

MASTS DPMS Mingulay Reef Complex workshop
Crieff Hydro 20/21st November 2013

Overarching question which was discussed:

How will the Mingulay Reef complex and the wider system, fare in the face of predicted future climate change?

Outcomes:

- Identified key research gaps in building an integrated overview of the MRC.
- Formed new collaborations within MASTS to seek funding to address these gaps.
- Identified an overall 'theme' to work within for future funding opportunities
- Identified smaller manageable projects within the overarching theme to address in the short to mid - term.
- Submitted a MASTS MSS ship time expression of interest encompassing group interests
- Created an 'action plan'

Key gaps identified:

Present day

1. **Oceanography/ hydrography/ hydrodynamic modeling of the region**
 - Greater spatial and temporal resolution data is needed
 - What is the connectivity within and between systems?
 - How does the oceanography/ hydrography link to:
 - Fish dispersal
 - Zooplankton/phytoplankton circulation from surface to bottom
 - Water chemistry
 - Biodiversity
2. **How does Carbon/ Nitrogen/ Sulphur/ Nutrients and trace gases cycle through the MRC?**
 - What are the sources/ sinks?
 - Is the MRC (and the coral habitats) a net sink or source for carbon over long time scales?
 - Does sulphur contribute to the MRC carbon budget / flux?
 - How do the following contribute towards this, and how are they linked?
 - Corals, Sponges, Megafauna

Present day - past history

3. **Reef biodiversity**
 - What is the present diversity over spatial and temporal timescales?
 - How is this controlled? (Top down or bottom up?)
 - What was the past reef diversity at different points in time?

Past history

4. **Reconstructing past environments**
 - How has the MRC complex and its environment changed from past to present?
 - Further reconstruction from coral skeletons/ associated sediment and fauna is needed
 - Does the MRC act as a blue carbon store?

Future changes

5. **How will the key organisms be impacted by future conditions (and how will this affect ecosystem C/N fluxes?)**
 - Coral
 - Sponges
 - Phyto/zooplankton (Carbon supply)
 - Fish
6. **What is the cost of acclimation for organisms living in future environments?**
 - Cost to reproduction
 - Will future carbon supplies supply facilitate potential increased costs of living?

Case study theme

All the above identified research gaps refer to carbon cycling, storage or export in one aspect or another, and so fall within the following theme title:

Carbon cycling, storage and export at the MRC: Past, present and future

The following are examples of how identified gaps fit within this theme.

- **Hydrodynamics/ hydrography:** crucial to identify the flux between the seafloor and sea surface, C/N export and import.
 - **Corals/sponges/ macrofauna:** key organisms in carbon cycling at the seafloor
 - **Trace gases, in particular sulphur compounds:** these are a potentially large source of carbon emitted from corals and sponges.
 - **Past environments:** we need to understand the cycling and storage in the past, which includes knowledge of biodiversity and reconstructions of past local climates. Potential changes in the future cannot be quantified without understanding how past events shaped the MRC.
 - **Fish:** these are a key part of food web and carbon exchange in and between reef systems at the MRC. Additionally, there will be societal interests on the role of fish within the MRC.
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Actionable short and mid-term outcomes within the overall theme:

- 1. Quantifying sponge/coral/sediment Carbon and Nitrogen assimilation**
 - Quantify benthic – pelagic coupling
 - Data for this outcome already exists within MASTS for sponges and corals
 - Integrate data with existing video transects for habitat type and cover, to estimate regional benthic- pelagic coupling
 - Sediment and Eddy lander data would facilitate linking ‘individuals – community – environment’
 - Carefully selected cores would also address the component of carbon which is stored in the reef carbonate structures
- 2. The connectivity within and around the MRC**
 - Within:
 - How are the MRC macrofauna connected between different reefs within the MRC area? This data already exists within larger, lower resolution models.
 - What is the fish movement within the MRC? Baited landers on ships of opportunities could help address this.
 - Both of these points tie into the import/export of carbon, but also into the general importance of the MRC
 - Around:
 - How is Lophelia connected to other coral reefs?
 - Does the MRC seed Norway reefs?
 - The MRC reefs are connected to Rockall
 - **This is important for the MRC as a Special Area of Conservation**
- 3. Integrating higher resolution smaller scale hydrodynamic models to larger scale regional models**
 - Data exists for this already (Juan/ Dimitry)

- It can be supplemented by CTD data from future MSS cruises
- It can be supplemented by existing MSS data
- This will tie into connectivity, and C/N benthic-pelagic coupling

4. Reconstructing past environment controllers of coral productivity (and hence associated biodiversity and cycling)

- Using existing Ellett line data (Mingulay/ Rockall)
- Reconstruct mixing between gyres (subpolar/subtropical)
- Using last 40 years of coral growth – can Nb isotope in corals replicate mixing in gyres?
- What determines coral productivity?
- From data over last 40 years push further into the past
- New sampling required

5. Benthic landers: builds into many of the above points

- Corals and other organisms on landers will be useful for Proxy work – reconstructing past environment validation
- This will provide the first measurements of growth in situ (summer vs winter)
- Sediment traps can be placed to see how this changes through the year.

Points of action with regard to the above outcomes:

1.
 - a. *Seb Hennige, Andrea Gori and Georgios Kazanidis* will lead the Coral and Sponge Carbon and Nitrogen outcome. This includes collating existing data and a Carnegie grant bid
 - b. *Nick Kamenos* to lead with investigation of *Lophelia* reefs as potential carbon sinks (blue carbon) with input from *Heidi Burdett* and *Natalie Hicks*
2.
 - a. *Natalia Serpetti* will investigate what is required to modify existing data on megafauna connectivity for the MRC.
 - b. *Rosanna Milligan* will coordinate with *David Bailey* for investigating fish connectivity within the MRC.
 - c. Ongoing work in conjunction with *Murray Roberts* is investigation CWC connectivity between Rockall, the MRC and wider regions. An update to SNH will be supplied as more information becomes available
3. *Juan Moreno-Navas* and *Dmitry Aleynik* to lead integrating higher resolution and larger area models together, and investigating funding lines for this (Carnegie)
4. *Kirsty Crocket* to lead "Reconstructing past environment controllers of coral productivity" Likely as a submission as a NERC standard grant
5. *Murray Roberts* will lead long-term investigation into places benthic landers at the MRC

Contact detail of MRC case study participants:

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