Nippon Foundation. This program is a global interdisciplinary initiative created to further our knowledge of how best to attain sustainability for the world's oceans. It currently involves 18 leading marine science institutes all around the world (www.nereusprogram.org/). The specific task devoted to Agrocampus Ouest is to focus on the above mentioned scientific aspects, especially using EcoTroph as a key approach to analyze climate change and fisheries impacts on marine food webs. A PhD started in late 2016 devoted to the modelling of the effects of changes in species assemblages on the trophic functioning of the global ocean. The proposed Postdoc aims to make this theoretical approach more operational, developing a new dynamic version of the EcoTroph model and focusing on a selection of ecosystem models considered as case studies to a assess various fishing strategies and management options.

Postdoc work

The Postdoc aims to develop a new dynamic version of the EcoTroph model and to apply it to a selection of marine ecosystems, in order to answer the following questions: how will global change in the functioning of food webs affect fisheries productivity and ecosystems stability by 2030 and 2100? Which fisheries management strategies will be the most efficient to ensure fisheries sustainability at this time?

The Postdoc work will elaborate on the innovative approaches developed at Rennes regarding on the one hand trophic spectra of biomass, biomass flows kinetics and transfer efficiencies (Gascuel et al 2005, Maureaud et al. 2017, Du Pontavice et al. in prep.), and on the other hand, the EcoTroph modelling approach (Gascuel and Pauly 2009, Gascuel et al. 2011, Colleter et al. 2013). The first ones provide scientific bases to simulate the expected effect of climate change on the main parameters driving the biomass flow through marine food webs. The second one has been developed to analyze steady state conditions (in analogy and often used as a complement to Ecopath), but theoretical equations and a preliminary version of a dynamic EcoTroph (analogue to Ecosim) already exist. Thus, the Postdoc work will be organized in two steps (each leading to a peer reviewed paper).

In a first step the dynamic version of EcoTroph will be finalized (R programming). In such a version, the main parameters of the model (primary production, flow kinetics and transfer efficiencies) will be able to change over time, according to the fishing impacts or the expected effects of climate change. This new model will be tested applying it to a selection of ecosystems where EwE models have been previously developed and comparing the outputs of the two models over the past period. The selection of case studies will benefit from the EcoBase repository of all the published Ecopath models (this database is managed by Agrocampus Ouest for the international EwE consortium) and will include inter alias some models developed by the research team (Celtic sea, Guinean EEZ, …).

In a second step, a multi-model approach will be developed, using EwE and the dynamic version of EcoTroph in order to simulate climate change effects on the fisheries productivity and ecosystems stability by 2030 (a short term and manageable perspective) and by 2100. Based on case studies analyses, various fisheries management scenarios (MSY, MEY, selectivity, balanced harvest…) will be

compared. This approach should contribute to the emergence of an effective Ecosystem approach to fisheries management, and to the adaptation of management strategies to climate change.

References

Colleter M., Guitton J., Gascuel D., 2013 - An Introduction to the EcoTrophR package: analyzing aquatic ecosystem trophic network. The R Journal, 5(1): 98-107.

Gascuel D., Pauly D., 2009 - EcoTroph: modelling marine ecosystem functioning and impact of fishing. Ecological Modelling, 220: 2885-2898.

Gascuel D., Bozec Y.-M. Chassot E., Colomb A, Laurans M., 2005 – The trophic spectrum : theory and application as an ecosystem indicator. ICES Journal of Marine Sciences, 62: 443-452.

Gascuel D., Guénette S., Pauly D., 2011 - The trophic-level based ecosystem modelling approach: Theoretical overview and practical uses. ICES Journal of Marine Sciences, 68: 1403-1416.

Maureaud A., Gascuel D., Colléter M., Palomares M.L.D, Du Pontavice H., Pauly D., Cheung W.W.L., 2017 - Global change in the trophic functioning of marine food webs. PLoS ONE, 12(8): e0182826,