# Fostering interactions of **different disciplines**

A European project is seeking to bring together multiple disciplines to inform policy makers on improved conservation techniques. **Drs David McKenzie** and **Julian Metcalfe** outline their efforts

**Can you begin by outlining your positions within this project?**

**DM:** The COST Action was conceived in order to develop a network of researchers who could work with policy makers to improve conservation techniques. It brings together contributors from 17 EU nations. I am the Chair of the Management Committee which guides the Action and has two members from each participating nation. The Action has three working groups – Dr Metcalfe is the leader of WG3, which has the aim of making conservation physiology research relevant to stakeholders.

**Can you explain in fundamental terms the objective of conservation physiology?**

**JM:** Conservation physiology aims to provide a mechanistic understanding of how animals function within their environment, with the objective of improving their conservation. In particular, it focuses on using such an understanding to predict the impacts of environmental change and conservation interventions on animal populations.

**What is the current limitation of our knowledge base in marine conservation?**

**DM:** Global climate change is disrupting marine biodiversity and the International Panel on Climate Change has warned that more pronounced effects are expected in the near future. We need a mechanistic understanding of the processes that are driving current changes in marine fish biodiversity so that we can improve our ability to forecast future effects.

**How will advancing our understanding of physiology improve marine conservation?**

**DM:** Physiology has a central role in defining ecological performance of all animals, and fishes are particularly physiologically sensitive to the external factors of global climate change. A better knowledge of their physiology can improve understanding of current patterns of abundance and distribution, and so help to resolve current management issues and conservation problems. Measures of physiological performance or underlying stress have potential as markers of population productivity and vulnerability or resilience to environmental changes.

**Do you consider physiology to be the key to solving the problems of marine fish conservation?**

**JM:** Not entirely – we must integrate physiological understanding with knowledge of habitat selection in the wild in order to predict the optimal habitat for species. New techniques are enabling physiological measurements of animals in the wild and are providing insights into how fish select habitats. Incorporating physiology into forecast modelling is likely to be essential in managing conservation techniques.

**How is the CONPHY COST Action fostering interactions amongst researchers and practitioners?**

**JM:** We have held three workshops towards this end. In particular, at the end of May 2012 17 scientists involved in the COST Action came together for a meeting in Oristano, Sardinia to discuss how physiological information can be incorporated into modelling tools to aid in the management of marine fish biodiversity and resources. Most of the participants were experts in various methods of ecosystem modelling and we hope that further collaborations will continue to improve how we work. As the Action develops we will be inviting policy advisors and decision makers to our meetings so they can hear about new developments and tools we are developing to support improved management.

**How do you anticipate engaging with policy advisors and decision makers across the EU?**

**JM:** We believe that we can help to develop a unified conceptual framework in which to predict the effects of global climate change. Currently the value of such information is not widely appreciated. In part, this is a result of physiologists not being particularly effective at promoting their science for policy making. We plan to bring together stakeholders through seminars, workshops and a conference in order to define the context in which we need to operate. This will play a fundamental role in determining the direction and scope of future research.

**To what extent will CONPHY support improved conservation and management?**

**JM:** We aim to help scientists gain a better understanding of legal and policy frameworks relevant to fisheries and habitat management and therefore appreciate the requirements of resource managers and policy makers. It will provide these stakeholders with improved modelling of future changes and so improve decision-making processes by strengthening the scientific evidence upon which they are based.

**What events relating to this work are you planning in the forthcoming year?**

**DM:** In 2013 young researchers will be funded to participate in the Dynamic Energy Budget symposium in Texel, The Netherlands, in a workshop dedicated to the applications for marine fish ecology. Later in the Action we are planning training schools on telemetry techniques and the evaluation and comparison of current modelling approaches.

# The value of physiology

The **CONPHY** European COST Action is investigating how conservational physiology can aid efforts to determine distribution and abundance of marine fish species, and thereby contribute to a more sustainable management of fishery resources

**MARINE ECOSYSTEMS PROVIDE** essential resources and services, among which marine fishes are of prime socioeconomic value both globally and in Europe. The past few decades have witnessed an alarming trend of marine fish biodiversity loss due to human activities such as excessive exploitation of the resource or degradation of the species natural habitats. As a result, most commercial fish stocks are now either overfished or nearing capacity. Climate change is also disrupting biodiversity and potential future changes may have further profound effects on commercial fisheries which may threaten food security.

The field of conservation physiology investigates how individual physiological responses to environmental conditions can influence the abundance and distribution of animal populations, towards their more successful conservation and management. By forming a mechanistic understanding of how animals function in their environment, researchers can improve predictions of the impact of environmental change and conservation interventions.

Biologging and biotelemetry – the use of electronic devices attached to or implanted into animals and natural tagging methods such as the analysis of micro-chemical markers, are now providing information on movements, distributions and the population structure of some economically important species. These datasets are aiding researchers to better understand the strengths and uncertainties in current species distribution and productivity forecast models.

## BRINGING IT ALL TOGETHER

A European COST Action known as CONPHY has been conceived as a result of discussion among a number of marine fish ecophysiologists and ecologists from various EU countries. It was recognised that the emerging field of conservation physiology had the potential to contribute to the knowledge base underlying the sustainable management of European marine fish biodiversity and resources. The COST mechanism is well suited to this end, as it supports the development of networks of researchers and stakeholders and fosters interactions among scientists of different disciplines and professions. This network has brought together fish ecophysiologists, fish community ecologists, forecast modellers, resources managers and policy makers from 17 EU nations.

The main objective of the COST Action is to coordinate European research efforts to contribute to sustainable management of marine fish biodiversity and fishery resources. To achieve this, activities have been divided into three major working groups (WGs). WG1 is evaluating current knowledge about physiological responses to abiotic factors expected to have major impacts on marine fishes, to identify critical gaps to be addressed. WG2 is fostering communication among physiologists, community ecologists and forecast modellers in order to integrate data and ideas and improve forecasting of the potential impacts of climate change. WG3 is headed by Dr Julian Metcalfe and has the objective of enabling physiological knowledge to be incorporated into decision support tools and decision-making processes in order to make these developments relevant to stakeholders such as resource managers and decision makers.

## UNDERSTANDING PHYSIOLOGY IMPROVES CONSERVATION

Each species has adapted over time to a specific set of environmental conditions within which it functions optimally. Fish are particularly sensitive to abiotic factors (non-living aspects such as water temperature), that are being profoundly influenced by global climate change. Increasing sea water temperature, $CO_2$ and acidity and decreasing oxygen levels are already affecting the distribution of habitats that any given species can occupy successfully and sustainably.

A greater understanding of fish environmental physiology, specifically tolerance of abiotic factors, can improve the understanding of what defines current patterns of distribution and abundance. This knowledge should help to resolve current management and conservation problems for marine fishes, but also the ability accurately to predict the potential impact of climate change. Similarly, measures of physiological performance or underlying stress in a species have potential as biomarkers of population productivity and resilience to environmental changes.

# CONPHY

## CONSERVATION PHYSIOLOGY OF MARINE FISHES – COST ACTION FA1004

### OBJECTIVES

The main objective of the Action is to coordinate European research efforts to understand the physiological mechanisms that determine distribution and abundance of marine fish species, and thereby contribute to sustainable management of biodiversity and fishery resources.

### PARTNERS

Participating countries:

**Belgium • Croatia • Denmark • France • Germany • Greece • Iceland • Ireland • Italy • Malta • The Netherlands • Norway • Poland • Portugal • Spain • Sweden • UK**

### FUNDING

COST is a European funding scheme for networking activities, allowing the coordination of nationally-funded research on a European level.

### CONTACT

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Information on physiological tolerance of environmental factors is not sufficient in itself. This must be combined with an understanding about behavioural habitat selection in the wild. The rapidly evolving techniques of biologging and biotelemetry are now revealing the movements of individuals and populations within their environment and how they select habitats. New techniques are even enabling physiological measurements on animals in the wild, such as cardiac output, allowing better estimation of the energetic costs of selecting particular habitats. These techniques are providing insights into how fish make trade-offs between conflicting demands and the extent to which physiology drives habitat selection.

Current modelling methods predict impacts of future global warming scenarios by correlating estimated distributions of species with the prevailing environmental conditions to forecast biodiversity patterns or global catch potential. However, these models provide little understanding of underlying causal processes which may explain variations in species richness and community composition. Incorporating physiological information into forecast models should improve their predictive capacity, which is likely to be essential for the management of fishing pressures and developing strategies to adapt to global climate change.

### ENGAGING WITH DECISION MAKERS

It is Metcalfe's belief that the physiological knowledge obtained through this COST Action can help to provide a unifying conceptual framework for evaluating and predicting the effects of global climate change, and to identify biomarkers of stress and physiological proxies of ecological performance in exploited populations. It is part of the planned work to bring together more resource conservation managers, decision makers and the relevant scientists – such as ecologists, modellers and physiologists – through a variety of means including seminars and workshops.

> To resolve current conservation and management issues, a greater understanding must be sought of marine fishes' physiology in the wild

The COST Action will be particularly important in fostering the coordination of these different research activities, and WG3 will be explicitly responsible for ensuring that any developments in conservational physiology can be used and communicated effectively to a wide audience.

So far, the Action has funded seven short-term scientific missions (STSMs), for early-career scientists to travel to other laboratories to gain experience and training in specific methods and techniques. The Action also runs training schools for groups of young scientists. In January 2012 a school was run at the Helsingør Marine Biological Section of the University of Copenhagen, which taught 10 young researchers methods to measure metabolic rate and estimate metabolic scope in fishes. In the second year of the action it is planned to run another 10 STSMs, plus further training schools.

The Action will conclude with a high profile conference held with the aim of defining the policy and management context in which conservation physiology needs to operate. It is Metcalfe's hope that this will play a fundamental role in determining the direction and scope of future research so that the results and understanding are used effectively to improve the conservation and management of marine fisheries.