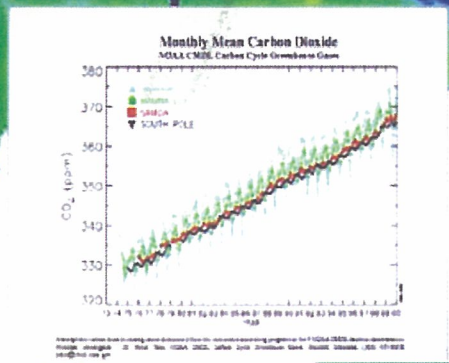
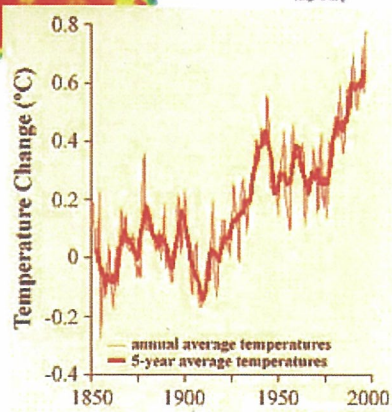
THE 9TH INTERNATIONAL SYMPOSIUM ON ANTARCTIC SCIENCE

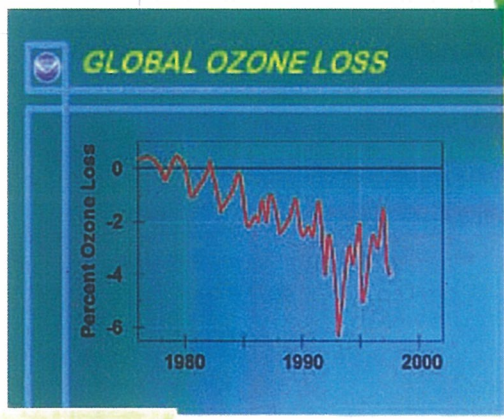
Environmental Changes in Antarctica: Impacts and Responses

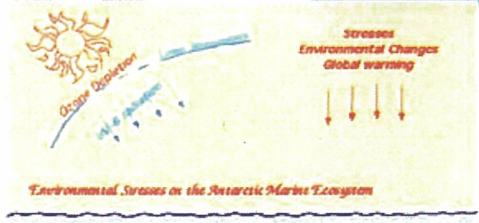
Editor: Sung-Ho Kang

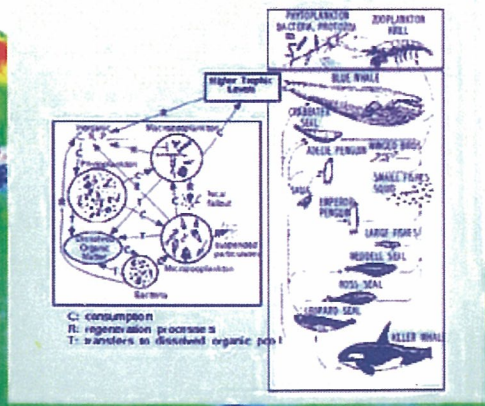
8-10 October 2002











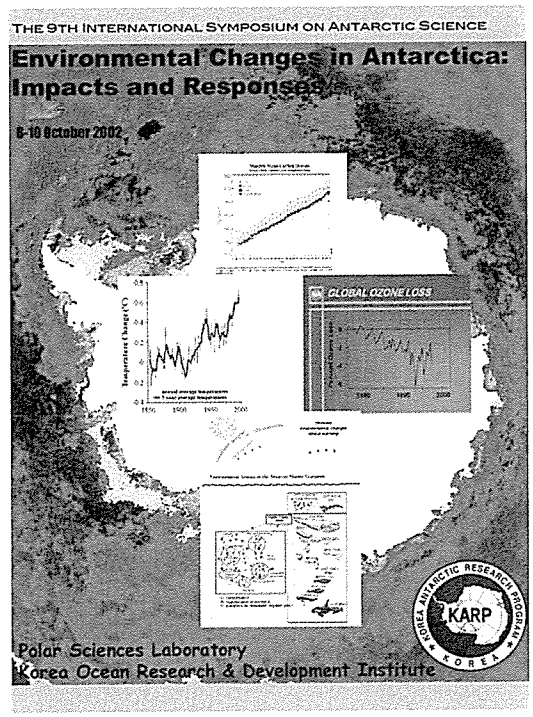
KOREA ANTARCTIC RESEARCH PROGRAM
KARP
KOREA

Polar Sciences Laboratory
Korea Ocean Research & Development Institute
Ansan, Republic of Korea

The 9th International Symposium on Antarctic Science

Environmental Changes in Antarctica: Impacts and Responses

Program and Abstracts



KORDI

Ansan, Republic of Korea

8-10 October 2002

한국해양연구원
Korea Ocean Research & Development Institute

Program

			Page no.
Tuesday 8 October 2002			
19:00-22:00	**Icebreaker Party hosted by Chairman of Korea Research Council of Public Science and Technology (Dr. Byong-Kwon Park)**		
Wednesday 9 October 2002			
09:00-09:30	**Registration**		
09:30-09:45	**Opening address**	Dr. Sang-Kyung BYUN (President of KORDI)	
09:45-10:00	**Welcome speech**	Dr. Byong-Kwon PARK (Chairman, Korea Research Council of Public Science and Technology)	
10:00-10:40	**Keynote speech** Ice-binding molecules in Antarctic ecosystems	Dr. James A. RAYMOND (Department of Biological Sciences, University of Nevada, U.S.A)	---- 4
Session I-1: Environmental monitoring Chairs: Dr. Kentaro WATANABE and Dr. SangHoon LEE			
11:00-11:30	**Keynote speech in Session I-1** Heavy metal pollution monitoring at the King Sejong Station	In-Young AHN, Heeseon J. CHOI, Kyung Ho CHUNG, Dohong KIM and Ko-Woon KIM (Republic of Korea)	---- 5
11:30-11:50	Local Environmental Impact of Antarctic Bases: Glacier Change on Hut Point Peninsula	Jana NEWMAN (New Zealand)	---- 6
11:50-12:10	Subcellular accumulation of Cd and Cu in different organs of the Antarctic clam *Laternula elliptica*	Heeseon J. CHOI, In-Young AHN, Ko-Woon KIM, Yong-Seok LEE and Kye-Heon JEONG (Republic of Korea)	---- 7
12:10-12:30	Temporal Dynamics and Predicting of Meiofauna Community Developments using Artificial Neural Networks in Marian Cove, King George Island, Antarctica	Wonchoel LEE, Sung-Ho KANG, P. A. ONTAGNA and I. S. KWAK (Republic of Korea and U.S.A.)	---- 8
12:30-14:00	**Lunch at KORDI cafeteria**		
Session II-1: Interaction between Antarctic environment and organisms Chairs: Dr. James A. RAYMOND and Dr. In-Young AHN			
14:00-14:30	**Keynote speech in Session II-1** Biochemical adaptation to the freezing environment - the biology of fish antifreeze proteins	Choy Leong HEW, Qingsong LIN, Zhengjun LI, Megan MIAO and Kai LOW (Singapore and Canada)	---- 10
14:30-14:50	Physiological adaptations of fishes to the polar environment	Cinzia VERDE and Guido di PRISCO (Italy)	---- 11
14:50-15:10	Molecular phylogeny of the Antarctic sea urchin, *Sterechinus neumayeri,* and its relationship with South Chilean sea urchins	Youn-Ho LEE, Miwha SONG, SangHoon LEE, Roxana LEON, Sylvia O. GODOY and Ivan CANETE (Republic of Korea and Chile)	---- 12
15:10-15:30	The threat of harmful algal blooms (HABs) in the polar water: a revisit	Kin Chung HO, Sung-Ho KANG, Ironside H. Y. LAM and I. J. HODGKISS (Hong Kong and Republic of Korea)	---- 13
15:30-15:50	**Coffee Break**		
Sessions III-1 + IV: Satellite Observation, Plaleoenvironments and Paleoclimate Chairs: Dr. Sung-Min HONG and Dr. Kin Chung HO			
15:50-16:10	Satellite ocean color monitoring at Syowa, East Antarctica	Kentaro WATANABE, Tooru HIRAEAKE and Mitsuo FUKUCHI (Japan)	---- 14
16:10-16:30	Remotely estimating primary production in Drake Passage	Sinjae YOO and Jisoo PARK (Republic of Korea)	---- 15
16:30-16:50	Stable isotope record in the Antarctic Polar Front of the Drake Passage, Antarctica: implifications for Marine Isotope Stage 3	Sung Ho BAE, Ho Il YOON, Byong-Kwon PARK and Cheon Yun KANG (Republic of Korea)	---- 16
16:50-17:10	Marine environmental evolution in the Maxwell Bay of King George Island (west Antarctica) during the postglaciation: revisited	Boo-Keun KHIM, Ho-Il YOON, Dongseon KIM and Bauhua LI (Republic of Korea)	---- 18

			Page no.
18:00-	**Reception hosted by director of Polar Sciences Laboratory (Dr. Yeadong KIM)**		
Thursday 10 October 2002			
09:00-09:30	**Registration**		
Session II-2: Interaction between Antarctic environment and organisms Chairs: Dr. Choy Leong HEW and Dr. Youn-Ho LEE			
09:30-10:00	**Keynote speech in Session II-2** Are krill merely particles on an oceanic conveyor belt?	Stephen NICOL (Australia)	---- 20
10:00-10:20	Differing levels of krill density over mesoscale area in the Southwest Atlantic sector of Southern Ocean during early summer 2001/2002: possible causes and consequences	Hyoung-Chul SHIN, DonHyug KANG, Dohong KIM, Jisoo PARK, Jae-Shin KANG, Sung-Ho KANG, Youn-Ho LEE and Sinjae YOO (Republic of Korea)	---- 21
10:20-10:40	Functioning of the geoecosystem of the west of Admiralty Bay (King George Island, Antarctic): outline of research at Arctowski station	S. RAKUSA-SUSZCZEWSKI (Poland)	---- 22
10:40-11:00	**Coffee Break**		
Session III-2: Marine biological processes in the Southern Ocean Chairs: Dr. Stephen NICOL and Dr. Young-Chul KANG			
11:00-11:30	**Keynote speech in Session III-2** Polar microalgae as indicators of environmental change	Sung-Ho KANG, Jae-Shin KANG and Eun-Jung KIM (Republic of Korea)	---- 23
11:30-11:50	Marine biological processes in the Antarctic Ocean: its importance to the global environmental change	Mitsuo FUKUCHI, Tsuneo ODATE and Sakae KUDOH (Japan)	---- 25
11:50-12:10	Fluxes and composition of siliceous phytoplankton particles in year-round sediment trap materials from Bransfield Strait, Antarctica	Jae-Shin KANG, Sung-Ho KANG, DongSeon KIM Eun-Jung KIM and Dong Yup KIM (Republic of Korea)	---- 27
12:10-12:30	Preliminary analysis of fecal pellets from an Antarctic sediment trap and the implications for the grazing pressure in the upper water column and the downward carbon flux	Hyoung-Chul SHIN, Dongseon KIM and Dong-Yup KIM (Republic of Korea)	---- 29
12:30-13:30	**Lunch at KORDI cafeteria**		
13:30-14:00	**Photo and Coffee time**		
Session I-2: Environmental monitoring Chairs: Dr. S. RAKUSA-SUSZCZEWSKI and Dr. Sung-Ho KANG			
14:00-14:30	**Keynote speech in Session I-2** Recent progress in marine biological monitoring of JARE program	Mitsuo FUKUCHI, Kunio TAKAHASHI, Haruko UMEDA, Graham HOSIE, Toru HIRAWAKE and Kentaro WATANABE (Japan and Australia)	---- 30
14:30-14:50	Annual reproductive cycle of the Antarctic sea urchin, *Sterechinus neumayeri* (Echinodermata: Echinoidea) collected from Marian Cove, King George Island, Antarctica	Do-Hyung KANG, Kwang-Sik CHOI and Youn-Ho LEE (Republic of Korea)	---- 31
14:50-15:10	Annual Reproductive Cycle of the Antarctic Clam, *Laternula elliptica* (Mollusca: Bivalve) Collected from Marian Cove, King George Island, Antarctica	Do-Hyung KANG, Kwang-Sik CHOI and In-Young AHN (Republic of Korea)	---- 32
15:10-15:30	**Coffee Break**		
15:30-15:50	Spatial distributions of heavy metals in Marian Cove, Antarctica	Kyung Ho CHUNG, Seon Mi NAM and Hosung CHUNG (Republic of Korea)	---- 34
15:50-16:10	A Preliminary Study for Long-term Biomonitoring on the Terrestrial Environment around King Sejong Station, King George Island, Antarctica	Ji Hee KIM and Hosung CHUNG (Republic of Korea)	---- 35
16:10-16:30	Biological research activities of PRIC in the recent and the coming 3 years	Bo CHEN, Yong YU, Jianfeng HE (China)	---- 36
17:00-	**Moving to Seoul and Hotel check-in**		
19:00-	**Farewell Banquet hosted by president of KORDI (Dr. Sang-Kyung BYUN)**		

Poster presentation

1. Photosynthesis and formation of UV-absorbing substances in Antarctic macroalgae under different levels of UV-B radiation
Taejun HAN, Byeong-Jik PARK, Young-Seok HAN, Sung-Ho KANG, SangHoon LEE (Republic of Korea)

2. Phylogeny of the Ceramiaceae (Rhodophyta) in the Pacific with regard to the Ceramoideae
Eun Chan YANG, Sung Min BOO (Republic of Korea)

3. Factors that affect hatchling size hierarchy in the chinstrap penguin (*Pygoscelis antarctica*)
Dohong KIM, Jose VALENCIA, Javier GONZALES and Sang-Hoon LEE (Republic of Korea)

4. Biotechnological Opportunity in Polar Region: Cold-Active Enzymes
Yong YU, Bo CHEN and Yinxin ZENG
(China)

Abstracts

Keynote speech — *Wednesday 9 October 2002*

Ice-binding molecules in Antarctic ecosystems

James A. RAYMOND* 1

1. Department of Biological Sciences, University of Nevada, Las Vegas, NV 89154 USA
*[E-mail: raymond@unlv.edu]

Some of the most striking examples of the interaction between Antarctic organisms and their environment involve the abilities of poikilothermic organisms to survive in the presence of ice. Although behavioral and colligative mechanisms for avoiding freezing damage are important, the most interesting mechanisms involve proteins and glycoproteins that bind to ice and interfere with its growth or recrystallization. One family of molecules of this type is fish antifreezes, which bind to nascent ice crystals and prevent them from growing. They and can provide fish with 1 or 2°C of freezing protection, which is just enough to survive in seawater at its freezing point. Several classes of fish antifreezes with different evolutionary origins have been discovered. However, they all have converged on an ability to bind to ice, making it thermodynamically less favorable for water molecules to join the ice lattice. On the other hand, photosynthetic organisms such as ice algae, lichens, cyanobacteria, and mosses that live in sea ice or in terrestrial environments are exposed to temperatures much lower than the temperature of polar seawater. In such environments, 1°C of freezing protection would be of little use. Instead, the strategy seems to be to use other ice-binding molecules, probably glycoproteins, to attenuate the damage that occurs to cell membranes and cell walls by the physical growth or recrystallization of ice. Such adaptations have allowed these organisms to colonize other cold environments in addition to the polar regions.

Heavy metal pollution monitoring at the King Sejong Station

In-Young AHN* 1, Heeseon J. CHOI 1, Kyung Ho CHUNG 1,
Dohong KIM 1, Ko-Woon KIM 1

1. Polar Sciences Laboratory, Korea Ocean Research and Development Institute,
Ansan P.O. Box 29, Seoul 425-600, Republic of Korea *[E-mail: iahn@kordi.re.kr]

Coastal environment of King George Island is potentially subject to contamination by pollutant arising from station operations, such as emission from fossil fuel burning, oil spill and waste disposal etc. As a preparatory step to assess these impacts on the marine environment and living organisms, two molluscan species (the bivalve *Laternula elliptica* and the gastropod *Nacella concinna*) were selected as biomonitors for metal pollution monitoring, and their baseline levels have been investigated for the past several years at King Sejong Station. In this review, some important results from the monitoring studies are summarized, and discussed in relation to the environmental characteristics of this region. The Antarctic clam *L. elliptica* is suggested as a suitable biomonitor in the shallow subtidal waters, while the limpet *N. concinna* in the intertidal waters. These studies also revealed that some metals, particularly Cu were highly elevated in their tissues, which has been attributed to summertime inflow of glacial melt-water loaded with Cu coming from terrestrial sources. In addition, the glacial melt-water inflow turns out to be causing a significant variability in the tissue levels of some metals such as Fe, Mn, Cd and Pb.

Local environmental impact of Antarctic bases: Glacier change on Hut Point Peninsula

Jana NEWMAN* 1

1. University of Canterbury, Department of Geography, Private Bag 4800, Christchurch, New Zealand *[E-mail: jln20@student.canterbury.ac.nz]

Antarctica is a unique environment that has global significance; it contains 90% of the world's fresh water and is important in processes of global atmospheric and oceanic circulation. Antarctic glaciers and ice sheets act as barometers for change, both natural and anthropogenic because of their sensitivity to change. Hut Point Peninsula on Ross Island is an area of intense human activity with two major Antarctic stations (McMurdo Station, USA, and Scott Base, New Zealand) which host up to 1300 people during the summer season. A small unnamed glacier between McMurdo Station and Scott Base has retreated significantly over the last 50 years. The overall aim of this research is to quantify change in this glacier and examine linkages between that change and local human activity. The approach used involves analysis of glacier volume change over the last 50 years using field survey and remote sensing and examination of the linkages between that change and temporal change in human activity. Results so far indicate that the glacier has lost a significant fraction of its volume and that these changes reflect the increase in human activity in the region over this period. This research demonstrates that the impacts of human activity associated with bases can have significant

Subcellular accumulation of Cd and Cu in different organs of the Antarctic clam *Laternula elliptica*

Heeseon J. CHOI* 1, In-Young AHN 1, Ko-Woon KIM 1,
Yong-Seok LEE 2, Kye-Heon JEONG 2

1. Polar Sciences Laboratory, Korea Ocean Research and Development Institute, Ansan P.O. Box 29, Seoul 425-600, Republic of Korea *[E-mail: hschoi@kordi.re.kr]
2. Department of Life Sciences, Soonchunhyang University, Republic of Korea

Toxic heavy metals, cadmium and copper are naturally elevated in the Antarctic clam *Laternula elliptica* collected from Marian Cove, King George Island. Especially in the digestive gland and kidney, concentrations of Cd and Cu are comparable to those found in other bivalves collected from highly polluted areas or bivalves exposed to unnaturally high levels of metals in experimental media. Experiments have been conducted aiming to understand cellular metal homeostasis processes responsible for the high Cd and Cu accumulation in *L. elliptica.* In this paper, some of the important results on subcellular distributions of Cd and Cu are summarized. In natural populations, both the soluble metal-binding ligands in the cytosol and insoluble particulate fractions were found to be involved in the high Cd and Cu accumulation. A metallothioneins-like protein (MTLP) played a major role in cytosolic Cd and Cu sequestration. In a Cd exposure experiment, MTLP tended to increase with increasing tissue Cd concentrations, suggesting that the MTLP also play an important role in cellular Cd sequestration when the animal is exposed to high concentrations of metal (50 $\mu g\ l^{-1}$ Cd) in a short period of time (less than 2 weeks). Relative contribution of cytosolic metal binding ligands including MTLP and other cellular particulate fractions to cellular metal accumulation varied with the organ, metal, and exposure time.

Temporal dynamics and predicting of meiofauna community developments using artificial neural networks in Marian Cove, King George Island, Antarctica

Wonchoel LEE* 1, Sung-Ho KANG 2, P. A. ONTAGNA 3 and I. S. KWAK* 1

1. Department of Life Science, Hanyang University, Seoul, 133-791, Republic of Korea
*[E-mail: wlee@hanyang.ac.kr]
1. Polar Sciences Laboratory, Korea Ocean Research & Development Institute, Ansan P.O. Box 29, Seoul 425-600, Republic of Korea
3. Marine Science Institute, The University of Texas at Austin, Port Aransas, Texas 78373, U.S.A.

Temporal dynamics of meiofauna community in Marian cove, King George Island were observed from January 22 to October 29 1996. Generally 14 taxa appeared study location and especially appearance rate of nematodes were occupied 90.12 %, harpacticoids were 6.55 % and Kinorhynchs 1.54 %. Monthly dynamics of density in meiofauna showed increased tendency from January to May 1996 while after August 1996 density developments various. Community dynamics in temporal domain, however, does not show a tendency and regular patterns due to complexity and non-linearity resided in spatial and temporal variations of communities consisting of multi-species. Also, many environmental factors were affected and connected direct or indirect organisms compositions: Many studies suggest the control factors such like strong wind and irregular discharges of river (Guidi-Guilvard and Buscail, 1995), the development time and reproductive strategy of the dominant species (Bouvy and Soyer, 1989), and the predation on the meiofauna (Sibert, 1979; Findlay, 1981; Coull, 1985; Smith and Coull, 1987). In addition to studies about meiofauna in polar region rarely reported (Pfannkuche and Thiel, 1987; Szymelfenig et al., 1995 for arctic, Herman and Dahms, 1992 for Antarctic) due to its difficulties of sampling, there is no information on the temporal variations of meiofauna communities in the subtidal zones of Antarctic coastal areas. There are some reports on the intertidal meiofauna in Kerguelen Island (Bouvy and Soyer, 1989) and on the deep sea meiofauna in the Weddell Sea (Herman and Dahms, 1992) near the present study site. In

these terms, artificial neural networks have been effectively used to pattern and predicted complex data in various fields in engineering and biological works by employing their feasibility in adapted learning and flexibility in information extraction (e.g., Zurada, 1992; Haykin, 1994). This research described the general occurrences and temporal dynamics of the meiofauna in the subtidal zone, on the basis of the extensive sampling of Marian Cove, King George Island during the ten months. And we suggest an inclusive method of implementing artificial neural networks for field application for predicting community development.

Biochemical adaptation to the freezing environment- the biology of fish antifreeze proteins

Choy Leong HEW* 1, Qingsong LIN 1, Zhengjun LI 1, Megan MIAO 1 and Kai LOW 1

1. Department of Biological Sciences, National University of Singapore, Singapore
*[E-mail: dbshead@nus.edu.sg]

Many organisms are known to survive in icy environment. These include both the over wintering terrestrial insects and plants as well the marine fishes inhabiting at high latitudes. The adaptation of these organisms is both a fascinating and important topic in biology. Marine teleosts in particular, can encounter ice-laden seawater that is approximately 1° C colder than the colligative freezing point of their body fluids. These animals produce a unique group of proteins, the antifreeze proteins (AFPs) or antifreeze glycoproteins (AFGPs) that absorb to the ice nuclei and prevent ice crystal growth. Presently there are at least four different AFPs type and one AFGP type that are isolated from a wide variety of fishes. The tertiary structures of several of these proteins have been elucidated. Despite their functional similarity in lowering the freezing temperature of the body fluid via a non-colligative mechanism, there is no apparent common protein homology or ice binding motifs among these proteins, except that the surface –surface complementarities between the protein and ice are important for binding. The remarkable diversity of these proteins and their odd phylogenetic distribution would suggest that these proteins might have evolved recently in response to seal level glaciations just 1-2 million years ago in the northern hemisphere and 10-30 million years ago around Antarctica. Winter flounder, *Pleuronectus americanus* has been used as a popular model to study the regulation of AFP gene expression. It has a built-in annual cycle of AFP expression controlled negatively by the growth hormone .The signal transduction pathways, transcription factors and promoter elements involved in this process have been studied in our laboratory and these studies will be presented.

Physiological adaptations of fishes to the polar environment

Cinzia VERDE* 1 and Guido di PRISCO 1

1. Institute of Protein Biochemistry, CNR, Via Marconi 12, I-80125 Naples, Italy
*[E-mail: verde@dafne.ibpe.na.cnr.it or diprisco@dafne.ibpe.na.cnr.it]

During continental drift, Antarctica played a key role in altering ocean circulation and forcing climate toward cooling. Climate change can affect every aspect of an organism's biology, from cellular physiology and biochemistry to food web and habitat. Antarctic marine organisms evolved physiological and biochemical mechanisms to survive and grow in the increasing cold. The study of the evolutionary history and biology of the Antarctic biota is steadily gaining momentum. Research has been addressed to several biological systems. The oxygen-transport system is under investigation in Antarctic fish in an effort to understand the interplay between ecology and biochemical and physiological processes. Hemoglobin, being a direct link between the exterior and body requirements, has experienced a major evolutionary pressure to adapt and modify its functional features. Fish of the dominant suborder Notothenioidei contain hemoglobin, except Channichthyidae (the most phyletically derived family), whose genomes retain transcriptionally inactive DNA sequences closely related to the Hemoglobin gene of red-blooded nototheniods and have lost the Hemoglobin locus. Our structure/function studies on 38 of the 80 red-blooded species are aimed at correlating hemoglobin sequence, multiplicity and oxygen binding with ecological constraints, and at obtaining phylogenetic information on evolution. Sluggish bottom dwellers have a single major hemoglobin. However, three species have different life styles; they have uniquely specialized oxygen-transport systems, adjusted to the mode of life of each species.

Molecular phylogeny of the Antarctic sea urchin, *Sterechinus neumayeri*, and its relationship with South Chilean sea urchins

Youn-Ho LEE* 1, Miwha SONG 1, SangHoon LEE 1, Roxana LEON 2, Sylvia O. GODOY 2, Ivan CANETE 2

1. Polar Sciences Laboratory, Korea Ocean Research and Development Institute, Ansan P.O. Box 29, Seoul 425-600, Republic of Korea *[E-mail: ylee@kordi.re.kr]
2. Departamento Ciencias y Recursos Naturales, Universidad de Magallanes, Avenida Bulnes N 01890, Chile

The Antarctic sea urchin *S. neumayeri* is an Antarctic endemic species that inhabits dominantly the bottom of the shallow water. Like many of the Antarctic species, the sea urchin has attracted much attention in terms of its adaptation to the unique cold environment of the Antarctic. Yet, understanding on the evolutionary history of the species remains still limited. To investigate the phylogenetic relationship of *S. neumayeri* in relation to Chilean sea urchins, we inferred molecular phylogenies of the species using mitochondrial genes, cytochrome oxidase subunit I (COI; 680 nt) and 12SrDNA(789 nt). The divergence time of the species was then estimated from the trees with reference to the time of separation between Strongylocentrotidae and Parechinidae, 35 to 50 MYA. The tree of COI with *S. neumayeri*, *Paracentrotus lividus*, four Strongylocentrotidae species (*Strongylocentrotus purpuratus, S. intermedius, S. nudus, Hemicentrotus pulcherrimus*) and two Chilean species (*Pseudechinus magellanicus* and *Loxechinus albus*) shows that *S. neumayeri* is the most closely related with *L. albus* and then with *P. lividus*. On the other hand, the other Chilean species *P. magellanicus* constitutes the basal taxon of the COI tree as expected from the morphological phylogeny. The tree of 12SrDNA shows a congruent pattern of tree topology with the COI tree. Divergence between *S. neumayeri* and *L. albus* seems to have occurred 25-35 MYA and separation of the two species cluster from *P. lividus* occurred 29-37 MYA. The time of split between *S. neumayeri* and *L. albus* coincides with or a little predate the opening time of the Drake Passage, suggesting that the cladogenic event should have been provoked by the tectonic movement.

The threat of harmful algal blooms (HABs) in the polar water: a revisit

Kin Chung HO* 1, Sung-Ho KANG 2, Ironside H. Y. LAM 3 and I. J. HODGKISS 3

1. School of Science and Technology, The Open University of Hong Kong, 30 Good Shepherd St., Hoamntin, Kowloon, Hong Kong Hong Kong, PR China *[E-mail: kcho@ouhk.edu.hk]
2. Polar Sciences Laboratory, Korea Ocean Research & Development Institute, Ansan P.O. Box 29, Seoul 425-600, Republic of Korea
3. Department of Ecology & Biodiversity, The University of Hong Kong, Hong Kong, PR China

While phytoplankton productivity and the risks of eutrophication in polar waters have been widely studied in recent years, the threat of harmful algal blooms (HABs) has not yet been thoroughly investigated. A commonly known harmful microalgal species, *Alexandrium tamarense*, has been successfully isolated and identified from water samples taken from Drake Passage during a survey in December 2001. Trace quantities of algal toxins, for example, saxitoxins and gymnotoxins, were also detected from shellfish samples collected off the coast of King George Island of the South Shetland Islands in 1993-4. Results obtained from Antarctic waters are comparable to those obtained in August 1999 in the northern Bering Sea and the Beaufort Sea up to 78°N, in which both *A. tamarense* and *A. catenella* were identified. During the past decade, increased incidents of PSP intoxication in Alaska, USA have been reported. Hence, collected findings suggest that *Alexandrium*-related HABs are not only limited to temperate, tropical and subtropical regions, but also occur in polar regions. Further investigations on the relationship between distribution of *Alexandrium* spp. and the oceanographic conditions in Arctic and Antarctic waters, and the similarity of toxicity and genotypes for various strains of *Alexandrium* spp. should be conducted to understand whether *Alexandrium* spp. originated from temperate regions and then spread to the Arctic and Antarctic, or the reverse. The influences of recent environmental changes to phytoplankton community in polar regions should also be revisited.

Satellite ocean color monitoring at Syowa, East Antarctica

Kentaro WATANABE* 1, Tooru HIRAEAKE 1 and Mitsuo FUKUCHI 1

1. National Institute of Polar Research,9-10, Kaga 1-chome, Itabashi-ku, Tokyo 173-8515, Japan *[E-mail: kentaro@nipr.ac.jp]

As one of monitoring programs in the Japanese Antarctic Research Expedition (JARE), an ocean-color satellite (SeaWiFS) data receiving system (TeraScan) was installed at Syowa station (69°00'S, 39°35'E) in late January, 2000. Since then, the LAC (local area coverage) data have been recorded for monitoring primary productivity in the Indian Sector of the Southern Ocean. The quantity of the data (lines/pass and passes/day) received at Syowa changed seasonally. The data recorded were brought back to the Center for Antarctic Environment Monitoring at the National Institute of Polar Research (NIPR) in Tokyo for processing to analyze and to transfer to Goddard Space Flight Center of NASA for archiving. The coverage of the station includes Kerguelen Is. and Weddell Sea. The increase of estimated chlorophyll concentration was observed in the water north of fast ice edge near Syowa and in the Gunnels Ridge water in mid-March, 2000 after R/V SHIRASE left for home from Syowa. An intensive bloom was observed in Breid Bay (24-26 °E) in late January, 2001, where high chlorophyll concentrations were reported in December-January during the past JARE cruises.

Remotely estimating primary production in Drake Passage

Sinjae YOO* 1 and Jisoo PARK 1

1. Marine Environment and Climate Change Laboratory, KORDI, Ansan P.O. Box 29, Seoul 425-600, Republic of Korea *[E-mail: sjyoo@kordi.re.kr.kr]

Primary production and associated biogeochemical fluxes within Southern Ocean are globally significant and poorly known compared to temperate marine ecosystems. Here, we present results of primary production estimation in Antarctic Sea based upon phytoplankton pigment concentrations and photosynthetic rates which were measured by in situ C-14 experiments. We conducted a cruise from November 30 to December 9, 2001 during the 15th Korea Antarctic Research Program, where bio-optical properties and primary production were measured in addition to basic biological surveys. The study area include the Weddell Sea and Drake Passage near by South Shetland Islands which are under the influence of Antarctic Circumpolar Current and Antarctic Polar Front. Satellite ocean color data from the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) were used to examine distributions of chlorophyll concentration within Antarctic Sea during that time. Underwater light field and vertical chlorophyll profiles were obtained at 27 stations by using CTD with a submersible fluorometer, and fluorescence data were calibrated with in situ chlorophyll concentrations. From these data, we calculated water column primary production, and evaluated the importance of vertical chlorophyll structure. We also made suggestions for further study for better estimating water column primary production.

Stable isotope record in the Antarctic Polar Front of the Drake Passage, Antarctica: implifications for Marine Isotope Stage 3

Sung Ho BAE* 1, Ho Il YOON 1, Byong-Kwon PARK 2, and Cheon Yun KANG 1

1. Polar Sciences Laboratory, Korea Ocean Research and Development Institute, Ansan P.O. Box 29, Seoul 425-600, Republic of Korea *[E-mail: shbae@kordi.re.kr]
2. Chairman, Korea Research Council of Public Science and Technology, Republic of Korea

A high-resolution study including oxygen and carbon stable isotopes as well as planktonic foraminifera, carbonate, ice-rafted debris (IRD) contents, were performed on one core sediment (DP00-02) taken from the seamount top near Antarctic Polar Front (APF) in the Drake Passage, Western Antarctica. Based on the oxygen stable isotope records measured on *Neogloboquadrina pachyderma* (sinistral), this sediment core is interpreted to represent a stratigraphic record back to the lower isotope stage 5 (~129 kyr). Isotope stages 5, 4 and 1 show a high abundance of carbonate and planktonic foraminifer with relatively low IRD content. In contrast, isotope stages 3 and 2 are characterized by low abundance of carbonate with remarkably high IRD content. This is probably attributed by a local/regional influence due to front structural changes, related to the fluctuation of APF, i.e., the south and northward migration of polar water mass. The glacial-interglacial shifts in (^{18}O values of N. pachyderma (sin.) may reach up to 1 to 1.2 ‰ indicating that, global ice volume changes have affected the isotope records. However, the isotope stage 3, generally interpreted as the less warmer period in the global record than Holocene and stage 5, corresponds to much lighter values compared to the global climate curve. This isotope shift, exceeding the glacial-interglacial ice volume effect, can be explained either by increases in sea-surface temperature or decreases in salinity. If the stage 3 values were purely temperature controlled, this would indicate warmer sea surface conditions in the south of APF than further north which is hardly possible if a similar current pattern as in the Holocene and stage 5 is assumed for stage 3. Furthermore, the APF in the present is significantly distant to the north of study site. As it is unlikely that the APF was farther

south during the stage 3, interpreted as less warmer than Holocene and stage 5, the sea surface temperature variations should be minimized. It may be therefore argued that the (^{18}O values predominantly reflect changes in salinity. This may be resulted from a mixing with warmer sub-Antarctic water of lower salinity and/or from upwelled penetration of isotopically light Circumpolar Deep Water.

Marine environmental evolution in the Maxwell Bay of King George Island (west Antarctica) during the postglaciation: revisited

Boo-Keun KHIM* 1, Ho-Il YOON 2, Dongseon KIM 2 and Bauhua LI 3

1. Department of Marine Science, Pusan National University, Pusan 629-730, Republic of Korea * [E-mail: bkkhim@pusan.ac.kr]
2. Polar Sciences Laboratory, Korea Ocean Research & Development Institute, Ansan P.O. Box 29, Seoul 425-600, Republic of Korea
3. Faculty of Earth Science, China University of Geosciences, Wuhan 430074, PR China

A variety of sedimentological, geochemical, paleontological and isotopic analyses were conducted on three sediment cores from the Maxwell Bay of the King George Island (west Antarctica) to reconstruct the postglacial glacimarine sedimentary environments. The lithologic dissimilarity, consisting of the lower sedimentary unit of diamictons and the upper unit of fine-grained sediments, corresponds to the downcore variation of geochemical and paleontological properties. TOC- and Bsi-low coarse-grained diamictons are characterized by low abundance of benthic foraminifera, which suggests the advanced coastal-glacier margins and/or extensive sea-ice cover with limited productivity and meltwater supply. In contrast, TOC- and Bsi-high fine-grained sediments are abundant in benthic foraminifera, which recommends more open-water and warm conditions, favoring enhanced productivity and increased meltwater supply into the bay. Surficial texture of foraminifera (i.e., the degree of dissolution) is another evidence on the increasing productivity because higher rates of organic matter accumulation under the retreat of coastal glaciers and the enhanced meltwater flux into the bay may have played an important role in the carbonate dissolution due to porewater acidification by organic matter oxidation. Relationship between TOC and TS demonstrates that the additional sulfur within the sediment has not originated from in situ pyrite formation under the reducing condition, but may be attributed to the clastic sand supply from the hydrothermal-origin, quartz-pyrite rocks widely distributed in King George Island. The bottom water hydrographic condition after deglaciation was explained by benthic foraminiferal stable isotopic composition, which confirms the lithologic and geochemical evolution. The

lithologic variation, dated to approximately 8000 yr B.P. (measured ^{14}C age) and characterized by textural, geochemical, paleontological and isotopic contrasts, preserves the postglacial environmental change, reflecting a major coastal-glacier retreat in the Maxwell Bay.

Are krill merely particles on an oceanic conveyor belt?

Stephen NICOL* 1

1. Australian Antarctic Division, Channel Highway, Kingston, Tasmania, 7050, Australia
*[E-mail: steve.nicol@aad.gov.au]

Interpretation of the population dynamics Antarctic krill has been dominated by the concept of krill flux. This concept, developed from the South Atlantic, views krill as mere particles in the flow of the ACC and thus their distribution and abundance can be simply described by the ebb and flow of the regions' currents. This concept has a number of important implications both for the understanding of regional population dynamics but also for the understanding of the Antarctic marine ecosystem and for its management. In this paper I want critically examine the concept of krill flux, look at the evidence that has led to the development of the concept of flux, examine evidence that may not accord with a concept of flux and finally look at alternative models that could explain krill distribution and abundance and examine their implications and predictions.

Differing levels of krill density over mesoscale area in the Southwest Atlantic sector of Southern Ocean during early summer 2001/2002: possible causes and consequences

Hyoung-Chul SHIN* 1, DonHyug KANG 2, Dohong KIM 1, Jisoo PARK 3, Jae-Shin KANG 1, Sung-Ho KANG 1, Youn-Ho LEE 1, Sinjae YOO 3

1. Polar Sciences Laboratory, Korea Ocean Research and Development Institute (KORDI), Ansan P.O. Box 29, Seoul 425-600, Republic of Korea *[E-mail: hcshin@kordi.re.kr]
2. Department of Ocean Science, Hanyang University, Ansan, Republic of Korea
3. Marine Environment and Climate Change Laboratory, KORDI, Ansan P.O. Box 29, Seoul 425-600, Republic of Korea

An acoustic survey detected a krill scarcity in the Bransfield Strait during early summer 2001/2002, however, the area west of South Orkney Islands exhibited a density similar to other years. It has been reported that the abundance of krill in different parts of the Southwest Atlantic sector of the Southern Ocean are linked, influenced by the same gross physical and biological factors, and the krill biomass within a season does not vary greatly. There may be, however, within-season, and regional variability of krill densities. The krill then in these two areas may have been supplied from different sources or may be responding to local conditions. Chlorophyll biomass does not explain the different levels of krill biomass density but the temporal, spatial change of chlorophyll gives a clue. Krill have been suspected of being transported in water currents, and may have arrived in the Bransfield Strait from upstream, later than in usual years. On the other hand, krill found west of the South Orkney Islands may have originated from the Weddell Sea, which might be another predictable wintering ground for krill and hence a source of krill supply.

Functioning of the geoecosystem of the west of Admiralty Bay (King George Island, Antarctic): outline of research at Arctowski station

S. RAKUSA-SUSZCZEWSKI* 1

1. Department of Antarctic Biology, Polish Academy of Sciences, Ustrzycka 10/12, Warsaw 02-141, Poland *[E-mail profesor@dab.waw.pl]

Changes in the area of investigations reflect climatic changes at the South Shetland Islands. Air temperature and deglaciation increases. The ice free space area at the SSSI 8 site has enlarged three-fold during the last 21 years, thus creating conditions for colonisation and succession. Special role in transport is being played by wind, water and snow. They distribute nutrients, mineral substances, seeds, fragments of plants and animals. Plant and animal colonization is patchy. It is dependant, to a high degree, on physical factors. The newly uncovered ice free areas are at first inhabited by a vascular plant, the grass Deschampsia antarctica. The border of the land-oasis with Admiralty Bay is the place of the processes related to animal feeding at the sea, and to reproduction on land. Bird colonies and pinniped lairs form centers of fertilization surrounded by high chemical gradients dependent on the direction of nutrients distribution (e.g. NH_4) by water and wind. During the last 25 years the numbers of penguins in this region have decreased, and thus the amounts of the materials excreted on land have diminished. The numbers of fur seals change in multi-annual cycles, and their migration into this area is related to the El Nino phenomenon. The quantities of elephant seals in the area do not change. Organic matter deposited by the sea onto the shore is the source of nutrients and deficient chemical elements on land. Mineral matter is washed out and wind blown into the waters of Admiralty Bay. These processes change seasonally, and have their multi-annual trends. Negative effects on the environment by man induced activities at Arctowski station are slight, nonetheless they are noticeable. Physical processes have the largest influence on the living conditions and distribution of plants and animals, and as a consequence, on the functioning of the geo-ecosystem in the coastal-shore zone of the Maritime Antarctic.

Polar microalgae as indicators of environmental change

Sung-Ho KANG 1, Jae-Shin KANG 1 and Eun-Jung KIM 1

1. Polar Sciences Laboratory, Korea Ocean Research and Development Institute (KORDI), Ansan P.O. Box 29, Seoul 425-600, Republic of Korea *[E-mail: shkang@kordi.re.kr]

Polar ocean plays an important role in the carbon cycle. The carbon cycle could change in the near future in response to rising CO_2, surface temperature and stratification, which may reduce capacity of take up CO_2 of human origin. There is increasing interest to better understand the ecology of the polar ocean. Models predict that global warming will have a major impact on the biogeochemisty of the polar ocean via changes in upper ocean stratification and microalgal community composition. Understanding the factors controlling species composition of microalgal blooms is important because microalgal taxa can vary considerably in terms of their biogeochemistry and their functional role within their respective ecosystems. Taxonomic differences in photophysiology may strongly influence microalgal community composition.

Polar marine microalgae can be used as tracers of various environmental parameters. Microalgal assemblages known to be closely associated with sea-ice can be used as tracers of sea-ice cover. The close relationship between sea ice affected areas and sea ice-related microalgae in water samples, the sediment trap, and the surface sediment record by their distribution pattern makes their distribution pattern a proxy of sea-ice reconstruction in the past. If near-shore and shelf assemblages are found in deep waters, these forms are indicators of lateral transport. Freshwater assemblages found in marine sediment provide evidence of either fluvial or eolian transport. High abundance of bloom-forming taxa reflects condition of rapid nutrient uptake and growth rates, while aggregates of large mat-forming taxa may indicate conditions of prolonged water column stability.

Past field and laboratory studies have not provided definitive measurements of the taxon-specific ecological and physiological characteristics that may explain patterns of horizontal distribution or that can be used for the parameterization of biogeochemical models. Even many biological markers (biochemical, physiological, and optical) used in

the field as diagnostic indicators of nutrient limitation and biomass have not rigorously tested to determine if they accurately reflect the responses of microalgal species represented in the water column. To use the polar microalgae as indicators of the environmental changes, standardized representative natural and biological parameters are needed so that replicate samples (including controls) can be taken over extended periods of time.

Marine biological processes in the Antarctic Ocean: its importance to the global environmental change

Mitsuo FUKUCHI* 1, Tsuneo ODATE 1, and Sakae KUDOH 1

1. National Institute of Polar Research,9-10, Kaga 1-chome, Itabashi-ku, Tokyo 173-8515, Japan *[E-mail: fukuchi@nipr.ac.jp]

Many works on the productivity of the Antarctic Ocean have been published elsewhere, however, most works are based on a single observation on one cruise in particular time of year. Time-series works are necessary for understanding a real process happening in water. Marine biologists working with JARE (Japanese Antarctic Research Program) has been long desiring to carry out a time series observations to cover a seasonal process of biological production. Also, the time series information is essential to understand and evaluate the importance of biological process to the global environmental change. In 2000/2001 season, the JARE firstly operated a marine science dedicated cruise (JARE 43). This is the first year of the 5 years term of JARE program (phase-VIth). Science plan of the STAGE (Studies on the Antarctic Ocean and Global Environment) of the JARE 43 was programmed after long discussion within an international and interdisciplinary frameworks. The main themes of STAGE are 1) Biogeochemical cycles between lower atmosphere and surface ocean, 2) DMS(P) production/formation in biological processes, 3) Sinking process from surface ocean to meso-and bathypelagic oceans, and 4) Roles of Antarctic sea-ice variation and bottom water formation in global climate system. The major target area in 2001/2002 austral summer was south of 61° S along 140° E, where a CTD observation as one of WOCE lines has been repeated by the ANARE (Australian National Antarctic Research Program). The time series observations by several research vessels, that is, Aurora Australis (Cruise leader: Dr. H. Marchant, ANARE-AAD) (October-December 2001), RV Hakuho Maru (Cruise leader: Dr. M. Terazaki, ORI, University of Tokyo) (January 2002), Tangaroa (Cruise leader: Dr. T. Odate, JARE-NIPR) (February 2002), and Shirase (Cruise leader: F. Nishio, JARE-Chiba University) (March 2002)were successfully

completed. The Tangaroa was chartered by the JARE 43 and 25 scientists covering the above four themes were on board. Throughout four cruises, several core measurements with standard methods were repeated to aquire a full picture of seasonal processes. Samples and data are still under processing, however, some results will be presented. During the coming season of 2002/2003 summer, the similar time serial/multi ships observation, but more on process oriented studies, will be conducted.

Fluxes and composition of siliceous phytoplankton particles in year-round sediment trap materials from Bransfield Strait, Antarctica

Jae-Shin KANG* 1, Sung-Ho KANG 1,
DongSeon KIM 1, Eun-Jung KIM 1 and Dong Yup KIM 1

1. Polar Sciences Laboratory, Korea Ocean Research and Development Institute, Ansan P.O. Box 29, Seoul 425-600, Republic of Korea *[E-mail: jskang@kordi.re.kr]

Fluxes, abundance and species composition of siliceous phytoplankton in sediment trap materials were measured in the Bransfield Strait, Antarctica. Traps were deployed at two sites in central (KAST 1) and eastern Bransfield Strait (KAST 2) during December 1999 to December 2000. The assemblages of siliceous phytoplankton in the surface water near South Shetland Islands were measured at 54 stations from 9 to 19 January, 2001. These analyses and comparison to assemblages of siliceous phytoplankton in surface water provide information concerning the influence succession, and deposited floral assemblage. There was a significant settling of siliceous phytoplankton into the trap during the austral summer in eastern and central Bransfield Strait (>5 X 10^9 valves m^{-2} day^{-2} and >2 X 10^9 valves m^{-2} day^{-2}, respectively). The estimated flux of siliceous phytoplankton into the trap shows a considerable seasonal variation. At KAST 1, the flux was the highest in late February (3.2 X 10^{10} valves m^{-2} day^{-1}) and decreased abruptly toward March. The abundant species was *Minidiscus chilensis* during January and changed to *Thalassiosira* spp. in February. During winter (March through August), the abundant species were *Fragilariopsis* spp. and *Chaetoceros* spore. At KAST 2, the flux was the highest in mid-January (7.5 X 10^9 valves m^{-2} day^{-1}) and decreased toward February. The abundant specie was *M. chilensis* in January. The mean abundance of siliceous phytoplankton was 3.2 X 10^5 cells l^{-1} in the surface water near South Shetland Island. *M. chilensis* and *Thalassiosira* spp. were also abundant species in surface water during January, accounting for 51% of total siliceous phytoplankton. The concentration of *M. chilensis* in the surface water was the highest in the north of South Shetland Island (1.6 X 10^6 cells l^{-1}) , whereas *Thalassiosira* spp. was abundant in the eastern Bransfield Strait Region. According to the abundance and

species composition in the trap material, the abundance of siliceous phytoplankton (mostly *M. chilensis)* decreased in the surface water of vicinity of South Shetland Island and the abundance (mostly *Thalassiosira* spp.) increased in the eastern Bransfield Strait during February. Our study suggests that abundance and species composition of siliceous phytoplankton in the trap materials could provide information of assemblages and succession of siliceous phytoplankton in the surface water.

Preliminary analysis of fecal pellets from an Antarctic sediment trap and the implications for the grazing pressure in the upper water column and the downward carbon flux

Hyoung-Chul SHIN* 1, Dongseon KIM 1, Dong-Yup KIM 1

1. Polar Sciences Laboratory, Korea Ocean Research and Development Institute, Ansan P.O. Box 29, Seoul 425-600, Republic of Korea *[E-mail: hcshin@kordi.re.kr]

A preliminary assessment of faecal pellets recovered from an Antarctic sediment trap was undertaken. The analyzed samples were part of the year-round trap collections obtained from two depths (678 m and 1678 m), south of Elephant Island, and were collected during a 10-day period of mid February 2000. Zooplankton faeces dominated the trap material and the fecal material from krill was by far the most significant contributor. At a minimum, more than 1/3 of the total flux in the upper trap could be attributed to the fecal material of krill. Smaller pellets of other origins were of much lesser importance and the contribution of flocculent faecal material could hardly be quantified. Size distribution of krill faeces demonstrates that the larger pellets are much better preserved during sinking with smaller pellets lost along the way. The density of krill faecal strings in the trap were lower than measured for fresh pellets of other euphausiid species but sufficiently high so that the pellets sink quite rapidly and reach the upper trap within a few days. The downward flux of carbon and biogenic silica mediated by krill faeces was substantial. This suggests that the grazing pressure of krill, the removal of diatom cells from the upper water column in particular, might be more intense than previously thought. It also implies that the abundance and distribution of large grazers such as krill and salps can be critical in determining the downward carbon flux.

Recent progress in marine biological monitoring of JARE program

Mitsuo FUKUCHI* 1, Kunio TAKAHASHI 1, Haruko UMEDA 1,
Graham HOSIE 2, Toru HIRAWAKE 1 and Kentaro WATANABE 1

1. National Institute of Polar Research,9-10, Kaga 1-chome, Itabashi-ku, Tokyo 173-8515, Japan *[E-mail: fukuchi@nipr.ac.jp]
2. Australian Antarctic Division, Channel Highway, Kingston, Tasmania 7050, Australia

In 1965, the Japanese Antarctic Research Expedition (JARE) established the routine observations on physical oceanography, chemical oceanography and marine biology. Since then, plankton investigations on board icebreakers as well as population census of Adelie penguins around the Japanese Antarctic Station, Syowa, had been carried out every year. In 1996, the routine observation on marine biology was reviewed and it was revised into the monitoring program of marine biology. New items of observations have been added to the previous routine items, such as, ocean color observation with SeaWiFS satellite on board the icebreaker SHIRASE and at Syowa, continuous observations of zooplankton abundance with an optical particle counter (OPC) and a continuos plankton recorder (CPR). Long-term observation of sediment trap moorings was also added. The OPC and CPR revealed interesting phenomena of surface zooplankton distribution in the Antarctic Ocean and these methods seem to be suitable for the long-term monitoring program. Recent findings from OPC and CPR observation are presented. At the same time, the previous results of data processing on phytoplankton samples are also introduced.

Annual reproductive cycle of the Antarctic sea urchin, *Sterechinus neumayeri* (Echinodermata: Echinoidea) collected from Marian Cove, King George Island, Antarctica

Do-Hyung KANG 1, Kwang-Sik CHOI* 1 and Youn-Ho LEE 2

1. School of Applied Marine Sciences, Cheju National University, 1 Ara 1 Dong, Jeju, Jejudo, 690-756, Republic of Korea *[E-mail: skchoi@cheju.ac.kr]
2. Polar Sciences Laboratory, Korea Ocean Research and Development Institute, Ansan P.O. Box 29, Seoul 425-600, Republic of Korea

The Antarctic sea urchin, *Sterechinus neumayeri* (Meissner 1900) is the most abundant regular sea urchin in shallow Antarctic waters. Annual reproductive cycle of the Antarctic sea urchin, *S. neumayeri* were investigated from December 1998 to January 2000. For analysis, Antarctic sea urchins were sampled at Marian Cove, King George Island using SCUBA, fixed in 10% neutral formalin in situ and transported to the laboratory. After recording test diameter, height, total weight and tissue wet weight, gonad was fixed in Davison's fixative for histological preparation. Gonad development status of individual Antarctic sea urchin was then categorized into one of the six stages (early developing, late developing, fully matured, spawning/partially spawned, spent and absorbing) based on histological observation. Test diameter of the 440 Antarctic sea urchins was within a range from 30.5 to 73.5 mm. Gametogenesis was found to be started in early January and primary oocytes and previtellogenic oocytes were mainly observed in this season. In late of February, many Antarctic sea urchins were early developing stages and most of the Antarctic sea urchins sexually developed from March to August. Fully mature eggs were mainly observed in September and October. Mean diameters of fully mature eggs were ranged from 80.1 to 133.6 _m. Spawning activities of most Antarctic sea urchins were observed during early October and continued through December. Antarctic sea urchins collected in December displayed spent and absorbing gonad with few residual eggs, primary oocytes and previtellogenic oocytes. Fully mature and spawning peak of the gonad status of *S. neumayeri* in the study area was considered in austral summer seasons with the high primary production.

Annual reproductive cycle of the Antarctic clam, *Laternula elliptica* (Mollusca: Bivalve) collected from Marian Cove, King George Island, Antarctica

Do-Hyung KANG 1, Kwang-Sik CHOI* 1 and In-Young AHN 2

1. School of Applied Marine Sciences, Cheju National University, 1 Ara 1 Dong, Jeju, Jejudo, 690-756, Republic of Korea *[E-mail: skchoi@cheju.ac.kr]
2. Polar Sciences Laboratory, Korea Ocean Research and Development Institute, Ansan P.O. Box 29, Seoul 425-600, Republic of Korea

The soft-shelled clam, *Laternula elliptica* (King & Broderip) is one of the most common marine organisms inhabiting in shallow subtidal water around the Antarctic continent and islands. Seasonal changes in the gonadal tissues of the Antarctic clam, *L. elliptica* were investigated over two years period from February 1998 to January 2000. For analysis, clams were sampled at Marian Cove, King George Island using SCUBA, fixed in 10% neutral formalin in situ and transported to the laboratory. After recording shell length, height and tissue wet weight, the middle part of the body was sectioned longitudinally for histological preparation. Gonadal maturation, oocyte diameter, and the area of oocytes in a follicle in a unit microscopic field were measured with Planimetrical methods. Microscopic examination of the gonad revealed that *L. elliptica* was hermaphrodite. Of the 639 clams examined, the smallest clam of 34.5 mm, estimated to be 3 year-old, exhibited mature gonad indicating that below this size may be the minimum size for reproduction. Seasonal change in gonadal tissues in terms of size and shape was obvious although eggs and sperm were observed in the gonad all year round. Oocyte diameter increased from March to November. Reproductive stage of the clam could be categorized into six stages according to appearance of the gonadal tissues and oocyte diameter; early developing (invisible to 20 μm), developing (21 to 80 μm), fully developed (81 to 140 μm), spent (120 to 140 μm), and absorbing (degenerated eggs). Fully mature eggs were observed in December and January. Clams collected in February and March displayed spent gonad with few residual eggs. It was believed that most clams at Marian Cove spawned during

January and February and gametogenesis resumed after March. Spawning peak of *L. elliptica* in the study area coincides with the phytoplankton blooming that may maximize survival of the offspring.

Spatial distributions of heavy metals in Marian Cove, Antarctica

Kyung Ho CHUNG* 1, Seon Mi NAM 1 and Hosung CHUNG 1

1. Polar Sciences Laboratory, Korea Ocean Research & Development Institute, Ansan P.O. Box 29, Seoul 425-600, Republic of Korea
*[E-mail: khchung@kordi.re.kr]

Dissolved and particulate heavy metals were measured in the surface waters of Marian Cove, King George Island, Antarctica, during austral summer in 2000, as a part of environmental monitoring program at the King Sejong Station. The mean values of dissolved heavy metals such as Cd, Co, Cu, Ni, Pb, and Zn were 0.068 ± 0.005 μg l^{-1}, 0.014 ± 0.006 μg l^{-1}, 0.263 ± 0.052, 0.386 ± 0.024 μg l^{-1}, 0.024 ± 0.011 μg l^{-1}, 0.365 ± 0.087 μg l^{-1}, respectively. On the other hand, the mean values of particulate heavy metals such as Cd, Co, Cr, Cu, Mn, Ni, Pb and Zn were 0.47 ± 0.19 μg l^{-1}, 11.70 ± 8.94 μg l^{-1}, 71.27 ± 63.24 μg l^{-1}, 88.75 ± 48.36 μg l^{-1}, 618.97 ± 445.99 μg l^{-1}, 22.93 ± 30.33 μg l^{-1}, 25.13 ± 10.11 μg l^{-1}, 193.47 ± 64.33 μg l^{-1}, respectively. Dissolved heavy metals showed high levels in the waters of adjacent to land, especially glaciated ice cliffs. Particulate heavy metals showed the same distribution pattern as dissolved heavy metals. This indicating that summertime inflow of melt-waters from glaciated ice cliffs and land were the important contributors for both heavy metals in this area. The affinity to dissolved phase were dominated in Cd and Ni, however, Co, Pb, Zn showed the affinity to particle phase.

A Preliminary study for long-term biomonitoring on the terrestrial environment around King Sejong Station, King George Island, Antarctica

Ji Hee KIM* 1 and Hosung CHUNG 1

1. Polar Sciences Laboratory, Korea Ocean Research & Development Institute, Ansan P.O. Box 29, Seoul 425-600, Republic of Korea
*[E-mail: jhalgae@kordi.re.kr]

Terrestrial vegetation and species composition were investigated around King Sejong Station, and vegetation map was made out in detail with GPS as a baseline survey for long-term biomonitoring on the terrestrial environment. In total 35 species (22 genera) of lichens, 18 species (12 genera) of bryophytes, 2 species (genus *Prasiola*) of freshwater macroalgae, and 2 species of flowering plants were identified in the present study. The two flowering plants, *Colobanthus quitensis* and *Deschampsia antarctica*, were recorded around the station for the first time. *Usnea* community is the most widespread and extensive lichen community, and *Andreaea, Sanionia georgico-uncianta,* and *Constomum magellanicum* communities are representative of bryophytes communities in the area. For biomonitoring around the station, investigation of vegetation will be carried out annually based on the results. To obtain information on the concentration of airborne heavy metals emitted mainly by the use of fossil fuels at the station, relatively inexpensive and effective biomonitoring system with lichens and bryophytes should be introduced. The study suggests *Usnea aurantiaco-atra, Himantormia lugubris* (lichens), *Andreaea gainii,* and *S. georgico-uncinata* (bryophytes) may be appropriate species for biomonitoring, according to their abundant populations and wide distribution patterns.

Biological research activities of PRIC in the recent and the coming 3 years

Bo CHEN* 1, Yong YU 1, Jianfeng HE 1

1. Polar Research Institute of China, Shanghai 200129, China
   *[E-mail: chenbo688@sina.com]

The polar biological group in PRIC has been devoted to the studies on polar marine biology, especially in the coastal sea ice ecology near Larsmann Hills and biological oceanography in the area of Prydz Bay, East Antartica since 1990, to improve our understanding of biological communities and their adaptation to the changing environment, processes of ecological dynamics in sea ice zone, carbon flux and its role in biogeochemical cycle. Three CAA and NSFC funded projects concerning the sea ice biological processes in the coastal sea ice region near Larsmann Hills and in Greenland Sea, cold-adapted microbes producing degradative enzymes in Chukchi Sea and Bering Sea, marine bacterial community and diversity based on 16S rDNA analysis in the area of Canada Basin were conducted. Since 1996, a microbiological study was developed to understand the characteristics of polar microorganisms and their adaptation in the extreme environment , as well as their bioactive products. A series of bacterial and fungi strains producing a various enzymes (extracellular protenase, cellulase, lipase, acylase) were found. Several bacterial strains from Arctic and Antarctic water or sediments showed strong anti-fungal (anti *Fosarium Solani*) or antibiotic resistant (anti vancomycin resistant *Enterococcus*, VRE and Methicillin resistant *Staphylococcus aureus*, MRSA) activity.

A new plan of ecological environmental monitoring will be conducted in the Great Wall Station, King George Islands. This plan is designed to understand the influence of global changes and human activities on Antarctic ecological environments through a series of physical and biological monitoring. A special budget of about one million US Dollars will be covered by the Chinese central government in the coming 3 years to greatly improve the equipments in Great Wall Station and to develop the long-term ecological environmental monitoring program.

The Ninth International Symposium on Antarctic Science
8-10 October 2002, Ansan, Korea

Poster presentation

Photosynthesis and formation of UV-absorbing substances in Antarctic macroalgae under different levels of UV-B radiation

Taejun HAN* 1, **Byeong-Jik PARK** 1, **Young-Seok HAN** 1,
Sung-Ho KANG 2, **SangHoon LEE** 2

1. Department of Biology, University of Incheon, Republic of Korea
   *[E-mail: taejunhan@yahoo.co.kr]
2. Polar Sciences Laboratory, Korea Ocean Research & Development Institute,
   Ansan P.O. Box 29, Seoul 425-600, Republic of Korea

Effects of artificial and solar UV-B radiation on five rhodophytes (*Curdiea racovitzae, Gigartina skottsbergii, Iridaea obovata, Myriogramme manginii, Palmaria decipiens*) from Antarctica have been investigated using PAM fluorescence in laboratory and in the field. Laboratory studies showed that there was significant difference in the UV sensitivity between different species, and that the differences appeared to be correlated with the depth of collection of the specimens. It was apparent from the observations that the samples such as *M. manginii, P. decipiens* collected from 20_30 m depths were more sensitive to UV-B radiation compared with those collected from shallower depths. The present study confirmed that acclimation to the surrounding light regime is an important factor to determine the UV-sensitivity of a species or individuals and that PAM measurements are rapid and non-destructive methods to evaluate UV influences. From field studies on *M. manginii* and *P. decipiens* it was observed that the plants exhibited diurnal changes in quantum yield with the minimum values at noon followed by recovery in the evening. Photoinhibition occurred in these species could therefore be accounted for by so-called dynamic photoinhibition. It seems likely that this protective mechanism may contribute to survival of the species in shallow water where they may encounter intense solar radiation. The presence or absence of UV-B portion in solar radiation affected the photosynthetic recovery process, and the rate of recovery was much slower in UV-present than in UV-absent conditions. A functional role of UV-B appears to delay the recovery of photosynthesis in the studied macroalgae. Differential sensitivity to UV-B recognised

between *M. manginii* and *P. decipiens* seemed to correspond well with the amount of UV-absorbing substances (UVAS) contained in the respective species. Higher tolerance to solar radiation by the latter species may be due to the higher amount of UVAS. There were variations of UVAS concentrations in algal thalli depending on season and depth of collection.

The Ninth International Symposium on Antarctic Science
8-10 October 2002, Ansan, Korea

Poster presentation

Phylogeny of the Ceramiaceae (Rhodophyta) in the Pacific with regard to the Ceramoideae

Eun Chan YANG* 1, Sung Min BOO 1

1. Department of Biology, Chungnam National University, Daejon, Republic of Korea
*[E-mail: smboo@hanbat.chungnam.ac.kr]

The family Ceramiaceae was estabilished by Fries in 1835 that is cosmopolitan from tropical to boreal waters. The family is subdivided to three subfamilies based on diagnostic characters, vegetative and reproductive structures, viz Ceramioideae, Callithamnioideae, and Compsothamnioideae. Phylogenetic analyses of the Ceramiaceae from the Pacific water using psbA (D1 protein of photosystem II coding gene in plastid) sequences were performed for a better understanding of the systematics of that family. We determined newly 59 sequences from 11 tribes, 20 genera, and 49 species including replicates of some species and outgroup taxa, which were collected in Australia, Chile, France, Japan, Korea, New Zealand, Russia, UK, and USA. The length of the psbA determined in this study was 1083 bp. The variable positions are 300 nucleotides (32%) and 267 positions (29%) are parsimony informative. The G+C content is 39%. Pairwise distances are in a range of 5.2% between the tribes Dohrnielleae and Ceramieae to 14.8% between the tribes Spyridieae and Spongoclonieae. The trees cast some questions about the monophyly of the family Ceramiaceae. The Ceramioideae is not monophyletic, the tribes Wrangelieae and Griffithsieae (formerly in the Ceramioideae) being included in the Compsothamnioideae. The tribe Spyridieae was basal to the Ceramioideae. These results contradict morphology-based taxonomy and require further studies using other genes.

Poster presentation

Factors that affect hatchling size hierarchy in the chinstrap penguin (*Pygoscelis antarctica*)

Dohong KIM* 1, Jose VALENCIA 2, Javier GONZALES 3 and Sang-Hoon LEE 1

1. Polar Sciences Laboratory, Korea Ocean Research & Development Institute, Ansan P.O. Box 29, Seoul 425-600, Republic of Korea
   *[E-mail:dhkim@kordi.re.kr]
2. Departamento Cientifico, Instituto Antartico Chileno, Av. Luis Thayer Ojeda 814, Correo 9, Providencia, Santiago, Chile
3. Investigador integrante del proyecto 040, Instituto Antartico Chileno, Av. Luis Thayer Ojeda 814, Correo 9, Providencia, Santiago, Chile

The chinstrap penguin *Pygoscelis antarctica* lay a two-egg clutch, with a long interval between laying of the first and second egg, and within broods chicks often hatch asynchronously. In this study, we examine whether intra-clutch egg-size variation and/or hatching asynchrony give rise to an initial size hierarchy within broods in a chinstrap penguin population at the Barton Peninsula, King George Island. In addition, the factors (including laying interval, laying and hatching date, and laying order) that could influence hatching asynchrony were explored. Laying and hatching interval between two eggs were 3.3 ± 0.08 SE (1-5 days) and 0.8 ± 0.10 SE (-2-3 days), respectively. Hatching was asynchronous in 61 % of the 98 clutches, asynchrony raging from 1 to 3 days. The duration of the incubation period of first egg was significantly longer than that of second egg, indicating an onset of incubation of first egg before the laying of the second egg. However, there was no relationship between laying interval and degree of hatching asynchrony, suggesting that a large part of the variation in hatching asynchrony remains unexplained. On the other hand, the duration of the incubation period was negatively associated with laying date, indicating that chinstrap penguins which started breeding later advanced the onset of incubation. The negative association between the duration of incubation and laying date suggests that colony sound facilitates sexual activities and agonistic activities, a process that could influence the timing of reproduction in the chinstrap penguin as many colony-dwelling birds.

The Ninth International Symposium on Antarctic Science
8-10 October 2002, Ansan, Korea

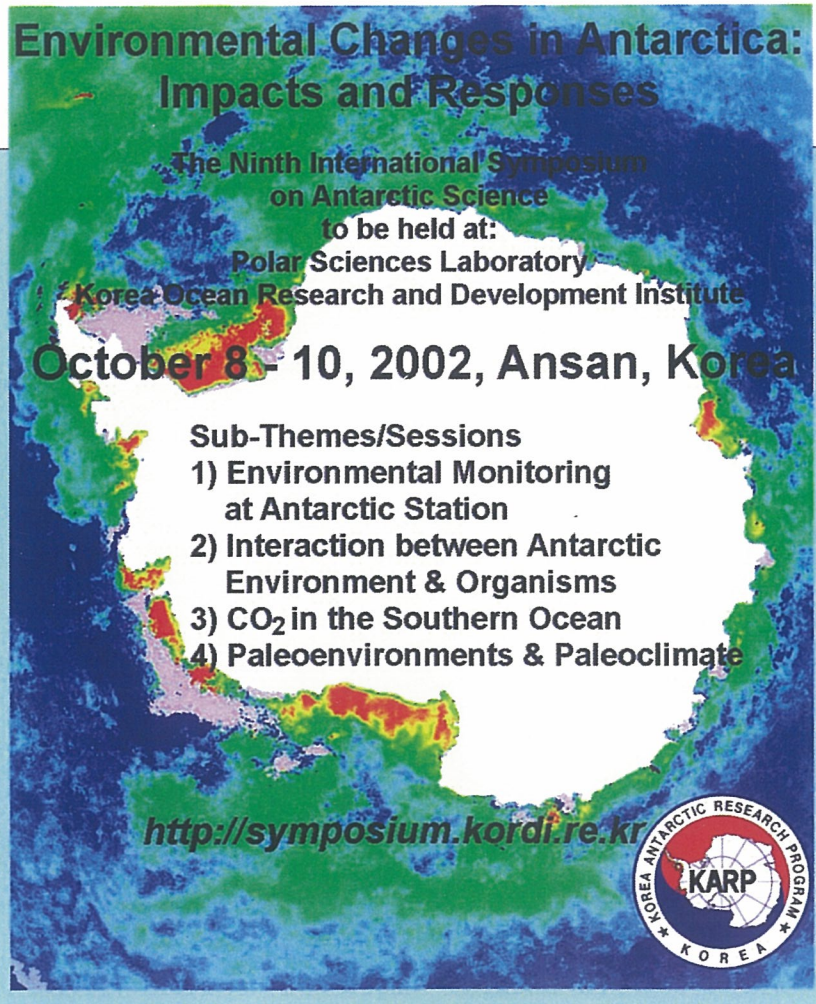
Poster presentation

Biotechnological Opportunity in Polar Region: Cold-Active Enzymes

Yong YU* 1, Bo CHEN 1 and Yinxin ZENG 1

1. Polar Research Institute of China, 451 Jinqiao Road, Shanghai 200129, China
*[E-mail: yurenyy77@sina.com.cn]

Prokaryotes dominate many polar region ecosystems. To adapt the extreme environment, they optimize the basic cell processes necessary for growth and survival. The adaptations of cellular processes represent potential biotechnological exploration. One case is the production of cold-active enzymes by bacteria from polar region. A series of studies on detection of enzyme activity were conducted in the recent two years. Lots of isolates from Arctic and Antarctic waters and sediments were found to have a capacity of producing a variety of enzymes, such as protease, cellulase, lipase, agarase, amylase, and acylase. Whole cell and cell-free assays indicated the presence of protease, cellulase and lipase enzyme(s) exhibiting strong cold adaptation in several strains. The strain Ar1 from surface water in Chukchi Sea is a potential candidate for biotechnological application due to its elaborating several cold adapted enzymes (protease, cellulase, lipase, agarase and amylase). The optimal temperature of cellulase and lipase at pH 8.0 is 35℃ and 25 ℃, respectively. It is apparent that polar bacteria are important sources of cold-active enzymes.


Environmental Changes in Antarctica:
Impacts and Responses
The Ninth International Symposium
on Antarctic Science
to be held at:
Polar Sciences Laboratory
Korea Ocean Research and Development Institute
October 8 - 10, 2002, Ansan, Korea
Sub-Themes/Sessions
1) Environmental Monitoring
at Antarctic Station
2) Interaction between Antarctic
Environment & Organisms
3) CO_2 in the Southern Ocean
4) Paleoenvironments & Paleoclimate
http://symposium.kordi.re.kr
KOREA ANTARCTIC RESEARCH PROGRAM
KARP
KOREA