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PRELIMINARY STUDIES ON ENVIRONMENTAL MONITORING AT KING SEJONG STATION, KING GEORGE ISLAND DURING THE 1992/1993 SEASON

Agenda *Item 10 a*

(Submitted by the Republic of Korea)

1. Background

Antarctic marine environment has been least affected by human activities, and its ecosystem is characterized by relatively high diversity and biomass comparable to highly productive areas in the world. However, significant chemical contamination of marine environments and observable impacts to the benthic communities have been documented around some human settlements in the Antarctic (Lenihan et al., 1990).

Bivalve mollusks are known to concentrate heavy metals in their tissue and have been used extensively for monitoring pollution in coastal marine waters around the world under the design of the Mussel Watch program. In the Antarctic, at least two species, that is *Adamussium colbecki* and *Laternula elliptica* appear to meet the criteria for 'Mussel Watch' program (Farrington *et al.*, 1983).

The Antarctic lamellibranch *Laternula elliptica* (king and Broderip) is endemic to the Antarctic with circum-polar distribution in nearshore waters around the Antarctic Continent and islands. By virtue of its wide distribution and high biomass, *L. elliptica* is nowadays highly recommended as a representative species possibly indicating human impacts on the Antarctic nearshore environments (SCAR, 1992). Up to now there have been no published data on heavy metal levels of *L. elliptica*, whereas metal levels of *A. colbecki* have been reported from various areas of Antarctic coastal waters (Mauri *et al.*, 1990; Berkman & Nigro, 1992).

2. Objectives

- To determine baseline levels of heavy metals in *Laternula elliptica*
- To determine whether *L. elliptica* could be used as an indicator species in monitoring heavy metal contamination in Antarctic nearshore waters.

3. Study Area

Marian Cove, Collins Harbor and the vicinity in the Maxwell Bay have been investigated to search *Laternula elliptica* during the 1991/1992 and the 1992/1993 austral summer months. In Marian Cove, the density of *L. elliptica* ranged from 36 to 88 individuals (ind.) m^{-2} with the mean of 65 ind. m^{-2} at about 15 m depth. Highest density of *L. elliptica* up to 136 ind.(9 kg) m^{-2} occurred in Collins Harbor (62°10'S, 58°47'W), and Collins Harbor was chosen as a representative habitat of *L. elliptica* (Ahn, 1994).

4. Methods

4.1 *Sample Collection*

In the early February of 1993, *Laternula elliptica* and habitat sediment were hand-collected by SCUBA divers from 20-30 m depth of Collins Harbor (Fig. 1). The sampled animals were frozen at -20°C and maintained at this state until heavy metal analysis was conducted. Frozen samples of *L. elliptica* were partially thawed at room temperature and the total fresh weights (with and without shell) of each sample were determined. Then each of the clams was dissected into gonad, gill, kidney, digestive gland, siphon epidermis and the remainder (siphon, foot, mantle etc). Parts of each dissected clam were then freeze-dried for 48 hours. After freeze-drying, samples were ground.

4.2 *Analytical Procedure*

About 0.5 g of each sample was placed in a 60 ml teflon jar and oxidized with 10 ml of quartz distilled nitric acid at room temperature for 2 hours. For complete digestion each sample was added with 10 ml nitric acid and refluxed in a screw-capped teflon jar on a hot plate (ca. 120° C) for several hours. The sample was then dried to remove excess acid at 80° C and cooled down at room temperature, and the residue was dissolved in 1 N HNO_3. After centrifuging, the supernatant was taken and diluted (1:5 to 1:100) for measurement. The concentrations As, Cd, Co, Cr, Cu, Mn, Ni, Pb and Zn were determined using an inductively coupled plasma mass spectrometer (PQ II+, VG Element). The concentration of Fe was determined using a flame atomic absorption spectrophotometer (Spectra AA-20, Varian), and that of Hg by cold vapor Atomic Absorption Spectrophotometry.

5. Results and Discussion

Size of *Laternula elliptica* used for the metal analysis ranged from 77 to 94 mm (mean = 86, SD = 8) in shell length and from 63 to 127 g in total wet weight (mean = 102, SD = 22). Metal contents were highly variable among different organs (Table 1). Kidney seems the target organ for Zn, Cd and Pb, whereas siphon epidermis for Mn, Cu and Ni. Mercury level did not vary significantly among different soft parts of the clam. Overall, the metal levels in *L. elliptica* are comparable to the values obtained from the representative suspension-feeding bivalves in temperate waters (Table 2). It is surprising to find such high metal levels in a species endemic to the Antarctic, where metal contamination appears unlikely. In particular, copper (39 $\mu g\ g^{-1}$ dry weight, ppm) and Manganese (74 ppm) levels were considerably high compared with the values reported from the representative bivalve species in temperate waters, *Mytilus* spp. (Table 2).

The sources of elevated Cu and Mn seem to be natural rather than anthropogenic. Lee *et al.* (1990) reported that copper level in the surface waters of the Maxwell Bay was elevated in the nearshore waters compared to the offshore waters, and ascribed this in part to fresh water input during summer. These Cu, Pb, Zn and Cd levels were much elevated with respect to the values in the Southern Ocean (Orren & Monteiro, 1985). Copper levels were highly elevated also in the habitat sediment (68-88 ppm) compared to the worldwide mean values (28-30 ppm) reported by (Cantillo & O'Connor, 1992). The elevation of Cu in sediment has apparently originated from erosion of terrigenous volcanic rocks which contain high level of Cu. Surrounding land consisted mainly of volcanic rocks containing high levels of Cu (>100-186 ppm) and Mn (500-1400 pm) (Jwa and Lee, 1992). Metal concentrations slightly varied throughout the vertical depth within the sediment cores, indicating the elevations of some metal species are natural and not caused by human impacts.

Thus, relatively high levels of heavy metals were measured in *Laternula elliptica*, a species endemic to the Antarctic, where metal contamination appears unlikely. Further studies are required on bioaccumulation processes in *L. elliptica*. In addition, metal levels of the same species should be investigated at different Antarctic nearshore waters in order to elucidate baseline ecological patterns that could be used in interpreting anthropogenic impacts.

6. References

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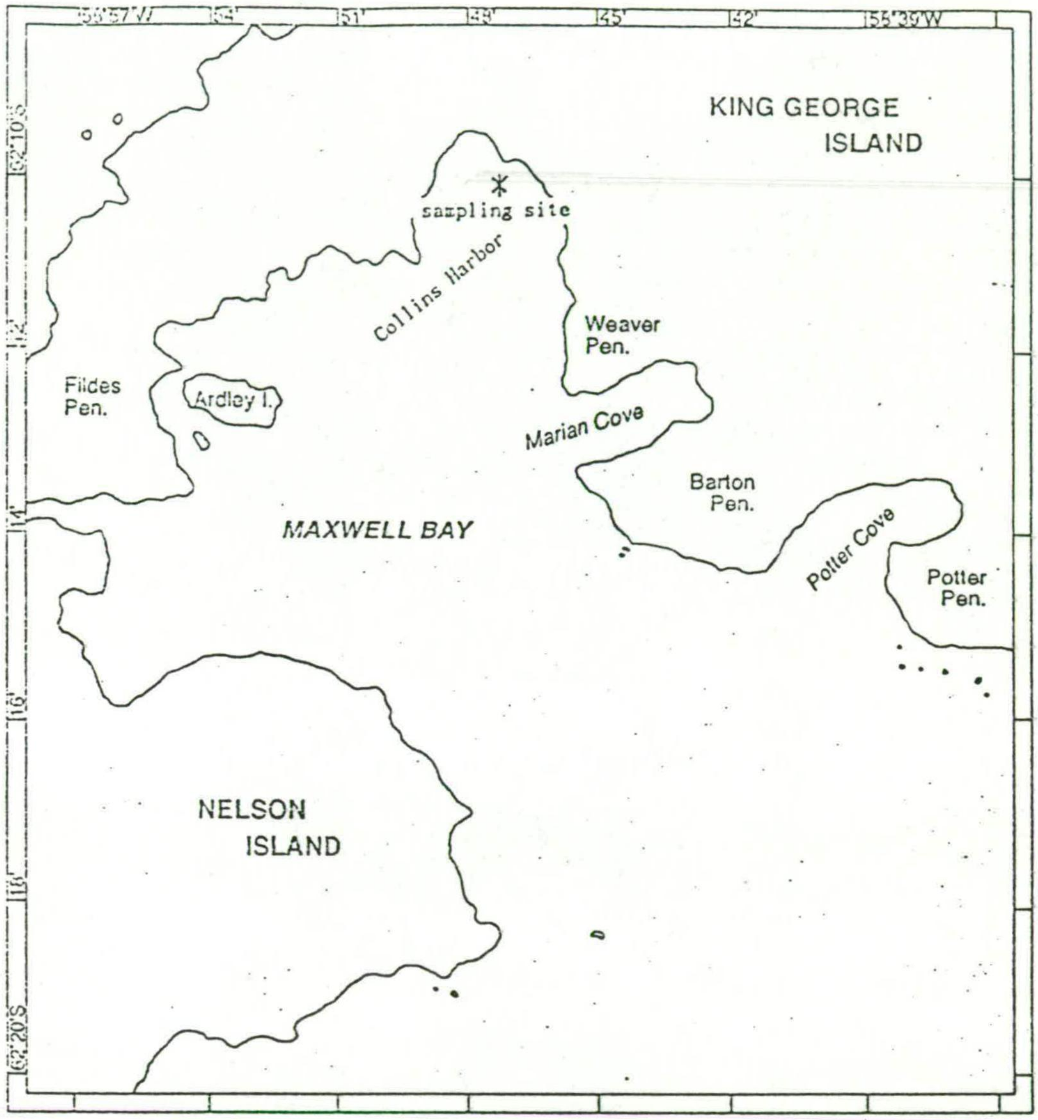

Figure 1. Geographic location of Collins Habor and the sampling site.

Table 1. Heavy metal concentration (μg g^{-1} dry weight) in the organs of *Laternula elliptica* collected on the 25th of January, 1993 in Collins Harbor. Means (Standard deviations) are represented (n = 12).

Metal	Siphon epidermis	Digestive glands	Gonad	Gill	Kidneys	Remainder
Mn	3920(1500)	19(7.5)	30(22)	45(16)	190(112)	102(46)
Cu	168(46)	38(5.0)	15(6)	21(8.9)	33(14)	50(20)
Zn	78(9.4)	153(39)	85(14)	206(72)	1687(926)	115(22)
Pb	14(4)	5.5(4.2)	2.2(0.7)	2.8(1.7)	38(22)	1.4(0.42)
Cd	2(0.78)	11.5(4.1)	4.8(1.9)	7.2(1.8)	42(15)	3.9(1.3)
Ni	131(35)	6.3(1.8)	4.5(1.9)	6.2(1.7)	21(14)	2.7(1.0)
Co	38(14)	2.8(0.85)	1.5(0.85)	2.7(0.75)	5.7(2.1)	2.3(0.72)
Cr	10(2.1)	2.9(0.72)	1.7(0.51)	2.9(0.81)	4.7(2.6)	1.7(0.85)
As	76(26)	61(16)	35(10)	59(21)	28(6.9)	21(6.0)
Hg	0.03(0.01)	0.14(0.083)	0.055(0.013)	0.094(0.043)	0.062(0.039)	0.057(0.011)

Table 2. Comparison of mean metal concentrations (n=12) in the soft tissues of *Laternula elliptica* with the values in other suspension-feeding bivalve species in temperate waters. Siphon epidermis was excluded in the calculation of mean body metal concentration.

unit: $\mu g\ g^{-1}$ dry weight

Metal	*Laternula elliptica*	*Mytilus edulis*	*Mytilus californianus*	*Crassostrea virginica*
Mn	74	2.7/7.5[a]		
Cu	39	4.4/15[*]	5.2/11[*]	30/530[*]
Zn	157	67/220[*]	100/220[*]	520/3700[*]
Pb	3.1	0.55/14[*]	0.5/8.4[*]	0.18/1.8[*]
Cd	6.3	0.92/4.3[*]	1.4/9.2[*]	1.2/9.1[*]
Ni	4.3	0.87/4.2[*]	1.3/6.3[*]	1.7/4.5[*]
Co	2.3			
Cr	2.0			
As	32			
Hg	0.07	0.005/0.03[b]		

[*]: Lauenstein *et al.*(1990)
[a]: Choi *et al.*(1992)
[b]: Latouche and Mix (1982)