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ENVIRONMENTAL MONITORING OF THE HUMAN IMPACTS AT KING SEJONG  
STATION, KING GEORGE ISLAND

*(Agenda item 22)*

*(Submitted by Rep. of Korea)*

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Environmental monitoring of the human impacts at King Sejong Station, King George Island

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## Introduction

Environmental impacts made by human activities at Antarctic bases have been of our growing concerns over the past years. In order to assess the human impacts at the Korean Antarctic station, environmental monitoring programs have been implemented recently. Fundamental for the understanding of the environmental impacts is a precise evaluation of the current state of the environment.

At the 19th ATCM, Korea introduced the scope, objectives, and methods of the monitoring programs in the information papers submitted to ATCP's. In this paper, we present a summary of the monitoring studies, some are new, and some with preliminary results, where available. The monitoring studies are categorized into 3 subgroups by the nature of the research activities.

## Monitoring Programs

### 1. Coastal marine ecosystem monitoring

Focused mainly on phytoplankton communities in the Marian Cove, monthly variations in the species composition, abundance, and production are being investigated. The study includes other ecosystem components at the base of the coastal marine food web, such as microorganisms and benthic microalgae. Scientists also measure routinely in parallel oceanographic and meteorological parameters, such as ice cover, seawater and air temperature, salinity, wind speed and direction, and UV radiation. This study is to understand the change of the community structure and the components' interactive functions with the changes of the environmental parameters.

The study also attempts to characterize the material flux and the energy budget within the ecosystem. Operation of the station inevitably places the nearby ecosystem under the direct influence of the human activities; for example, the release of the sewage, although treated by the standard method, puts extra loads of organic matter to the coastal marine ecosystem. One of the ultimate goals of this monitoring study is to evaluate the human influence on the flow of the organic material in the ecosystem.

This work, started from the 1993/1994 season, and amended and expanded year after year, is now being carried out year round at the station. A similar study, but with a smaller scope and for a limited period of the year, is being performed every

year at fixed stations in the central Bransfield Strait area.

In anticipation of future international collaborations with other programs, e.g., CS-ESIZ (Coastal Shelf Ecosystem and Sea Ice Zone) program, scientists incorporate the standard methods and protocols into the current work frame for the measurement of the environmental parameters. Our monitoring study is open to the other nations operating stations at the King George Island for the participation of or coordination with their existing programs.

2. Baseline levels of pollutants in the coastal marine ecosystem; monitored in a benthic shell fish *Laternula elliptica*.

Although the Antarctic environments have been least affected by human activities, significant chemical contaminations of coastal benthic fauna were well documented, particularly in the area of human settlement, i.e., Antarctic stations. Bivalve mollusks are known to accumulate heavy metals in their tissue, and have been used extensively for the monitoring of the pollution in coastal marine waters. Mussel Watch program is a good example of the worldwide use of the bivalve mollusks.

Concentrations of the heavy metals, such as Mn, Cu, Zn, Pb, Cd, Ni, Co, Cr, and Fe, were determined in various tissues (digestive glands, gonads, gills, kidneys, muscle) of the Antarctic clam *L. elliptica*, one of the common marine benthic organisms in the Antarctic nearshore waters. *L. elliptica* were collected from the Marian Cove and the Collins Harbour in the Maxwell Bay. The two sampling sites are about 6 km-distant from each other, the Collins Harbour being away from the King Sejong Station at the Marian Cove.

The study is to determine the baseline levels of the heavy metals from the distant site, the Collins Harbour, where the anthropogenic influence is unlikely or least, and compare the baseline with the levels in the clams collected near the station. Results showed that *L. elliptica* tends to accumulate most of the heavy metals with tissue concentrations being comparable to those of mussels and oysters in temperate waters.

We have presented the results in detail at the previous ATCM, and elsewhere in the form of research paper. The overall conclusion is that the bivalve species serves as a suitable biomonitor for metal pollution in the Antarctic coastal waters, and that this monitoring program is worth continue for the coming next decade.

3. Impacts on the terrestrial ecosystem; heavy metal accumulations in lichen around the station

Human activities at the Antarctic stations generate airborne pollutants. These pollutants, e.g., PCB, sulphur dioxide, can

affect the algae component of the lichen, unbalancing the symbiotic interactions, which may result in the total destruction of the lichen community. Heavy metals are also known to be concentrated in the lichens.

We have chosen the lichen, *Usnea antarctica*, to monitor the effect on the terrestrial ecosystem of the airborne pollutants, which are mostly from the exhaust fume of the fossil fuel combustion. Lichens are often used as a bioindicator, since they are long-lived organisms and very sensitive to airborne pollutants. Concentrations of the heavy metals, organic toxins, and refractory hydrocarbons are of our interest in this monitoring study.

Sampling schemes of the 1994/1995 season were introduced in the information papers of the 19th ATCM. To repeat briefly, 25 sampling sites were dispersed on a quarter circle (a delta-fan shape) along the 5 radii evenly spaced, with the Antarctic station at the center of the circle. Spacing between the sites were ca. 100 m, and thus the outermost circle and the sites on this circle are 500 m away from the station.

Scientists analyzed the lichen specimen by ICP-MASS to investigate the dispersion of the airborne pollutants (heavy metals at present) from the combustion gas and their accumulation in the lichen tissue. Preliminary results from the analysis of Pb showed that the concentration was max. 18.6 ppm within the 100 m circle (within the station premise) and decreased to the background level, 1.4 ppm, at the most distant sites (500 m from the station). The highest concentrations are in the area within 200 m distance, and the level dropped to the background beyond this distance. Interestingly, higher levels of the concentration were found in the leeward direction of the dominant wind direction.

### Conclusions

Scientists currently plan similar studies to be implemented in the near future, for the soil and packed snow (or ice) in the station area. The existing programs certainly need to be further revised and expanded. We invite multinational collaborations for a better understanding of the environmental impacts by the human activities. Korea pledges its sincere duty to minimize the human impacts in the Antarctic. The effort for the environmental conservation also involves the contributions from non-scientific fields, for example, improvements of the incineration method, sewage treatment system, and waste handling.