DEVOTES Summer School course

From Species to Ecosystems:

## Modelling Marine Ecology for Management Applications

Director:

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Coordinator of the European 7th FP DEVOTES project (Development of innovative tools for understanding marine biodiversity and assessing good environmental status: www.devotes-project.eu).

Objectives: This is the 11th AZTI's Marine Research Division Summer School and the second one organized within the European FP7 project "DEVOTES" (Development of innovative tools for understanding marine biodiversity and assessing good environmental status: www.devotes-project.eu), in which most of the teachers of this Summer School are involved. As in previous years, we want that attendees can acquire new knowledge on recent trends in marine research, related to management of our oceans. This Summer School will explore the potential and recent advances in the use of marine modelling (some of them developed in DEVOTES), at different scales (from species to ecosystems), in management applications, including scenarios of climate change. Hence, the main objective of the school is to give an overview on the marine modelling to ocean and coastal management, with a closer view to the European Marine Strategy Framework Directive (MSFD), especially in descriptors such as: biodiversity, fishing, food-webs and seafloor integrity.

Dates: 15th to 17th July 2014

Venue: Aquarium of San Sebastián (Spain)
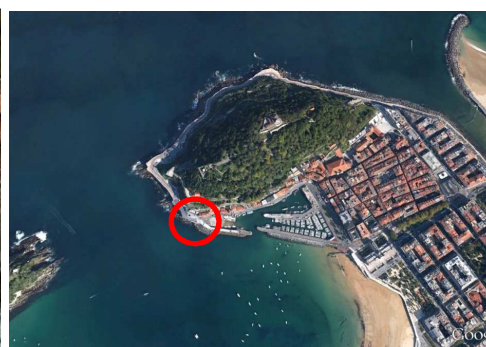
Registration Fees:

Early registration (until 30th May)	90 €
Early student registration (until 30th	70 €
Late registration (until 14th July)	100 €
Late student registration (until 14th July)	90 €

Programme and contents of the lectures

Tuesday 15th July: Modelling species and habitats

- **9:15-9:30 Introduction**: short introduction on why this course and the applications, including some comments on the DEVOTES project *(Angel Borja, AZTI, Spain)*
- **9:30-10:30 Modelling suitable habitats for species: the case of lobster Homarus** *(Ibon Galparsoro, AZTI, Spain):* Predicting species distribution and habitat suitability modelling, across broad spatial scales, is now a major challenge in marine ecology. The resulting knowledge is of considerable use in supporting the implementation of environmental legislation, integrated coastal zone management and ecosystem-based fisheries management. This presentation deals with the identification of seafloor morphological characteristics, together with wave energy conditions, which determine the presence of European lobster (Homarus gammarus) by applying Ecological-Niche Factor Analysis (ENFA). This approach demonstrates the applicability of the method in case studies where only presence data are available, together with the inclusion of environmental variables obtained from different sources.
- **10:30-11:00 Coffee Break**
- **11:00-12:00 Modelling suitable habitats for species: the case of plankton and seagrasses** *(Guillem Chust, AZTI, Spain):* The lecture will introduce you to the basics concepts of habitat suitability models, as well as the most used algorithms such as MaxEnt and GAM, among others. Two very different case studies will be presented: the use of such models for detecting poleward shift associated to climate change in zooplankton species, and the application of the models to assess future habitat distribution for seagrass species.
- **12:00-13:00 Integrating food web and bottom up dynamics into top down modelling** *(Eider Andonegi, AZTI, Spain):* this lecture will include fish stock assessment strengths and weaknesses, hake and anchovy relationships in the Bay of Biscay (GADGET modelling environment), and predicting fish responses to climate change, including management actions.

Wednesday 16th July: Modelling communities and food webs

- **9:00-10:00 Modelling benthic and planktonic communities, including connectivity** *(Guillem Chust, AZTI, Spain):* The lecture will introduce you to the concepts of community analysis and main theories explaining the maintenance of local diversity (ecological niche and neutral theory of biodiversity). Two contrasting case studies will be analysed: testing neutral theory in plankton communities, and the role of dispersal limitation in benthic communities (macroalgae, macroinvertebrates and seagrasses).
- **10:00-11:00 Understanding the mechanics of marine food webs** (*Axel Rossberg, Cefas, UK*): Marine food webs are characterized by a number of emergent patterns linking richness, body sizes, trophic levels, abundances, and diets of species. Modern food-web theory explains how these patterns arise from biological and mechanistic constraints.
- **11:00-11:30 Coffee Break**
- **11:30-12:30 Applying food-web theory for management and the Marine Strategy Framework Directive** *(Axel Rossberg, Cefas, UK*): Theoretical insights into structure and dynamics of food webs from the previous talk will be applied to address specific management problems in the

context of the MSFD. Among them, the choice of state indicators for food webs and strategies for fisheries management aiming at maximum sustainable yield.

- **12:30-13:30 Taking into account uncertainty when modelling food-webs** *(Nathalie Niquil, CNRS, France)*: The Linear Inverse Modelling – Monte Carlo Markov Chain approach is a statistic method for estimating missing values of the flows in food-web models. The method will be presented on practical cases, explaining the different steps. The main advantage of this method is that each flow is characterized by a probability density function, allowing the definition of a confidence interval.

Thursday 17th July: Modelling ecosystems

- **9:00-10:15 Characterizing food-web properties with Ecological network analysis, implications for the MSFD** (*Nathalie Niquil, CNRS, France*): Based on food-web models derived from LIM-MCMC or Ecopath approaches, numerical indices called Ecological Network Analysis indices can be calculated for characterizing the ecological functioning (recycling, trophic efficiency, diversity of the flows, etc.). Some of these indices may be used as indicators of food web health. The presentation will give examples of comparative studies.

- **10:15-10:45 Coffee Break**

- **10:45-12:00 Climate forced simulations of marine ecosystems** *(Icarus Allen, Plymouth Marine Laboratory, UK)*: Global change, the result of natural and anthropogenically induced climate change impacts upon the structure and function of marine ecosystems via a number of abiotic and biotic drivers. Climate change may lead to large scale changes in climate patterns, ocean circulation and climatic variables such as temperature and light. Enhanced atmospheric CO_2 levels will lead to acidification of the oceans with significant impacts on ocean biogeochemistry, calcareous organisms and potentially the reproductive success of higher trophic levels. These changes will all impact on the overall trophodynamic structure and functioning of marine ecosystems. This lecture will discuss the use of numerical models to simulate and predict changes in the state of marine ecosystem in response to climate drivers at both global and regional scales. Topics covered with include, climate forcing and regional downscaling, scenario definition, the concept of uncertainty in future projections. It will be illustrated with examples including both global applications and regional downscaling.

- **12:15-13:30 Operational Ecology: Marine ecosystem modelling for European directives** *(Icarus Allen, Plymouth Marine Laboratory, UK)*: Coastal seas provide many beneficial goods and services to humankind, such as fisheries, recreation, climate regulation and coastal defences, however, these marine environments are being disrupted by climate change and human activities. Operational Ecology involves the development and evaluation ecosystem forecast tools to help assess and manage the risks posed by human activities on the marine environment, thus improving the ability to predict the "health" of European marine ecosystems in terms of both indicators and environmental services. This lecture will cover a range of topics relating to marine ecosystem forecast including model skill assessment, timescales of predictability, data assimilation and data visualisation. It will be illustrated with examples from European Regional Seas. Finally I will discuss mapping model outputs to meet user requirements in the context of the MSFD.