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Cd, Fe AND Zn CONTENT OF THE EPIPHYTIC LICHEN *HYPOGYMNIA PHYSODES* IN A FINNISH SUBURB

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ABSTRACT

The epiphytic lichen *Hypogymnia physodes* was analysed for its content of cadmium, iron and zinc in a suburb of Helsinki. The metal contents were slightly higher than those from unpolluted areas in central Finland. Elevated concentrations were found in the vicinity of a big shipyard.

INTRODUCTION

Mosses and lichens have often been successfully used as monitors of airborne pollutants. The epiphytic lichen *Hypogymnia physodes* (L.) Nyl. has proved to be suitable for investigation of both long-range transport of heavy metals (Solberg and Selmer-Olsen, 1978; Lodenius, 1981) and local pollution (Steinnes and Krog, 1976; Laaksovirta and Olkkonen, 1977; Lodenius and Laaksovirta, 1979; Pilegaard, 1979; Pilegaard et al., 1979).

The aim of this study was to investigate the distribution of cadmium, iron and zinc in a suburb of Helsinki with only a few metal emitting sources.

STUDY AREA, MATERIAL AND METHODS

The suburb Vuosaari is situated 15 km east of the centre of Helsinki on the Gulf of Finland. There are approximately 15,000 inhabitants and the only industrial plant of importance is a big shipyard. Almost all of the flats

are oil-heated and two lichen deserts (areas with none or only severely stunted *Hypogymnia*) can be found (Fig. 1). However, the contribution of metals from oil combustion in domestic homes is quite small. If the metal contents of heavy fuel oil reported by Andersson and Grennfelt (1973) are used, the annual Cd emission from heating in Vuosaari may be estimated as some hundred grams, that of Fe as about 50 kg and that of Zn as about 10 kg. In a survey of the heavy metal contents of fungi (Lodenius et al., 1981), very high Cd content was found in some mushroom species in this suburb, but no reason for this could be detected.

40 Samples of *Hypogymnia physodes* were collected in the winter of 1980. Six control samples were obtained from unpolluted, rural localities in central Finland (Juva, Kontiolahti, Nurmes, Polvijärvi, Pyhäntä and Siilinjärvi). Each sample was collected from the bark of 3–4 pines (*Pinus sylvestris* L.) at a height of 1–1.5 m above ground. The samples were oven-dried at + 50°C, homogenized and dissolved in concentrated HNO₃.

The Cd content was measured using AAS (Perkin-Elmer 5000 equipped with a HGA 500 graphite furnace, an As 40 autosampler, a PRS 10 printer and a model 56 chart recorder). D₂ background correction was used. The Fe and Zn contents were measured with flame AAS (Perkin-Elmer 290 B). All the measurements were made according to the Perkin-Elmer instruction manuals.

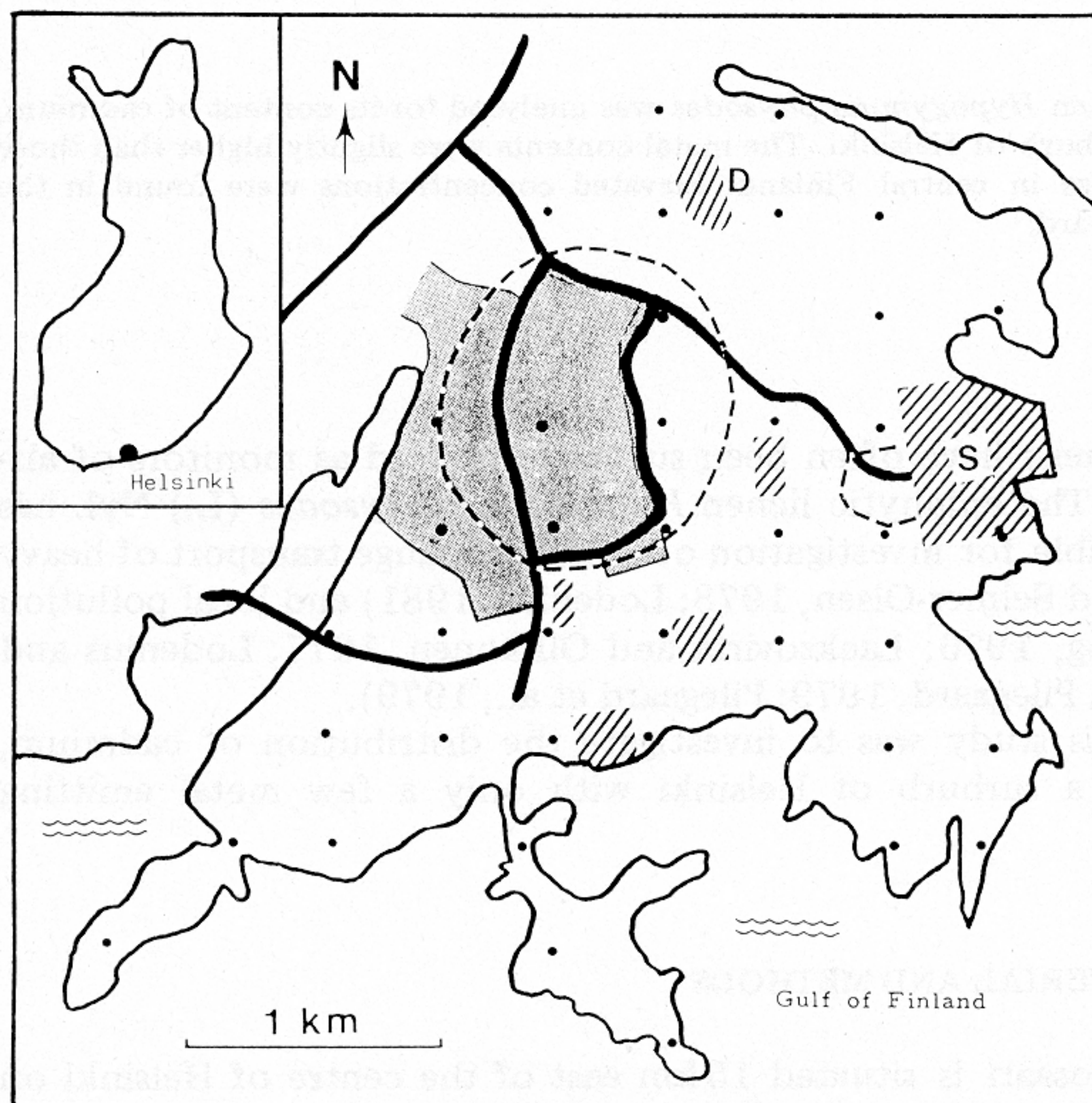


Fig. 1. The study area. Main roads (solid lines), residential area (dotted), lichen deserts (broken lines), sampling points (dots) and industrial areas (diagonal stripes) are marked. S = shipyard, D = dumping ground.

RESULTS AND DISCUSSION

The mean Cd and Zn contents of the lichens in Vuosaari were significantly higher ($p < 0.05$) than those of the control samples, while the mean Fe content was only slightly higher. The background Cd content in Vuosaari (Table 1) was very similar to that reported by Pilegaard et al. (1979) from rural sites in Denmark (0.35 mg/kg). The maximum Cd content in Vuosaari (1.6 mg/kg) was surprisingly high, considering it was found in the forest area in northern Vuosaari (Fig. 2). This value approximates that found near a Swedish brass foundry (max. 1.7 mg/kg; Folkesson, 1979) but is significantly lower than the maximum concentrations in *Hypogymnia* transplants near a Danish steelworks (21.7 mg/kg; Pilegaard, 1979). Slightly elevated Cd concentrations were also found in the vicinity of the shipyard, but there seem to be no large Cd emissions in this area. The high Cd content in mushrooms is obviously not caused by air-borne pollution.

The mean Fe content of the lichens was at the same level as reported by Seaward (1974) and Pilegaard et al. (1979). Slightly elevated concentrations were found near the shipyard, but all the values were significantly lower than the maximum values reported from the vicinity of a Finnish metal and chemical industrial complex (21,000 mg/kg; Laaksovirta and Olkkonen, 1977) and the Danish steelworks (Pilegaard, 1979).

The Zn content of *Hypogymnia physodes* in Vuosaari was also at the level reported for unpolluted areas (Mäkinen and Pakarinen, 1977; Schönbeck, 1974; Seaward, 1974; Pilegaard et al., 1979) and thus considerably lower than the maximum values from the Finnish industrial complex (5,600 mg/kg; Laaksovirta and Olkkonen, 1977), the Danish steelworks (22,000 mg/kg; Pilegaard, 1979) and the Swedish brass foundry (450 mg/kg; Folkesson, 1979). The Zn concentrations were quite evenly distributed in Vuosaari with slightly elevated values both in the residential area and near the shipyard.

The distribution of the metals shows higher values in the central and eastern parts of Vuosaari, with a maximum near the shipyard. The low

TABLE 1

Cd, Fe AND Zn CONTENTS (mg/kg dry weight) OF *HYPOGYMNIA PHYSODES* IN VUOSAARI ($n = 40$) COMPARED WITH THE CONTROL AREAS ($n = 6$)

		Vuosaari	Control areas
Cd	Mean \pm S.D.	0.50 \pm 0.27	0.29 \pm 0.12
	Range	0.15—1.6	0.13—0.48
Fe	Mean \pm S.D.	1800 \pm 1500	1500 \pm 830
	Range	770—4300	660—3000
Zn	Mean \pm S.D.	140 \pm 34	98 \pm 17
	Range	65—210	77—120

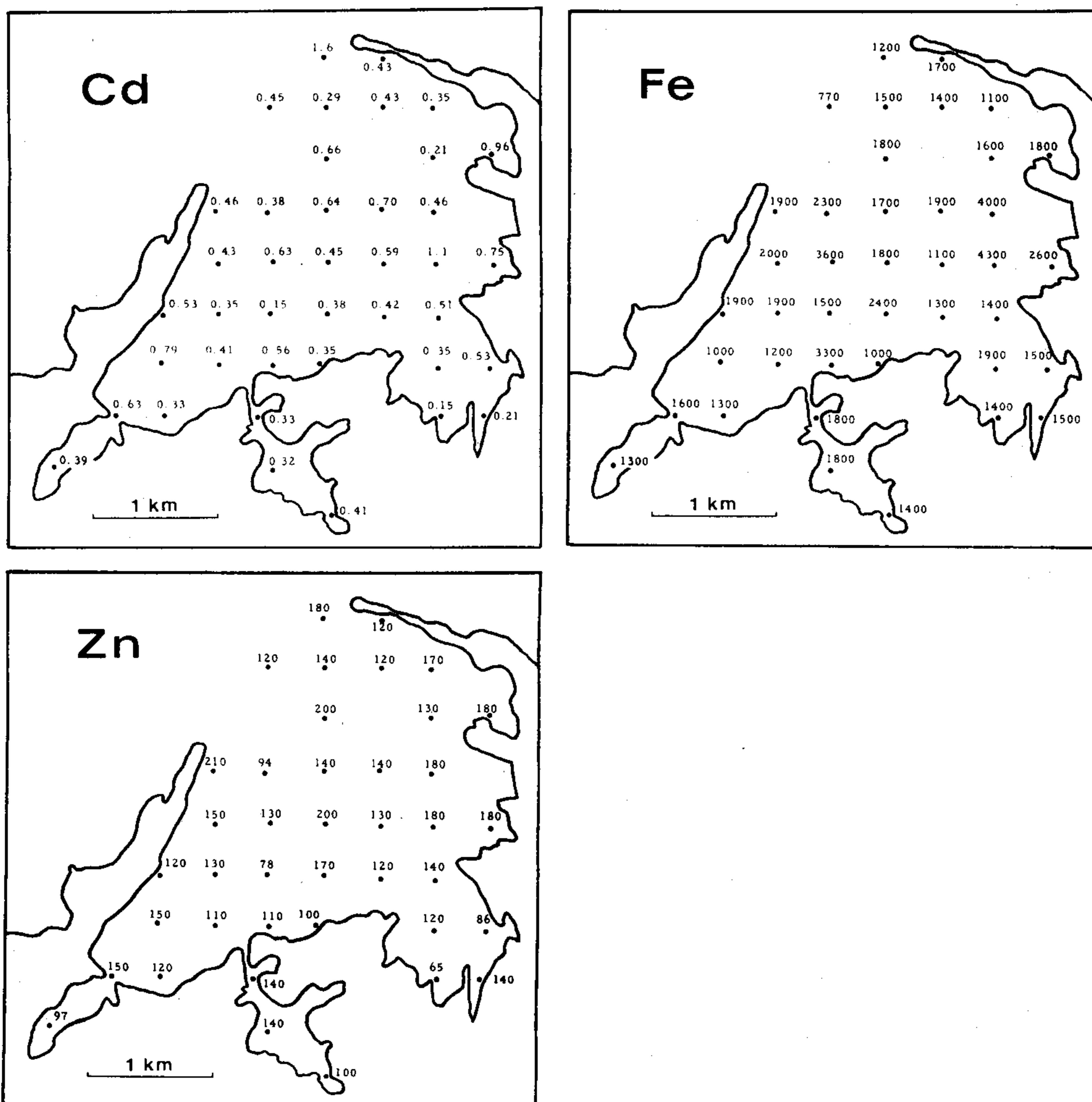


Fig. 2. Cd, Fe and Zn content (mg/kg dry weight) of *Hypogymnia physodes* in Vuosaari.

values in the northern part of the residential area may be due to the fact that the lichens were severely stunted (cf. Steinnes and Krog, 1976; Lodenius, 1981). The occurrence of Cd in the environment is often associated with Zn and a significant ($r = 0.484, p < 0.01$) correlation between these two elements was found. No correlation was observed between Fe and the other metals.

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