Preliminary Analysis of Heavy Metals and Organochlorines in Minke Whales Taken from the Coastal Japan (Sub-area 7) and Offshore Area (Sub-area 9) in the Western North Pacific

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ABSTRACT

Preliminary comparison of accumulation levels of heavy metals (Cd and Hg) and organochlorines (PCB's and DDT's) in minke whales was made for the coastal Japan (sub-area 7) and offshore area (sub-area 9) of the western North Pacific, to determine these geographical differences. Although relatively high concentrations of Cd, Hg and PCB's were observed in whales from the offshore area, it could be explained by the age-related accumulation characteristics of these pollutants. The objective could not be determined. Further analysis will be required to examine the geographical differences (maybe caused by stock or sub-stock) of these metal and pollutant accumulations.

INTRODUCTION

Expectation in studies on heavy metals and organochlorines in the North Pacific minke whale is high as a useful means to provide a key to the ongoing discussion on the presence of stock and sub-stock of the minke whale. Study on this subject is now being promoted. Although final results of the discussion will be presented after the completion of the work, this preliminary report covered a part of these analysis for male animals sampled in the Japanese whale research program under special permit in North Pacific (JARPN) in sub-area 9 of the North Pacific in 1994. Further, this report shows comparisons with analytical values of minke whales caught in the small-type coastal whaling in Ayukawa in sub-area 7 in 1987 as well as the results of preliminary discussion on the presence of differences in concentration levels in heavy metals such as cadmium (Cd), mercury (Hg) and organochlorines as PCBs and DDE.

MATERIALS AND METHODS

Samples used for analysis of heavy metals were liver and kidney of 10 males and 2 females taken from 21 minke whales sampled in sub-area 9 (north of 42 degrees N, 157-170 degrees E) in the 1994 JARPN. Concerning organochlorines, blubber samples of 10 males were used. For purpose of comparison, 23 samples of liver and 20 samples of kidney from male animals sampled at the small-type coastal whaling in Ayukawa in sub-area 7 in 1987 were supplied

for analysis of heavy metals and 10 samples of male blubber were supplied for analysis of organochlorines. The analysis of heavy metals and organochlorines followed what has been conveyed in the previous reports (Tanabe *et al.*, 1984; Honda *et al.*, 1987). The organochlorine analysis was conducted at the Ehime University.

RESULTS AND DISCUSSION

Table 1 shows the concentrations of heavy metals of male minke whales in sub-areas 7 and 9, and Table 2 shows that for female. The mean Cd concentration in male liver was 0.45ppm (range: 0.04-1.15) in sub-area 7, and 3.22 ppm (range: 1.56-7.22) in sub-area 9. The mean Cd concentration in kidney in male was 2.08ppm (0.23-5.29) and 9.37ppm (3.39-15.30) in female, thus higher value was observed in whales sampled in sub-area 9 than those sampled in sub-area 7. Further, Hg concentration in liver of male was higher in sub-area 9 (mean 0.99ppm, range: 0.32-3.19) than in sub-area 7 (mean 0.34ppm; range: 0.05-0.96), showing a similar trend as that of Cd. The Cd and Hg levels in liver and kidney in female animals also showed a similar trend as that of male, i.e. higher levels in sub-area 9 than in sub-area 7, although the number of specimens examined was small.

Table 3 shows the concentration of organochlorines in blubber. PCB and DDE concentrations in male blubber was also higher in sub-area 9 than in sub-area 7, as in the cases of Cd and Hg. The mean PCB concentration in sub-area 9 was 2.4 ppm (range: 1.8-3.1), a level double that of sub-area 7 with 1.1ppm (range: 0.69-1.4). No significant difference was observed in DDE density between the two sub-areas, with that in sub-area 7 being 1.6ppm (0.97-2.8) and that in sub-area 9 1.5ppm (1.3-1.9).

It has been clarified that these metals and pollutants such as Cd, Hg and PCBs were accumulated with age. Then, comparison using accumulation curve of the substances is necessary to compare different areas accurately. However, no useful information is available now because of the difficulty in making age determination of the North Pacific minke whale. In this paper, accumulation curve was conjectured from the relations between the concentrations of these metals and pollutants and body length and the differences in accumulation levels between sea areas were examined. Figs. 1 and 2 show Hg concentrations in liver and kidney and its relations with the body length. Figs. 3 and 4 show Cd concentrations in liver and kidney, respectively, and Fig. 5 shows PCB concentration in blubber and its relation with the body length. As pointed out in previous reports, these pollutants increased with the growth of body size. Further, the differences between areas identified from the mean value were deemed to be differences in body size of animals from which samples were collected. In other words, this is because most of animals sampled in sub-area 9 were larger than those sampled in sub-area 7, and these pollutants which have age-accumulative nature also showed a higher concentration in sub-area 9.

However, it is not possible to draw a conclusion on the difference of accumulation levels of pollutants between sea areas from the results of JARPN because the number of animals analyzed was small, examination based on accumulation curve was not made

as the age of specimens was uncertain, and the differences in years were not examined because the year in which the specimens were collected differed between areas. In order to obtain a final conclusion, it might be necessary to increase the number of specimens and conduct examination based on biological information such as age, sex and reproductive status. Further, as these pollutants are concentrated mainly through food chain, the trophic level is also an important factor. In this regard, discussion based on information on feeding habit of minke whales is also needed.

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Table 1. Comparison of concentration levels of cadmium and mercury in liver and kidney of male minke whales between Areas 7 (Ayukawa) and 9 (Offshore).

		Liver		Kidney	
		Cd (ppm)	Hg (ppm)	Cd (ppm)	Hg (ppm)
Area 7	Mean	0.45±0.32	0.34±0.18	2.08±1.16	0.13±0.12
	Range	(0.04-1.15)	(0.05-0.96)	(0.23-5.29)	(0.03-0.49)
	n	23	23	19	20
Area 9	Mean	3.22±1.62	0.99±0.76	9.37±3.65	1.29±0.77
	Range	(1.56-7.22)	(0.32-3.19)	(3.39-15.3)	(0.26-2.72)
	n	10	10	10	10

Table 2. Comparison of concentration levels of cadmium and mercury in liver and kidney of female minke whales between Areas 7 (Ayukawa) and 9 (Offshore).

		Liver		Kidney	
		Cd (ppm)	Hg (ppm)	Cd (ppm)	Hg (ppm)
Area 7	Mean	0.46±0.33	0.27±0.13	2.35±1.13	0.09±0.03
	Range	(0.13-1.26)	(0.03-0.50)	(1.14-5.18)	(0.03-0.18)
	n	14	15	12	12
Area 9	Mean	1.82	0.35	9.58	0.38
	Range	(1.55-2.09)	(0.04-0.66)	(6.25-12.9)	(0.03-0.73)
	n	2	2	2	2

Table 3. Comparison of PCBs and DDE accumulation levels (ppm) and DDE/PCBs ratio in blubber of male minke whales between Areas 7 (Ayukawa) and 9 (Offshore).

		PCBs	DDE	DDE/PCBs
Area 7	Mean	1.1	1.6	1.5
	Min	0.69	0.97	1.3
	Max	1.4	2.8	2.0
	n	10	10	10
Area 9	Mean	2.4	1.5	0.65
	Min	1.8	1.3	0.51
	Max	3.1	1.9	0.80
	n	10	10	10

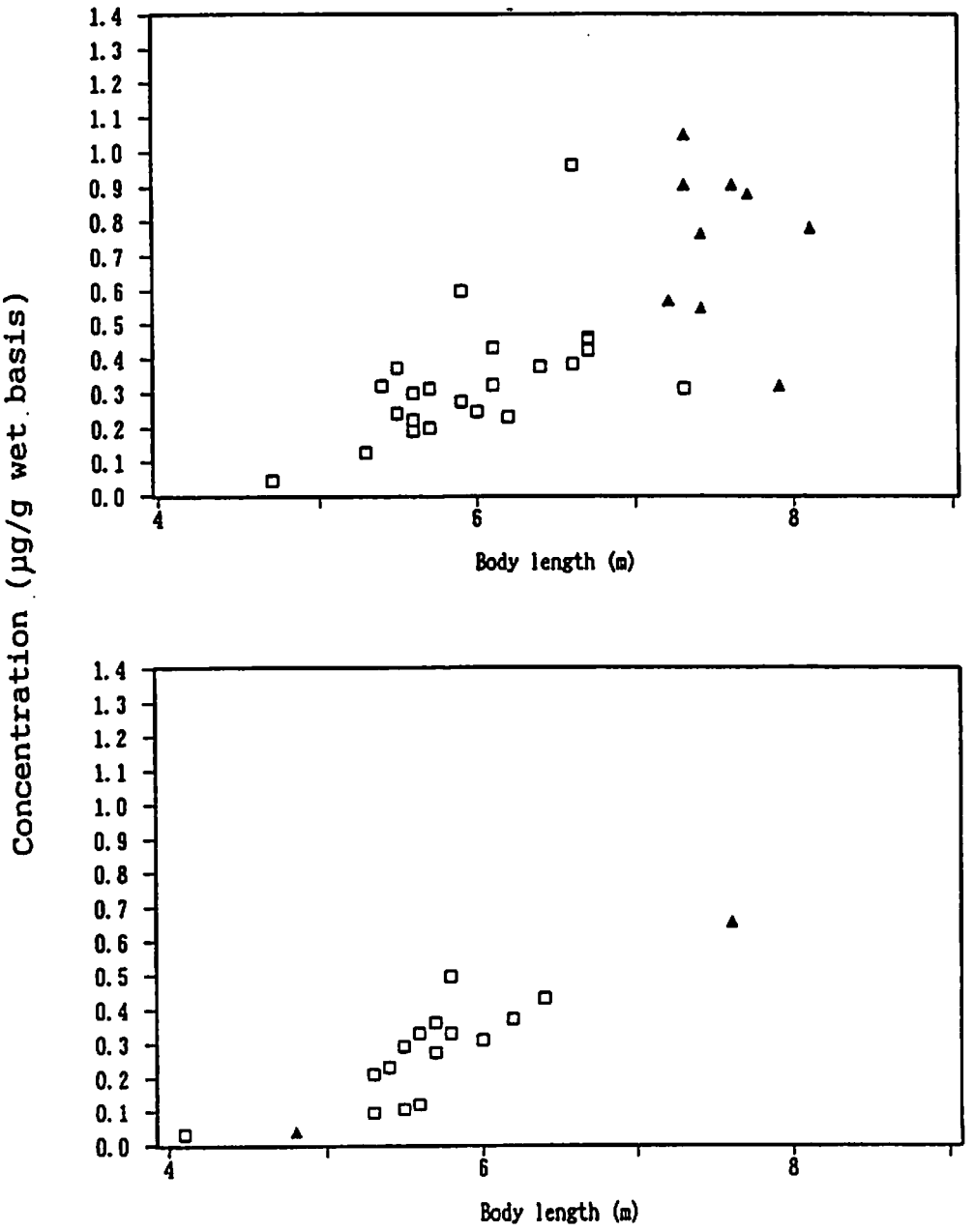

Fig. 1. Comparison of mercury concentrations (µg/g, wet basis) in liver of minke whales between Areas 7 (Ayakawa) and 9. Upper: males, bottom: females □ Area 7, ▲ Area 9

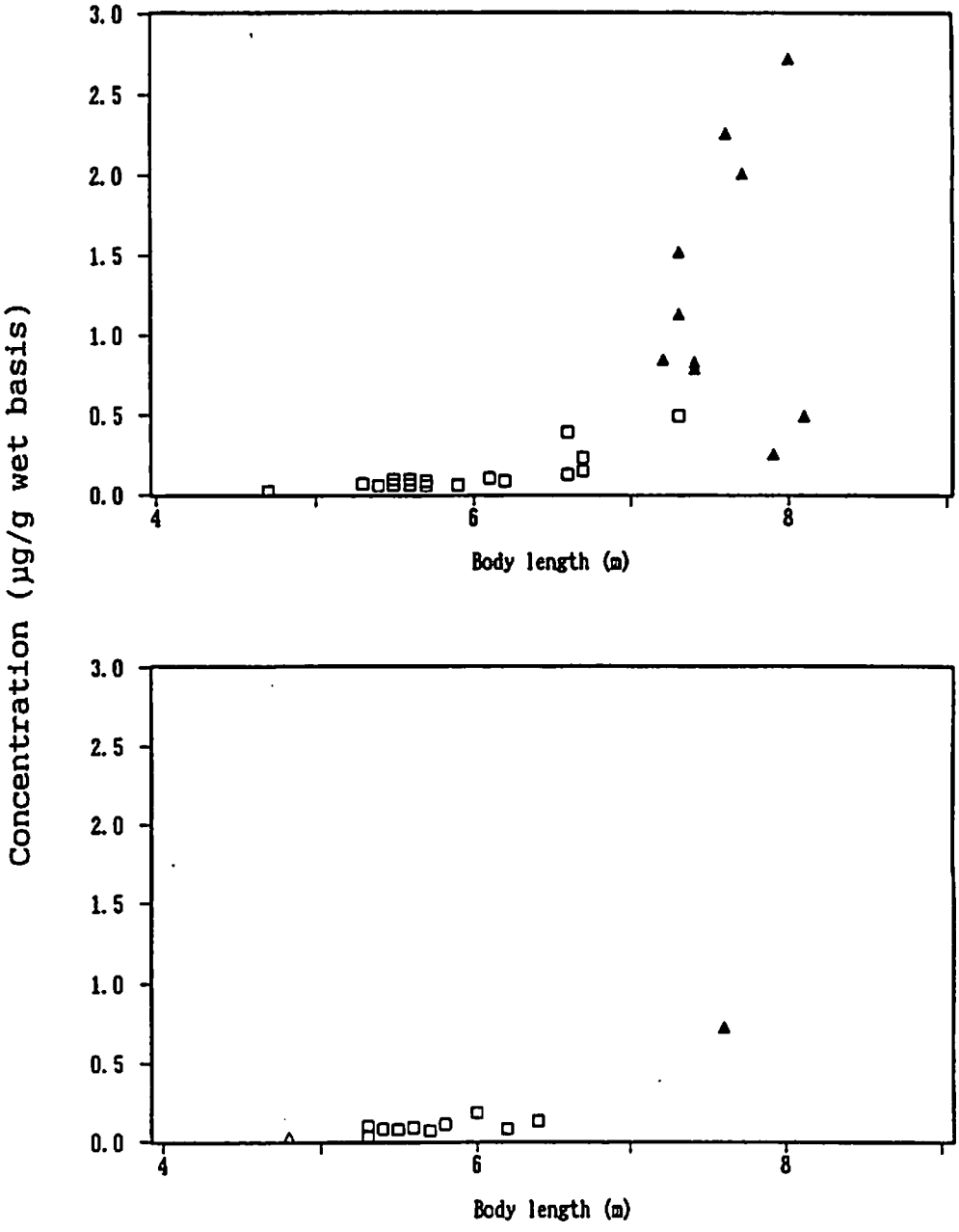

Fig. 2. Comparison of mercury concentrations (μg/g, wet basis) in kidney of minke whales between Areas 7 (Ayakawa) and 9. Upper: males, bottom: females □ Area 7, ▲ Area 9

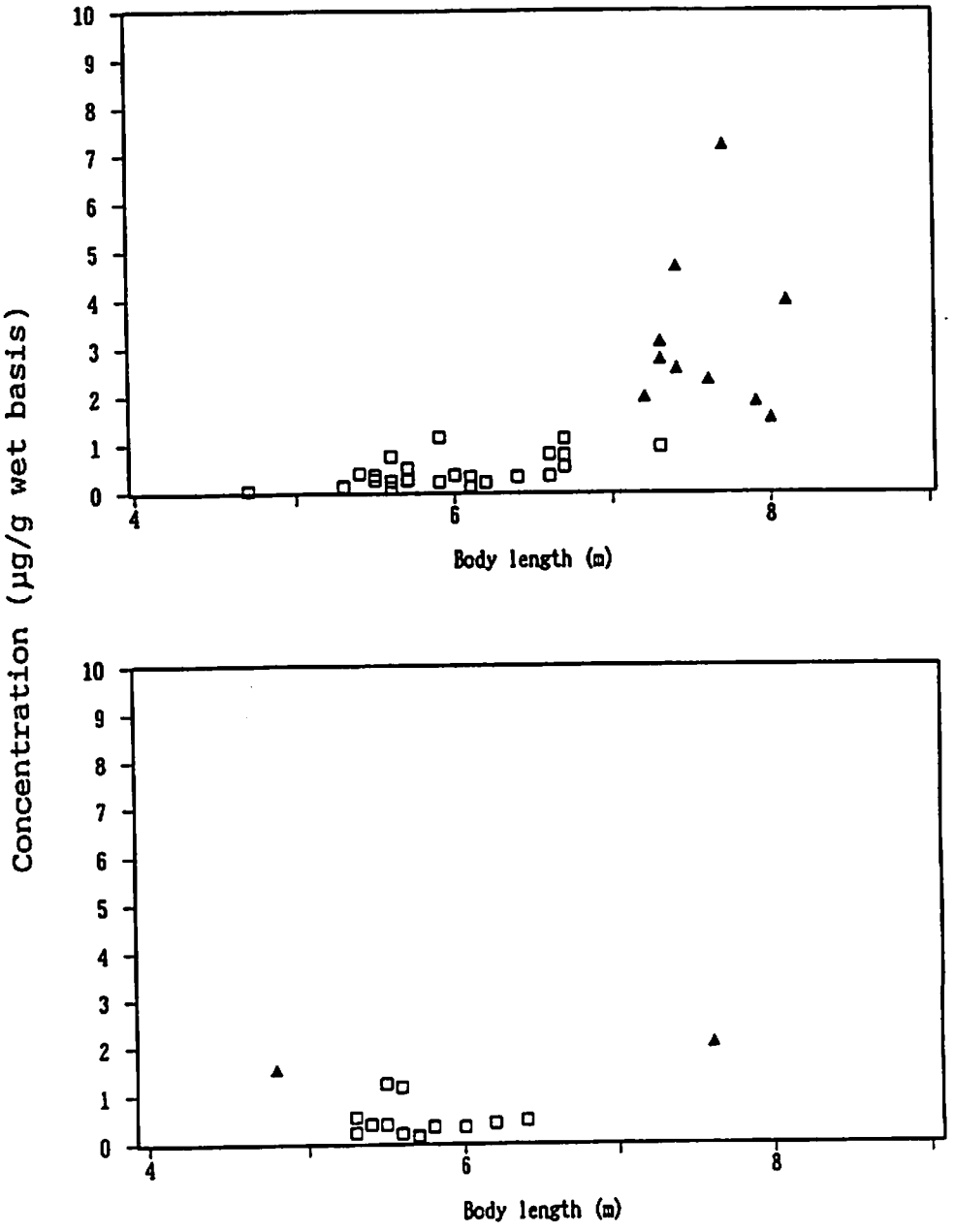

Fig. 3. Comparison of cadmium concentrations (µg/g, wet basis) in liver of minke whales between Area 7 (Ayakawa) and 9. Upper: males, bottom: females □ Area 7 ▲ Area 9

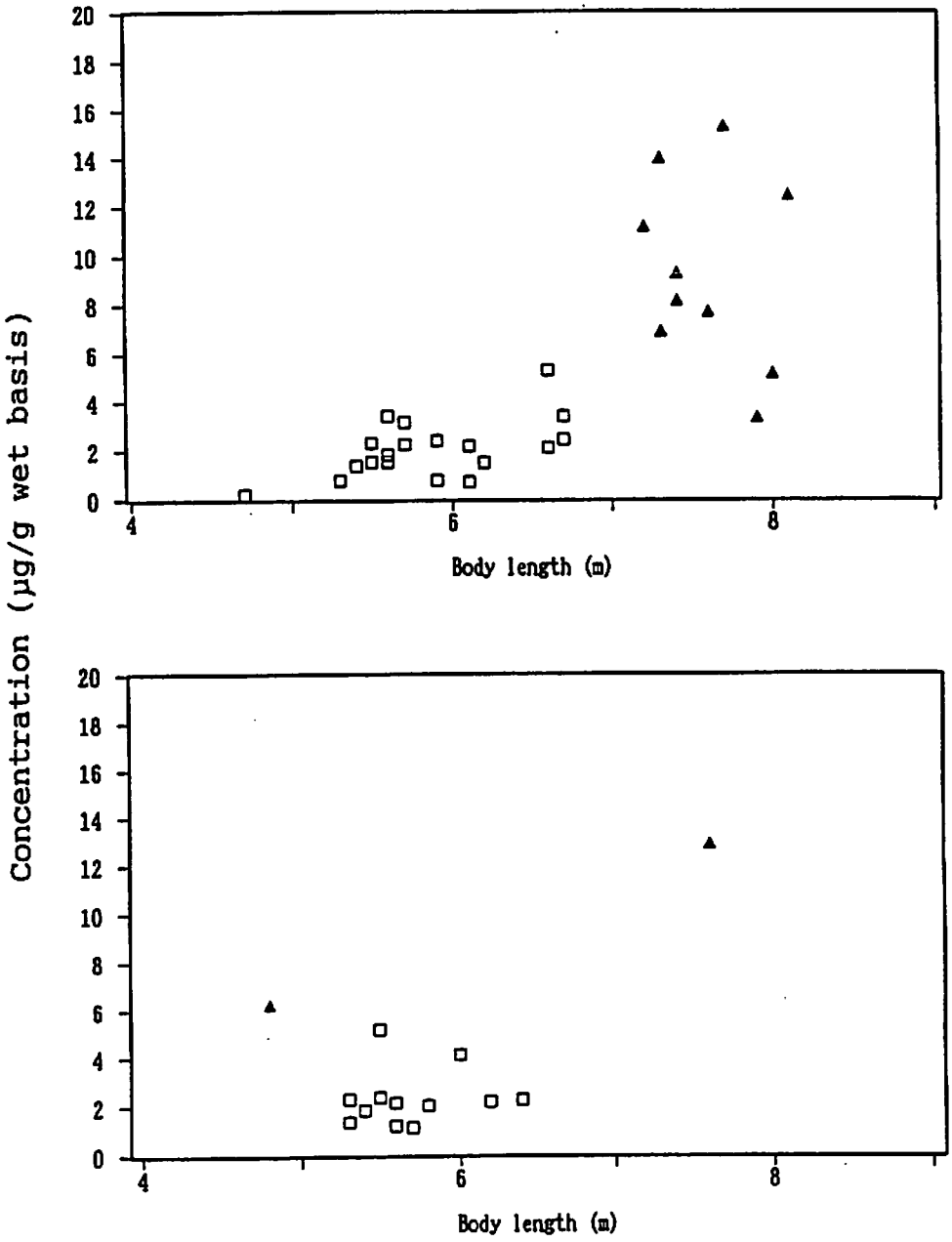

Fig. 4. Comparison of cadmium concentrations (µg/g, wet basis) in kidney of minke whales between Area 7 (Ayakawa) and 9. Upper: males, bottom: females □ Area 7, ▲ Area 9

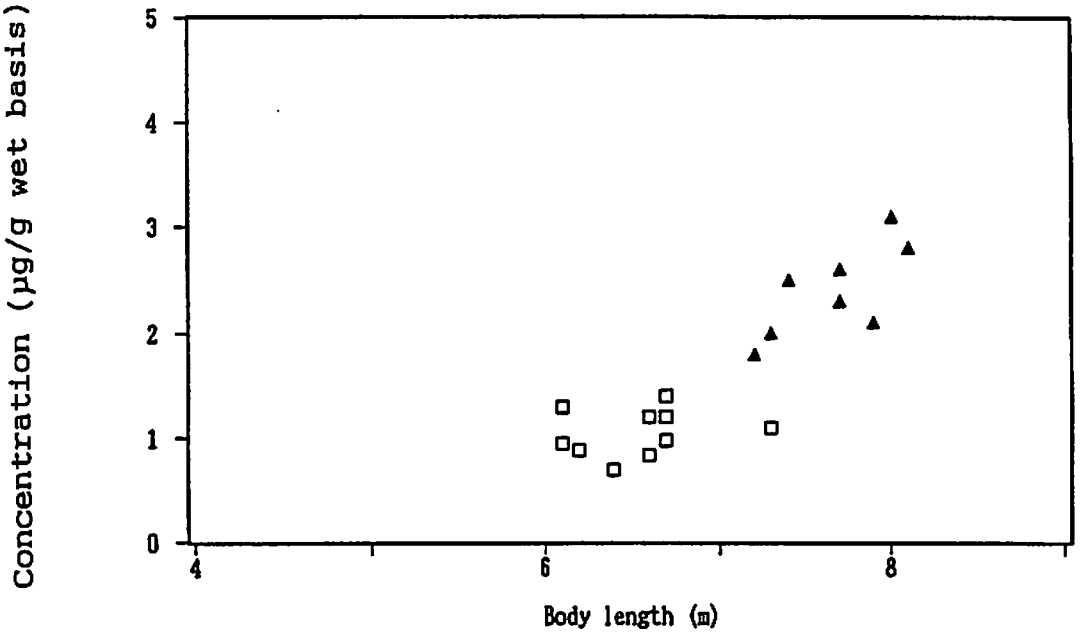

Fig. 5. Comparison of PCBs concentrations (µg/g, wet basis) in blubber of male minke whales between Area 7 (Ayakawa) and 9.
□ Area 7, ▲ Area 9