Environment Related Studies at the King Sejong Station, King George Island during the 1998/99 (Republic of Korea) (Agenda item #15, ATCM XXIII)

A. **Nearshore Marine Biological Studies**

During the whole year of 1998, seasonal variations in species composition and abundance of microalgal communities occurring in the Marian Cove have been investigated by collecting seawater samples on a regular time interval. Related oceanographic and meteorological parameters, such as ice cover, seawater and air temperature, salinity, wind speed and direction, and W radiation have also been measured. This long-term and regular monitoring on microalgal communities at the Marian Cove has been conducted year-round since the 1993/94 season in order to understand natural processes within the nearshore marine ecosystem and furthermore to clarify changes in the ecosystem consequent to environmental changes. Microalgae are major primary producer to sustain Antarctic marine ecosystem, thus their change means change *of* whole marine ecosystem.

During the summer months *of* the 1998/99 season, experimental studies to determine the enhanced UV effect on the development of sea urchin *(Sterechin~s neumayeri)* embryos were conducted at the station. Under a persistent and intense UV-radiation, abnormal development *of* the embryos was observed at blastula stage. In addition, molecular phylogeny *of* some key species such as sea urchins and clams *(Laternula elliptica)* were investigated in order to understand the evolution and adaptation *of* Antarctic marine invertebrates in the Antarctic shallow waters. We transferred the specimens to Korea, and sequenced mitochondrial genes such as cytochrome oxidase subunit I and 12S rRNA. The genetic sequences will be used for the construction of molecular phylogeny *of* the marine invertebrates.

B. Long-term and Regular Monitoring on Solar Ultraviolet Radiation and Total ozone over the King Sejong Station

Solar ultraviolet (W) and W-B radiation have been measured routinely at King Sejong Station since 1994, using an Eppley Total Ultraviolet Radiometer (model TWR) and a Robertson-Berger type UV-Biometer (model 501), respectively. These observations are used to investigate temporal variations *of* solar UV radiation and the UV-B radiation/ozone relationship at the station, which is located on the marginal area *of* the ozone hole. Time series *of W* and W-B radiation showed significant seasonal variations. Radiation dropped nearly to zero during winter and increased gradually up until the beginning *of* summer. In springtime, UV and UV-B radiations were recorded as relatively high compared to those in summer, and the enhanced UV radiations were shown to be mainly associated with the ozone depletion. Data on daily total ozone have been obtained from Brewer ozone spectrophotometer (MK IV) installed at King Sejong

station on January 1998. The first data set collected during the year of 1998is currently under analysis. Collected data are also being analyzed in conjunction with biological parameters obtained from the nearshore microalgal studies.

C. Environmental Monitoring on Human Impacts at the Station

This work is to assess the impacts on the surrounding environment and living organisms caused by emissions from fuel combustion, solid waste incineration, and liquid waste disposal (mostly grey water) at the station. Soil, nearshore marine sediment, bivalve molluscs *(Laternula elliptica),* limpets *Nacella concinna),* and lichen have been regularly collected to assess metal pollution and other environmental changes. The work done during the years of 1998 and 1999 are summarized as follows.

1. Marine pollution Monitoring

As a preparatory work for a long-term regular monitoring of sea water quality adjacent to the King Sejong Station, nutrients, trace metals, pH, temperature and salinity etc. were measured at several stations within the Marian Cove. Analysis showed that local geochemical process (inflow of ice-melt water loaded with some heavy metals, such as Cu, Mn from the surrounding terrestrial environment) apparently have a great influence on the natural backgound of physico-chemical properties of the sea water in the cove. This suggests that the local geochemical process should be considered in water quality monitoring. Apart from the influence of natural geochemical process, concentration of Pb was the highest at the sampling station nearest to the King Sejong Station, indicating that Pb was originated from the station.

Heavy metal concentrations were determined also in the tissues of marine organisms. In the 1998/99 summer, various sizes of the Antarctic clam, *Laternula elliptica,* which was suggested as a suitable biomonitor for metal pollution from a previous study, were collected to determine the effects of size on metal accumulation. In addition, the limpet, *Nacella concinna* were collected from intertidal zones of two sites (area near the station and a control site) to determine utility of this limpet species as an indicator for heavy metal pollution monitoring in intertidal areas. The Antarctic limpet was shown to strongly accumulate most of heavy metals analyzed, and this result suggests that *N. concinna* can be used as a useful indicator for metal pollution monitoring in the intertidal zones along the Antarctic Peninsula and the adjacent islands where this species is abundant and easily collective.

In addition, a basis for long-term monitoring on the nearshore benthic community was established using a new method, *under water stereo-photogrammetry.* Quantitative analysis on abundance of indicator species and some other dominant species can be easily conducted by taking under water video and consequently by analyzing still images using a computer program. Furthermore, histological and molecular studies to develop

biomarkers which could be used as sensitive tools for early detection and prediction of human impacts was initiated using clams and sea urchins.

2. Monitoring on atmospheric and terrestrial pollution

The occurrence of atmosphenc pollution by heavy metals (Cr, Cu, Fe, Mn, Mo, Ni, Pb, and Zn) which might be emitted into the air from the station was investigated using epilithic lichen, *Usnea antarctica.* For most of heavy metals, there were no significant differences between the lichens collected at the station and the lichens from remote sites (about 1 km). However, Pb contents in the lichens collected within 2OO m from the station were shown to be significantly higher than the values in the lichens from the remote sites, indicating that Pb was released probably from combustion of diesel oil and leaded gasoline at the station. Management plan to reduce the emission of Pb was recommended, and during the 1998/99 austral summer, an aerosol sampling system was installed at the station to assess the accurate amount of emission. Air samples are currently being collected biweekly by overwintering members and the samples will be analyzed early next year.

3. List of Publication in 1998 & 1999 on Environmental Monitoring Work

Ahn, I.-Y. et al. (1999). A preliminary study on heavy metals in the Antarctic limpet, *Nacella concinna (Strebel*, 19O8) (Gastropoda: Patellidae) in an intertidal habitat on King George Island. *Korean J. Polar Resear.* Vol. I O/No. I (in press)
Hong, S.-M. et al. (l999). Lichen biomonitoring for the detection of local heavy metal pollution aroung King Sejong Station, King George Island. *Korean ~. Polar Resear.* Vol. I O/No. I (in press)
KoRDI (1998) Annual Report of Environmental Monitoring on Human Impacts at the King Sejong Station. BSPP 98OOI-O2-1151-7, Ministry of Maritime Affairs & Fisheries. (Abstracts and some parts in English)
Ko RDI(1998) A map for bathymetry of the Marian Cove