PSnews No.10

Polar Science

The followings are published in Vol.3(3).

Microbiological and Ecological Responses to Global Environmental Changes in Polar Regions (MERGE): An IPY Core Coordinating Project

Takeshi Naganuma and Annick Wilmotte

An integrated program, "Microbiological and Ecological Responses to Global Environmental Changes in Polar Regions" (MERGE), was proposed in the International Polar Year (IPY) 2007–2008 and endorsed by the IPY committee as a coordinating proposal.

MERGE hosts original proposals to the IPY and facilitates their funding. MERGE selected 3 key questions to produce scientific achievements. Prokaryotic and eukaryotic organisms in terrestrial, lacustrine, and supraglacial habitats were targeted according to diversity and biogeography; food webs and ecosystem evolution; and linkages between biological, chemical, and physical processes in the supraglacial biome. MERGE hosted 13 original and 7 additional proposals, with 2 full proposals. It respected the priorities and achievements of the individual proposals and aimed to unify their significant results. Ideas and projects followed a bottom–up rather than a top–down approach. We intend to inform the MERGE community of the initial results and encourage ongoing collaboration. Scientists from non–polar regions have also participated and are encouraged to remain involved in MERGE.

MERGE is formed by scientists from Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Egypt, Finland, France, Germany, Italy, Japan, Korea, Malaysia, New Zealand, Philippines, Poland, Russia, Spain, UK, Uruguay, USA, and Vietnam, and associates from Chile, Denmark, Netherlands, and Norway.

Bacterial dominance of phototrophic communities in a High Arctic lake and its implications for paleoclimate analysis

Dermot Antoniades, Julie Veillette, Marie–Josee Martineau, Claude Belzile, Jessica Tomkins, Reinhard Pienitz, Scott Lamoureux and Warwick F. Vincent

The phototrophic communities in meromictic, perennially ice–covered Lake A, on Ellesmere Island in the Canadian High Arctic, were characterized by pigment analysis using high performance liquid chromatography. Samples were taken to determine the vertical changes down the water column as well as variation between years. These

analyses showed that Lake A had distinct phototrophic communities in its oxic and anoxic layers. The pigment analyses indicated that phototrophic biomass in the upper, oxic waters was dominated by picocyanobacteria, while in the lower, anoxic layer photosynthetic green sulphur bacteria were dominant. Interannual variation in pigment concentrations was related to the penetration of photosynthetically active radiation in the water column, suggesting that light availability may be limiting the net accumulation of photosynthetic bacterial biomass in Lake A. Pigment analysis of the surface sediments indicated that deposition was dominated by the photosynthetic sulphur bacterial contribution. The sedimentary record of bacterial pigments in polar meromictic lakes offers a promising tool for the reconstruction of past changes in ice cover and therefore in climate.

Spore-forming halophilic bacteria isolated from Arctic terrains: Implications for long-range transportation of microorganisms

Kise Yukimura, Ryosuke Nakai, Shiro Kohshima, Jun Uetake, Hiroshi Kanda and Takeshi Naganuma

Organisms living in the Arctic terrains such as Greenland have to deal with low temperature conditions. The mechanisms by which bacteria resist to low temperature are largely unknown; however, a well-known survival strategy of the microorganisms inhabiting the Arctic is spore forming. Moreover, halophilic bacteria are often resistant to various stresses. We have attempted isolation of spore-forming halophilic bacteria from Arctic terrains. We isolated 10 strains of spore-forming halophilic bacteria from the samples collected from a glacial moraine in Qaanaaq, Greenland in July 2007. Identification based on 16S rRNA gene sequence similarities showed that the isolates were closely related to the Oceanobacillus, Ornithinibacillus, Virgibacillus, Gracilibacillus, and Bacillus genera. In addition, the 16S rRNA sequences of some isolates were extremely similar to those of strains from the desert sand in China (100% identity, near full length), the source of the so-called "yellow dust." Previous research indicated that yellow dust had been transported to Greenland by the wind. Our research implies the long-range transportation of these microorganisms to locations such as the Arctic.

Arctic microbial ecosystems and impacts of extreme warming during the International Polar Year

Warwick F. Vincent, Lyle G. Whyte, Connie Lovejoy, Charles W. Greer, Isabelle Laurion, Curtis A. Suttle, Jacques Corbeil and Derek R. Mueller

As a contribution to the International Polar Year program MERGE (Microbiological and Ecological Responses to Global Environmental change in polar regions), studies were conducted on the terrestrial and aquatic microbial ecosystems of northern Canada (details at: www.cen.ulaval.ca/merge/). The habitats included permafrost

soils, saline coldwater springs, supraglacial lakes on ice shelves, epishelf lakes in fjords, deep meromictic lakes, and shallow lakes, ponds and streams. Microbiological samples from each habitat were analysed by HPLC pigment assays, light and fluorescence microscopy, and DNA sequencing. The results show a remarkably diverse microflora of viruses, Archaea (including ammonium oxidisers and methanotrophs), Bacteria (including filamentous sulfur-oxidisers in a saline spring and benthic mats of Cyanobacteria in many waterbodies), and protists (including microbial eukaryotes in snowbanks and ciliates in ice-dammed lakes). In summer 2008, we recorded extreme warming at Ward Hunt Island and vicinity, the northern limit of the Canadian high Arctic, with air temperatures up to 20.5oC. This was accompanied by pronounced changes in microbial habitats: deepening of the permafrost active layer; loss of perennial lake ice and sea ice; loss of ice-dammed freshwater lakes; and 23% loss of total ice shelf area, including complete break-up and loss of the Markham Ice Shelf cryo-ecosystem. These observations underscore the vulnerability of Arctic microbial ecosystems to ongoing climate change.

Byers Peninsula: A reference site for coastal, terrestrial and limnetic ecosystem studies in maritime Antarctica

A. Quesada, A. Camacho, C. Rochera and D. Velazquez

This article describes the development of an international and multidisciplinary project funded by the Spanish Polar Programme on Byers Peninsula (Livingston Island, South Shetlands). The project adopted Byers Peninsula as an international reference site for coastal and terrestrial (including inland waters) research within the framework of theInternational Polar Year initiative. Over 30 scientists from 12 countries and 26 institutions participated in the field work, and many others participated in the processing of the samples. The main themes investigated were: Holocene changes in climate, using both lacustrine sediment cores and palaeo-nests of penguins; limnology of the lakes, ponds, rivers and wetlands; microbiology of microbial mats, ecology of microbial food webs and viral effects on aquatic ecosystems; ornithology, with investigations on a Gentoo penguin rookery (*Pygoscelis papua*) as well as the flying ornithofauna; biocomplexity and life cycles of species from different taxonomic groups; analysis of a complete watershed unit from a landscape perspective; and human impacts, specifically the effect of trampling on soil characteristics and biota. Byers Peninsula offers many features as an international reference site given it is one of the largest ice-free areas in the Antarctic Peninsula region, it has a variety of different landscape units, and it hosts diverse aquatic ecosystems. Moreover, the Byers Peninsula is a hotspot for Antarctic biodiversity, and because of its high level of environmental protection, it has been very little affected by human activities. Finally, the proximity to the Spanish polar installations on Livingston Island and the experience derived from previous expeditions to the site make it logistically feasible as a site for ongoing

monitoring and research.

The Environmental and Genetic Approach for Life on Earth (EAGLE) project

Hiroshi Kanda

The Transdisciplinary Research Integration Center (TRIC) advances the basic objectives under the umbrella of the Research Organization of Information and Systems (ROIS). The TRIC co-ordinates the development of novel fields of research within the Inter-University Research Institute Corporation of Japan. The TRIC program fosters integrated research and develops information platforms that support the quest for new paradigms in the fields of Earth science and life systems. The project, "Environmental and Genetic Approach for Life on Earth with a Study of Relevant Modeling and Prediction Techniques (EAGLE)" began under the TRIC program in 2005. The goal of the EAGLE project is to improve our understanding of ecosystems on Earth and to investigate the mechanisms leading to the evolution of life and the adaptation of species as a result of past environmental changes. The EAGLE project is also positioned as a national project of the "Microbiological and Ecological Responses to Global Environmental Changes in polar regions (MERGE) program", so called, "MERGE-Japan" which was initiated as part of the International Polar Year (IPY, 2007-2008). A general outline of the current achievements and discussion of the EAGLE project during the IPY period are presented in this progress report.

Effects of climatic changes on anisakid nematodes in polar regions

Jerzy Rokicki

Anisakid nematodes are common in Antarctic, sub-Antarctic, and Arctic areas. Current distributional knowledge of anisakids in the polar regions is reviewed. Climatic variables influence the occurrence and abundance of anisakids, directly influencing their free-living larval stages and also indirectly influencing their predominantly invertebrate (but also vertebrate) hosts. As these parasites can also be pathogenic for humans, the paucity of information available is a source of additional hazard. As fish are a major human dietary component in Arctic and Antarctic areas, and are often eaten without heat processing, a high risk of infection by anisakid larvae might be expected. The present level of knowledge, particularly relating to anisakid larval stages present in fishes, is far from satisfactory. Preliminary molecular studies have revealed the presence of species complexes. Contemporary climate warming is modifying the marine environment and may result in an extension of time during which anisakid eggs can persist and hatch, and of the time period during which newly hatched larvae remain viable. As a result there may be an increase in the extent of anisakid distribution. Continued warming will modify the composition of the parasitic nematode fauna of marine animals, due to changes

in feeding habits, as the warming of the sea and any localised reduction in salinity (from freshwater runoff) can be expected to bring about changes in the species composition of pelagic and bentic invertebrates.

Report on species of *Gyrodactylus* Nordmann, 1832, distribution in polar regions

Magdalena Rokicka

The aim of this study was to compare the *Gyrodactylus* fauna in the Arctic and Antarctic regions. Fish were collected from waters surrounding the South Shetland Islands in the Antarctic and from the Revelva River and Hornsund Fjord in south Spitsbergen in the Arctic. Eighty–two individual fish representing seven species from three families (Channichthyidae, Harpagiferidae, and Nototheniidae) were found in Antarctica and 2 *Gyrodactylus* infections with altogether 95 specimens were reported. Two new species were identified: *Gyrodactylus* sp. 1 Rokicka, Lumme, Zietara, 2009, from the gills of the black rock cod, *Notothenia coriiceps* Richardson, 1844, and *Gyrodactylus* sp. 2 Rokicka, Lumme, Zietara, 2009, from the gills of the gaudy notothen, *Lepidonotothen nudifrons* Lonnberg, 1905. No *Gyrodactylus* were found in the 95 Arctic fish examined, which represented four species from four families (Salmonidae, Gadidae, Cottidae, and Liparidae).

Report on anisakid nematodes in polar regions – Preliminary results

Joanna Dzido, Agnieszka Kijewska, Magdalena Rokicka, Agnieszka Swiatalska–Koseda and Jerzy Rokicki

The aim of this study is to extend our knowledge of the distribution of anisakid nematode parasites in Arctic and Antarctic polar regions. We examined vertebrate (fish) taxa characteristic of the faunas in both polar regions for the presence of parasitic nematodes. The material was collected from Svalbard (Arctic) between July and August 2008 and from King George Island (South Shetland Islands, Antarctic Peninsula) between November 2007 and January 2008. In addition, faecal, bird, and invertebrate samples were collected and examined for the presence of anisakid nematodes or eggs. *Anisakis simplex* s.s. was found in the body cavity of Arctic cod, and *Contracaecum* sp. and *Pseudoterranova* sp. were found in Antarctic notothenioids. Eggs of *Anisakis* sp. and *Contracaecum* sp. were recovered from the faeces of *Mirounga leonina*. We present the first record of the occurrence of *Anisakis simplex* C in the Antarctic fishes *Notothenia coriiceps* and *N. rossii*.