SCAR 2020

Antarctic Science – Global Connections

SCAR OPEN SCIENCE CONFERENCE 2020

SESSION 33

THE ANTARCTIC SEAFLOOR – ECOSYSTEM INTERACTIONS AND ENVIRONMENTAL DRIVERS OF CHANGE

Jodie Smith
Alix Post, Narissa Bax, Huw Griffiths

ABSTRACTS SUBMITTED TO THE (CANCELLED) SCAR 2020 OSC IN HOBART

251

Macroalgal community variation correlated with annual sea ice cover along a 450 kilometer latitudinal gradient on the central western Antarctic Peninsula

Charles D. Amsler[1], Margaret O. Amsler[1], Andrew G. Klein[2], Sabrina Heiser[1], Aaron W.E. Galloway[3], Katrin Iken[4], James B. McClintock[1], Alex T. Lowe[5], Julie B. Schram[3], Ross Whippo[3]

[1]University of Alabama at Birmingham, Birmingham, United States, [2]Texas A&M University, College Station, United States, [3]Oregon Institute of Marine Biology, Charleston, United States, [4]University of Alaska, Faribanks, Fairbanks, United States, [5]Smithsonian Institution, Edgewater, United States

Macroalgal forests dominate hard benthos in shallow waters along the northern portion of the western Antarctic Peninsula (WAP). Macroalgal biomass and species richness decline dramatically between southern Anvers Island and northern Marguerite Bay but observations in this gap have been limited to a few qualitative reports from the 1970s. We hypothesized that this pattern can be correlated with annual sea ice coverage patterns that govern light availability. We used satellite imagery of annual sea ice duration and extent as well as water turbidity during ice-free periods to identify 14 study sites that differed in ice coverage but were similar in terms of turbidity along the central WAP between the Joubin Islands west of southern Anvers Island (S 64° 46.4') and the Terra Firma Islands in Marguerite Bay (S 68° 41.5'). Divers video recorded benthic organisms continuously on replicate vertical transects between 40 and 5 m depths with horizontal transects at every 5 m depth interval along each vertical transect. Macroalgae and invertebrates were collected by hand and airlift for species determinations and for both fatty acid and stable isotope food web analyses. As expected, community composition varied markedly with annual sea ice coverage, ranging from lush macroalgal forests at the lowest annual ice coverage to communities with no fleshy macroalgae where annual sea ice coverage was maximal. Combined with the satellite record and sea ice models, these data should allow predictions of how Antarctic benthic communities have and will continue to change with changes in annual sea ice.

694

A submerged volcanic cone in Deception Island (Antarctica) – Benthic communities and proximal volcanism in a rapidly changing sedimentological environment

Carlos Angulo-Preckler[1], Gabor Kereszturi[3], Antonio Alvarez-Valero[4], Cristina García-Hernández[2], Joaquín Hopfenblatt-Hours[5], María Gómez-Ballesteros[6], Xosé Otero[8], Jaime Caza[8], Jesús Ruiz-Fernández[2], Adelina Geyer[5], Conxita Avila[7]

[1]Uit The Arctic University of Norway, Tromso, Norway, [2]University of Oviedo, , Spain, [3]Geosciences, School of Agriculture and Environment, Massey University, , New Zeland, [4]University of Salamanca, , Spain, [5]Institute of Earth Science Jaume Almera, ICTJA, Barcelona, Spain, [6]Spanish Oceanographic Insitute, IEO, Madrid, Spain, [7]University of Barcelona, Barcelona, Catalonia, [8]CRETUS Institute, University of Santiago de Compostela, , Spain

Deception Island (DI) is amongst the most active volcanoes, with >20 explosive eruptions in the last two centuries. DI's caldera-forming eruption, a volcano-climatic event with hemispheric impact occurred 3980 ± 125c.y. before present, is the largest eruption documented in Antarctica during Holocene. Mortality of benthic organisms occurred by eruptions in 1967, 1969, 1970, with very low abundances from 1967-1973. Volcanic activity post-caldera-forming comprises many scattered eruptive vents across the island. A submarine volcanic axis with several volcanic cones is observed within the caldera, and volcanic edifices, morphologically well-preserved in the southern part of the bay raise from the seafloor up to >50 m. A multidisciplinary team sampled one of the submerged volcanoes, Stanley Patch (SP), in Port Foster (PF). Geophysical data allocated the volcano and characterized its morphology and inner structure. Direct sampling by SCUBA provided sediment and rocks, and photographs/video images of benthic organisms and landscape. Morphology of SP cone and textural characteristics of pyroclastic rocks (vesiculation, bubble shape) indicate an explosive volcanism origin, and fits with the post-caldera magmatic trend. A sediment core from the crater (4 cm Ø, 8 cm length) was collected for sedimentological, geochemical and geochronological analysis. Antarctic climate and seasonal sea ice, together with organic degradation due to high sedimentation rates, explain low TOC data. SP, and the whole PF, provide a unique, great natural laboratory for benchmarking the reestablishment of benthic communities on a volcanological-influenced shallow marine environment, offering relevant data for future studies evaluating global change effects on Antarctic seabed.

66

Towards quantifying three key negative feedbacks on climate change; blue carbon gains from sea ice, ice shelf and glacier losses

D K A Barnes[1], C J Sands[1], C Held[2], B Moreno[3], R Downey[4], A Roman Gonzalez[5], C Munoz Ramirez[6], J Scourse[5], C Moreau[7], T Souster[8], N Bax[9], B Gogarty[9], M Haward[9], J McGee[9]

[1]British Antarctic Survey, Cambridge, United Kingdom, [2]Alfred Wegner Institut, Bremerhaven, Germany, [3]Herriott Watt University, Edinburgh, UK, [4]Australian National University, Canberra, Australia, [5]University of Exeter, Exeter, UK, [6]University of Catolica de la Santisma, Concepcion, Chile, [7]University Libre de Bruxelles, Bruxelles, Belgium, [8]University of Ulster, Belfast, UK, [9]University of Tasmania, Hobart, Australia

Diminishing prospects for environmental preservation under climate change is intensifying efforts to boost capture, storage and sequestration of carbon. However, as Earth's biological carbon sinks also shrink, remediation has become a key part of the narrative for terrestrial ecosystems. In contrast, blue carbon on polar continental shelves have stronger pathways to sequestration and have increased with climate-forced marine ice losses – becoming the largest known natural negative feedback on climate change. This work explores the size and complex dynamics of blue carbon gains with spatiotemporal changes in sea ice (>100 MtCyr−1), ice shelves (40 MtCyr−1 = giant iceberg generation) and glacier retreat (under measurement by UK-Chile ICEBERGS project). Estimates suggest that reducing duration of seasonal sea ice is most important. Decreasing sea ice extent drives longer (not necessarily larger biomass) smaller cell-sized phytoplankton blooms, increasing growth of many primary consumers and benthic carbon storage – where sequestration chances are maximal. However, sea ice losses also create positive feedbacks in shallow waters through increased iceberg movement and consequential scouring of benthos. Unlike sea ice, which enhances existing sinks, ice shelf losses generate brand new carbon sinks both where giant icebergs were, and in their wake. These also generate small positive feedbacks from scouring, minimised by repeat scouring at hotspots. Blue carbon change from glacier retreat has been least well quantified, although emerging fjords are small areas which have high storage-sequestration efficiencies. Next steps are wider verification of blue carbon gains, projecting future change, environmental economic benefits and safeguarding these through law.

983

Seabed habitats and fauna of the Ross Sea Marine Protected Area: new photographic surveys of the Ross Sea continental slope and Pacific-Antarctic Ridge provide insights into distributions

David Bowden[1], Malcolm Clark[1], Alan Hart[1], Diana Macpherson[1], Sadie Mills[1], Arne Pallentin[1], Matt Pinkerton[1]
[1]*NIWA, Wellington, New Zealand*

To ascertain whether the Ross Sea Marine Protected Area (RSMPA) is fulfilling its primary role - to conserve representative ecological structure and function - the Science and Research and Monitoring Plan for the RSMPA requires improved baseline knowledge about the habitats encompassed by the RSMPA boundaries, assessment of how representative these are of the wider region, and how they might be affected by environmental change and human disturbances. During research voyages in 2018 and 2019 dedicated to informing the Research and Monitoring Plan, we ran seabed photographic transects in previously un-surveyed areas on the northern and eastern continental slopes of the Ross Sea, both inside and outside the RSMPA, and on a ridge feature north of the Ross Sea, 'Long Ridge', which is a focus of the long line fishery for Antarctic toothfish (Dissostichus mawsoni) and is thought to be a key spawning area for this species. Combined with data from earlier surveys, our imagery shows that areas of structurally complex and biologically diverse hydro-coral habitat are strongly associated with the outflows of the Drygalski and Glomar Challenger troughs where they intersect the continental shelf-break, that drag marks from long line anchors are widespread in places on the continental slope, and that benthic communities at sites on Long Ridge appear more similar to those on Admiralty Seamount than to those on the neighbouring Scott Seamounts.

434

Responses of Southern Ocean benthic habitats and communities to global environmental changes

Madeleine Brasier[1], David Barnes[2], Narissa Bax[1], Angelika Brandt[3], Anne Christianson[4], Rachel Downey[5], Blanca Figuerola[6], Huw Griffiths[2], Julian Gutt[7], Susanne Lockhart[8], Simon Morley[2], Alexandra Post[9], Anton Van de Putte[10], Hanieh Saeedi[3], Jonathan Stark[11], Cath Waller[12]

[1]Institute for Marine and Antarctic Studies, University of Tasmania, Hobart, Australia, [2]British Antarctic Survey, Cambridge, UK, [3]Senckenberg Research Institute and Museum, Frankfurt, Germany, [4]Pew Charitable Trusts, Washington, USA, [5]Fenner School of Environment and Society, Australia National University, Canberra, Australia, [6]Institute of Marine Sciences, Barcelona, Spain, [7]Alfred Wegener Institute, Bremerhaven, Germany, [8]California Academy of Sciences, San Francisco, USA, [9]Geoscience Australia, Symonston, Australia, [10]Department of Biology, KU Leuven, Leuven, Belgium, [11]Australian Antarctic Division, Kingston, Australia, [12]Faculty of Science and Engineering, University of Hull, Hull, UK

The benthic habitats of the Southern Ocean are hugely variable from ice scoured shallows to some rich, abundant, shelf communities with many endemics dominated by suspension or deposit feeders and their predators. They can be an important store of exported carbon from the overlying pelagic system and habitat for commercial fish species. Monitoring change in remote benthic ecosystems is challenging but with decades of coastal observations adjacent to some research stations, increasing ship-based surveys in regions of environmental change and improved data sharing there is much peer reviewed information to assess the responses of benthic habitats to major drivers of change. In this benthic component of the Marine Ecosystem Assessment for the Southern Ocean (MEASO), we outline the driver pathways of direct and indirect human impacts on the Antarctic benthos and review the observed responses to date as well as projections and predictions for the future. Specifically, we highlight the impacts of increasing ocean temperature, marine-ice loss and resulting changes to food availability, increased iceberg scour, ocean acidification, non-indigenous species and fishing pressure on benthic habitats of Antarctica's shelf. Where possible we indicate the most vulnerable areas or species to these drivers whilst considering the spatially variable, heterogeneous and patchy nature of Southern Ocean benthic environments. The MEASO process involved extensive engagement with stakeholders and policy makers. Here we provide a summary based on their feedback including the current measures in place to protect and manage the Antarctic benthos within CCAMLR as well as proposed work plans and potential outcomes.

1494

Functional resilience of benthic microbial communities to changing sea-ice dynamics in McMurdo Sound, Antarctica.

Ashleigh Currie[1], Alexis Marshall[1], Drew Lohrer[2], Craig Cary[1]
[1]University of Waikato, Hamilton, New Zealand, [2]National Institute of Water and Atmosphere, Hillcrest, New Zealand

Climate driven changes to sea-ice dynamics in polar marine ecosystems are impacting the timing and magnitude of seasonal primary productivity which directly affects the flux and turnover of organic matter in benthic ecosystems. As part of the New Zealand Antarctic Research Institute's "Resilience of Antarctic Biota and Ecosystems" project, we sought to undertake the first study to investigate how changing sea-ice dynamics may impact benthic microbial communities; the key drivers of carbon and biogeochemical cycling. Using a space-for-time model, two locations were chosen within McMurdo Sound with varying sediment organic carbon loading due to variations in annual sea-ice coverage; New Harbour with historically low productivity and persistent multi-year ice, and Cape Evans with high productivity and first-year ice that breaks out annually. Assessment of microbial community composition and taxonomic diversity (DNA barcoding) confirmed that low-productivity sediment communities were phylogenetically distinct from those at the high-productivity location. In examining the metabolic functional capacity (metagenomics) of these distinct sediment communities, both shared and site-specific energy-yielding metabolic functions were identified enabling this study to define the key signatures of microbial community resilience that maintain ecosystem services. Changes in oceanographic and atmospheric circulation patters are clearly driving fluctuations to sea-ice persistence in McMurdo Sound, of which ecological impacts are currently unknown. By examining the composition, structure and function of surface sediment microbial communities for shared and unique microbial processes within McMurdo Sound, this study provides a unique opportunity to describe how distinct microbial functions and their biogeochemical processes may be altered by climate change.

1073

Peracarid abundance and composition in the Atlantic sector of the Southern Ocean and Weddell Sea

Davide Di Franco[1,2], Katrin Linse[3], Huw Griffiths[3], Christian Haas[4,6], Hanieh Saeedi[1,2,5], Angelika Brandt[1,2]
[1]Senckenberg Research Institute and Natural History Museum, Department of Marine Zoology, Frankfurt, Germany, [2]Goethe University Frankfurt, Institute for Ecology, Diversity and Evolution, Frankfurt, Germany, [3]British Antarctic Survey, Cambridge, United Kingdom, [4]Alfred-Wegener-Institut for Polar and Marine Research, Bremerhaven, Germany, [5]OBIS Data Manager, Deep-Sea Node, Frankfurt, Germany, [6]University of Bremen, Institute for Environmental Physics, Bremen, Germany

Peracarids are one of the most dominant and species-rich groups of the Southern Ocean benthos. The composition of peracarid crustaceans and the influence of environmental factors on their abundance patterns were assessed in the Atlantic sector of the Southern Ocean and in the Weddell Sea. Samplings were performed by means of an epibenthic sledge (EBS) during the expeditions on board of the RRS James Clarke Ross (South Orkney Islands, JR15005; Prince Gustav Channel, JR17003a; Filchner Trough, JR275) and the RV Polarstern (Eastern Antarctic Peninsula, PS118). The sampled areas were characterised by different regimes of ice-cover extent and by a depth range of 403-2021 m.
In total 64,766 peracarids were found and sorted into five different orders (Amphipoda, Cumacea, Isopoda, Mysidacea and Tanaidacea). Amphipods were the most abundant group representing the 32% of the total abundances. The number of individuals decreased with depth, whilst ice-cover extent together with phytoplankton and chlorophyll concentration was positively correlated with the number of peracarids. Our study showed that environmental factors play an important role on peracarid distributional patterns and strongly influenced their abundance.

697

Environmental and biological drivers of skeletal mineralogy of marine calcifiers from the Antarctic shelf: insights from the CEAMARC voyage

Blanca Figuerola[1], Damian Gore[2], Narissa Bax[3], Marc Eleaume[4], Malgorzata Krzeminska[5], Piotr Kuklinski[5], Kirrily Moore[6], Jonathan S. Stark[7]

[1]Institute of Marine Sciences, Barcelona, Spain, [2]Macquarie University, Sydney, Australia, [3]University of Tasmania, Hobart, , Australia, [4]Muséum National d'Histoire Naturelle, Paris, France, [5]Institute of Oceanology Polish Academy of Sciences, Sopot, Poland, [6]Tasmanian Museum and Art Gallery, Hobart,, Australia, [7]Australian Antarctic Division, Hobart,, Australia

The Southern Ocean will be one of the first regions to be affected by ocean acidification (OA) due to low water temperature and higher CO2 solubility, low carbonate saturation levels and weak buffering capacity. Its pH levels have already decreased by 0.1 units and are projected to decline by a further ~0.3 units by 2100. The decline of carbonate ion concentrations can cause calcium carbonate (CaCO3) minerals to become undersaturated. Therefore, biodiverse shelf assemblages of marine calcifiers will be exposed to undersaturated conditions, potentially making them vulnerable to a range of effects such as dissolution of their shells or skeletons. Marine calcifiers depositing more soluble CaCO3 mineral phases (e.g. Mg-calcite) may be more vulnerable and among the first affected. Global warming may also exacerbate the effects of OA in species with Mg-calcite shells and skeletons as Mg content generally increases with seawater temperature. Our understanding of potential OA impacts on marine calcifiers, especially from high latitudes, is limited by the lack of mineralogical data for most species, and limited geographical coverage. This is the first study examining a large dataset of skeletal mineralogy from a broad range of Antarctic marine calcifiers collected over a wide depth range during the Collaborative East Antarctic Marine Census voyage. Here we discuss i) the potential environmental (e.g. depth) and biological (e.g. food availability) factors influencing their skeletal mineralogy, and ii) taxa that may be particularly vulnerable to near-future OA and may make suitable indicators to monitor effects of OA in the Southern Ocean.

601

Mapping seafloor biodiversity and carbon pathways on the Antarctic continental shelf

Nicole Hill[1], Jan Jansen[1], Ben Galton-Fenzi[2], David KA Barnes[3], Victor Shemaloff[1], Thomas Windsor[1], Craig Johnson[1]

[1]Institute For Marine And Antarctic Studies, Hobart, Australia, [2]Australian Antarctic Division, Kingston, Australia, [3]British Antarctic Survey, NERC, Cambridge, United Kingdom

Antarctic seafloor communities are rich, endemic and often high in biomass, but their distribution is poorly known because biological data away from research stations and a few other hotspots are sparse. Here we detail and present the highlights to date of an ambitious four-year project that aims to map the distribution of seafloor biodiversity, the primary production reaching it and the carbon stored by it, across the entire Antarctic continental shelf. The project consists of several components including; 1) the collation of a large repository of benthic images and the generation of a unique database of consistently annotated data on abundances of benthic, 2) the application of a unique and validated approach to estimate the redistribution of surface primary production to the seafloor, 3) the use of new statistical methods in ecology to match the sparse biological data with environmental data to enable full-coverage maps, and 4) the estimation of the amount of atmospheric carbon stored by animals at the seafloor. The project will explore patterns in and drivers of several aspects of Antarctic seafloor biodiversity including species groups, bioregions and vulnerable marine ecosystem taxa. Maps of the predicted distribution will be invaluable tools underpinning policy, spatial management, conservation, and future science.

1315

An ensemble modelling approach to mapping functional group diversity at South Georgia – A case study for assessing priority zones for conservation at very large MPAs

Oliver Hogg[1], Katrin Linse[2], Huw Griffiths[2], Veerle Huvenne[3], Chris Darby[1]
[1]Centre for Environment, Fisheries and Aquaculture Science, Lowestoft, U.K., [2]British Antarctic Survey, Cambridge, U.K., [3]National Oceanography Centre, University of Southampton, Southampton, U.K.

The functional structure of a community can be represented by faunal traits such as mobility, feeding and reproductive strategies. Classification of these traits into functional groups represents a means of simplifying the complexity of biological systems, helping to inform on the provision of ecosystem services and predict community responses and resilience to disturbances. As such, we argue the analysis of functional groups and their diversity is an important consideration in the effective management and conservation of the marine environment.

Using a multi-model, ensemble approach to habitat suitability modelling, we mapped functional group distribution and diversity in respect to management zones at sub-Antarctic South Georgia. This was analysed alongside conventional metrics of conservation management (e.g. vulnerable marine ecosystems). Modelling across large remote polar regions such as South Georgia, at a scale relevant to their management, is challenging due to reliance on presence-only, spatial heterogeneous data. An ensemble approach allowed quantification of variance in modelling performance between response variables and modelling algorithms, providing a measure of confidence for each model.

The spatial distribution of high functional diversity demonstrated the highest likelihood of occurrence on the island's upper continental slope, thus overlapping with the boundary of the managed fisheries zone. As such, we discuss the implications of these results in informing on spatial management of the MPA. Furthermore, we discuss modelling improvements and data validation techniques, such as using fisheries longline camera data, that could aid the use of habitat suitability maps in managing the impact of fishing on Antarctic benthic ecosystems.

766

A circumpolar database of high-quality biological and environmental data for analysing Antarctic seafloor biodiversity

Jan Jansen[1], Nicole Hill[1], Victor Shelamoff, Thomas Windsor[1], Ben Galton-Fenzi[2], Craig Johnson[1]
[1]IMAS, University of Tasmania, Hobart, Australia, [2]Australian Antarctic Division, Kingston, Australia

The Antarctic seafloor contains unique and diverse species communities. However, because observations are sparse, the distribution of Antarctic seafloor biodiversity is little known, hindering implementing conservation measures, developing policy and predicting responses of Antarctic marine ecosystems to environmental change. In this talk I present two key developments that change the type of questions we can ask and answer regarding Antarctic seafloor biodiversity and its potential future change:
First, we've collated seafloor images from all major Antarctic expeditions dating back to 1985 into a single, circumpolar database containing close to 100,000 images and annotated a representative subset of approximately 2,000 images to morphospecies level. Annotations are reproducible, editable by experts, suitable for training deep-learning models and will become open source.
Second, we've created the first circumpolar maps of estimated food-availability at the seafloor, a critical environmental factor influencing all seafloor animals. In addition to food-availability and other environmental data such as bathymetry, the environmental database contains seafloor current speeds, tidal movements and ocean temperatures at 2km resolution.
I use these two databases in an initial analysis to show the spatial extent of the continental shelf that has similar environmental conditions to where imagery has been sampled from. This analysis also highlights gaps in the coverage and is useful to prioritise future sampling efforts.
The two databases will allow for the first time to estimate distributional patterns of Antarctic seafloor fauna abundances and diversity at the continental scale, estimate their total biomass and secondary production, and characterise ecoregions for conservation and management.

275

Krill Observational Moorings for Benthic Investigation (KOMBI)

Rob King[1], So Kawaguchi[1], Martin Cox[1], Brian Miller[1]
[1]*Australian Anatrctic Division, Kingston, Australia*

An as of yet unknown proportion of the krill population travels to and may reside near the seafloor and so may offer a bridge between the pelagic and benthic realms enabling the transport of carbon and nutrients. Australia plans to construct three sea floor moorings to monitor sea floor habitat use by krill over an entire year. The moorings will be deployed in the Indian Ocean sector around 66°S 63°E from Australia's RV Investigator during the Antarctic krill biomass survey in CCAMLR Division 58.4.2 East from January to March 2021. Each mooring will consist of an upward looking Nortek Signature 100 Echosounder / ADCP secured with a 6 metre tether to a sea floor lander. The lander will include a CTD and an illuminated video system that is capable of recording 5 minutes of video every 5 hours for an entire year. An autonomous passive acoustic instrument for recording marine mammal vocalisations will also be attached to the mooring to further extend the coverage of such instruments currently deployed in the East Antarctic. The moorings will be recovered from the Australian Antarctic Division's RSV Nuyina during the following summer.

274

Factors influencing the distribution of organic matter in sediment on the Sabrina Coast slope and rise

Philip O'Brien[1], Bradley Opdyke[2], Amy Leventer[3], Alix Post[4], Leanne Armand[2], Megan Duffy[3], Liam Holder[5], Adrian Lopez-Quiros[6], Dimitrios Evangelinos[6]

[1]Macquarie University, Sydney, Australia, [2]Australian National University, Acton, Australia, [3]Colgate University, Hamilton, USA, [4]Geoscience Australia, Symonston, Australia, [5]Imperial College, London , United Kingdom, [6]Universidad de Granada, Granada, Spain

Understanding the processes affecting the composition and distribution of organic matter on the seafloor has important implications for predicting the nature and distribution of seafloor communities on the Antarctic slope. Models of Antarctic margin sedimentation have emphasised the delivery of organic matter to the sea floor from the water column during interglacial periods and organic-poor siliciclastic material from the ice sheet during glacials. Cores from the Sabrina Coast slope show a more complex picture with some interstadia seeing deposition of foraminifer-rich clays rather than biosilicious material. Thus, the nature of organic matter delivered to the sea floor is influenced by the characteristics of the individual glacial or interglacial cycle. The distribution of organic matter on the sea floor is also influenced by depositional environments with most sediment accumulating on ridges separating submarine canyons. Sediment gravity flows and ocean currents then rework material in in some settings. Canyons show signs of bed erosion, but a surprising feature in some canyons is the preservation of biosiliceous mat deposits. These likely accumulated during episodes of specific water column structure after the LGM and are preserved in ponds on canyon floors but not on the intervening ridges. Thus, the availability of organic matter within sea floor deposits varies through time with oceanographic variations and spatially with sea floor processes.

320

Antarctic seafloor habitats: Physical processes and sensitivity to change

Alexandra Post[1], Madeleine Brasier[2], Jodie Smith[1], Philip O'Brien[3], Amy Leventer[4]
[1]Geoscience Australia, Canberra, Australia, [2]University of Tasmania, Hobart, Australia, [3]Macquarie University, Ryde, Australia, [4]Colgate University, Hamilton, USA

Physical processes on the Antarctic shelf and slope create a patchwork of seafloor habitats, contributing to the observed diversity of benthic communities. Many of these key physical drivers are vulnerable to future change, including substrate characteristics, sedimentation and food availability, sea ice regimes, scouring by icebergs and ocean chemistry. Current and future retreat and melt of ice sheets and ice shelves creates a cascade of changes to seafloor environments. Ice shelf collapse initially increases the impact of ice scour on the seafloor and icebergs release ice-rafted debris, potentially including large dropstones, while melt and onshore runoff increases sediment input and affects productivity regimes. Changes to sea ice cover and distribution affect light availability and primary productivity, and may alter the formation of water masses, such as dense shelf waters, that can subsequently cascade downslope, providing an advected food supply to the slope. Changes in ocean chemistry associated with increasing acidification can affect the distribution of calcified benthic organisms. This presentation will assess the known distribution of communities on the shelf and slope of the George V and Sabrina regions to determine which habitats are most vulnerable to change, and how these benthic communities may respond to changes in these key physical drivers. These results can inform management of seafloor environments to minimise additional pressures in sensitive areas and to identify refuge areas that can be prioritised for protection.

699

In depth exploration of the biodiversity of asterozoan fauna in Admiralty Bay and Bransfield Strait, Antarctic Peninsula

Jolien Claes[1], Louraine Salabao[2,3], Yuri Hooker[5,6], Adriana Gonzalez Pestana[5,6], Isa Schön[3,4], Marc Kochzius[1]
[1]Marine Biology, Ecology and Biodiversity, Department of Biology, Vrije Universiteit Brussel, Brussels, Belgium, [2]Laboratoire de Morphologie fonctionnelle et évolutive, Institut de Chimie, University of Liège, Liège, Belgium, [3]Centre for Environmental Sciences, Zoology: Toxicology and Biodiversity, University of Hasselt, Hasselt, Belgium, [4]Royal Belgian Institute of Natural Sciences, Freshwater Biology, Brussels, Belgium, [5]Instituto Nacional de Investigación de Glaciares y Ecosistemas de Montaña (INAIGEM), , Peru, [6]Laboratorio de Biología Marina, Facultad de Ciencias y Filosofía, Universidad Peruana Cayetano Heredia, , Peru

Both Asteroidea and Ophiuroidea, together referred as the Asterozoa, are marine invertebrates forming a major part of the benthic ecosystem of the Southern Ocean and are dominating in abundance and biomass. They represent major links within food chains and account for substantial transitions and fluxes of organic matter within this highly productive environment.
However, research on them is complicated due to difficulties in accurately identifying them based on morphological methods alone. The asterozoans are riddled with taxonomic uncertainties and have undergone multiple revisions in individual taxonomic groups throughout time. These uncertainties can have a range of different reasons, including unclear descriptions, in which morphologically relevant structures have appeared under different names depending on the author, the difficulty in identifying juvenile and pre-metamorphosed larval stages, adaptive plasticity during different developmental stages, and the presence of cryptic and sibling species. To solve this confusion, we aim at complementing these traditional methods with molecular approaches for species delimitations (i.e. amplification and sequencing of the mitochondrial cytochrome oxidase (COI) barcoding gene), to investigate in depth the diversity of Asterozoa in Admiralty Bay and along the Bransfield Strait. In this study, molecular and morphological approaches will be jointly applied to samples collected during the ANTARXXVII campaign from December 2019 to January 2020 through diving and sampling with a Van Veen grab. By integrating both approaches, our study will provide a more accurate taxonomy and a better understanding of the pattern of biodiversity, generating a baseline for further studies on biodiversity, ecology and conservation.

280

Small but important: Environmental drivers decisive for community composition are different when meiofauna is included in benthic surveys of regions with varying sea-ice regimes

Friederike Säring[1], Gritta Veit-Köhler[2], Derya M. Seifert[1], Freija Hauquier[3], Heike Link[1]
[1]University of Rostock, Department Maritime Systems, Albert-Einstein-Str. 21, 18059 Rostock, Germany, [2]Senckenberg am Meer, German Centre for Marine Biodiversity Research (DZMB), Südstrand 44, 26382 Wilhelmshaven, Germany, [3]Marine Biology Research Group, Ghent University, Kijgslaan 281/Sterre S8, B-9000 Ghent, Belgium

Benthic organisms depend on food input from the water column. Separate studies on Southern Ocean macro- and meiofauna showed that sea ice - among other environmental factors - plays a major role in structuring communities. It is, however, unknown how environmental changes may affect the benthos altogether. We investigated the relation among environmental factors, food availability at the sea floor, and meio- plus macrofauna community compositions. Samples were taken during two expeditions with RV Polarstern, PS 81 and PS 96: Four investigated areas represent three different sea-ice conditions in the Southern Ocean: I. South-Eastern Weddell Sea (lasting ice cover), II. Drake Passage (least ice cover), III. Bransfield Strait and the North-Western Weddell Sea (variable ice cover). Faunal analysis were carried out on sediment cores. Environmental factors were temperature, salinity, and chlorophyll a for the water column and grain size, TOC, TN, and pigment content for the sediment. Preliminary results indicate that macrofauna communities in regions with “lasting ice cover” are more similar to communities in regions with “least ice cover”, than to those from regions with “variable ice cover”. Against our expectations food input (Chla content, TOC) has only a strong impact on macrofauna community composition. In contrast, ice cover and TOC are the structuring factors for meiofauna and meio-plus-macrofauna communities. Based on these results the previously under estimated meiofauna plays a major role for the community structure at the seafloor. These findings show that a complete assessment of the influence of environmental changes should encompass all major faunal components.

770

Do habitat-formers facilitate deep sea benthic communities?

Victor Shelamoff[1], Jan Jansen[1], Nicole Hill[1], Thomas Windsor[1], Craig Johnson[1]
[1]*University Of Tasmania, Institute For Marine And Antarctic Studies, Hobart, Australia*

Positive interactions between species often shape the composition of communities, however, the importance of these interactions can fluctuate spatially and with different environmental conditions. There are multiple environmental factors that control the distribution of deep-sea benthic communities, but it is unclear whether species which provide complex physical structure such as bryozoans and sponges etc. have additional effects on the distribution, composition and productivity of the associated communities. We are in the process of compiling and annotating the most comprehensive set of deep-sea benthic images around the Antarctic continent, which in combination with the corresponding environmental data including modelled food availability, will form an invaluable database for understanding and predicting patterns in benthic biodiversity. Using this database, we will present findings which examine the relationship between structural habitat-formers and mobile species across different habitats types and different levels of food availability. We will discuss the significance of facilitation in driving species composition and secondary productivity and the role of environmental conditions in mediating the association between habitat-formers and mobile species.

1585

The coastal marine benthic ecosystem of the Vestfold Hills, East Antarctica: a hotspot of biodiversity and heterogeneity.

Jonathan Stark[1]
[1]*Australian Antarctic Division, Kingston, Australia*

The Vestfold Hills in East Antarctica (location of Australia's Davis station) is an area of permanently ice free coastal habitat, consisting of rocky peninsulas, valleys and islands with marine systems that include shallow embayments, deep fjords, sheltered waters in-between islands and the mainland, and open coast. We present on overview of this marine ecosystem, based on recent and past research dating back to 1977, including a large scale environmental survey in 2010 and hydroacoustic mapping of benthic habitats. Surveys of the fjords are limited and their bathymetry and geomorphology are poorly known, despite their large extent in this biologically important area. The marine benthic ecosystem of this area appears to be highly heterogeneous, with a wide range of habitats, within which there are a wide range of benthic communities with very high levels of heterogeneity. Several distinct communities have been observed which may be classifiable into discrete biotopes. Biotope examples include the invertebrate dominated communities found under sea-ice such as the polychaete reefs in Ellis Fjord, and mixed assemblages of filter feeding invertebrates; to communities dominated by varying proportions of red and brown macroalgae. These patterns appear to be influenced by a combination of physical and biological drivers including sea ice, physical disturbance (or lack of), high levels of pelagic primary production, and reproductive and dispersal processes. Some of these biotopes and communities may be quite resistant or resilient to environmental change, however, some biotopes may be highly vulnerable and at risk.

58

Biogeochemistry of surface sediments in an Antarctic nearshore area affected by recent glacier retreat: Collins Harbor, King George Island

Natalia Venturini[1], Luis Cerpa[2], Pablo Muniz[1], Noelia Kandratavicius[1], Marcel Rodríguez[1], Aldo Indacochea[3], Báslavi Cóndor-Luján[3], Rubens C.L. Figueira[4]

[1]Oceanografía y Ecología Marina (OEM), Instituto de Ecología y Ciencias Ambientales (IECA), Facultad de Ciencias, Universidad de la República. Iguá 4225, 11200, Montevideo, Uruguay, [2]Instituto Geológico, Minero y Metalúrgico (INGEMMET), Av. Canadá 1470, San Borja, Lima, Perú, [3]Universidad Científica del Sur, Facultad de Ciencias Veterinarias y Biológicas, Carrera de Biología Marina (UCSUR), Carretera Panamericana Sur 19, Villa EL Salvador 15067, Lima, Perú, [4]Laboratorio de Química Inorgânica Marinha, Instituto Oceanográfico da Universidade de São Paulo (IOUSP), Praça do Oceanográfico 191, 05508-120, São Paulo, Brasil

Biochemical composition of sedimentary organic matter, grain size, major and trace elements were analysed at 10 sampling stations in Collins Harbor, Maxwell Bay, to evaluate sources of particulate material in the seafloor. Surface sediment samples were taken with a grab, during the ANTAR XXV expedition in January 2018, onboard the BAP Carrasco from the Peruvian Navy. Coarse sediment fractions decreased, while mud content increased towards the centre of the bay. Positive correlation between mud and biopolymeric carbon (BPC) indicated depositional conditions and organic material accumulation in the deepest central area. Proteins (PRT) predominated over other biochemical classes contributing to labile organic carbon, followed by lipids (LIP) and carbohydrates (CHO). PRT positive correlation with Ba, Ca and Al indicated that labile organic carbon inputs derived from marine primary production. Whereas, PRT positive correlation with K and Ti suggested also the influence of terrestrial supply through Collins Glacier meltwater runoff. Mn/Ti, Mn/Al and Fe/Al ratios decreased towards the centre of the bay, while the Ba/Al ratio showed the opposite trend. This distributional pattern suggested the diminish of glacial and terrigenous sedimentation towards the deepest central area of the bay, with the increment of marine particulate material deposition and accumulation. Igeo values between 0 and 1 showed unpolluted conditions in Collins Harbor for Cr, Ni, Cu, Zn, As and Pb, which concentrations may reflect background values for this area. Natural inputs from weathering, glacial runoff and marine primary production are main sources of particulate material in Collins Harbor, with none detected anthropogenic contributions.

691

Using Bayesian network inference to infer likely changes in benthic community composition communities from the marine protected area of South Orkney Islands Southern Shelf

Emily Mitchell[1], Rowan Whittle[2], Huw Griffiths[2]
[1]The University of Cambridge, Cambridge, United Kingdom, [2]British Antarctic Survey, Cambridge, United Kingdom

The benthic communities around the South Orkney Islands have exceptionally high biodiversity, representing one fifth of the species found in the Southern Ocean. It is not understood how community dynamics are likely to change in the advent of anthropogenic change such as the removal of Porifera due to potential long-line fishing. To investigate likely consequences of Porifera removal on community dynamics we use Bayesian network inference to reconstruct a fine-scale (~1m) and large-scale (~1km) ecological networks from five areas around the South Orkney Islands. These networks are used to identify the key drivers on community composition and then to infer how taxa abundances change when Porifera are removed from the system. We found that substrate is the most connected node for the small-scale network while in the large-scale network Porifera had the most significant dependencies on other taxa. When Porifera were removed from the network, the abundances of all taxa were reduced significantly, apart from Arthropods who showed a small increase in abundance. The taxa such as Bryozoans, Molluscs and Echinoderms that had direct dependencies on Porifera showed the greatest reduction, while taxa such as Cnidaria, that had intermediate dependencies showed a smaller reduction. The negative feedback between Arthropods and Euryalida counteracted the reduction of Porifera, so were not negatively impacted. This study is the first time the cascade effects of removing key ecosystem structuring organisms has been used to statistically analyses data from a Southern Hemisphere MPA, and demonstrates the importance of considering the community dynamics when assessing resilience.

1502

Patterns in the distribution of seafloor biodiversity on the North Antarctic Peninsula

Thomas Windsor[1]
[1]*Institute For Marine And Antarctic Studies (UTAS), Hobart, Australia*

Antarctic seafloor communities are unique and highly diverse. Changing environmental conditions, in particular along the rapidly warming Antarctic Peninsula, are expected to cause shifts in the composition, function and distribution of these communities. Understanding current distributional patterns of seafloor biodiversity can serve as a baseline from which to monitor future shifts in faunistic patterns. However, the complex interplay between various environmental factors peculiar to high-latitude systems often makes it difficult to isolate the main predictors of seafloor biodiversity – particularly at larger scales – and can confound attempts to accurately predict the distribution of benthic assemblages. We use statistical models based on generalised linear models to analyse distributional patterns of 80 morphospecies identified from seafloor imagery alongside various environmental variables previously reported to correlate with benthic community structure. We identify key broad-scale environmental drivers of faunal distributions on the continental shelf of the North Antarctic Peninsula and generate predictive maps of seafloor biodiversity. Distributional maps of seafloor biodiversity are valuable for gauging the potential locations of Vulnerable Marine Ecosystems across areas of shelf for which we lack direct biological observations, and can therefore be used to inform marine spatial management and conservation strategies.

ISBN: 978-0-948277-59-7

www.scar2020.org