

Short Note

Polychlorinated biphenyl congeners in Antarctic biota from the Barton Peninsula, King George Island

JEONG-HOON KIM¹, HYOUN SOO LIM¹, IN-YOUNG AHN¹, SANG-HWAN LEE², MINKYUN KIM³ and HYUN PARK^{1*}¹Korea Polar Research Institute, KORDI, Songdo-dong 7-50, Yeonsu-gu, Incheon 406-840, Korea²Technology Research Center, Mine Reclamation Corporation, Seoul 110-727, Korea³Research Institute of Industrial Science & Technology (RIST), Pohang 790-600, Korea

*Corresponding author: hpark@kopri.re.kr

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Introduction

Although Antarctica is largely pristine, relatively volatile persistent organic pollutants (POPs) can be carried there by long-range atmospheric transport (Risebrough *et al.* 1976). Their highly lipophilic and persistent nature allows ready accumulation in organisms and subsequent biomagnification through the food web. Here, we describe the distribution and concentration profiles of dioxin-like PCB congeners, and estimate transference rates through the food web in various Antarctic organisms.

Methods

Antarctic organisms from various trophic levels were collected from around Narebski Point and Marian Cove, Barton Peninsula, King George Island, South Shetland Islands between 2007 and 2008. Marine sediment and marine animals were hand-collected by SCUBA divers or by using nets. The muscles and livers of southern giant petrel, brown skua, south polar skua, and gentoo penguin were collected from fresh carcasses. The eggs of south

polar skua, Antarctic tern, gentoo penguin, and chinstrap penguin were collected at the beginning of the breeding season. The Antarctic krill, black rockcod and Antarctic silverfish were collected using a fishing lamp and nets near King Sejong Station. Antarctic limpets, clam, and crustacea were collected at inter tidal zones near Narebski Point. Pooled samples were treated and extracted according to the US Environmental Protection Agency (USEPA) method 1668A (USEPA 1999), and dioxin-like PCB congeners were analysed and quantified using high-resolution gas chromatography/high-resolution mass spectrometry (HRGC/HRMS) on a DFS mass spectrometer (Thermo Fisher Scientific, Bremen, Germany) using EPA method 1668A (USEPA 1999) for PCB congeners (Park *et al.* 2009).

Results and discussion

Samples were analysed for dioxin-like PCB congeners (IUPAC 77, 81, 105, 114, 118, 123, 126, 156, 157, 167, 169, and 189) (Table I). The dioxin-like PCB concentrations were 18.52 pg g⁻¹ in sediments from *c.* 20 m depth in Marian

Table I. Concentrations of dioxin-like PCB congeners (pg g⁻¹ wet weight) in Antarctic biota.

sample organ	GP			SGP			BS		SPS		CP	AT	NC	PA	AKR	crustacea	AL	clam	Sediments*
	muscle	liver	egg	muscle	liver	muscle	liver	muscle	liver	egg	egg	egg							
PCB77	0.00	0.4	11	0	9	5	288	306	1207	211	32	9	1	36	1	5	13	1	0.24
PCB81	0.00	0.1	3	0	2	13	492	147	800	119	4	16	0	11	0	2	1	0	0
PCB105	46.1	7.5	106	161	822	1510	8716	19966	97427	16757	253	1337	15	1044	26	305	421	79	1.72
PCB114	3.3	0.6	8	27	80	123	737	1277	5101	1629	19	73	1	95	2	24	34	6	0.26
PCB118	225.8	34.0	450	1192	4402	7583	66004	117923	151369	115533	931	4046	78	6879	145	1957	2308	385	9.33
PCB123	17.2	1.0	12	16	74	7616	702	1089	4119	1289	21	82	1	563	2	19	38	4	0.16
PCB126	0	1.0	23	16	65	136	992	928	4437	1109	27	89	1	123	2	17	42	4	0.18
PCB156	46.8	7.5	63	314	1692	3483	22386	33961	161576	31595	138	829	30	2705	60	600	1022	163	2.93
PCB157	11.4	1.4	18	52	367	628	3718	7681	29950	8185	34	235	7	550	12	153	203	39	0.62
PCB167	32.7	6.5	56	259	1443	3509	26013	33383	144235	28076	123	603	30	2791	62	555	1033	150	2.45
PCB169	0	1.0	21	0	127	301	2306	1227	6479	1438	34	65	2	295	6	26	104	6	0
PCB189	0	2.2	0	67	0	1250	0	0	0	0	14	132	13	0	26	238	443	20	0.63
Total	383	63	769	2104	9082	26156	132353	217887	606701	205940	1630	7517	177	15093	345	3901	5661	856	18.52

GP = gentoo penguin, *Pygoscelis papua*, SGP = southern giant petrel, *Macronectes giganteus*, BS = brown skua, *Catharacta lomnbergi*, SPS = south polar skua, *Catharacta maccormicki*, CP = chinstrap penguin, *Pygoscelis antarctica*, AT = Antarctic tern, *Sterna vittata*, NC = *Notothenia coriiceps*, PA = *Pleurogramma antarcticum*, AKR = Antarctic krill, *Euphausia superba*, crustacea, *Gondogeneia antarctica*, AL = Antarctic limpet, *Nacella concinna*, clam = *Laternula elliptica*.
* pg g⁻¹ dry weigh.

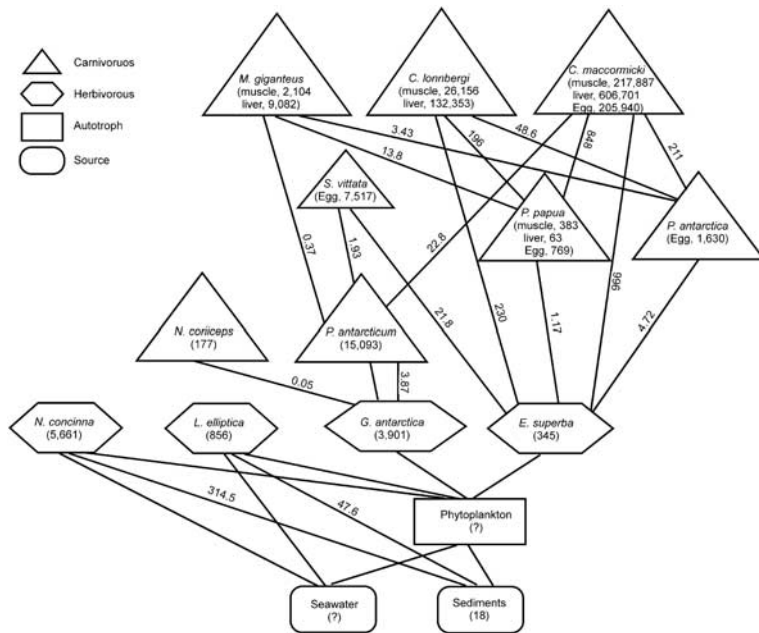


Fig. 1. Transference rates of PCBs and ecological relationships between organisms and the abiotic environment. The numbers within the boxes are the total PCB concentrations (pg g^{-1}) and the numbers on the lines are the transference rates.

Cove. The mean dioxin-like PCB concentrations were 0.35 ng g^{-1} in krill, 3.9 ng g^{-1} in amphipods, 15.1 ng g^{-1} in silverfish, 4.1 ng g^{-1} in gentoo penguin, and 1.6 ng g^{-1} in chinstrap penguin eggs. Species of south polar skua and brown skua regarded as predators, scavengers, and kleptoparasites in this area (Malzof & Quintana 1998) had the highest concentration of ΣPCB . The uptake of contaminants by lower level biota, such as plankton, bivalves, and crustaceans is by bioconcentration from the abiotic environment. Biomagnification in higher trophic level biota is from contaminant uptake is by feeding on lower trophic levels (Gray 2002). The higher concentration of dioxin-like PCBs in predators (brown skua and south polar skua) compared with amphipods etc. confirms the importance of biomagnification. The highest transference rates were observed in the link between the highest carnivorous predators (two skua species) and their major prey, penguins and krill (Fig. 1). This study is the first to report dioxin-like PCB concentrations and bioaccumulation in various food web levels around Narębski Point (ASPA No. 171). Further comprehensive studies of contamination, including other POPs and heavy metals, will be conducted in this area.

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