IP 15
Agenda Item: 4.3.7
Person Responsible:

XXXIV SCAR Delegates Meeting

Kuala Lumpur, Malaysia, 29-30 August 2016

Integrating Climate and Ecosystem Dynamics in the Southern Ocean (ICED) programme

Executive Summary

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Important Issues or Factors:

ICED is a regional programme of Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) and is closely linked with SCAR. ICED is undertaking integrated circumpolar analyses to improve our understanding of change and the implications for Southern Ocean ecosystems and their management. Progress has been made in understanding the structure and functioning of ecosystems, modelling species and food webs, and with qualitative assessments of change. We are building on this to more comprehensively assess (and where possible quantify) key impacts of change on Southern Ocean ecosystems and to ensure this informs management and policy.

Recommendations/Actions and Justification:

We would like SCAR to particularly note the mutually beneficial opportunities for strengthening interactions and collaborations with ICED. This includes (i) our recent (and upcoming) work with CCAMLR and the CEP, and (ii) our work on models, scenarios and projections (including our upcoming workshop and conference).

Budget Implications:

Key ICED activities planned for 2016-17 will benefit from SCAR involvement and expertise and as such may require SCAR funds; e.g. this could include attendance of key individuals involved in other SCAR groups at our planned workshop on projections, and ongoing work with CCAMLR and CEP.

Introduction/Motivation

ICED is a regional programme of the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) Programme and is closely linked with SCAR. ICED is undertaking integrated circumpolar analyses to improve our understanding of change and the implications for Southern Ocean ecosystems and their management. A diverse range of multidisciplinary research is underway through core activities such as historical data rescue and synthesis, fieldwork, and modelling. Considerable progress has been made in understanding the structure and functioning of ecosystems, modelling species and food webs, and with qualitative assessments of change. ICED's current major focus is to build on this to more comprehensively assess (and where possible quantify) key impacts of change on Southern Ocean ecosystems and to ensure this informs management and policy. This will be achieved through the analysis and integration of available data together with development of models, scenarios and projections. These activities and their outputs will provide valuable information for ecosystem-based management in the region.

Progress to Date

ICED Science:

Our recent scientific progress has been forged in three main areas: (1) assessments of change in the Southern Ocean; (2) identifying and addressing major gaps in knowledge (focussing on links between biogeochemistry and food webs); and (3) quantifying and modelling food webs. We have also made progress with our aim to inform management and policy. ICED has enabled collaborations to take place between scientists from different disciplines and key recent highlights include:

- A body of research to understand and quantify the state and variability of Southern Ocean marine ecosystems (with a focus on the controls on structure and functioning at both regional and circumpolar scales). This includes detailed work on key species from Antarctic krill to whales, and links between biogeochemistry and ecology and the effects of change such as ocean acidification.
- Development of regional models and end-to-end ecosystem models, historical circumpolar data analyses, and the continual integration of the physical, biogeochemical and ecological aspects of our research.
- A range of activities and research to detect, project and manage the impacts of change in Southern Ocean ecosystems.

For recent science highlights (i.e. published papers) see Appendix.

International events

International workshop on Pteropod and Ocean Acidification, British Antarctic Survey, June 2015. ICED scientists were involved in convening this workshop and the outcomes have been submitted to Biological Review and presented at the High CO_2 Symposium in May 2016. Further outputs are planned.

Scientific Committee on Antarctic Research (SCAR) Cross-Program Workshop on Interactions between Biological and Environmental Processes in the Antarctic, September 2015, Barcelona, Spain. ICED links with SCAR, in particular AnT-ERA, were strengthened through our participation in this activity which followed on from and complemented the ICED Workshop on *Southern Ocean Food webs and Scenarios of Change, British Antarctic Survey, November 2013*.

IMBER IMBIZO IV, October 2015, Trieste, Italy. ICED scientists developed and lead a workshop: *Integrated modelling to support assessment and management of marine social-ecological systems in the face of global change*.

EURO-MARINE Consortium General Assembly, January 2016, Portugal. ICED scientists attended, ensuring links between ICED and the shared vision of this European network whilst building on the legacy of EUR-OCEANS in developing the ICED network and science strategy. See http://www.euromarinenetwork.eu/.

ICED scientists presented at numerous conferences, e.g: American Geophysical Union Fall Meeting, 12-16 December 2015, San Francisco, USA; World Seabird Conference 26-30 October 2015, Cape Town, South Africa.

International links

SCAR

ICED contributed to the annual SCAR report and Science Highlights for the Antarctic Treaty Consultative Meeting 2015; to the SCAR Cross-Program Workshop in September 2015; and ICED SSC's Richard Bellerby led the development of a major SCAR report on ocean acidification in the Southern Ocean which has involved input from numerous ICED scientists.

ICED has continued its close partnership with SOOS with members of ICED also on the SOOS SSC. Collaborations are ongoing and most recently include SOOS's request for ICED to contribute to the development of a Southern Ocean database and map of field activities.

Scientific Committee on Oceanic Research (SCOR)

ICED scientists contributed to a review of SCOR activities including positive aspects of their relationship with SCOR.

International Whaling Commission (IWC)

ICED scientists have been involved in key IWC work including the completion of the Southern Hemisphere humpback whale assessment (led by Jen Jackson).

Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR)

ICED participated as a member of the SCAR delegation[2] at the second Joint Workshop of the CCAMLR Scientific Committee and the Antarctic Treaty's Committee on Environmental Protection (CEP), 19-20th May 2016, Punta Arenas, Chile. The report and recommendations encourages development of links between ICED, SCAR and SC-CAMLR (Working paper submitted to WG-EMM-2016) and ICED will attend WG-EMM in July 2016 to further this work.

EU-POLARNET

ICED scientists submitted a contribution to the newly formed EU-PolarNet Consortium's (2015-2020, see www.eu-polarnet.eu) future series of white papers addressing urgent polar research questions. As well as contributing to developments of EU-PolarNet's emerging Project Themes, ICED is also seeking to become a 'Cooperation Partner' of the Consortium, working together with range of other International Partners with shared goals.

Future Plans

- A series of ICED community papers are planned for 2016-17 that present clear messages on change in the Southern Ocean. These include scenarios of change, historical data rescue and synthesis, stakeholder engagement, polar food web diversity and functioning, and an ICED mid-term programme review.
- ICED is providing input to a range of meetings in 2016 including the Joint Workshop of SC-CAMLR and the CEP, Punta Arenas, Chile, May 2016; the High CO_2 Symposium, Hobart, May 2016; SC-CAMLR WG-EMM, July 2016; and the SCAR Open Science Conference, Kuala Lumpur, August 2016.

- ICED workshops and meetings planned for2016-18 will synthesise research to date, forming a comprehensive view of status and changes in Southern Ocean ecosystems. These will include an ICED workshop on projections of change (2017) and an ICED International Conference on Assessing Status and Trends of Habitats, Key Species and Ecosystems in the Southern Ocean, Hobart, Australia, 2018 (www.measo2018.aq).

Recommendations/Expected Outcomes

Through IMBER, SCAR and associated programmes, ICED will continue to raise the profile of Southern Ocean science and ensure that our activities reflect international as well as regional priorities. We will also continue to engage with stakeholders to facilitate the provision and uptake of policy-relevant science on Southern Ocean climate and ecosystem dynamics. We will publish the upcoming ICED community papers on scenarios, historical data, stakeholder engagement, and Antarctic-Arctic food web diversity and functioning; and further develop key science areas as outlined in the soon to be published ICED review.

We are keen to continue to develop our links with SCAR in order to enhance our joint scientific understanding and progress, and to strengthen the impact of our input to CCAMLR, CEP and other relevant bodies concerned with conservation and management of the Southern Ocean. As such we recommend SCAR endorses and encourages activities including: following up on the recommendations and capitalising on the opportunities generated from the recent Joint CCAMLR-CEP workshop[3]; encouraging and facilitating the sharing of scientific expertise in understanding Southern Ocean ecosystems and change (including attending the ICED workshop on projections in 2017 and conference in 2018, and vice versa with ICED involvement in relevant SCAR activities); and ICED's ongoing work with SOOS.

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[2]SCAR, 2016. Integrating Climate and Ecosystem Dynamics in the Southern Ocean (ICED) programme: presentation abstract. Workshop Paper 14. Joint CEP/SC-CAMLR Workshop. Punta Arenas, Chile, 19 - 20 May 2016.

[3]United Kingdom & United States, 2016. Report of the Joint CEP / SC-CAMLR Workshop on Climate Change and Monitoring, Punta Arenas, Chile, 19-20 May 2016. Antarctic Treaty Consultative Meeting XXXIX Working Paper 53. Santiago, Chile, 23 May - 1 June 2016.

Appendix

Selected ICED Papers (see also www.iced.ac.uk).

2016

Cavanagh RD, Hill SL, Knowland CA, Grant SM. Stakeholder perspectives on ecosystem-based management of the Antarctic krill fishery. Marine Policy 2016; 68: 205-211 doi:10.1016/j.marpol.2016.03.006

Jackson JA, Carroll E, Smith TD, Zerbini AN, Patenaude N, Baker CS. An integrated approach to historical population assessment of the great whales: case of the New Zealand southern right whale. Royal Society Open Science 2016; DOI: 10.1098/rsos.150669

Moreno R, Stowasser G, McGill RAR, Bearhop S, Phillips R. Assessing the structure and temporal dynamics of seabird communities: the challenge of capturing marine ecosystem complexity. Journal of Animal Ecology 2016; 85:199–212.

Pedro S, Xavier JC, Tavares S, Trathan PN, Ratcliffe N, Paiva VH, Medeiros R, Pereira ME, Pardal MA. Feathers as a tool to assess mercury contamination in Gentoo penguins: variations at the individual level. PlosOne, 2016; DOI: 10.1371/journal.pone.0137622

Tarling G, Peck V, Ward P, Ensor N, Achterberg E, Tynan E, Poulton A, Mitchell E, Zubkov M. Response of polar pelagic food-webs to predicted changes in ocean chemistry. Deep-Sea Research II 2016; http://dx.doi.org/10.1016/j.dsr2.2016.02.008.

2015

Bedford, M., J. Melbourne-Thomas, S. Corney, T. Jarvis, N. Kelly, and A. Constable. 2015. An integrated approach to understanding prey-field use by a Southern Ocean top predator. Marine Ecology Progress Series doi: 10.3354/meps11203

Hauck J, Völker C, Wolf-Gladrow D, Laufkötter C, Vogt M, Aumont O, Bopp L, Buitenhuis ET, Doney SD, Dunne J, Gruber N, Hashioka T, John J, Le Quéré C, Lima ID, Nakano H, Séférian R and Totterdell I. On the Southern Ocean CO2 uptake and the role of the biological carbon pump in the 21st century, Global Biogeochemical Cycles 2015; 29 (9):1451-1470. DOI: 10.1002/2015GB005140

Hauck J. Völker C. Rising atmospheric CO2 leads to large impact of biology on Southern Ocean CO2 uptake via changes of the Revelle factor. Geophysical Research Letters 2015; 42:1459-1464. DOI: 10.1002/2015GL063070.

Jackson JA, Ross-Gillespie A, Butterworth D, Findlay K, Holloway S, Robbins J, Rosenbaum H, Baker CS, Weinrich M, Zerbini A. Synthesis review of the status of Southern Hemisphere humpback whales. 2015. 67th Annual Meeting of the International Whaling Commission (IWC). Document SC/66a/SH3 submitted to the IWC Scientific Committee.

Johnston, NM, Murphy, EJ and Cavanagh, RD. 2015. Unlocking the past to understand the future. Antarctic Science; 28(1):1. DOI: doi.org/10.1017/S0954102015000619.

Manno C, Stowasser G, Enderlein P, Fielding S, Tarling GA. The contribution of zooplankton faecal pellets to deep-carbon transport in the Scotia Sea (Southern Ocean). Biogeosciences 2015; 12, 1955–1965, 2015 doi:10.5194/bg-12-1955-2015

Navarro J, Cardador L, Brown R, Phillips RA. Spatial distribution and ecological niches of non-breeding planktivorous petrels. Scientific Reports 2015; 5L12164.

Ratcliffe N, Hill SL, Staniland IJ, Brown R, Adlard S, Horswill CA, Trathan PN. Do krill fisheries compete with macaroni penguins? Spatial overlap in prey consumption and catches during winter. Diversity and Distributions 2015; doi: 10.1111/ddi.12366.

Saunders RA, Collins MA, Ward P, Stowasser G, Hill SL, Shreeve R, Tarling GA. Predatory impact of the myctophid fish community on zooplankton 1 in the Scotia Sea (Southern Ocean). Marine Ecology Progress Series 2015; 541:45-64 doi: 10.3354/meps11527

Young EF, Belchier M, Hauser L, Horsburgh GJ, Meredith MP, Murphy EJ, Pascoal S, Rock J, Tysklind N, Carvalho GR. Oceanography and life history predict contrasting genetic population structure in two Antarctic fish species. Evolutionary Applications 2015; 8(5):486-509 DOI: 10.1111/eva.12259 .

Watkins JL, Reid K, Ramm D, Zhao XY, Cox M, Skaret G, Fielding S, Wang XL, Niklitschek E. The use of fishing vessels to provide acoustic data on the distribution and abundance of Antarctic krill and other pelagic species. Fisheries Research 2015; doi: 10.1016/j.fishres.2015.07.013.

ICED papers submitted to CCAMLR/CEP in 2016

United Kingdom, 2016. Report on the activities of the Integrating Climate and Ecosystem Dynamics in the Southern Ocean (ICED) programme. Information Paper 64. Antarctic Treaty Consultative Meeting XXXIX Information Paper 64. Santiago, Chile, 23 May - 1 June 2016.

SCAR, 2016. Integrating Climate and Ecosystem Dynamics in the Southern Ocean (ICED) programme: presentation abstract. Workshop Paper 14. Joint CEP/SC-CAMLR Workshop. Punta Arenas, Chile, 19 - 20 May 2016.

United Kingdom, 2016. Report on the activities of the Integrating Climate and Ecosystem Dynamics in the Southern Ocean (ICED) programme. Workshop Paper 15. Joint CEP/SC-CAMLR Workshop. Punta Arenas, Chile, 19 - 20 May 2016.

Murphy, E., Cavanagh, R., Johnston, N., Hofmann, E. and Constable, A. 2016. Integrating Climate and Ecosystem Dynamics in the Southern Ocean (ICED) programme: developing links between ICED and CCAMLR. WG-EMM-16/22. CCAMLR.