

Research Discovery Camps¹ The Namibian Node in a proposed RGNO² for southern Africa

Geomicrobiological Oceanography in the Benguela Current Upwelling System



Sam Nujoma Marine & Coastal Resources Research Centre (SANUMARC³) 2012, the University of Namibia's Marine Research Campus, north of Henties Bay. The center conducts interdisciplinary research in the fields of marine and coastal resources and training through modules that address natural, technical and social science issues. It is an ideal place on the African South Atlantic coast to conduct training and research in physical, chemical and biological oceanography, aquaculture, aquatic ecology and a number of other topics. SANUMARC is also an Operating Unit of the United Nations University Institute for Natural Resources of Africa.

Research Discovery Camps

We are proposing postgraduate Research Discovery Camps on the “Geochemistry, Ecology and Diversity of marine Microorganisms in Ocean Upwelling Systems” to take place at SANUMARC³ of UNAM⁴. A “Research Discovery Camp” is a training opportunity for advanced Master students and creative PhD candidates in their formative years to learn about new developments in evolving scientific fields. Participants get acquainted with professional technology and experience collaboration by carrying out guided research projects in a team for a few weeks in Namibia and abroad. Acquiring skills, learning about new tools, extending knowledge and participating innovatively are major goals of Research Discovery Camps. The program intends to become a node of an RGNO² in southern Africa as originally inspired by SCOR⁵. The proposed Research Discovery Camps contribute to scientific training in diverse fields of geomicrobial oceanography. The initiative responds to needs for scientific, technical and engineering expertise through generating new knowledge and exchanging know-how for ocean observation and for economic and social development in and for SADC⁶ countries, as well as making it possible for students to study ocean science issues important for the region and in the region. It is SANUMARC's long-term goal to train people who will later be able to develop the use of the „aquatic resources of the SADC region in a sustainable manner in order to provide food, employment, income and recreational resources for the people ...”.

Aims

A Research Discovery Camp is an intensive, exploratory research experience with five main objectives:

- 1) to design original research projects leading to the discovery of novel microorganisms and understanding their role in natural geochemical processes,
- 2) to collect reliable field data, to safely practice research on field trips, cruises and expeditions and to be trained for inquiry-based field work, experiments in the laboratory and teaching,
- 3) to develop interest and build confidence in doing exciting research of high quality in interdisciplinary teams,
- 4) to work critically with the scientific literature and to embed the research results into the existing knowledge base, by reading and writing about the research topics and
- 5) to design quantitative models based on research data.

¹Research Discovery Camps, Geochemistry, Ecology and Diversity of Microorganisms in the Benguela Upwelling System

²RGNO = Regional Graduate Network in Oceanography of SCOR: http://www.scor-int.org/RGSO_Design_Principles.pdf

³SANUMARC = Sam Nujoma Marine & Coastal Resources Research Centre, Henties Bay, Namibia:

http://www.unam.na/centres/henties/henties_index.html

⁴UNAM = University of Namibia: <http://www.unam.na>

⁵SCOR= Scientific Committee on Oceanic Research: Graduate Education in Oceanography in developing countries as a means to understand global environmental problems: The Results of a Team Residency at the Rockefeller Foundation Bellagio Study Center 1998 http://www.microeco.ethz.ch/rgno_namibia_18-21/files/SCOR_1998_Bellagio_Report.pdf

⁶SADC = Southern African Development Community, <http://www.sadc.int>. 15 countries: Angola, Botswana, Democratic Republic of Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, United Republic of Tanzania, Zambia, Zimbabwe

Contents

During the years 2014 - 2017, we aim to offer 4 pilot projects emphasizing marine geomicrobial ecology and aquatic geochemistry of pelagic and benthic zones in the open ocean and in coastal environments. We will focus on productivity in ocean upwelling regions and consequences of global changes. So far, neither marine molecular ecology nor geomicrobiology and biogeochemistry of the ocean are offered as study programs anywhere in southern Africa; Research Discovery Camps are thus responding to a need. Expertise for these fields and didactic experience are available from work in similar discovery camps in Concepción, Chile (ECODIM), the Microbial Diversity Courses in Woods Hole (USA), the GeoBiology Courses on Catalina Island (USA) and the Microbial Oceanography Course in Hawaii.

Research Discovery Camps at SANUMARC are application-motivated, interdisciplinary projects with clearly defined science goals. They are linked to each other and embedded into ongoing research programs. The 4 specialized modules are:

- 1) *Microbially coupled cycling of nitrogen and sulfur in redox transition zones.*
- 2) *Pelagic and benthic carbon balancing across the continental shelf and its effect on ocean H^+ -buffering.*
- 3) *Organic biomarkers in sediment matter and phosphorite-containing glauconites as proxies for former and present environmentally influenced depositional and upwelling processes.*
- 4) *Effects of high primary productivity on microbial community compositions and changes.*

Investigating the proposed research themes will advance the knowledge about present and past microbially driven geochemical and nutrient cycling in the Benguela Current upwelling areas. Participants will be introduced to marine microbiology from the community level to the “omics” level, to lipid biomarker molecules and to dominant authigenic minerals for the reconstruction of paleo-environmental conditions. Local and international researchers will train students to address questions of regional importance, of global interest and of relevance for society, e.g. causes of variability of fish and shellfish populations, stability of current-induced upwelling during past and future global changes, consequences of mining at the sea bottom and prospecting for marine biotechnology.

Networks

The four topics have been defined based on knowledge of past, ongoing and anticipated research projects in the continental shelf of the Benguela Current region and in other upwelling areas of the world. Course instructors are recruited from the investigators of these and related projects. Topics and approaches will vary over time as progress and interests demand.

Some experiments and measurements will require advanced methodologies and expensive equipment, which is not necessarily available in Namibia. This technical limitation shall be overcome by creating South-South and South-North networks, which will allow students to carry out analyses at well-equipped laboratories during internships in the region and abroad, e.g. at and with the support of the IAEA laboratories in Monaco⁷.

Some of the proposed research themes are linked to similar investigations carried out in the Humboldt Current System (Chile, Peru) and the Santa Barbara Basin in the North-South flowing California Current. We can thus compare observations made in Namibia with results of investigations in other regions of the world. This can best be achieved by inviting investigators involved in research projects carried out in these regions and from all over the world to participate in Benguela Ecosystem projects.

“Benguela research” is well supported by a number of programs and national, regional, and international institutions which stimulate regional capacity building: the GENUS⁸ and SPACES⁹ initiatives and projects coordinated or carried out by SANCOR¹⁰, ICEMASA¹¹, ACCESS¹², Ma-Re¹³ and Norway’s Nansen-Tutu Centre for Marine Environmental Research at UCT¹⁴. The Namibian Research Discovery Camps aim to become a partner in these networks for southern Africa and be supported by them.

Through the exchange of graduate students, faculty and guest lecturers between the RGNO-affiliated local research institutions and from around the world, we initiate partnerships for innovative modes of joint research projects and graduate education in ocean sciences. Thus, all partners - instructors as well as trainees - will benefit. This is a particularly attractive model for institutions in developing regions of the world that might not be able to offer research-driven training alone.

Participation in RGNO Discovery Camps is competitive and participants are selected from all over the

⁷ IAEA = International Atomic Energy Agency, Monaco Labs: <http://www.iaea.org/monaco/page.php>

⁸ GENUS = Geochemistry and Ecology of the Namibian Upwelling System: <http://genus.zmaw.de>

⁹ SPACES = Science for the Assessment of Complex Earth System Processes

¹⁰ SANCOR = South African Network for Coastal and Oceanic Research, <http://sancor.nrf.ac.za>

¹¹ ICEMASA = International Centre for Education, Marine and Atmospheric Sciences over Africa: <http://www.icemasa.org>

¹² ACCESS = Applied Center for Climate and Earth Systems Science: <http://www.access.ac.za>

¹³ Ma-Re = Marine Research Institute: <http://ma-re.uct.ac.za>

¹⁴ Nansen Tutu Center at the University of Cape Town: <http://ma-re.uct.ac.za/nansen-tutu-centre/>

world. RGNO alumni are encouraged to remain partners in the network for research, observation and training and to initiate and realize opportunities for life-long learning. In addition, the network facilitates the sharing of technical resources; it can initiate new research projects and foster public awareness about exploitation and protection of ocean habitats.

RGNO research proposals can be funded by private and public research foundations and government agencies as well as by the biotechnology, the fishing and the mining industry.

Outlook

Over the next 4 years, SANUMARC and SCOR will offer annually a Research Discovery Camp emphasizing contents of the specialized modules described above. SANUMARC, UNAM and Nat MIRC are contributing to the Research Discovery Camps logistically and financially. The partnership also intends to support the development of the research infrastructure with basic equipment needed to continue innovative work to the point, that researchers will find it attractive to work at the Research Center in Henties Bay. Having basic tools available will allow participating institutions long-term planning towards their goals, to develop new approaches, to successfully apply for research grants, to compete for contract work and to provide training and capacity building by themselves. This will strengthen local efforts in building up knowledge, advanced research laboratories and field infrastructure from which all stakeholders will benefit.

We are in the process of assembling a regional support group with representatives from institutions of the marine research corridor along the coast of southwestern Africa: SANUMARC, Nat MIRC¹⁵ of MFMR¹⁶, GSN¹⁷, BCC¹⁸, INIP¹⁹, the Universities of Namibia (UNAM) and Cape Town (UCT) as well as SCOR and POGO²⁰. The group will coordinate postgraduate training within the RGNO of southern Africa and with similar activities elsewhere. The members of the support group are in positions to disseminate research results to regional decision-makers and open doors locally and abroad that lead to new challenges and incentives and to the recognition of RGNO courses as parts of university degree programs. They also have contacts to local institutions and government agencies that can help to get access to local ocean-going and land-based infrastructure, to foreign research cruises and to people in the region to raise funding to partially support the activities.

Partners of the core group that have developed and will execute the project together with others

The topics emerged out of regional needs. They will supplement observations carried out by Nat MIRC and deepen insights into the ecological stability and sensitivity of the Benguela Upwelling System. Local investigators are in charge of defining the goals and realizing the program within the terms of the funded proposal. The present core group consists of (in alphabetical order):

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The first RGNO Research Discovery Camp will take place in March 2014. Details are available from the course website http://www.microeco.ethz.ch/rgno_namibia_18-21/RGNO_Namibia.html

¹⁵ NatMIRC = National Marine Information and Research Centre with laboratories in Swakopmund and Lüderitz

¹⁶ MFMR = Ministry of Fisheries and Marine Resources: <http://www.mfmr.gov.na>

¹⁷ GSN = Geological Survey of Namibia, Directorate of the Ministry of Mines and Energy: <http://www.mme.gov.na/gsn/>

¹⁸ BCC = Benguela Current Commission: <http://www.benguelacc.org>

¹⁹ INIP = Angola's Fish Research Institute (Instituto Nacional Investigaçao Pesqueira)

²⁰ POGO = Partnership for Observation of the Global Oceans: <http://www.ocean-partners.org>