

## **Marine connectivity and its applications to MPA network design and fisheries management - Workshop Report**

Peter Wright (Marine Scotland Science) opened the workshop and welcomed participants. After a brief introduction outlining the main motivations and objectives of the workshop he presented a talk focused on the use of microchemistry to assess the home range of the spawning stock and evaluate how related a nursery ground is to a spawning ground. This was followed by a talk by Alejandro Gallego (Marine Scotland Science) focused on the use of biophysical models to assess connectivity in marine species. The third talk by Thomas Adams (SAMS) presented a study using biophysical models to assess larval connectivity in the Firth of Lorn, an area proposed for marine renewable development. The last talk by Oscar Gaggiotti (Scottish Oceans Institute) discussed the use of population genetics approaches to infer connectivity in marine species.

The four talks were followed by an open floor discussion focused on two main questions:

- a) Is there an interest in establishing a MASTS community project focused on the study of marine connectivity and its application to the design of MPA networks?
- b) What activities would people like to see included in the project?

From the discussion it transpired that there is much interest in developing such a project with support from MASTS and specifically focused on the Scottish MPA network. The activities could include: (1) international actions involving marine connectivity networks from other countries -several workshop participants have collaborations with researchers in other European countries, Latin America and the US, and (2) large-scale, interdisciplinary project aimed at gathering much needed information about connectivity for the improvement of the Scottish MPA network.

There was general agreement about the timely nature of the initiative given that the list of sites identified as potential MPAs was recently submitted to the Scottish government. There is ample room for activities focused on (1) refining the Scottish MPA network and defining its connections with the other UK and European MPAs; (2) management of activities within and outwith the protected sites; (3) invasive species and potential risks associated with the development of marine renewables.

MASTS is a rich community in terms of knowledge and expertise, therefore, the aim is to find a theme in which we can incorporate all the people in a single brush – this would result in a very comprehensive assessment of connectivity in relation to MPAs. All stakeholders should be included: governmental agencies, NGOs and academic institutions.

The discussion was lively and covered many items including choosing the set of species that would be the focus of the research project, the questions that could be addressed, and the methods that should be used.

Although all species are important, only a limited set can be studied due to limited funding/resources. The MPA consultations and proposals have identified priority marine features/ habitats that are important to Scotland. This may be because of rarity and/ or ecosystem function. They may be an indication of what the government and Marine Scotland consider to be important species. This is a starting point but not an exhaustive list. Criteria for refining this list include the questions that will be addressed by the proposal. For example, renewables may suggest basking sharks and marine mammals while fisheries issues would suggest commercially important species.

Obvious criteria are ecological and life-history considerations but another consideration is that we need a basis for the testing and validation of biophysical models using population genetics and microchemistry tools. Therefore we should include species that are amenable to the use of all three approaches.

Practical considerations such as including species that are currently being studied can also be used. For example, a group from the University of Aberdeen has developed molecular tools to assess connectivity in elasmobranchs, a species group that is considered important based on other criteria (see above).

There was general agreement that choosing the final set of species that could be studied is very important and that we need to come up with a strategy that would allow us to reach this goal.

Concerning the questions and methods, there were two important observations that are closely intertwined. First, MPAs are segments of a larger habitat and they may or may not be sustainable by themselves so activities outwith the protected areas are important. Thus, the research project should also consider non-protected areas. Second, we still don't understand enough to predict the full impacts of MPA designation on connectivity (i.e. will they be a success or a failure?) and, at the moment, we cannot quantify the amount of disturbance the network can take before it is negatively impacted to a point from which it may not recover. Answers to these questions require the use of demographic modelling, something that the four presentations did not address directly. Metapopulation dynamics will need to be considered, especially in relation to sinks and sources of larvae.

In closing it was mentioned that the Scottish process has been a pragmatic application of the best available science and evidence, which is considered a good start. Although science driven, the development of proposals for sites in Scotland is not perfect. Evidence is lacking for a lot of species and connectivity is an important aspect of research that will inform the process, but research in this area will also help assess the future success of the MPA network.

## Recommendations

- MASTS biodiversity Theme: there are plans to have an exercise to cast around the MASTS community for ideas for key topics and questions that need to be addressed – there is intention for a workshop to discuss this. We could articulate a series of questions that could feed into the theme activity.

Thus it would be very useful if participants would join the Biodiversity forum so as to be part of this exercise.

- In order to move forwards it was agreed that participants should send a short paragraph describing their main research/management interests to Oscar Gaggiotti (oeg@st-andrews.ac.uk). Information about general objectives of their work, the species involved and the methods used would be instrumental for the organization of a second workshop focused on better defining the strategy for developing the MASTS community project.