CHEMICALS
IN THE ENVIRONMENT

Report on Environmental Survey and Monitoring
of Chemicals in FY2003

Environmental Health Department
Ministry of the Environment
Government of JAPAN

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Substance

BHC (HCH)	Benzenehexachloride (Hexachloro cyclohexane)
CFC	Chlorine fluorine carbons
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
HCB	Hexachlorobenzene
PBDD	Polybrominated dibenzo-*p*-dioxin
PBDE	Polybrominated diphenyl ether
PBDF	Polybrominated dibenzofuran
PCB	Polychlorinated biphenyl
PCDD	Polychlorinated dibenzo-*p*-dioxin
PCDF	Polychlorinated dibenzofuran
TBT	Tributyltin compounds
TPT	Triphenyltin compounds

Other

CAS RN	CAS(Chemical Abstracts Service) Registry Number
FY	Fiscal Year (from April to March)
GC/MS	Gas Chromatography / Mass Spectrometry
LC/MS	Liquid Chromatography / Mass Spectrometry
MOE	Ministry of the Environment
MQL	Measured Quantitation Limit
ND	Not Detected
OECD	Organisation for Economic Co-operation and Development
POPs	Persistent Organic Pollutants
PRTR	Pollutant Release and Transfer Register

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Chemicals in the Environment

Introduction

The number of industrially produced chemical substances is estimated to be in the tens of thousands. Chemical substances have become indispensable in our daily lives, but they may also affect human health and the ecosystem, depending on the method employed for their production, use and disposal. Indeed, dioxins, PCBs, endocrine disruptors and other substances have caused serious social problems.

The Ministry of the Environment (MOE), Government of Japan, has been conducting successive investigations on the persistence of chemical substances in the general environment since 1974 and has published the results in "Chemicals in the Environment." The results of environmental surveys of FY2002 are compiled in "Chemicals in the Environment (FY2003)." We hope that those concerned with this issue will utilize this report and that the information provided will be helpful for the environmental preservation of this country.

Scope of investigation included in this report

As a method for selecting target substances, the following three types of surveys, each with their own purpose, were introduced so that the survey results could be effectively utilized for measures against chemical substances in the environment.

Initial Environmental Survey for grasping the status of environmental persistence of chemical substances and others, targeting the Designated Chemical Substances by the Law Concerning the Examination and Manufacture, etc. of Chemical Substances (hereinafter called the Chemical Substances Control Law), candidate substances for the PRTR System, unintentionally formed substances, and the substances required by social factors.

Environmental Survey for Exposure Study for grasping the exposure amount of chemical substances to humans and wildlife, which is necessary for the environmental risk assessment.

Monitoring Investigation for monitoring target substances included in the Stockholm Convention on Persistent Organic Pollutants (hereinafter called the POPs Treaty) and other substances that are possible candidates for target substances of the Treaty; highly persistent substances for which environmental standards are not yet established but grasping their annual environmental status is required from among Class 1 & 2 Specified Chemical Substances and Designated Chemical Substances specified in the Chemical Substances Control Law.

To avoid duplication, the results of chemical substances (dioxins, etc.) that have been monitored by other divisions of MOE are not included in this report (see below).

Environmental Investigation by Other Divisions of MOE

Name of Investigation	Media	Target Chemical Substances
Monitoring Investigation of Hazardous Air Pollution Substances	Air	Benzene, Aldehydes, Mercury and its compounds, Benzo[*a*]pyrene, etc.(19 species)
Water Quality Monitoring	Surface water, Ground water	Cadmium, Total Cyanogen, etc.
Environmental Investigation on Agrochemicals	Soil, Agricultural products, Air, Suface water	Pesticides
Monitoring of the Precautionary Monitoring Targets	Surface water, Ground water	Chloroform, *trans*-1,2-Dichloroethylene, etc.
Priority Substances for the Survey on Method and Monitoring	Water environment	Zinc, etc.
Investigation of Dioxins	Air, Surface water, Bottom sediment, Soil, Wildlife	PCDDs, PCDFs, Coplanar PCBs, PBDDs, PBDFs

Chapter 1 Outline of Environmental Investigation on the Status of Pollution by Chemical Substances

1. History of the General Inspection Survey

The Chemical Substance Control Law (see Table 1-1 and Appendix A) was enacted in 1973 and in response to the law, the Environment Agency of Japan (the former MOE) initiated successive environmental safety inspections, namely the General Inspection Survey of Chemical Substances on Environmental Safety, for the purpose of grasping the persistence of existing chemical substances in the general environment. In the First (FY1979-1988) and Second Comprehensive Survey of Chemical Substances on Environmental Safety, a total of about 800 substances were selected from among the Priority List (First term: about 2,000, Second term: about 1,100 substances). In addition to the above, Wildlife Monitoring, Follow-up Survey of the Status of Pollution by Unintentionally Formed Chemical Substances, and Monitoring of Surface Water and Bottom Sediment had been undertaken.

In the intervening time, in order to correspond to status change relating to the chemical substances and environmental issues such as the enactment of the Law Concerning Reporting, etc. of Releases to the Environment of Specific Chemical Substances and Promoting Improvement Their Management (hereinafter called the PRTR Law), effectuation of the POPs Treaty and efforts to address the endocrine disruptor issue, as well as to cope with the current political issues, it became necessary to reconstruct the survey system based on the new standpoint. Thus, revision work on the survey policy was initiated in FY2001 and the Revision of the General Inspection Survey of Chemical Substances was approved at the Special Committee for the Assessment of Chemical Substances, Central Environment Council held on May 2002.

Surveys have been conducted since FY2002 based on the revision policy, where substances were selected by the Expert Group on Substance Selection (in the General Inspection Survey) corresponding to the needs of various divisions of governmental and other organizations so that the survey results might be utilized for the prevention of pollution by chemical substances in the environment. These surveys have been carried out using methods suitable for the respective purposes of the Initial Environmental Survey, the Environmental Survey for Exposure Study and the Monitoring Investigation.

Table 1-1 Outline of the Chemical Substances Control Law (see also Appendix A)

Enactment (amendment): 1973 (1986)

Purpose: 1) Prevention of environmental pollution by chemical substances that are not readily degradable and have the potential to affect human health;

2) Enactment of necessary regulations on the production, import, and use of new chemical substances in response to the examination of their characteristics.

Contents: Regulation (substantial prohibition) on production and import of "Class 1 Specified Chemical Substances" that are not readily biodegradable, are highly accumulative and chronically toxic. Regulation (notification of production, import amount, etc.) on production and import of hardly biodegradable and chronically toxic "Class 2 Specified Chemical Substances," and regulation (report of production, import amount, etc.) on "Designated Chemical Substances" that are hardly degradable and suspected as being chronically toxic.

Figure 1-1 System of the General Inspection Survey (conceptual diagram)

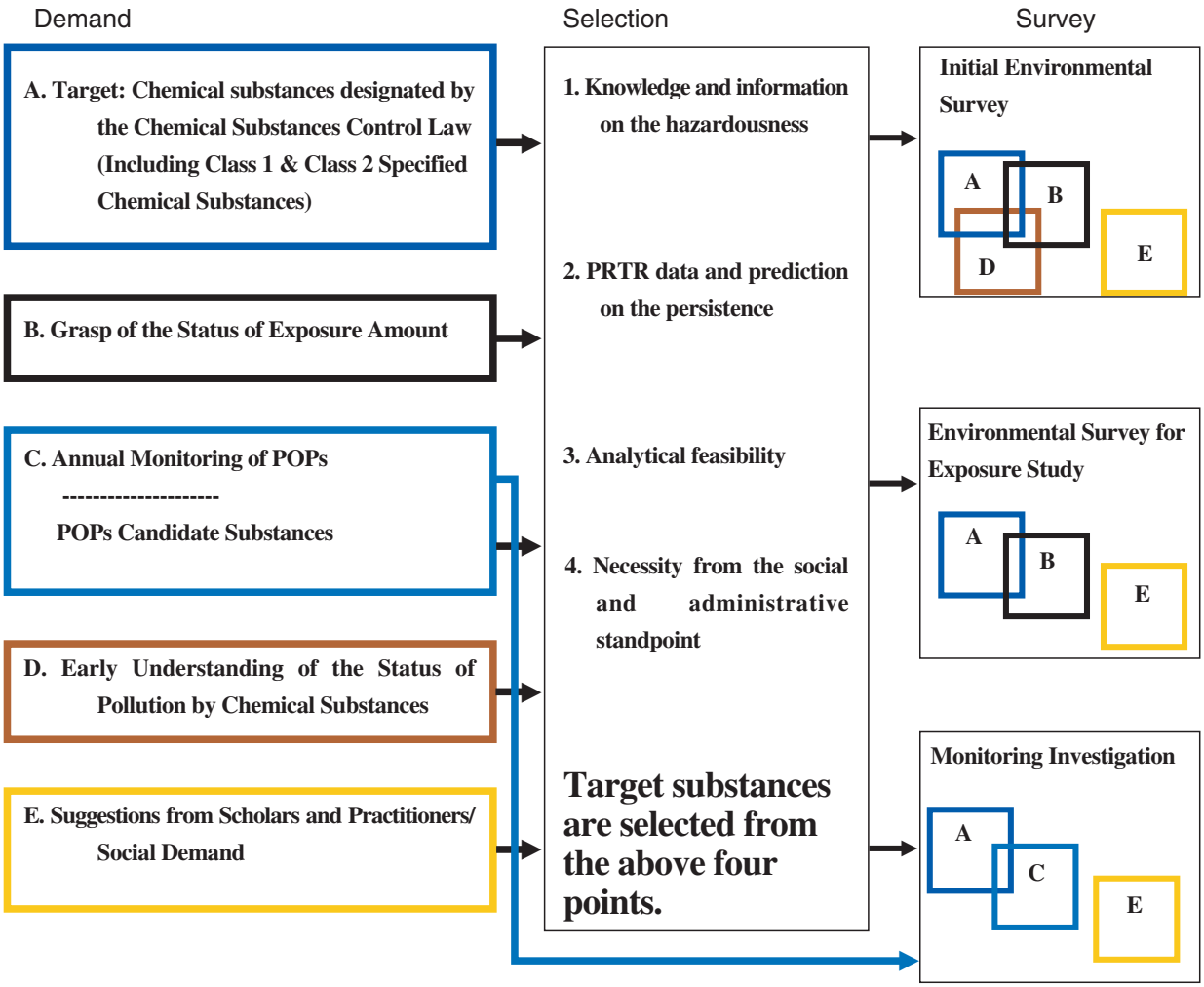
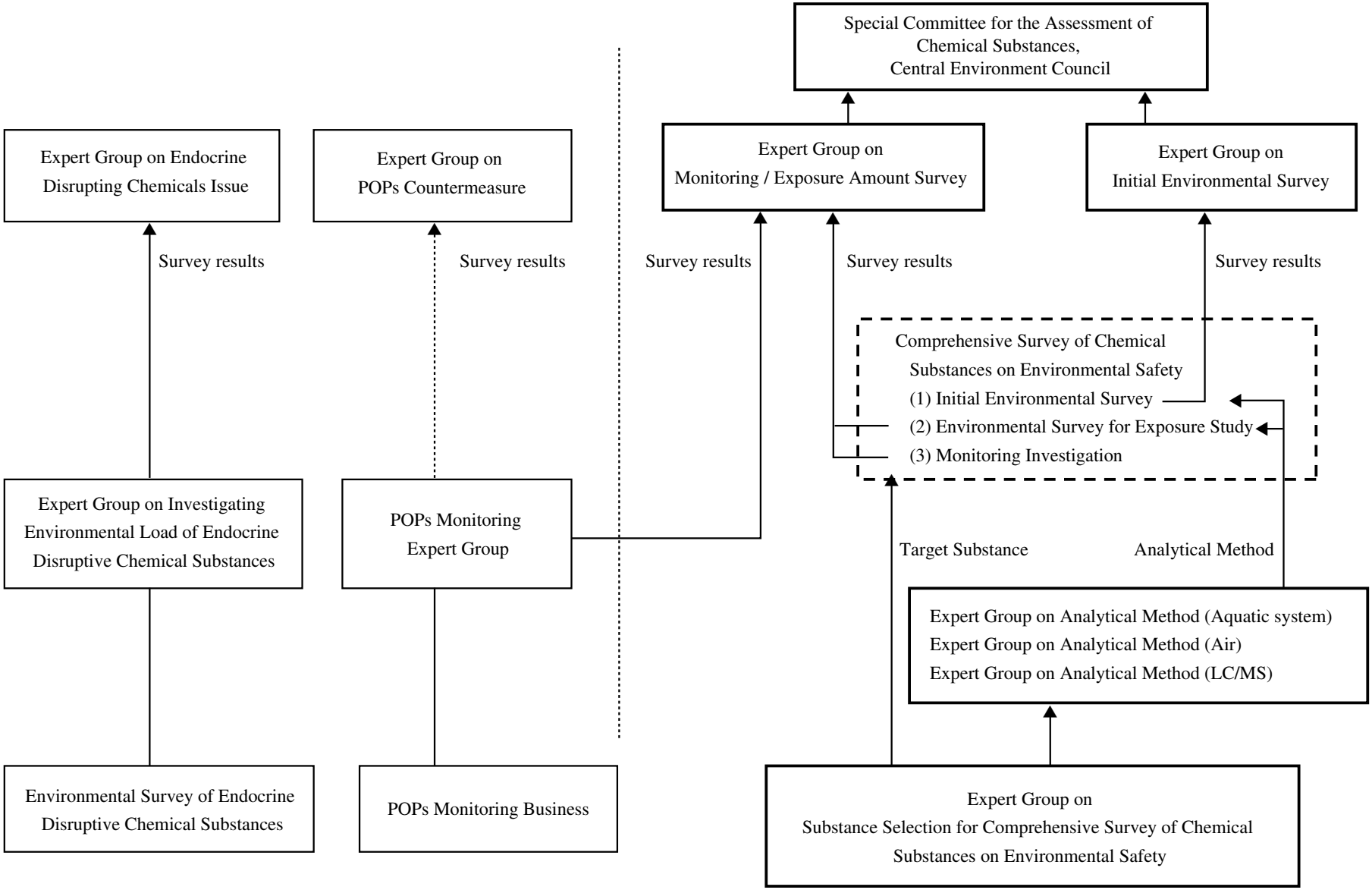


Figure 1-2 System of the Expert Groups for the FY2002 General Inspection Survey of Chemical Substances

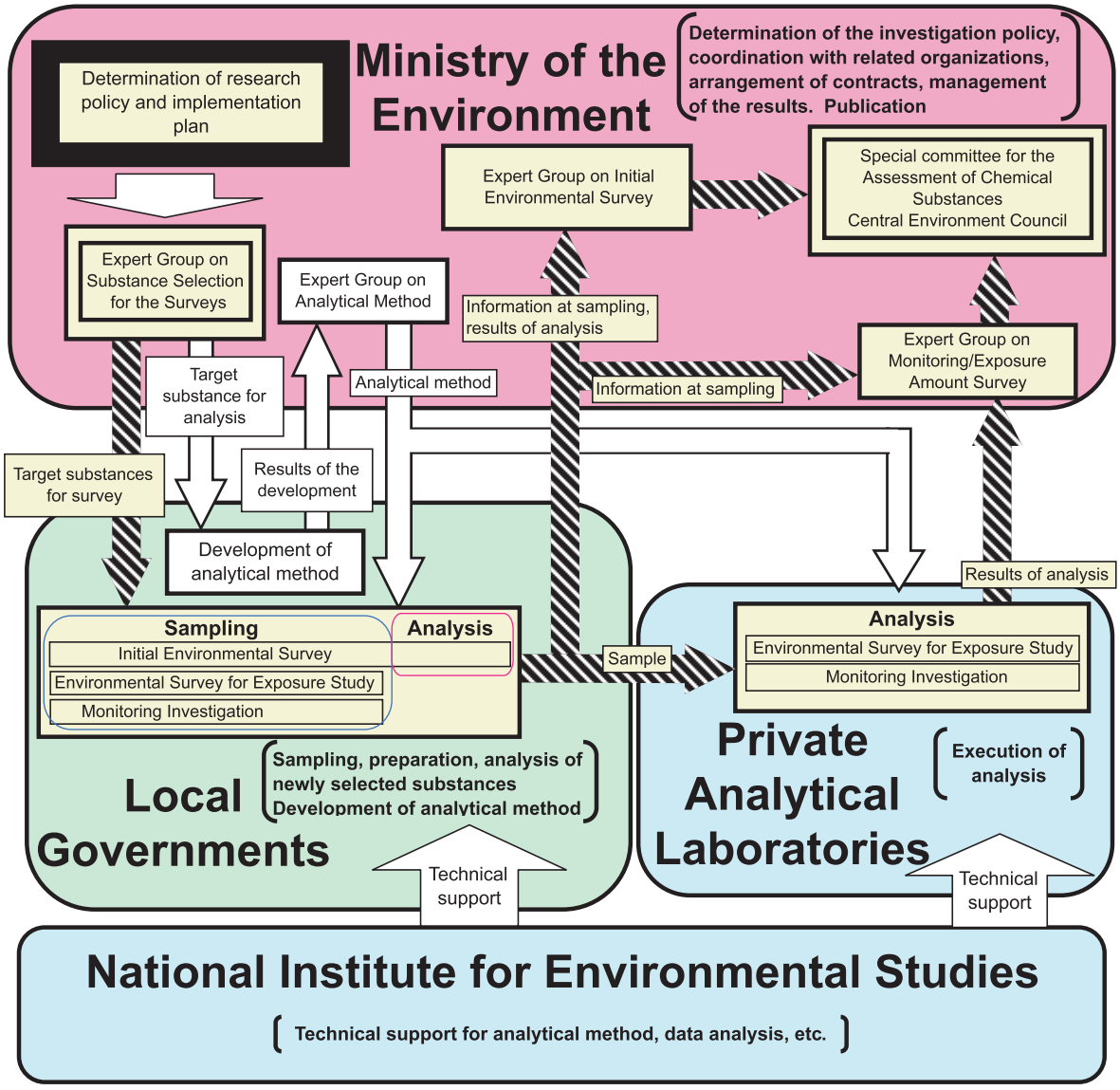


2. FY2002 Expert Group on Substance Selection for the General Inspection Survey

In June and July 2002, meetings of the Expert Group on Substance Selection were held for the purpose of discussing and selecting target substances, requested from various divisions of governmental organizations, and other substances recommended by scholars and practitioners as substances for which investigation is necessary, based on toxicity information; PRTR data and, if possible, prediction results of environmental persistence; feasibility of establishing analytical methods; and from the standpoint of social and administrative needs.

Survey media was also discussed and selected at the meeting, taking into consideration the relationship between the possible exposure route and media, for instance, selecting multiple media for a specific substance. Consequently, target substances and media for the FY2002 Initial Environmental Survey, Environmental Survey for Exposure Study and Monitoring Investigation in the General Inspection Survey were selected.

Figure 1-3 System of the General Inspection Survey – Organizations and Their Roles



3. Scope of the survey

(1) Initial Environmental Survey

The purpose of this survey is to grasp the status of environmental persistence of chemical substances and others targeting the Designated Chemical Substances specified in the Chemical Substances Control Law, candidate substances for the PRTR System, unintentionally formed substances, and substances required by social factors. Furthermore, development of analytical methods and assessment of the survey results were conducted, when necessary. In FY2002, 13 substances (groups) including epichlorohydrin, chlorodifluoromethane (CFC-22), and bromomethane were selected as the survey target. In addition, development of analytical methods for 8 substances (groups) including chlordecone has been started.

(2) Environmental Survey for Exposure Study

In the FY2002 survey, 6 substances (groups) including 1,2-dichlorobenzene, perfluorooctane sulfonic acid (PFOS), polychlorinated naphthalene, brominated diphenyl ethers, and benzo[*a*]pyrene were selected as target substances.

(3) Monitoring Investigation

In this Monitoring Survey, substances for which environmental persistence is high but environmental standards are not yet established and a grasp of their annual environmental status is required, were selected as the target substances for the survey from among those included in the POPs Treaty, substances that could be candidate target substances of the Treaty, Class 1 & 2 Specified Chemical Substances and Designated Chemical Substances specified in the Chemical Substances Control Law. In the FY2002 survey, 8 substances (groups) including 6 POPs and organotin compounds were selected as target substances.

Chapter 2 Summary of the FY2002 Initial Environmental Survey

1. Purpose of the Survey

The purpose of this Initial Environmental Survey is to grasp the status of environmental persistence of those substances such as Designated Chemical Substances specified in the Chemical Substances Control Law, candidate substances for the PRTR system, unintentionally formed chemical substances and the substances required by social factors.

2. Surveyed substances, media and areas

In the FY2002 Initial Environmental Survey, the following 13 substances (groups) totaling 24 substances-media, which had been discussed and selected from among substances and media given priority at the FY2002 Expert Group on Substance Selection for the Comprehensive Survey of Chemical Substances on Environmental Safety were surveyed.

Table 2-1 Target Substances and Media for the FY2002 Initial Environmental Survey

Survey No.	Target substance	Number of surveyed areas per media			
		Surface water	Bottom sediment	Aquatic wildlife	Air
1	Isoprene	14	14		
2	Epichlorohydrin				6
3	1-Octanol	19	19	8	
4	Chlorodifluoromethane				15
5	*p*-Chloronitrobenzene			9	
6	Dinitrotoluene				8
7	Methylbromide	16			
8	Terephthalic acid	23	22		
9	2,4,6-Tri-*tert*-butylphenol	20	19	7	
10	Nitrobenzene	18	17		6
11	Polychlorinated terphenyls {total, 1–14 chlorides and 9 isomers (groups)}	10	10	2	
12	Methacrylic acid				11
13	Methyl-*tert*-butyl ether	18	18		

Surveys for surface water were conducted on 1 to 8 substances (groups) at 29 areas including 8 areas where all 8 target substances were surveyed; for bottom sediment on 1 to 7 substances (groups) at 27 areas including 8 areas where all 7 substances (groups) were surveyed; for aquatic wildlife on 1 to 4 substances (groups) at 10 areas including 2 areas where all 4 target substances (groups) were surveyed; and for air on

1 to 5 substances (groups) at 18 areas including 4 areas where all 5 substances (groups) were surveyed.

Surveyed areas of the FY2002 Initial Environmental Survey are shown in Figure 2-1 (surface water, bottom sediment), Figure 2-2 (aquatic wildlife) and Figure 2-3 (air).

3. Sampling and analytical method

Suggested sampling and analytical methods are shown in Appendix C and Appendix D, respectively.

4. Survey results

Five substances (groups) in surface water, 4 substances (groups) in bottom sediment, 2 substances (groups) in aquatic wildlife, and 5 substances (groups) in air were detected.

Detection results of the FY2002 Initial Environmental Survey are shown in Table 2-3, and the detection results of polychlorinated terphenyl homologs and their isomers are shown in Table 2-4.

A total of 801 substances (groups) were surveyed in the past (from FY1974 to FY2002), of which 346 substances (groups) were detected in the general environment.

Table 2-2 Summary of Results of the Environmental Survey

	Surface water	Bottom sediment	Aquatic wildlife	Air	Total
Number of surveyed substances	765*	739	251	248	801*
Number of detected substances	157*	236	101	162	346*
Ratio of detection (%)	20.5*	31.9	40.2	65.3	43.2*

* : In the FY2002 survey, 2 substances (perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) for surface water were newly surveyed in the Environmental Survey for Exposure Study.

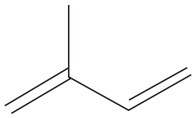
5. Evaluation of the survey results

In the FY2002 survey, 9 substances (groups) from among the 13 substances (groups) {epichlorohydrin (air), 1-octanol (surface water, bottom sediment, wildlife), chlorodifluoromethane (air), dinitrotoluene (air), terephthalic acid (surface water, bottom sediment), nitrobenzene (surface water, bottom sediment, air), polychlorinated terphenyl (surface water, bottom sediment, wildlife), methacrylic acid (air), and methyl-*tert*-butyl ether (surface water)} were detected.

Survey number	Target substance	Status of survey (√ : detected, n: not detected, --: not surveyed)			
		Surface water	Bottom sediment	Aquatic wildlife	Air
1	Isoprene	n	n	--	--
2	Epichlorohydrin	--	--	--	√
3	1-Octanol	√	√	√	--
4	Chlorodifluoromethane	--	--	--	√
5	*p*-Chloronitrobenzene	--	--	n	--
6	Dinitrotoluene	--	--	--	√
7	Methylbromide	n	--	--	--
8	Terephthalic acid	√	√	--	--
9	2,4,6-Tri-*tert*-butylphenol	n	n	n	--
10	Nitrobenzene	√	√	--	√
11	Polychlorinated terphenyls	√	√	√	--
12	Methacrylic acid	--	--	--	√
13	Methyl-*tert*-butyl ether	√	n	--	--

Evaluations of survey results for each substance (group) are described below.

[1] Isoprene (CAS RN: 78-79-5; surveyed media in FY2002: surface water and bottom sediment)



Chemical formula / molecular weight: C_5H_8 / 68.13

Melting point: -145.95°C [1] , -146.7°C [2]

Boiling point: 34.067°C [1]

Water solubility (Sw): 300 mg/L (20°C)[3]

Specific gravity: 0.681[1]

n-Octanol/water partition coefficient (LogPow): 2.30 (observed value)[4]

Degradability: Not easily degradable [16]

Accumulativeness: Low concentration [16]

Use: Mainly raw material for synthetic rubber; raw material for geraniol, linalool, flavor and others; raw material for intermediates of agrochemicals such as chrysanthemic acid; raw material for isophytol [15]

Production / import amount:

Production amount: About 80,000 t [10] in FY2001

Released amount (Reported by PRTR): FY2001

Released to the atmosphere: 122,140 kg/year

Released to public water bodies: 0 kg/year [27]

Survey results

In FY1978, survey of isoprene in surface water was conducted in 4 areas under the detection limit of 1 μg/L and it was not detected. In FY2002, survey was conducted under the detection limit of 0.1 μg/L and it was not detected in any surveyed areas. Although isoprene was not detected in the past surveys, it is difficult to grasp the tendency of its persistence, as the value of the detection limit in the past was high.

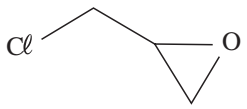
In FY1978, survey of isoprene in bottom sediment was conducted in 4 areas under the detection limit of 1 ng/g-dry and it was not detected. In FY2002, survey was conducted under the detection limit of 10 ng/g-dry and it was not detected in any surveyed areas. As isoprene was not detected in the past surveys, it can be judged to have no significant increase in concentration.

As shown in the above data, isoprene was not detected in surface water or bottom sediment and it was confirmed that isoprene is not persistent in either surface water or bottom sediment under the detection limit adopted in this survey.

○ Survey Results of Isoprene

Media	Year	Detection frequency (number)		Detected range	Detection limit
		Sample	Area		
Surface water	FY1978	0% (0/12)	0% (0/4)	---	1 μg/L
	FY2002	0% (0/42)	0% (0/14)	---	0.1 μg/L
Bottom sediment	FY1978	0% (0/12)	0% (0/4)	---	1 ng/g-dry
	FY2002	0% (0/42)	0% (0/14)	---	10 ng/g-dry

[2] Epichlorohydrin (CAS RN: 106-89-8; surveyed media in FY2002: air)



Chemical formula / molecular weight: $C_3H_5C\ell O$ / 92.53

Melting point: -25.6°C [4)]

Boiling point: 117.9°C [4)]

Water solubility (Sw): 60,000 mg/L (20°C) [5)]

Specific gravity: 1.18122)

n-Octanol/water partition coefficient (LogPow): 0.45 [6)]

Degradability: Easily degradable [16)]

Accumulativeness: BCF: 3 (calculated value)[22)]

Use: Raw material for epoxy resin, synthetic glycerin, glycidyl methacrylate, detergent, ion exchange resin and others; processor for textiles; solvent, plasticizer, stabilizer, insecticide and bactericide; raw material for pharmaceuticals, intermediates for organic synthesis [10)]

Production / import amount:

Domestic production amount in FY2001: 119,806 t
Import amount: 12,431 t
Export amount: 26,570 t [10)]
Estimated amount of domestic circulation: 105,667 t
Reported production amount to OECD: Over 10,000 t [24)]

Released amount (Reported by PRTR):

Released to the atmosphere: 95,247 kg/year [27)]
Released to public water bodies: 1,869 kg/year [27)]

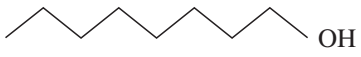
Survey results

Survey of epichlorohydrin in air was carried out in FY2002 for the first time. The survey was conducted under the detection limit of 0.14 ng/m^3 and epichlorohydrin was detected in 4 areas out of 5, with the maximum detected value being 2.8 ng/m^3. Thus, it was confirmed that epichlorohydrin is persistent in air under the detection limit adopted in this survey.

○Survey Results of Epichlorohydrin

Media	Year	Detection frequency (number)		Detected range	Detection limit
		Sample	Area		
Surface water	FY1977	0% (0/3)	0% (0/2)	---	10 μg/L
	FY1986	0% (0/27)	0% (0/9)	---	0.5 μg/L
Bottom sediment	FY1977	0% (0/3)	0% (0/1)	---	60 ng/g-dry
	FY1986	0% (0/27)	0% (0/9)	---	20 ng/g-dry
Air	FY2002	70% (7/10)	80% (4/5)	1.0 - 2.8 ng/m^3	0.14 ng/m^3

[3] 1-Octanol (CAS RN: 111-87-5; surveyed media in FY2002: surface water, bottom sediment and aquatic wildlife)



Chemical formula / molecular weight: $C_8H_{18}O$ / 130.23

Melting point: -15.5°C [7)] , -15°C [4)]

Boiling point: 195.1°C [7)] , 194-195°C [4)]

Water solubility (Sw): 540 mg/L (25°C)

Specific gravity: 0.827 (20°C) [4)]

n-Octanol/water partition coefficient (LogPow): 3 [7)] , 2.97 [4)]

Degradability: Easily degradable [16)]

Accumulativeness: Unknown

Use: Solvent (flavor, cosmetics, organic synthesis), raw material for synthesis (plasticizer, stabilizer, detergent, cross-linking agent) [21)]

Released amount (Reported by PRTR):

Released to the atmosphere: 1,924 kg/year [27)]

Released to public water bodies: 49 kg/year [27)]

Survey results

In FY1979, survey of 1-octanol in surface water was conducted in 9 areas under the detection limit of 5-50 μg/L and it was not detected in any area. In FY2002, survey was conducted under the detection limit of 0.002 μg/L and it was detected in 8 areas out of 17, with the maximum detected concentration being 0.046 μg/L. Although 1-octanol was not detected in the past surveys and it was detected this time, it is difficult to grasp the tendency of its persistence, as the detection limit in the past survey (5-50 μg/L) is higher than the maximum detected concentration (0.046 μg/L).

In FY1979, survey of 1-octanol in bottom sediment was conducted in 9 areas under the detection limit of 300-1,000 ng/g-dry and it was not detected in any area. In FY2002, survey was conducted under the detection limit of 0.24 ng/g-dry and it was detected in 11 areas out of 17, with the maximum detected concentration being 24 ng/g-dry. Although 1-octanol was not detected in the past surveys and it was detected this time, it is difficult to grasp the tendency of its persistence in the environment, as the detection limit in the past survey (300-1,000 ng/g-dry) is higher than the maximum detected concentration (24 ng/g-dry).

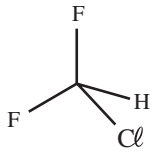
Survey of 1-octanol in aquatic wildlife was carried out in FY2002 for the first time. The survey was conducted under the detection limit of 0.77 ng/g-wet and it was detected in 4 areas out of 7, with the maximum detected value being 62 ng/g-wet.

Consequently, although it is difficult to grasp the tendency, persistence of 1-octanol in surface water, bottom sediment and aquatic wildlife was confirmed under the detection limit adopted in this survey.

○ Survey Results of 1-Octanol

Media	Year	Detection frequency (number)		Detected range	Detection limit
		Sample	Area		
Surface water	FY1979	0% (0/27)	0% (0/9)	---	5 - 50 μg/L
	FY2002	47% (24/51)	47% (8/17)	0.002 - 0.046 μg/L	0.002 μg/L
Bottom sediment	FY1979	0% (0/27)	0% (0/9)	---	300 - 1,000 ng/g-dry
	FY2002	63% (31/49)	65% (11/17)	0.94 - 24 ng/g-dry	0.24 ng/g-dry
Aquatic wildlife	FY2002	57% (12/21)	57% (4/7)	2.4 - 62 ng/g-wet	0.77 ng/g-wet

[4] Chlorodifluoromethane (CAS RN: 75-45-6; surveyed media in FY2002: air)



Chemical formula / molecular weight: $CHC\ell F_2$ / 86.47

Melting point: -157.4°C [4),7)], -146°C [8)]

Boiling point: -40.7°C [4),7)], -41°C [8)]

Water solubility (Sw): 2,770 mg/L (25°C) [4),7)]

Specific gravity: Not known

n-Octanol/water partition coefficient (LogPow): 1.08 [7),8)]

Degradability: Not easily degradable [16)]

Accumulativeness: Low concentration

Use: Freon gas [21)], coolant [10)]

Production / amount:

Production amount: 39,983 t [26)] in FY1993

Released amount (Reported by PRTR):

Released to the atmosphere: 1,190,875 kg/year [27)]

Released to public water bodies: 2,400 kg/year [27)]

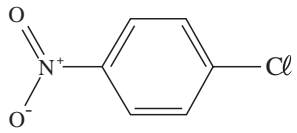
Survey results

Survey of chlorodifluoromethane in air was carried out in FY2002 for the first time. The survey was conducted under the detection limit of 6 ng/m^3 and it was detected in 15 areas out of 15, with the maximum detected value being 4,600 ng/m^3. Thus, it was confirmed that chlorodifluoromethane is widely persistent in air under the detection limit adopted in this survey.

○ Survey Results of Chlorodifluoromethane

Media	Year	Detection frequency (number)		Detected range	Detection limit
		Sample	Area		
Air	FY2002	100% (45/45)	100% (15/15)	340 - 4,600 ng/m^3	6 ng/m^3

[5] *p*-Chloronitrobenzene (CAS RN: 100-00-5; surveyed media in FY2002: aquatic wildlife)



Chemical formula / molecular weight: $C_6H_4C\ell NO_2$ / 157.56

Melting point: 83.5°C [9), 10)] Boiling point: 239-242°C [9)]

Water solubility (Sw): 225 mg/L (20°C)[7)]

Specific gravity: 1.520[9), 10)]

n-Octanol/water partition coefficient (LogPow): 2.39 [7)]

Degradability: Not easily degradable [16)]

Accumulativeness: Low concentration [16)]

Use: Azo dyes, intermediate for sulfur dye [10)]

Production / import amount:

Production amount (estimated)[10)]: 15,000 t in FY2001

Released amount (Reported by PRTR):

Released to the atmosphere: 117 kg/year [27)]

Released to public water bodies: 200 kg/year [27)]

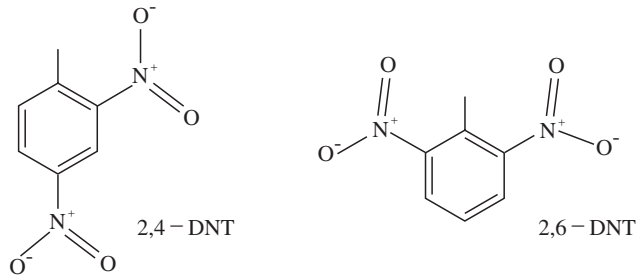
Survey results

In FY1991, survey was conducted in 46 areas under the detection limit of 7.5 ng/g-wet, and *p*-chloronitrobenzene was not detected in aquatic wildlife. In FY2002, survey was conducted under the detection limit of 7.8 ng/g-wet and it was also not detected in any surveyed areas. As it was not detected in both surveys under similar detection limits, it can be judged that there is no significant increase in its concentration. Thus, it was confirmed that *p*-chloronitrobenzene is not persistent in aquatic wildlife under the detection limit adopted in this survey.

○ Survey Results of *p*-Chloronitrobenzene

Media	Year	Detection frequency (number)		Detected range	Detection limit
		Sample	Area		
Surface water	FY1978	0% (0/24)	0% (0/8)	---	0.05 - 0.075 μg/L
	FY1991	0% (0/156)	0% (0/52)	---	0.3 μg/L
	FY2001	0% (0/150)	0% (0/50)	---	0.087 μg/L
Bottom sediment	FY1978	0% (0/15)	0% (0/5)	---	2 - 2.5 ng/g-dry
	FY1991	0% (0/162)	0% (0/54)	---	40 ng/g-dry
	FY2001	0% (0/144)	0% (0/48)	---	2.2 ng/g-dry
Aquatic wildlife	FY1991	0% (0/138)	0% (0/46)	---	7.5 ng/g-wet
	FY2002	0% (0/25)	0% (0/9)	---	7.8 ng/g-wet
Air	FY1991	9% (5/54)	11% (2/18)	3.6 - 110 ng/m^3	3 ng/m^3

[6] Dinitrotoluene (CAS RN: 25321-14-6; surveyed media in FY2002: air)



Chemical formula / molecular weight: $C_7H_6N_2O_4$ / 182.15

Melting point: 54-93°C [8)]

Boiling point: 250-300°C [8)]

Water solubility (Sw): 270 mg/L (22°C)[7)], <30 mg/100 mL[8)]

Specific gravity: 1.3[8)]

n-Octanol/water partition coefficient (LogPow): 2.18 (calculated value)[7)], 2[8)]

Degradability: Not easily degradable [16)]

Accumulativeness: Low concentration [16)]

Use: Synthesis intermediates (toluidine dye, explosives)[21)]

Production / import amount: Over 10,000 t[21)]

Released amount (Reported by PRTR):

Released to the atmosphere: 9,960 kg/year [27)]

Released to public water bodies: 3,650 kg/year [27)]

Survey results

Survey of dinitrotoluene in air was carried out in FY2002 for the first time. The survey of 2,4-dinitrotoluene was conducted under the detection limit of 0.95 ng/m^3 and it was detected in 2 areas out of 7, with the maximum detected concentration being 1.5 ng/m^3.

The survey of 2,6-dinitrotoluene was conducted under the detection limit of 0.89 ng/m^3 and it was detected in 1 area out of 6, with the maximum detected concentration being 14 ng/m^3.

It is difficult to grasp the tendency of persistence of dinitrotoluene from the above data, but its persistence in air was confirmed under the detection limit adopted in this survey.

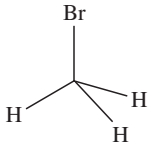
○ Survey Results of 2,4-Dinitrotoluene

Media	Year	Detection frequency (number)		Detected range	Detection limit
		Sample	Area		
Surface water	FY1976	0% (0/70)		---	0.08 - 0.1 μg/L
	FY1991	0% (0/48)	0% (0/16)	---	0.14 μg/L
Bottom sediment	FY1976	0% (0/50)		---	0.35 - 10 ng/g-dry
	FY1991	0% (0/48)	0% (0/16)	---	9.9 ng/g-dry
Aquatic wildlife	FY1976	0% (0/10)		---	60 ng/g-wet
	FY1991	0% (0/45)	0% (0/15)	---	50 ng/g-wet
Air	FY2002	14% (3/21)	29% (2/7)	1.0 - 1.5 ng/m^3	0.95 ng/m^3

○ Survey Results of 2,6-Dinitrotoluene

Media	Year	Detection frequency (number)		Detected range	Detection limit
		Sample	Area		
Surface water	FY1976	1% (1/70)		0.054	0.025 - 0.03 μg/L
	FY1991	0% (0/48)	0% (0/16)	---	0.11 μg/L
Bottom sediment	FY1976	5% (3/55)		---	0.7 - 10 ng/g-dry
	FY1991	0% (0/48)	0% (0/16)	---	11 ng/g-dry
Aquatic wildlife	FY1976	0% (0/10)		---	2 ng/g-wet
	FY1991	0% (0/45)	0% (0/15)	---	5 ng/g-wet
Air	FY2002	17% (3/18)	17% (1/6)	5.3 - 14 ng/m^3	0.89 ng/m^3

[7] Methyl bromide (CAS RN: 74-83-9; surveyed media in FY2002: surface water)



Chemical formula / molecular weight: CH_3Br / 94.94

Melting point: -94°C [11)]

Boiling point: 4°C [11)]

Water solubility (Sw): 900 mg/L [9)]

Specific gravity: 1.732 [12)]

n-Octanol/water partition coefficient (LogPow): 1.19 [11)]

Degradability: Not easily degradable [16)]

Accumulativeness: Low concentration [16)]

Use: Fumigator for foodstuff and soil, organic synthesis [10)]

Production / import amount:

Import amount: 1,130 t in FY2001
Export amount: 53 t [10)]
Estimated amount of domestic circulation: 1,077 t

Released amount (Reported by PRTR)

Released to the atmosphere: 542,393 kg/year [27)]
Released to public water bodies: 24 kg/year [27)]

Survey results

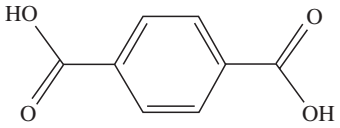
In FY1976, 60 samples were surveyed under the detection limit of 1.8-19 μg/L, and methyl bromide was not detected in any samples of surface water. In FY2002, survey was conducted in 16 areas under the detection limit of 0.1 μg/L, and it was not detected in any surveyed area. Although it was not detected in the past surveys, it is difficult to grasp the tendency of persistence, as the detection limit in the

past surveys was high. Consequently, it was confirmed that methyl bromide is not persistent in surface water under the detection limit adopted in this survey.

○ Survey Results of Methyl Bromide

Media	Year	Detection frequency (number)		Detected range	Detection limit
		Sample	Area		
Surface water	FY1976	0% (1/60)		---	1.8 - 19 μg/L
	FY2002	0% (0/48)	0% (0/16)	---	0.1 μg/L
Bottom sediment	FY1976	0% (0/40)		---	24 - 950 ng/g-dry
Aquatic wildlife	FY1976	0% (0/20)		---	12 - 50 ng/g-wet
Air	FY1980	19% (5/27)	38% (3/8)	64 - 130 ng/m^3	64 - 430 ng/m^3
	FY1998	92% (36/39)	93% (13/14)	49 - 340 ng/m^3	41 ng/m^3

[8] Terephthalic acid (CAS RN: 100-21-0; surveyed media in FY2002: surface water and bottom sediment)



Chemical formula / molecular weight: $C_8H_6O_4$ / 166.14

Melting point: 300°C (sublimation)[45)]

Boiling point: 402°C (sublimation)[8)]

Water solubility (Sw): 16 mg/L[9)]

Specific gravity: 1.51[4), 8)]

n-Octanol/water partition coefficient (LogPow): 2[4), 7)]

Degradability: Easily degradable [16)]

Accumulativeness: Unknown

Use: Raw material for synthesis (polyester fiber (Tetoron), engineering plastics (polyacrylate))[21)]

Production / import amount: Over 1,000,000 t[21)]

Released amount (Reported by PRTR):

Released to the atmosphere: 274 kg/year [27)]

Released to public water bodies: 25,044 kg/year [27)]

Survey results

In FY1983, survey of terephthalic acid in surface water was conducted in 8 areas under the detection limit of 2-50 μg/L and it was not detected in any area. Although terephthalic acid was surveyed

at 20 areas in FY1975 under the detection limit of 20-5,000 μg/L and it was detected in 3 areas, detected areas are limited and were not surveyed in FY2002. In FY2002, survey was conducted under the detection limit of 0.048 μg/L and it was detected in 2 areas out of 23, with the maximum detected concentration being 0.12 μg/L. However, it is difficult to grasp the tendency of its persistence in the environment, as the detection limit applied this time is lower than that of past surveys and the surveyed areas are changed in this survey.

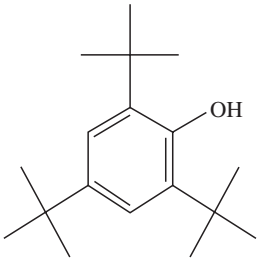
In FY1983, survey of terephthalic acid in bottom sediment was conducted in 8 areas under the detection limit of 50-280 ng/g-dry and it was not detected in any area. In FY2002, survey was conducted under the detection limit of 8.6 ng/g-dry and it was detected in 4 areas out of 21, with the maximum detected concentration being 20 ng/g-dry. It is difficult to grasp the tendency of its persistence in the environment, as the detection limit is lower than that of past surveys and the surveyed areas are changed in this survey.

Thus, although it is difficult to grasp the tendency of persistence in surface water and bottom sediment, persistence of terephthalic acid both in surface water and bottom sediment was confirmed under the detection limit adopted in this survey.

○Survey Results of Terephthalic Acid

Media	Year	Detection frequency (number)		Detected range	Detection limit
		Sample	Area		
Surface water	FY1975	6% (6/100)	15% (3/20)	200 - 700 μg/L	20 - 5,000 μg/L
	FY1983	0% (0/24)	0% (0/8)	---	2 - 50 μg/L
	FY2002	4% (3/69)	9% (2/23)	0.060 - 0.12 μg/L	0.048 μg/L
Bottom sediment	FY1983	0% (0/24)	0% (0/8)	---	50 - 280 ng/g-dry
	FY2002	13% (8/63)	19% (4/21)	10 - 20 μg/L	8.6 ng/g-dry

[9] 2,4,6-Tri-*tert*-butylphenol (CAS RN: 732-26-3; surveyed media in FY2002: surface water, bottom sediment and aquatic wildlife)



Chemical formula / molecular weight: $C_{18}H_{30}O$ / 262.44

Melting point: 129-132°C

Boiling point: 277°C [13)]

Water solubility (Sw): 35 mg/L

Specific gravity: Not known

n-Octanol/water partition coefficient (LogPow): Not known

Degradability: Not easily degradable [16)]

Accumulativeness: High concentration [16)]

Use: Anti-aging agent for rubber and plastic products [34)]

Production / import amount: 11,305 t (in FY1981, as trialkylphenol) [34)]

Released amount (Reported by PRTR): Not known

Survey results

In FY2001, survey of 2,4,6-tri-*tert*-butylphenol in surface water was conducted in 51 areas under the detection limit of 0.020 μg/L and it was not detected in any area. In FY2002, survey was conducted under the same detection limit (0.020 μg/L) and it was not detected in any of the surveyed areas. Thus, it can be judged that there is no significant increase in the concentration of 2,4,6-tri-*tert*-butylphenol.

In FY2001, survey of 2,4,6-tri-*tert*-butylphenol in bottom sediment was conducted in 53 areas under the detection limit of 7.0 ng/g-dry and it was detected in 1 area, with the detected range being 9.3-14 ng/g-dry. In FY2002, survey was conducted under the detection limit of 6.5 ng/g-dry and it was not detected in any area. Although its concentration was below the detection limit, detection of 2,4,6-tri-*tert*-butylphenol was reported in Nagoya Port (0.86 ng/g-dry, 1.0 ng/g-dry, 0.83 ng/g-dry). In the FY2001 survey, it was detected in two samples from Yokkaichi Port (9.3 ng/g-dry, 14 ng/g-dry). However, it is difficult to grasp the tendency of its persistence, as the FY2002 survey was not conducted in Yokkaichi Port.

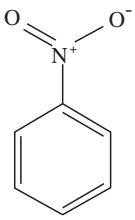
Survey of 2,4,6-tri-*tert*-butylphenol in aquatic wildlife was carried out in FY2002 for the first time. The survey was conducted under the detection limit of 21 ng/g-wet and it was not detected in any of the surveyed areas. However, although its concentration was below the detection limit, detection of 2,4,6-tri-*tert*-butylphenol was reported in 1 area (Yamato River, 0.68 ng/g-wet).

Although 2,4,6-tri-*tert*-butylphenol was not detected in any of the surveyed media (surface water, bottom sediment and aquatic wildlife), it is necessary to list it as a candidate substance for the Monitoring Investigation, as it is one of the Class 1 Specified Chemical Substances in the Chemical Substances Control Law and it was detected in bottom sediment in FY2001. Furthermore, it was selected as a target substance for air of the Initial Environmental Survey in FY2003.

○Survey Results of 2,4,6-Tri-*tert*-butylphenol

Media	Year	Detection frequency (number)		Detected range	Detection limit
		Sample	Area		
Surface water	FY1984	0% (0/30)	0% (0/10)	---	0.04 - 0.08 μg/L
	FY2001	0% (0/153)	0% (0/51)	---	0.020 μg/L
	FY2002	0% (0/48)	0% (0/16)	---	0.020 μg/L
Bottom sediment	FY1984	10% (3/30)	10% (1/10)	2.3 - 8.2 ng/g-dry	0.4 - 1.9 ng/g-dry
	FY2001	1% (2/159)	2% (1/53)	9.3 - 14 ng/g-dry	7.0 ng/g-dry
	FY2002	0% (0/57)	0% (0/19)	---	6.5 ng/g-dry
Aquatic wildlife	FY2002	0% (0/21)	0% (0/7)	---	21 ng/g-wet

[10] Nitrobenzene (CAS RN: 98-95-3; surveyed media in FY2002: surface water, bottom sediment and air)



Chemical formula / molecular weight: $C_6H_5NO_2$ / 123.11

Melting point: 5.7°C [4), 7)], 6°C [8)]

Boiling point: 210.8°C [4), 7)], 211°C [8)]

Water solubility (Sw): 2.09 g/L (25°C)[7)], 200 mg/100 mL[8)], 1.797 g/L (25°C)[4)]

Specific gravity: 1.2[8)], 1.2037 (20°C)[4)]

n-Octanol/water partition coefficient (LogPow): 1.85[4), 7)], 1.86[8)]

Degradability: Not easily degradable [16)]

Accumulativeness: Low concentration [16)]

Use: Raw material for synthesis {dye/flavor intermediate (aniline, benzidine, quinoline, azobenzene), solvent (cellulose nitrate), other use (dust suppressant, antioxidant)}[21)]

Production / import amount: Over 100,000 t[21)]

Released amount (Reported by PRTR):
Released to the atmosphere: 9,273 kg/year[27)]
Released to public water bodies: 5,402 kg/year[27)]

Survey results

In FY1977, survey of nitrobenzene in surface water was conducted in 39 areas under the detection limit of 0.1-30 μg/L and it was detected in 10 areas out of 39, with the detected range being 0.13-3.8 μg/L.

In FY1991, survey was conducted in 51 areas under the detection limit of 0.15 μg/L and it was detected in 1 area out of 51, with the detected range being 0.17 μg/L. In FY2001, survey was conducted in 49 areas under the detection limit of 0.037 μg/L, and it was detected in 2 areas out of 49, with the detected range being 0.046-0.51 μg/L. In FY2002, survey was conducted under the detection limit of 0.037 μg/L and it was detected in 2 areas out of 18, with the maximum detected concentration being 0.23 μg/L. Compared with the past survey for surface water, there is no apparent difference in the status of its persistence.

In FY1977, survey of nitrobenzene in bottom sediment was conducted in 39 areas under the detection limit of 1-1,000 ng/g-dry and it was detected in 9 areas out of 39, with the detected range being 9-1,500 ng/g-dry. In FY1991, survey was conducted in 54 areas under the detection limit of 23 ng/g-dry and it was detected in 1 area out of 51, with the detected range being 47-70 ng/g-dry. In FY2001, survey was conducted in 48 areas under the detection limit of 1.4 ng/g-dry and it was detected in 3 areas out of 48, with the detected range being 1.4-2.3 ng/g-dry. In FY2002, survey was conducted under the detection limit of 1.4 ng/g-dry and it was detected in 1 area out of 17, with the maximum detected concentration being 1.8 ng/g-dry. Compared with the past survey for bottom sediment, persistence of nitrobenzene showed a decreasing tendency in terms of detection range and the number of detected areas.

In FY1991, survey of nitrobenzene in air was conducted in 17 areas under the detection limit of 2 ng/m^3 and it was detected in 16 areas out of 17, with the detected range being 2.2-160 ng/m^3. Furthermore, median value, average value and geometric mean of the samples were 6.1 ng/m^3, 17.7 ng/m^3 and 6.8 ng/m^3, respectively (in calculating the average value, ND was assumed as one half of the detection limit). In FY2002, survey was conducted under the detection limit of 0.7 ng/m^3 and it was detected in 5 areas out of 6, with the maximum detected concentration being 14 ng/m^3. Furthermore, median value, average value and geometric mean of the samples were 4.1 ng/m^3, 4.6 ng/m^3 and 2.8 ng/m^3, respectively. Compared with the past survey for air, persistence of nitrobenzene in the environment showed a decreasing tendency in terms of detection range, average value and the geometric mean.

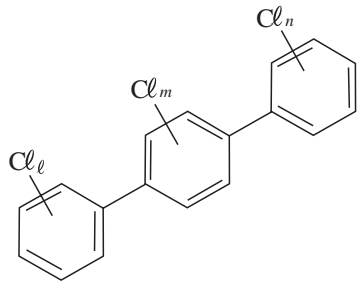
Based on the above data, there is little change in the detection frequency of nitrobenzene in bottom sediment and air and, although it exists widely in air, a decreasing tendency is observed in its concentration.

Little change is shown in the status of its persistence in surface water. Consequently, persistence of nitrobenzene in surface water, bottom sediment and air was confirmed under the detection limit adopted in this survey.

○ Survey Results of Nitrobenzene

Media	Year	Detection frequency (number)		Detected range	Detection limit
		Sample	Area		
Surface water	FY1976	39% (27/70)		0.1 - 1.4 μg/L	0.03 - 0.4 μg/L
	FY1977	19% (22/115)	26% (10/39)	0.13 - 3.8 μg/L	0.1 - 30 μg/L
	FY1991	1% (1/153)	2% (1/51)	0.17 μg/L	0.15 μg/L
	FY2001	3% (5/147)	4% (2/49)	0.046 - 0.51 μg/L	0.037 μg/L
	FY2002	11% (6/54)	11% (2/18)	0.12 - 0.23 μg/L	0.037 μg/L
Bottom sediment	FY1976	32% (15/47)		9.5 - 1,900 ng/g-dry	2 - 3.5 ng/g-dry
	FY1977	16% (19/117)	23% (9/39)	9 - 1,500 ng/g-dry	1 - 1,000 ng/g-dry
	FY1991	1% (2/162)	2% (1/54)	47 - 70 ng/g-dry	23 ng/g-dry
	FY2001	4% (6/144)	6% (3/48)	1.4 - 2.3 ng/g-dry	1.4 ng/g-dry
	FY2002	6% (3/51)	6% (1/17)	1.6 - 1.8 ng/g-dry	1.4 ng/g-dry
Aquatic wildlife	FY1976	100% (10/10)		3 - 580 ng/g-wet	
	FY1977	11% (9/85)	7% (2/29)	3 - 5 ng/g-wet	1 - 200 ng/g-wet
	FY1991	3% (4/147)	4% (2/49)	11 - 26 ng/g-wet	8.7 ng/g-wet
Air	FY1986	1% (1/73)	4% (1/24)	140 ng/m^3	100 ng/m^3
	FY1991	86% (42/49)	94% (16/17)	2.2 - 160 ng/m^3	2 ng/m^3
	FY2002	83% (15/18)	83% (5/6)	1.4 - 14 ng/m^3	0.7 ng/m^3

[11] Polychlorinated terphenyls (CAS RN: 61788-33-8; surveyed media in FY2002: surface water, bottom sediment and aquatic wildlife)



Chemical formula / molecular weight: (mixture) / (mixture)

Melting point: (mixture)

Boiling point: (mixture)

Water solubility (Sw): (mixture)

Specific gravity: 1.47-1.67 [14)]

n-Octanol/water partition coefficient (LogPow): 5.01[14)]

Degradability: Unknown

Accumulativeness: Unknown

Use: Electrical insulator[40)], occasionally used as a substitute for PCB[41)]

Production / import amount: Not known

Released amount (Reported by PRTR): Not known

Survey results

In FY1978, survey of polychlorinated terphenyls in surface water was conducted in 25 areas under the detection limit of 0.002-2.5 μg/L and it was not detected in any area. In FY2002, survey was conducted under the detection limit of 0.000013 μg/L(=0.013 ng/L) and it was detected in 1 area out of 10, with the maximum detected concentration being 0.44 ng/L. Although polychlorinated terphenyls were not detected in the past surveys, it is difficult to grasp the tendency of its persistence, as the value of the detection limit in the past was high.

In FY1978, survey of polychlorinated terphenyls in bottom sediment was conducted in 25 areas under the detection limit of 1-1,000 ng/g-dry and it was detected in 15 areas out of 25, with the detected range being 1-4,700 ng/g-dry. In FY2002, survey was conducted under the detection limit of 0.0091 ng/g-dry and it was detected in 9 areas out of 10, with the maximum detected concentration being 140 ng/g-dry. Compared with the past data, its persistence shows a decreasing tendency in terms of the detected range.

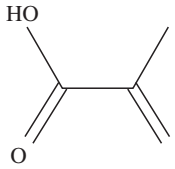
In FY1978, survey of polychlorinated terphenyls in aquatic wildlife was conducted in 66 samples under the detection limit of 0.2-100 ng/g-wet and it was detected in 3 samples, with the detected range being 0.3-3 ng/g-wet. In FY2002, survey was conducted under the detection limit of 0.0078 ng/g-wet and it was detected in 2 areas out of 2 (Tokyo Bay in Tokyo Metropolis, and offshore of Mizushima in Okayama Prefecture), with the maximum detected concentration being 0.54 ng/g-wet. It is difficult to grasp the tendency of its persistence, as the detection limit in the past surveys was higher in both cases than the maximum detected concentration in this survey.

Based on the above data, the concentration of polychlorinated terphenyls in bottom sediment shows a decreasing tendency. Although it is difficult to grasp the tendency of its persistence in surface water and aquatic wildlife, persistence of polychlorinated terphenyls was confirmed under the detection limit adopted in this survey.

○ Survey Results of Polychlorinated Terphenyls

Media	Year	Detection frequency (number)		Detected range	Detection limit
		Sample	Area		
Surface water	FY1974	0% (0/60)		---	0.1 μg/L
	FY1976	0% (0/156)		---	0.01 - 1 μg/L
	FY1978	0% (0/75)	0% (0/25)	---	0.002 - 2.5 μg/L
	FY2002	3% (1/30)	10% (1/10)	0.00044 μg/L (0.44 ng/L)	0.000013 μg/L (0.013 ng/L)
Bottom sediment	FY1974	0% (0/60)		---	50 ng/g-dry
	FY1976	14% (21/151)		1 - 330 ng/g-dry	1 - 200 ng/g-dry
	FY1978	49% (37/75)	60% (15/25)	1 - 4,700 ng/g-dry	1 - 1,000 ng/g-dry
	FY2002	90% (27/30)	90% (9/10)	0.59 - 140 ng/g-dry	0.0091 ng/g-dry
Aquatic wildlife	FY1974	27% (3/11)		50 - 120 ng/g-wet	100 ng/g-wet
	FY1976	0% (0/39)		---	1 - 200 ng/g-wet
	FY1978	5% (3/66)		0.3 - 3 ng/g-wet	0.2 - 100 ng/g-wet
	FY2002	100% (6/6)	100% (2/2)	0.015 - 0.54 ng/g-wet	0.0078 ng/g-wet
Air	FY2000	88% (21/24)	88% (7/8)	0.00092 - 0.0060 ng/m^3	0.001 ng/m^3

[12] Methacrylic acid (CAS RN: 79-41-4; surveyed media in FY2002: air)



Chemical formula / molecular weight: $C_4H_6O_2$ / 86.09

Melting point: 16°C [7), 8)]

Boiling point: 163°C [4), 7)], 159-163°C [8)]

Water solubility (Sw): 89,000 mg/L (20°C)[7)]

Specific gravity: 1.02[8)], 1.0153 (20°C)[4)]

n-Octanol/water partition coefficient (LogPow): 0.93[4), 7), 8)]

Degradability: Easily degradable [16)]

Accumulativeness: Unknown

Use: Raw material for synthesis (thermosetting resin, adhesives), processing agent (latex modifier, plastic modifier, processing agent for paper/textile, leather processor)[21)]

Production / import amount: Over 10,000 t [21)]

Released amount (Reported by PRTR):
Released to the atmosphere: 95,000 kg/year [27)]
Released to public water bodies: 20,353 kg/year [27)]

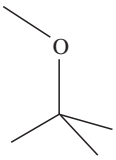
Survey results

Methacrylic acid in air was surveyed in FY2002 for the first time. The survey was conducted under the detection limit of 0.77 ng/m^3 and it was detected in 3 areas out of 9. The maximum detected concentration was 4.6 ng/m^3 and it was confirmed that methacrylic acid is persistent in air under the detection limit adopted in this survey.

○ Survey Results of Methacrylic Acid

Media	Year	Detection frequency (number)		Detected range	Detection limit
		Sample	Area		
Surface water	FY1987	0% (0/75)	0% (0/25)	---	6 μg/L
Bottom sediment	FY1987	0% (0/75)	0% (0/25)	---	140 ng/g-dry
Air	FY2002	22% (6/27)	33% (3/9)	1.1 - 4.6 ng/m^3	0.77 ng/m^3

[13] Methyl-*tert*-butyl ether (CAS RN: 1634-04-4; surveyed media in FY2002: surface water and bottom sediment)



Chemical formula / molecular weight: $C_5H_{12}O$ / 88.15

Melting point: -109˚C [2)]

Boiling point: 55.2˚C [10)]

Water solubility (Sw): 4.8 g/100 g [2)]

Specific gravity: 0.7455[2)]

n-Octanol/water partition coefficient (LogPow): Not known

Degradability: Not easily degradable [16)]

Accumulativeness: Unknown

Use: Octane number improver, antiknock agent, miscibility improver for the mixture of low-boiling-point solvent and lacquer thinner, solvent for high-performance liquid chromatography[2),10),43)]

Production / import amount: Not known

Released amount (Reported by PRTR): Not known

Survey results

Methyl-*tert*-butyl ether in surface water was surveyed in FY2002 for the first time. The survey was conducted under the detection limit of 0.006 μg/L and it was detected in 4 areas out of 15. The maximum detected concentration was 0.025 μg/L and it was confirmed that methyl-*tert*-butyl ether is persistent in surface water under the detection limit adopted in this survey.

Methyl-*tert*-butyl ether in bottom sediment was also surveyed in FY2002 for the first time. The survey was conducted under the detection limit of 0.70 ng/g-dry and it was not detected in any of the surveyed areas. It was confirmed that methyl-*tert*-butyl ether is not persistent in bottom sediment under the detection limit adopted in this survey.

Thus, it is difficult to grasp the tendency of its persistence in surface water and bottom sediment. However, it was confirmed that methyl-*tert*-butyl ether is persistent in surface water and not persistent in bottom sediment under the detection limit adopted in this survey.

○ Survey Results of Methyl-*tert*-butyl Ether

Media	Year	Detection frequency (number)		Detected range	Detection limit
		Sample	Area		
Surface water	FY2002	24% (11/45)	27% (4/15)	0.007 - 0.025 μg/L	0.006 μg/L
Bottom sediment	FY2002	0% (0/51)	0% (0/17)	---	0.70 ng/g-dry
Air	FY1999	80% (33/41)	87% (13/15)	22 - 330 ng/m^3	20 ng/m^3

Figure 2-1 Locations of the Initial Environmental Survey for Surface Water and Bottom Sediment (FY2002)

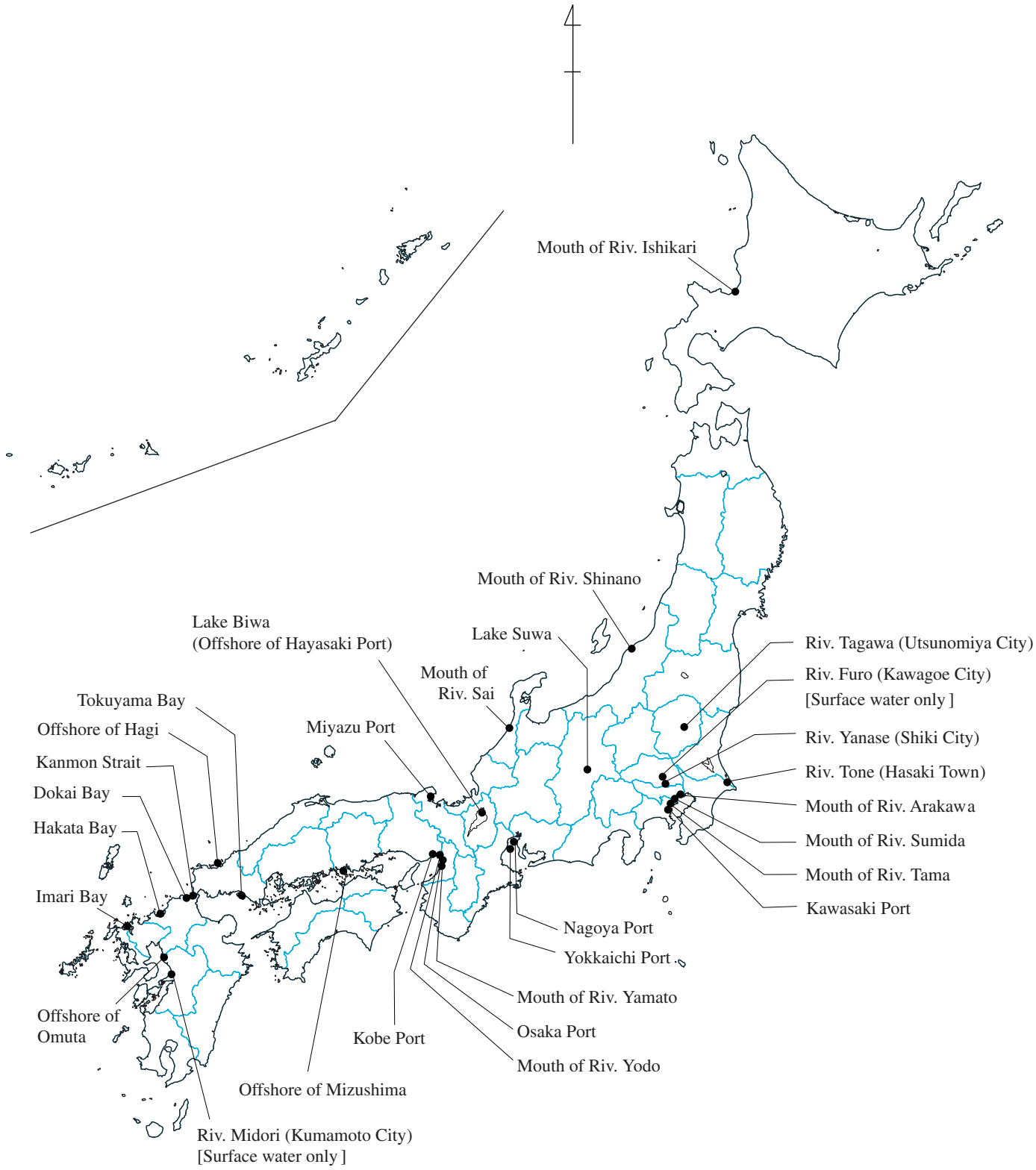


Figure 2-2 Locations of the Initial Environmental Survey for Aquatic Wildlife (FY2002)

Figure 2-3 Locations of the Initial Environmental Survey for Air (FY2002)

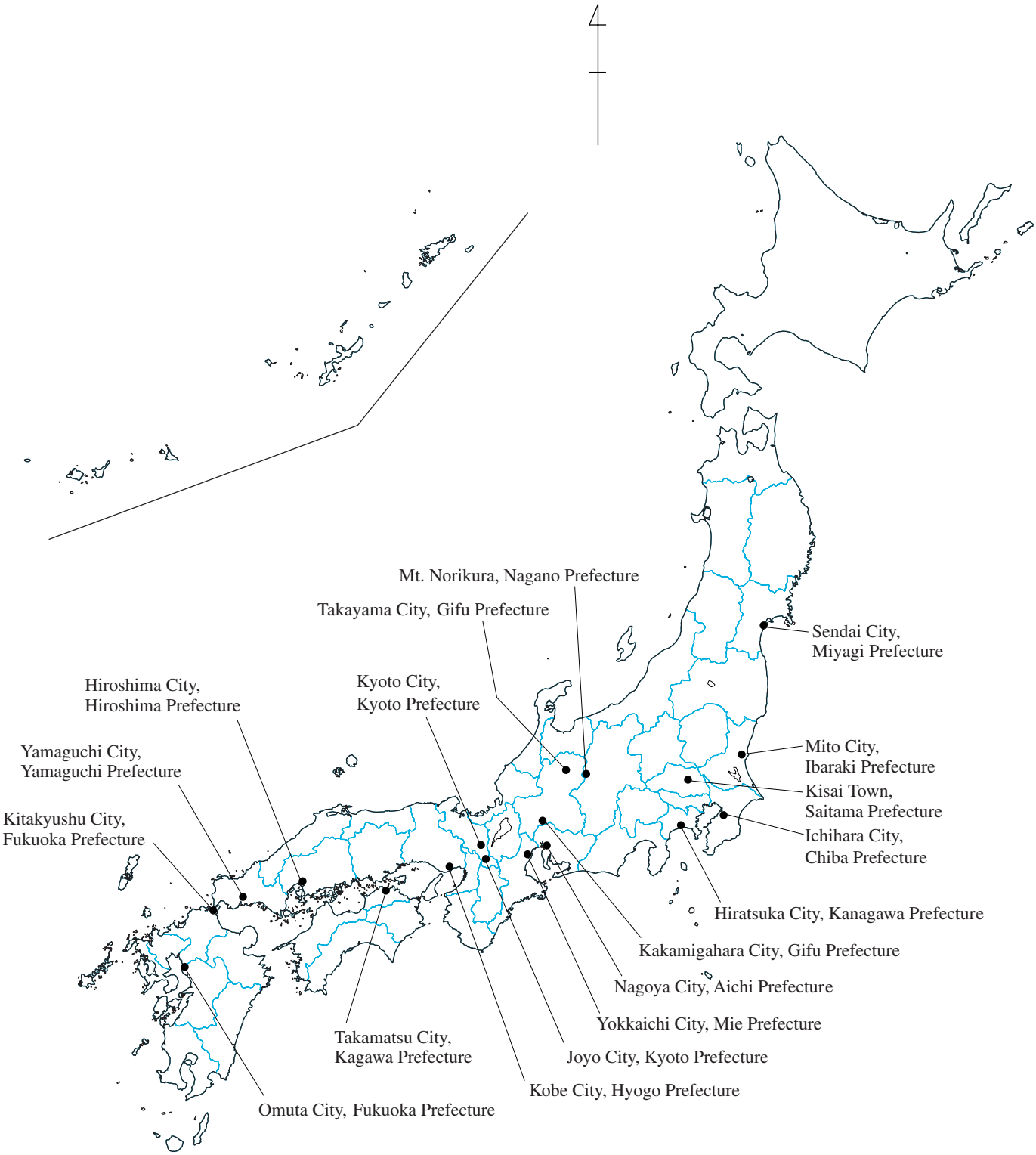


Table 2-3 Detection Results of the FY2002 Initial Environmental Survey

Survey No.	Substance	Surface water 29 areas in total		Bottom sediment 27 areas in total		Aquatic wildlife 10 areas in total		Air 18 areas in total	
		Detected range (μg/L) (frequency (area))	Detection limit (μg/L)	Detected range (ng/g-dry) (frequency (area))	Detection limit (ng/g-dry)	Detected range (ng/g-wet) (frequency (area))	Detection limit (ng/g-wet)	Detected range (ng/m^3) (frequency (area))	Detection limit (ng/m^3)
1	Isoprene	--- (0/14)	0.1	--- (0/14)	10				
2	Epichlorohydrin							1.0 - 2.8 (4/5)	0.14
3	1-Octanol	0.002 - 0.046 (8/17)	0.002	0.94 - 24 (11/17)	0.24	2.4 - 62 (4/7)	0.77		
4	Chlorodifluoromethane							340 - 4,600 (15/15)	6
5	*p*-Chloronitrobenzene					--- (0/9)	7.8		
6	Dinitrotoluene							1.0 - 1.5 (2/7)	0.95
6-1	2,4-Dinitrotoluene								
6-2	2,6-Dinitrotoluene							5.3 - 14 (1/6)	0.89
7	Methyl bromide	--- (0/16)	0.1						
8	Terephthalic acid	0.060 - 0.12 (2/23)	0.048	10 - 20 (4/21)	8.6				
9	2,4,6-Tri-*tert*-butylphenol	--- (0/16)	0.020	--- (0/19)	6.5	--- (0/7)	21		
10	Nitrobenzene	0.12 - 0.23 (2/18)	0.037	1.6 - 1.8 (1/17)	1.4			1.4 - 14 (5/6)	0.7
11	Polychlorinated terphenyls	0.00044 (= 0.44ng/L) (1/10)	0.000013 (= 0.013ng/L)	0.59 - 140 (9/10)	0.0091	0.015 - 0.54 (2/2)	0.0078		
12	Methacrylic acid							1.1 - 4.6 (9/9)	0.77
13	Methyl-*tert*-butyl ether	0.007 - 0.025 (4/15)	0.006	--- (0/17)	0.70				

(Note 1) Halftone screened area (gray) denotes that the survey was conducted in other media not targeted in this survey.
(Note 2) Frequency (area) indicates: Number of detected areas / Number of surveyed areas.
(Note 3) [---] in the range column denotes that there was no detected sample.

Table 2-4 Detection Results of Polychlorinated Terphenyl Homologs and Their Isomers in the FY2002 Initial Environmental Survey

Survey No.	Substance	Surface water 10 areas in total		Bottom sediment 10 areas in total		Aquatic wildlife 2 areas in total	
		Detected range (ng/L) (frequency (area))	Detection limit (ng/L)	Detected range (ng/g-dry) (frequency (area))	Detection limit (ng/g-dry)	Detected range (ng/g-wet) (frequency (area))	Detection limit (ng/g-wet)
11	Polychlorinated terphenyls	0.44 (1/10)	0.013	0.59 - 140 (9/10)	0.0091	0.015 - 0.54 (2/2)	0.0078
11-1	Monochlorinated terphenyl	--- (0/10)	0.013	0.052 - 0.84 (4/9)	0.019	0.005 - 0.017 (1/2)	0.0078
11-2	Dichlorinated terphenyl	--- (0/10)	0.016	0.040 - 2.6 (4/9)	0.019	--- (0/2)	0.016
11-3	Trichlorinated terphenyl	--- (0/10)	0.022	0.068 - 0.53 (2/10)	0.0091	--- (0/2)	0.0078
11-4	Tetrachlorinated terphenyl	0.045 (1/10)	0.024	0.086 - 1.0 (2/10)	0.017	--- (0/2)	0.020
11-5	Pentachlorinated terphenyl	0.39 (1/10)	0.024	0.044 - 0.41 (1/10)	0.020	--- (0/2)	0.021
11-6	Hexachlorinated terphenyl	--- (0/10)	0.42	0.17 - 2.9 (6/10)	0.039 - 0.19	--- (0/2)	0.077 - 0.096
11-7	Heptachlorinated terphenyl	--- (0/10)	0.42	0.078 - 5.7 (9/10)	0.039 - 0.19	0.20 - 0.26 (1/2)	0.077 - 0.096
11-8	Octachlorinated terphenyl	--- (0/10)	0.42	0.080 - 41 (9/10)	0.039 - 0.19	0.12 - 0.17 (1/2)	0.077 - 0.096
11-9	Nonachlorinated terphenyl	--- (0/10)	0.42	0.25 - 72 (9/10)	0.039 - 0.19	0.084 - 0.11 (1/2)	0.077 - 0.096
11.10	Decachlorinated terphenyl	--- (0/10)	0.42	0.17 - 22 (9/10)	0.039 - 0.19	--- (0/2)	0.077 - 0.096
11.11	Undecachlorinated terphenyl	--- (0/10)	0.42	0.10 - 1.6 (9/10)	0.039 - 0.19	--- (0/2)	0.077 - 0.096
11-12	Dodecachlorinated terphenyl	--- (0/10)	0.42	--- (0/10)	0.039 - 0.19	--- (0/2)	0.077 - 0.096
11-13	Tridecachlorinated terphenyl	--- (0/10)	0.42	--- (0/10)	0.039 - 0.19	--- (0/2)	0.077 - 0.096
11-14	Tetradecachlorinated terphenyl	--- (0/10)	0.33	--- (0/10)	0.031 - 0.19	--- (0/2)	0.061 - 0.076

Table 2-4 Detection Results of Polychlorinated Terphenyl Homologs and Their Isomers in the FY2002 Initial Environmental Survey (continued)

Survey No.	Substance	Surface water 10 areas in total		Bottom sediment 10 areas in total		Aquatic wildlife 2 areas in total	
		Detected range (ng/L) (frequency (area))	Detection limit (ng/L)	Detected range (ng/g-dry) (frequency (area))	Detection limit (ng/g-dry)	Detected range (ng/g-wet) (frequency (area))	Detection limit (ng/g-wet)
11-15	4-Monochloro-*o*-terphenyl	--- (0/10)	0.023	0.031 - 0.18 (3/8)	0.029	0.015 - 0.017 (1/2)	0.0078
11-16	4-Monochloro-*p*-terphenyl	--- (0/10)	0.013	0.032 - 0.098 (3/8)	0.019	--- (0/2)	0.026
11-17	2,5-Dichloro-*o*-terphenyl	--- (0/10)	0.021	--- (0/7)	0.019	--- (0/2)	0.016
11-18	2,5-Dichloro-*m*-terphenyl	--- (0/10)	0.016	0.023 - 0.13 (1/7)	0.091	--- (0/2)	0.016
11-19	2,4-Dichloro-*p*-terphenyl + 2,5-Dichloro-*p*-terphenyl	--- (0/10)	0.023	0.022 - 0.12 (1/7)	0.021	--- (0/2)	0.016
11-20	2,4,6-Trichloro-*p*-terphenyl	--- (0/10)	0.022	--- (0/8)	0.0091	--- (0/2)	0.0078
11-21	2,3,5,6-Tetrachloro-*p*-terphenyl	--- (0/10)	0.024	0.017 - 0.10 (1/8)	0.017	--- (0/2)	0.020
11-22	2,4,4",6-Tetrachloro-*p*-terphenyl	--- (0/10)	0.026	0.041 - 0.31 (1/8)	0.019	--- (0/2)	0.020
11-23	2,3,4,5,6-Pentachloro-*p*-terphenyl	0.39 (1/10)	0.024	--- (0/10)	0.020	--- (0/2)	0.021

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Chapter 3 Summary of Results of the FY2002 Environmental Survey for Exposure Study

1. Purpose of the Survey

The purpose of this survey is to grasp the status of environmental persistence of chemical substances such as the Designated Chemical Substances specified in the Chemical Substances Control Law and Class 1 Designated Chemical Substances of the PRTR Law, which is necessary for understanding the exposure amount to humans and wildlife used in the environmental risk assessment targeting these chemical substances.

2. Target survey substances and survey areas

In FY2002, environmental survey for exposure study was conducted on the following 6 substances (groups) totaling 15 substances-media selected from among the priority substances-media determined by the Expert Group on Substance Selection of the Comprehensive Survey of Chemical Substances on Environmental Safety.

Table 3-1 Target Substances and Media for the FY2002 Environmental Survey for Exposure Study

Survey No.	Target substance	Number of survey areas classified by media (number of households for diet)				
		Surface water	Bottom sediment	Aquatic wildlife	Air	Diet
1	1,2-Dichlorobenzene	38	62		28	
2	Perfluorooctane sulfonic acid (PFOS)	20				
3	Perfluorooctanoic acid (PFOA)	20				
4	Benzo[*a*]pyrene	38	62	10		
5	Polychlorinated naphthalenes (total and mono to octa chloride)			10	11	50
6 6-1 6-2	Polybrominated diphenylether Octabromide Decabromide	38	62	10		50

Surveyed areas are shown in Figures 3-1 to 3-4. Surveys were conducted for 3 or 5 substances in 38 areas in total for surface water, 3 substances in 62 areas in bottom sediment, 3 substances (groups) in 10 areas for aquatic wildlife, and 2 substances (groups) in 29 areas in total for air.

As to diet, 2 substances (groups) were surveyed in 10 areas (Hokkaido, Miyagi Prefecture, Tokyo Metropolis, Nagano Prefecture, Ishikawa Prefecture, Osaka Prefecture, Ehime Prefecture, Fukuoka Prefecture, and Okinawa Prefecture), at 5 households each (total: 50 households).

3. Sampling and analytical method

Suggested sampling and analytical methods are shown in Appendix C and Appendix D, respectively.

4. Survey results

Among the 6 substances in the total of 15 substances-media, 12 substances-media were detected, with the 3 substances-media exceptions being benzo[*a*]pyrene in aquatic wildlife and polybrominated diphenyl ethers in aquatic wildlife and diet.

Table 3-2 List of Detection Limits of the Environmental Survey for Exposure Study in FY2002

Survey No.	Substance	Number of survey areas classified by media				
		Surface water (ng/L)	Bottom sediment (ng/g-dry)	Aquatic wildlife (ng/g-wet)	Air (ng/m^3)	Diet (ng/g-fresh weight)
1	1,2-Dichlorobenzene	0.4	0.02		15	
2	Perfluorooctane sulfonic acid (PFOS)	0.04				
3	Perfluorooctanoic Acid (PFOA)	0.04				
4	Benzo[*a*]pyrene	0.29	0.30	0.2		
5	Polychlorinated naphthalene (total)(Note 2)			0.002 - 0.003	0.00002 - 0.001	0.001 - 0.005
6	Polybrominated diphenyl ethers					
6-1	Octabromide					0.5, 0.2 (Note 3)
6-2	Decabromide	120	9.7	0.25		

Note 1: Halftone screened area (gray) denotes that the survey was conducted in other media not targeted in this survey.

Note 2: Detection limits of Polychlorinated naphthalenes are shown as ranges based on the detection limits of homologs and isomers.

Note 3: The following two isomers are surveyed as octabromides in diet and each detection limit is shown on the right side of the isomers.

2,2',3,4,4',5,5',6-OctaBDE: 0.5 ng/g-fresh weight

2,3,3',4,4',5,5',6-OctaBDE: 0.2 ng/g-fresh weight

Table 3-3 Results of the Environmental Survey for Exposure Study in FY2002

Survey No.	Substance	Surface water 38 areas, 114 samples		Bottom sediment 62 areas, 186 samples		Aquatic wildlife 10 areas, 30 samples		Air 28 areas, 84 samples		Diet 10 regions, 50 areas	
		Range (ng/L) (frequency (area))	Median value (ng/L)	Range (ng/g -dry) (frequency (area))	Median value (ng/g-dry)	Range (ng/g -dry) (frequency (area))	Median value (ng/g-dry)	Range (ng/m^3) (frequency (area))	Median value (ng/m^3)	Range (ng/g -fresh weight) (frequency (area))	Median value (ng/g-fresh weight)
1	1,2-Dichlorobenzene	ND - 200 (10/38)	ND	ND - 38 (59/62)	0.55			18 - 2,200 (19/28)	ND		
2	Perfluorooctane sulfonic acid (PFOS)	0.07 - 24 (20/20)	1.2								
3	Perfluorooctanoic acid (PFOA)	0.33 - 100 (20/20)	2.5								
4	Benzo[*a*]pyrene	ND - 2.1 (7/38)	ND	ND - 1,200 (57/62)	41	--- (0/10)	ND				
5	Polychlorinated naphthalene (total)					0.012 - 2.0 (10/10)	0.12	0.00048 - 0.55 (11/11)	0.047	ND - 0.30 (36/50)	0.006
6	Polybrominated diphenyl ethers										
6-1	Octabromide									--- (0/50)	ND
6-2	Decabromide	ND - 590 (1/38)	ND	ND - 4,400 (34/62)	ND	--- (0/10)	ND				

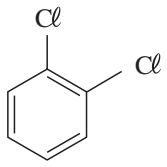
Note 1: Halftone screened area (gray) denotes that the survey was conducted in other media not targeted in this survey.

Note 2: Frequency (area) indicates: Number of detected areas / Number of surveyed areas.

Note 3: [---] in the range column denotes that there was no detected sample.

5. Survey results of each substance (group)

[1] 1,2-Dichlorobenzene (CAS RN: 95-50-1; surveyed media in FY2002: surface water, bottom sediment and air)



Chemical formula / molecular weight: $C_6H_4Cℓ_2$ / 147.0

Melting point: -17.3°C [7)]

Boiling point: 180.5°C [4), 5), 6)]

Water solubility (Sw): 100 mg/L (20°C) [3)]

Specific gravity: 1.3059

n-Octanol/water partition coefficient (LogPow): 3.43 (observed value) [9)], 3.45 (calculated value) [9)]

Degradability: Not easily degradable [16)]

Accumulativeness: Low [15)]

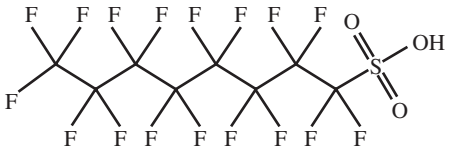
Survey of 1,2-dichlorobenzene in surface water was conducted under the detection limit of 0.4 ng/L and it was detected in 10 areas out of 38, with the maximum detected concentration being 200 ng/L.

Survey of 1,2-dichlorobenzene in bottom sediment was conducted under the detection limit of 0.02 ng/g-dry and it was detected in 59 areas out of 62, with the maximum detected concentration being 38 ng/g-dry.

Survey of 1,2-dichlorobenzene in air was conducted under the detection limit of 15 ng/m^3 and it was detected in 19 areas out of 28. The maximum detected concentration was 2,200 ng/m^3, exceeding the maximum value in the past (420 ng/m^3 in FY1999 survey).

Substance	Surface water 38 areas, 114 samples		Bottom sediment 62 areas, 186 samples		Air 28 areas, 84 samples	
	Detected range (ng/L) (frequency (area))	Median value (ng/L)	Detected range (ng/g-dry) (frequency (area))	Median value (ng/g-dry)	Detected range (ng/m^3) (frequency (area))	Median value (ng/m^3)
1,2-Dichlorobenzene	0.4 - 200 (10/38)	ND	0.02 - 38 (59/62)	0.55	18 - 2,200 (19/28)	ND

[2] Perfluorooctane sulfonic acid (PFOS) (CAS RN: 1763-23-1; surveyed media in FY2002: surface water)



Chemical formula / molecular weight: $C_8HF_{17}SO_3$ / 500.1

Melting point: Unknown

Boiling point: Unknown

Water solubility (Sw): Unknown

Specific gravity: Unknown

n-Octanol/water partition coefficient (LogPow): Unknown

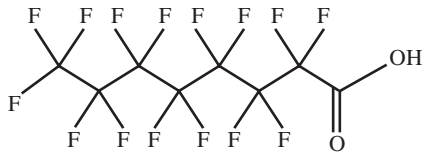
Degradability: Unknown

Accumulativeness: Unknown

Perfluorooctane sulfonic acid (PFOS) was surveyed in FY2002 for the first time. The survey was conducted under the detection limit of 0.04 ng/L and it was detected in 20 areas out of 20, with the maximum concentration being 24 ng/L.

Substance	Surface water 20 areas, 60 samples	
	Detected range (ng/L) (frequency (area))	Median value (ng/L)
Perfluorooctane sulfonic acid (PFOS)	0.07 - 24 (20/20)	1.2

[3] Perfluorooctanoic acid (PFOA) (CAS RN: 335-67-1; surveyed media in FY2002: surface water)



Chemical formula / molecular weight: $C_8HF_{15}O_2$ / 414.1

Melting point: Unknown

Boiling point: Unknown

Water solubility (Sw): Unknown

Specific gravity: Unknown

n-Octanol/water partition coefficient (LogPow): Unknown

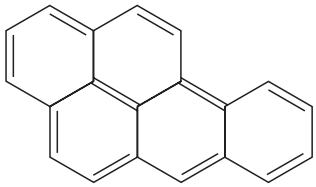
Degradability: Unknown

Accumulativeness: Unknown

Perfluorooctanoic acid (PFOA) in surface water was surveyed in FY2002 for the first time. The survey was conducted under the detection limit of 0.04 ng/L and it was detected in 20 areas out of 20, with the maximum concentration being 100 ng/L.

Substance	Surface water 20 areas, 60 samples	
	Detected range (ng/L) (frequency (area))	Median value (ng/L)
Perfluorooctanoic acid (PFOA)	0.33 - 100 (20/20)	2.5

[4] Benzo[*a*]pyrene (CAS RN: 50-32-8; surveyed media in FY2002: surface water, bottom sediment and aquatic wildlife)



Chemical formula / molecular weight: $C_{20}H_{12}$ / 252.3

Melting point: 179-179.3°C [19)]

Boiling point: 311°C (10 mmHg) [18)]

Water solubility (Sw): 0.003 mg/L [17)]

Specific gravity: Unknown

n-Octanol/water partition coefficient (LogPow): 6.57 (calculated value) [20)]

Degradability: Unknown

Accumulativeness: Unknown

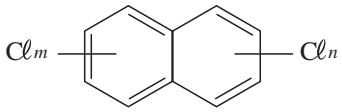
Survey of benzo[*a*]pyrene in surface water was conducted under the detection limit of 0.29 ng/L and it was detected in 7 areas out of 38, with the maximum detected concentration being 2.1 ng/L.

Survey of benzo[*a*]pyrene in bottom sediment was conducted under the detection limit of 0.30 ng/g-dry and it was detected in 57 areas out of 62, with the maximum detected concentration being 1,200 ng/g-dry.

Survey of benzo[*a*]pyrene in aquatic wildlife was conducted under the detection limit of 0.2 ng/g-wet and it was not detected in the 10 surveyed areas.

Substance	Surface water 38 areas, 114 samples		Bottom sediment 62 areas, 186 samples		Aquatic wildlife 10 areas, 30 samples	
	Detected range (ng/L) (frequency (area))	Median value (ng/L)	Detected range (ng/g-dry) (frequency (area))	Median value (ng/g-dry)	Detected range (ng/g-wet) (frequency (area))	Median value (ng/g-wet)
Benzo[*a*]pyrene	0.63 - 2.1 (7/38)	ND	0.34 - 1,200 (57/62)	41	--- (0/10)	ND

[5] Polychlorinated naphthalenes (CAS RN: 70776-03-3; surveyed media in FY2002: aquatic wildlife, air and diet)



Chemical formula / molecular weight: $C_{10}H_nCl_{(8-n)}$ / 162.6-403.7

Melting point: Unknown

Boiling point: Unknown

Water solubility (Sw): Unknown

Specific gravity: Unknown

n-Octanol/water partition coefficient (LogPow): Unknown

Degradability: Not easily degradable [16)]

Accumulativeness: High [15)]

Survey of polychlorinated naphthalenes in aquatic wildlife was conducted under the detection limit of 0.002-0.003 ng/g-wet and it was detected in 10 areas out of 10, with the maximum detected concentration being 2.0 ng/g-wet.

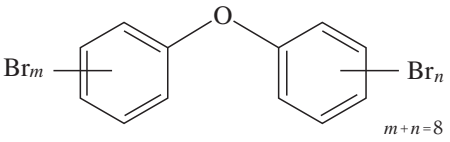
Survey of polychlorinated naphthalenes in air was conducted under the detection limit of 0.00002-0.001 ng/m^3 and it was detected in 11 areas out of 11, with the maximum detected concentration being 0.55 ng/m^3.

Polychlorinated naphthalenes in diet were surveyed in FY2002 for the first time. The survey was conducted under the detection limit of 0.001-0.005 ng/g-fresh weight and it was detected in 36 households out of 50, with the maximum detected concentration being 0.30 ng/g-fresh weight.

Substance	Aquatic wildlife 10 areas, 30 samples		Air 11 areas, 33 samples		Diet 10 regions, 50 areas	
	Detected range (ng/g-wet) (frequency (area))	Median value (ng/g-wet)	Detected range (ng/m^3) (frequency (area))	Median value (ng/m^3)	Detected range (ng/g-fresh weight) (frequency (area))	Median value (ng/g-fresh weight)
Polychlorinated naphthalenes (total)	0.012 - 2.0 (10/10)	0.12	0.00048 - 0.55 (11/11)	0.047	0.001 - 0.30 (36/50)	0.006

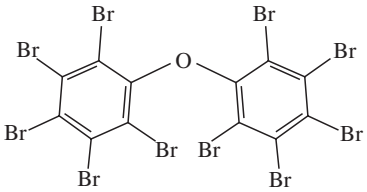
[6] Polybrominated diphenyl ethers (surveyed media in FY2002: surface water, bottom sediment, aquatic wildlife and diet)

Octabromide (CAS RN: 32536-52-0)



Chemical formula / molecular weight: $C_{12}H_2Br_8O$ / 801.4
Melting point: Unknown
Boiling point: Unknown
Water solubility (Sw): Unknown
Specific gravity: Not known
n-Octanol/water partition coefficient (LogPow): Unknown
Degradability: Not easily degradable [16)]
Accumulativeness: Low [15)]

Decabromide (CAS RN: 1163-19-5)



Chemical formula / molecular weight: $C_{12}Br_{10}O$ / 959.2

Melting point: 304˚C [7)], 295˚C [26)]

Boiling point: 425˚C (decomposition)[23)], 425˚C [26)]

Water solubility (Sw): 0.02-0.03 mg/L[22)], 0.025 mg/L [26)]

Specific gravity: 3

n-Octanol/water partition coefficient (LogPow): 5.2 (observed value)[13)], 5.236 (calculated value)[7)], 12.11 (calculated value)[26)], 5.24[27)]

Degradability: Not easily degradable [16)]

Accumulativeness: Low [15)]

Survey was conducted on decabromide (deca-BDE) for surface water, bottom sediment and aquatic wildlife, and on octabromide (octa-BDE) for diet.

The survey in surface water was conducted under the detection limit of 120 ng/L and it was detected in 1 area out of 38, with the maximum detected concentration being 590 ng/L.

The survey in bottom sediment was conducted under the detection limit of 9.7 ng/g-dry and it was detected in 34 areas out of 62, with the maximum detected concentration being 4,400 ng/g-dry.

The survey in aquatic wildlife was conducted in 10 areas and it was not detected in any surveyed area.

Polybrominated diphenyl ether in diet were surveyed in FY2002 for the first time. The survey was conducted on two isomers of octa-BDE under the detection limit of 0.5 ng/g-fresh weight for

2,2',3,4,4',5,5'-octa-BDE and 0.2 ng/g-fresh weight for 2,3,3',4,4',5,5',6-octa-BDE in 10 areas (50 households), and they were not detected in any samples.

Substance	Substance Surface water 38 areas, 114 samples		Bottom sediment 62 areas, 186 samples		Aquatic wildlife 10 areas, 30 sample		Diet 10 areas, 50 households	
	Detected range (ng/L) (frequency (area))	Median value (ng/L)	Detected range (ng/g-dry) (frequency (area))	Median value (ng/g-dry)	Detected range (ng/g-dry) (frequency (area))	Median value (ng/g-dry)	Detected range (ng/g-fresh weiht) (frequency (area))	Median value (ng/g-fresh weiht)
Polybrominated diphenyl ethers								
Octa-bromide							--- (0/50)	ND
Deca-bromide	240 - 590 (1/38)	ND	10 - 4,400 (34/62)	ND	--- (0/10)	ND		

Figure 3-1 Locations of the Environmental Survey for Exposure Study (Surface water, FY2002)

Figure 3-2 Locations of the Environmental Survey for Exposure Study (Bottom sediment, FY2002)

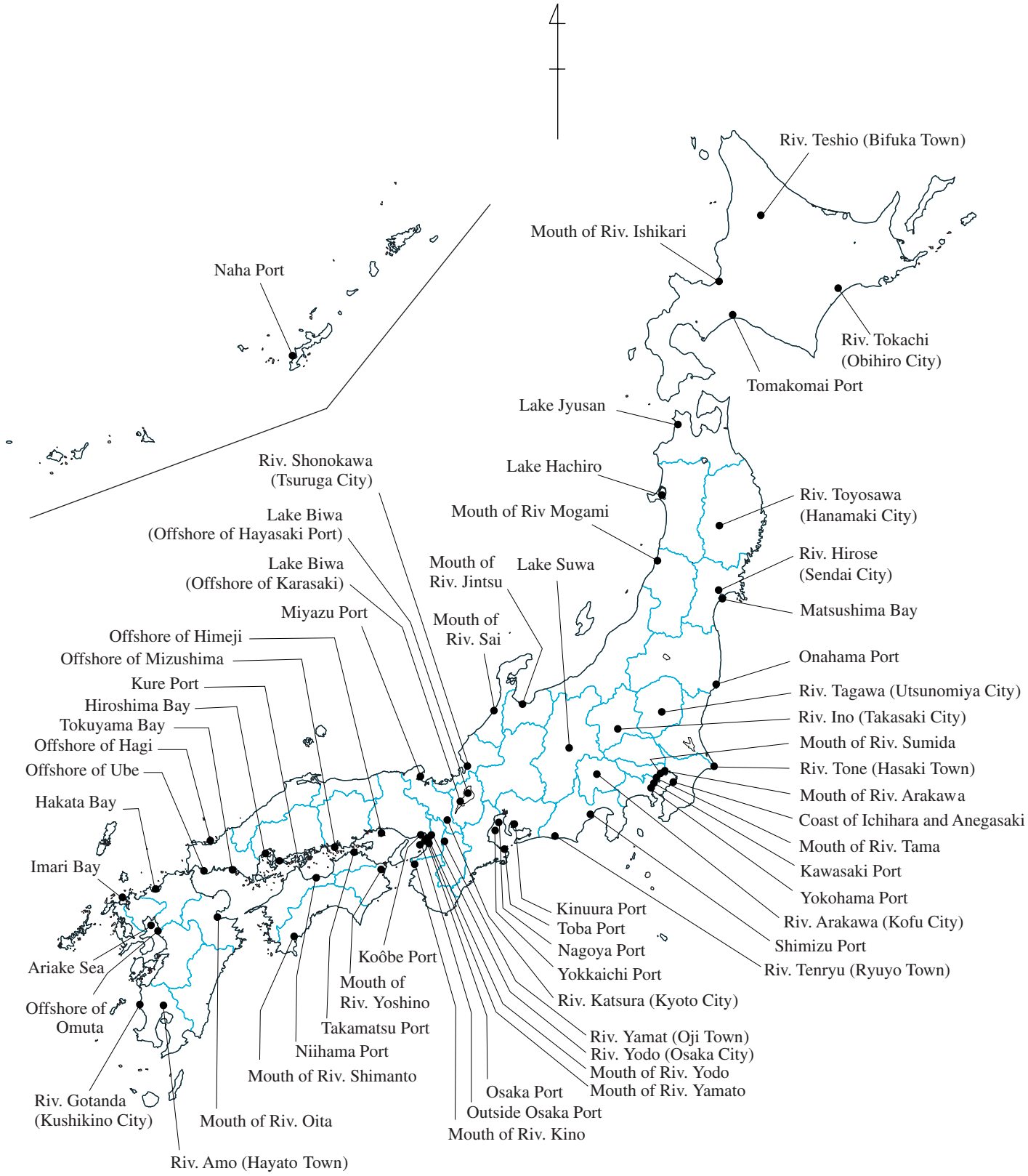
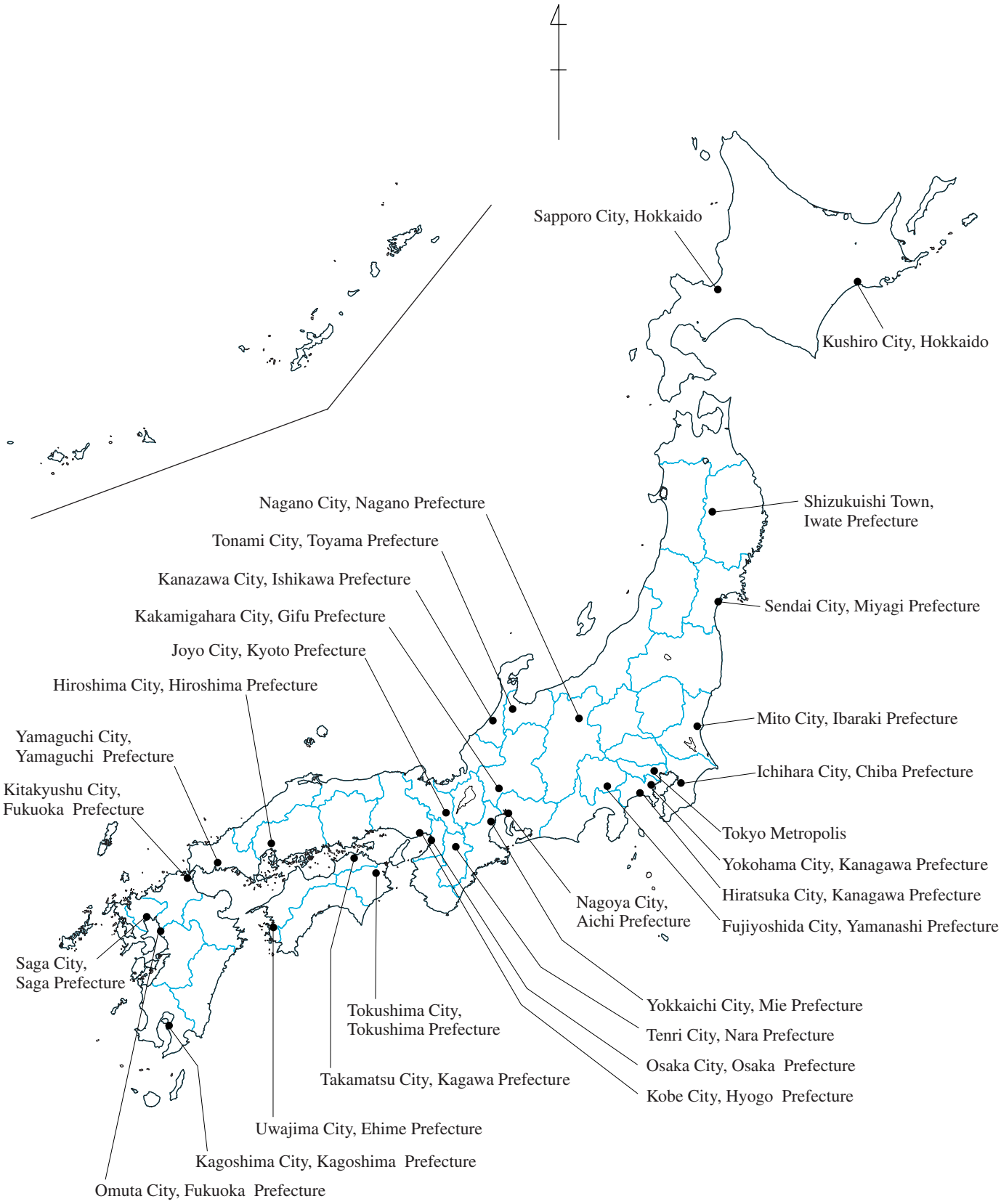


Figure 3-3 Locations of the Environmental Survey for Exposure Study (Aquatic wildlife, FY2002)

Figure 3-4 Locations of the Environmental Survey for Exposure Study (Air, FY2002)



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Chapter4 Summary of the FY2002 Monitoring Investigation

1. Purpose of the survey

The purpose of this survey is to conduct on an annual basis the monitoring of target substances included in the POPs Treaty and other substances that may be candidates for target substances of the Treaty; highly persistent substances for which environmental standards are not yet established and a grasp of their annual environmental status is required among Class 1 & 2 Specified Chemical Substances and Designated Chemical Substances specified in the Chemical Substances Control Law.

2. Surveyed substances and areas

In the FY2002 Monitoring Investigation following 8 substances (groups) totaling 29 substance-media, which had been discussed and selected from among the priority substances and media at the FY2002 Expert Group on Substance Selection for the Comprehensive Survey of Chemical Substances on Environmental Safety, were surveyed. Among them, PCBs, HCB, aldrin, dieldrin, endrin, DDTs, chlordanes and heptachlor are included in the target substances of the POPs Treaty.

Table 4-1 Target Chemical Substances and Media for the Monitoring Investigation

Survey No.	Target substances	Media			
		Surface water	Bottom sediment	Wildlife	Air
1	PCBs (Total PCB and following items were measured) Mono-CBs, Di-CBs, Tri-CBs, Tetra-CBs, Penta-CBs, Hexa-CBs, Hepta-CBs, Octa-CBs, Nona-CBs, Deca-CB	√	√	√	√
2	HCB (Hexachlorobenzene)	√	√	√	√
3	Drins Aldrin, Dieldrin, Endrin	√	√	√	√
4	DDTs *p*,*p*'-DDT, *p*,*p*'-DDE, *p*,*p*'-DDD, *o*,*p*'-DDT, *o*,*p*'-DDE, *o*,*p*'-DDD	√	√	√	√
5	Chlordanes *trans*-Chlordane, *cis*-Chlordane, *trans*-Nonachlor, *cis*-Nonachlor, Oxychlordane	√	√	√	√
6	Heptachlor	√	√	√	√
7	HCHs (Hexachlorocyclohexane) α -HCH, β -HCH	√	√	√	
8	Organotin compounds TBT (Tributyltin compounds), TPT (Triphenyltin compounds)		√	√	

As shown in Figures 4-A to 4-D, 38 areas for surface water, 63 areas for bottom sediment, and 23 areas for wildlife (fish, shellfish, birds) were surveyed. Surveyed substances in each medium were the same for all areas (surface water: 7 substances (groups), bottom sediment/wildlife: 8 substances (groups), air: 6 substances (groups)). And the species and characteristics of wildlife subject are shown in Table 4-2.

3. Analytical method

Suggested analytical methods are shown in Appendix D.

4. Method of assessment

The General Inspection Survey was reexamined in FY2001 and the system of the survey was modified in FY2002. Thus, continuity of the survey has been studied, comparing the target substances, survey areas and quantitation limits before and after the modification. Subsequently, change of the persistence of each substance was evaluated based on the results of continuity investigation.

4.1 Study of the continuity of the Monitoring Investigation

In the General Inspection Survey (initiated in FY1974), Wildlife Monitoring (initiated in FY1978), Surface Water and Bottom Sediment Monitoring, Study and Investigation of Designated Chemical Substances, etc., and the Follow-up Survey on the Status of Pollution by Unintentionally Formed Chemical Substances have been conducted as successive survey up to FY2001. Furthermore, aiming at early-stage detection and grasping the concentrations of persistent chemical substances in the general environment, the Environmental Investigation on Chemical Substances has been conducted on an annual basis. A summary of these investigations follows.

Name of Investigation	Starting Year(Note 1)	Media(Note 2)	Target Chemical Substances(Note 2)
Wildlife Monitoring	FY1978	Wildlife (Fish, Shellfish, Birds)	PCBs, HCB, Drins, DDTs, Chlordanes, HCHs, Organotin compounds
Surface Water and Bottom Sediment Monitoring	FY1986	Surface water, Bottom sediment	HCB, Dieldrin, DDTs, Chlordanes, HCHs, Organotin compounds
Study and Investigation of Designated Chemical Substances, etc.	FY1988	Surface water, Bottom sediment	Organotin compounds
Follow-up Survey on the Status of Pollution by Unintentionally Formed Chemical Substances	FY1989	Surface water, Bottom sediment, Wildlife (Fish), Air	PCBs
General Inspection Survey of Chemical Substances	FY1974	Surface water, Bottom sediment, Wildlife (Fish), Air	PCBs, HCB, Drins, Chlordanes, Heptachlor, HCHs,Organotin compounds

Note 1: Starting year is the starting year of investigation. Actual execution situation varies depending on each medium and target substance.

Note 2: Only the substances that are included in the FY2002 Monitoring Investigation are listed. Also, as to the media, only those for which surveys were conducted on the substances in the right column are listed.

(1) Change in target substances and media

Monitoring of the following substances, other than heptachlor in all media, were newly started in FY2002: aldrin, endrin, *o*,*p*'-DDT, *o*,*p*'-DDE, and *o*,*p*'-DDD for surface water and bottom sediment; HCB, aldrin, endrin, dieldrin, *p*,*p*'-DDT, *p*,*p*'-DDE, *p*,*p*'-DDD, *o*,*p*'-DDT, *o*,*p*'-DDE, *o*,*p*'-DDD, *trans*-chlordane, *cis*-chlordane, *trans*-nonachlor, *cis*-nonachlor, and oxychlordane for air.

(2) Change in survey areas

Surface water: Monitoring of PCBs was started at 28 areas in FY2000 and conducted at 29 areas in FY2001, whereas it was increased to 38 areas in FY2002. Monitoring of substances other than PCBs was started at 18 areas in 1986 and conducted at 18 areas in 1998, whereas it was increased to 38 areas in FY2002. The 14 survey areas in FY2002 have been monitored successively for over 4 years and 24 areas were newly monitored (no survey was conducted from FY1999 to FY2001).

Bottom sediment: Monitoring of PCBs was started at 36 areas in FY2000 and conducted at 39 areas in FY2001, whereas it was increased to 63 areas in FY2002. Monitoring of substances other than PCBs (excluding organotin compounds) was started at 18 areas in 1986 and conducted at 20 areas in 2001, whereas it was increased to 63 areas in FY2002. Among these, 17 areas have been monitored successively.

Monitoring of organotin compounds was started in FY1988 for TBT (17 areas) and in FY1889 for TPT (26 areas) and conducted at 34 areas in FY2001, whereas it was increased to 63 areas in FY2002, the same as the other substances. Among these, 27 areas have been monitored successively.

Wildlife: Wildlife Monitoring was started at 8 areas in FY1978 and the number of survey areas was increased year by year, and conducted at 23 areas in FY2001 and FY2002 (2 species of wildlife were surveyed at a specific area this year). In addition, as to PCBs, monitoring of their homologs and coplanar PCBs was conducted for fish and shellfish in FY1996, FY1997, FY2000, and FY2001.

Air: Monitoring of PCBs was conducted in FY2000 and FY2001. Monitoring of substances other than PCBs was not conducted in the past. The number of survey areas for PCBs increased considerably from 17 areas in FY2000 and 15 areas in FY2001 to 34 areas in FY2002.

(3) Change in quantitation (detection) limit

A list of comparisons between the quantitation (detection) limit in FY2001 and FY2002 surveys is shown in Table 4-3. The value of FY2001 is the "unified detection limit," which will be explained later, and the value of FY2002 is the quantitation limit (3 times the detection limit). Change of the detection status versus change in the detection limit is summarized in Table 4-4. In this table, only the areas where surveys have been conducted consecutively are counted in order to eliminate the effect of area change. Considerable change is observed from Table 4-3 in the quantitation (detection) limit of FY2002 compared with those up to FY2001.

In the wildlife monitoring, GC-ECD was used for analysis at the beginning; however, GC/MS is currently predominantly used and the analytical sensitivity reached a considerably higher level. However, as the analysis had been carried out mainly at research organizations of local governments until FY2001, it was necessary to treat the data taking into consideration the difference of analytical instruments of those research organizations. Consequently, the identical detection limit (called "unified detection limit") was used to treat the data. This unified detection limit are quantitative values easily attainable with the current analytical method.

In the FY2002 survey, in addition to the fact that analysis was conducted at a single organization for each medium, analysis with high-sensitivity GC/HRMS was adopted with the exception of organotin compounds. Thus, detection limits were lowered to approximately 1/1,000 of the unified detection limit.

In the monitoring of surface water and bottom sediment, GC/MS was used for analysis from the beginning with the target of attaining a detection limit of 0.01 μg/L for surface water and 1 ng/g-dry (= 1,000 pg/g-dry) for bottom sediment. In FY2002, analysis was conducted using high-sensitivity GC/HRMS and the detection limits were lowered to approximately 1/10,000 for surface water and 1/1,000 for bottom sediment compared with that in FY2001.

The total amounts of PCBs in the Follow-up Survey on the Status of Pollution by Unintentionally Formed Chemical Substances were analyzed by GC-ECD in FY1996/FY1997; however, they were analyzed by high-sensitivity HRGC/HRMS in FY2000/2001, resulting in the reduction of the detection limit to about 1/10,000 of that in FY1996/1997. In FY2002, the detection limit was the same as that in FY2001. Furthermore, as analysis has been conducted by HRGC/HRMS for coplanar PCBs since FY1996, there is no change in the detection limit.

As mentioned above, analysis of the substances has been conducted using high sensitivity instruments since the FY2002 monitoring investigation, with the exception of organotin compounds, and many substances-media were detected. As any change in observed values is important for the monitoring investigation, it was decided to show the quantitation limit (= 3 times the detection limit) hereafter to secure the reliability of the observed values, as follows:

† Quantitation limit is defined as 3 times the detection limit.
† Detection status (e.g. detected number/total sample number) is to be judged by the detection limit.
† In calculating “geometric mean”, measured values are to be used when the values are above the detection limit and one half of the observed values are to be used when the values are below the detection limit.
† In describing “geometric mean”, ”median value”, etc., observed values are to be expressed as “trace” when the values are below the quantitation limit, and as “not detected (ND)” when the values are below the detection limit.

(4) Summary of the study on the continuity of data

Based on the results of previous studies, the following points should be taken into account in the assessment of the survey results.

a. PCBs

PCBs have been surveyed successively for surface water and bottom sediment. They have also been surveyed for air in the "Follow-up Survey on the Status of Pollution by Unintentionally Formed Chemical Substances" and for wildlife (fish, shellfish, birds) in the "Wildlife Monitoring". In these surveys, PCBs have been monitored for 2 years (FY2000/FY2001) for surface water and air, 4 years (FY1996, FY1997, FY2000, FY2001) for bottom sediment, and 24 years (FY1978–FY2001) for wildlife. Consequently, surveys have been conducted for a sufficient period of time on wildlife in the assessment of annual change of the concentration in wildlife. However, it cannot be said that surveys have been conducted for a sufficiently long period of time on surface water, bottom sediment and air.

Survey areas of PCBs for surface water, bottom sediment and air in FY2002 have been changed substantially compared with those in FY2001 and before. Therefore, these facts must be taken into account in assessing the tendency of persistence in these media in terms of yearly change. As to wildlife media, the same as in the case of PCBs, 2 areas (offshore of Kushiro: angry rockfish; Shugen Island: sea bass) were replaced by 3 areas (Kawasaki Port: sea bass; Yokohama Port: common mussel; Mishima: purplish bifurcate mussel) in FY2002 compared with that in FY2001 and before. It is necessary to take this fact into consideration in assessing the annual change, since Kawasaki Port and Yokohama Port, where water pollution is considered severe, were added and the area offshore of Kushiro and surrounding Shugen Island, where pollution is comparatively low, were omitted from the survey areas.

As the detection limits of PCBs in FY2002 for surface water, bottom sediment and air are nearly the same as those of FY2001 and before, all data can be assessed with continuity. On the other hand, the detection limit of wildlife in FY2002 is lowered to 1/1,000 of that before FY2001. Accordingly, the detected amount has increased sharply, requiring consideration in assessing the tendency of persistence using detection frequency and/or geometric mean. It is also difficult to grasp the yearly change in wildlife by median value, 70% value, 80% value, etc., since the concentrations of PCBs in wildlife samples before FY2001 were mostly below the detection limit.

b. Organochlorinated compounds other than PCBs

Organochlorinated compounds other than PCBs have been surveyed successively for surface water and bottom sediment in the Surface Water / Bottom Sediment Monitoring and for wildlife (fish, shellfish, birds) in the Wildlife Monitoring. Successive survey has not been conducted for air in the past. HCHs in air is not targeted in the FY2002 survey. Furthermore, heptachlor has not been surveyed successively in the past in any media.

Among the organochlorinated compounds other than PCBs, hexachlorobenzene, dieldrin, *p*,*p*'-DDT, *p*,*p*'-DDE, *p*,*p*'-DDD, *trans*-chlordane, *cis*-chlordane, *trans*-nonachlor, *cis*-nonachlor, α-HCH, and

β-HCH were monitored for 13 years (FY1986–FY1998) in surface water and for 16 years (FY1986–FY2001) in bottom sediment. Oxychlordane was monitored only for 2 years (FY1986–FY1987) and other substances (aldrin, endrin, *o,p*'-DDT, *o,p*'-DDE, *o,p*'-DDD, and heptachlor) in surface water and bottom sediment had not been monitored successively. As to wildlife, aldrin and endrin had been monitored from FY1978 to FY1993, and other substances from around FY1980 to FY2001. Thus, it is difficult to grasp the tendency of persistence for substances (heptachlor, etc.) and media (air, etc.) on which monitoring survey was not conducted in the past. Furthermore, as the interval from the previous survey is large for oxychlordane in surface water and bottom sediment, and aldrin and endrin in wildlife, special consideration must be taken in assessing the tendency of the persistence.

Survey areas for organochlorinated compounds except PCBs in the FY2002 survey have been substantially changed (same as in the case of PCBs) from those in FY2001 and before. Thus, special consideration must be taken in assessing the tendency of persistence in terms of yearly change.

Detection limits of organochlorinated compounds except PCBs in FY2002 have decreased sharply to about 1/10,000 for surface water and to about 1/1,000 for bottom sediment and wildlife. Accordingly, the detected amount has increased sharply, requiring consideration in assessing the tendency of persistence using detection frequency and/or geometric mean. It is also difficult to grasp the yearly change in wildlife by median value, 70% value, 80% value, etc., as the concentrations of the organochlorinated compounds except PCBs in wildlife samples before FY2001 were mostly below the detection limit.

c. Organotin compounds

Organotin compounds have hitherto been successively surveyed in the Study and Investigation of Designated Chemical Substances, etc. for bottom sediment and Wildlife Monitoring for wildlife (fish, shellfish, birds). As to the past survey for organotin compounds, TBT in bottom sediment had been surveyed for 14 years (FY1988–FY2001), TPT in bottom sediment for 12 years (FY1990–FY2001), TBT in wildlife for 17 years (FY1985–FY2001), and TPT in wildlife for 13 years (FY1989–FY2001). Consequently, surveys both on bottom sediment and wildlife had been conducted for a sufficient period of time in assessing any change of their persistence on an annual basis.

Survey areas of FY2002 for organotin compounds have been substantially changed (same as in the case of PCBs) from those in FY2001 and before. Consequently, it is necessary to take due consideration in assessing the tendency of persistence comparing the data of FY2002 and FY2001 and before.

As the quantitation limits of organotin compounds for bottom sediment adopted in the FY2002 survey are nearly the same as those adopted in FY2001 and previous years, it is possible to assess the tendency of persistence with continuity. Detection limits of organotin compounds for wildlife in FY2002 have decreased to about 1/10 of those in FY2001 and before. Accordingly, the detected amount has increased considerably, requiring consideration in assessing the tendency of persistence using detection frequency and/or geometric mean.

4.2 Policy of assessment

Monitoring Investigation has been conducted for a long period of time, during which many changes and modifications have been made. Consequently, it is difficult to treat the data obtained during the initial years with the survey results in recent years as consecutive values. However, it might be possible to assess the surveyed values with continuity if they are limited to certain periods. The tendency of the survey results during a certain period of time is first assessed for each substance and medium. Next, the tendency of the total period as a whole was assessed.

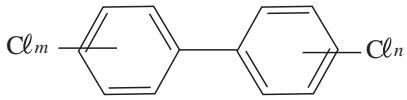
5. Survey results

Survey results are as follows. Quantitation limits in this survey are shown in Table 4-5 and the summary of the survey is shown in Table 4-6. Furthermore, annual changes of PCBs, HCB, dieldrin, endrin, *p,p*'-DDT, *p,p*'-DDE, *p,p*'-DDD, *trans*-chlordane, *cis*-chlordane, *trans*-nonachlor, *cis*-nonachlor, oxychlordane, α-HCH, β-HCH, TBT, and TPT in wildlife and bottom sediment are shown in the following figures.

† Figure 4-1: PCBs † Figure 4-2: HCB
† Figure 4-3: Dieldrin † Figure 4-4: Endrin
† Figure 4-5: *p,p*'-DDT † Figure 4-6: *p,p*'-DDE † Figure 4-7: *p,p*'-DDD
† Figure 4-8: *trans*-Chlordane † Figure 4-9: *cis*-Chlordane
† Figure 4-10: *trans*-Nonachlor † Figure 4-11: *cis*-Nonachlor † Figure 4-12: Oxychlordane
† Figure 4-13: α-HCH † Figure 4-14: β-HCH
† Figure 4-15: TBT † Figure 4-16: TPT

In this survey, the detection ratio of the substances has increased since the previous year because of the improvement in analytical sensitivity for the wildlife samples. As to POPs, all surveyed substances, excluding aldrin in birds, were detected in the samples of surface water, bottom sediment, wildlife (fish, shellfish) and air. Furthermore, organotin compounds were detected in the surveyed bottom sediment and wildlife (fish, shellfish), with the exception of birds.

[1] PCBs (CAS RN: 1336-36-3)



Chemical formula / molecular weight: (Mixture) / (mixture)
Melting point: (mixture)
Boiling point: (mixture)
Water solubility (Sw): (mixture)
Specific gravity: (mixture)
n-Octanol/water partition coefficient (LogPow): (mixture)

PCBs in surface water have been surveyed in the last 3 years and the geometric mean for FY2000, FY2001 and FY2002 is 560 pg/L, 440 pg/L and 460 pg/L, respectively. Although it is difficult to grasp the tendency of persistence, PCBs were detected in all samples from all surveyed areas every year and they are still evidently persistent in widespread areas.

PCBs in bottom sediment have been surveyed in the last 3 years and the geometric mean for FY2000, FY2001 and FY2002 is 15,000 pg/g-dry, 15,000 pg/g-dry and 9,200 pg/g-dry, respectively. Although their concentrations show a decreasing tendency, PCBs were detected in all samples from all surveyed areas every year and the persistence of PCBs in widespread areas is recognized.

Although persistent concentrations of PCBs in fish show a decreasing tendency from the initial surveys to recent years, it was detected in all samples from all surveyed areas with the quantitation limit (measured quantitation limit, hereinafter called MQL) of 1.2-3 pg/g-wet in the FY2002 survey and the persistence of PCBs in widespread areas is recognized.

Persistent concentrations of PCBs in shellfish showed a decreasing tendency in early years and the detected values in recent years were mostly below the MQL (10,000 pg/g-wet). However, in the FY2002 survey under MQL 1.2-3 pg/g-wet, they were detected in all samples from all surveyed areas. Although it is difficult to grasp the tendency of persistence because of the high MQL in the past years, persistence of PCBs in widespread areas is recognized.

It is difficult to grasp the tendency of persistence of PCBs in birds from the initial years of the survey, mainly because of the change of survey areas, in addition to the fact that only 2 areas were surveyed. Little change is observed in their persistence in recent years and the persistence of PCBs is still recognized.

PCBs in air have been surveyed in the last 3 years and the geometric mean for FY2000, FY2001 and FY2002 is 430 pg/m^3, 280 pg/m^3 and 100 pg/m^3, respectively, indicating a gradual decrease in the environmental concentration.

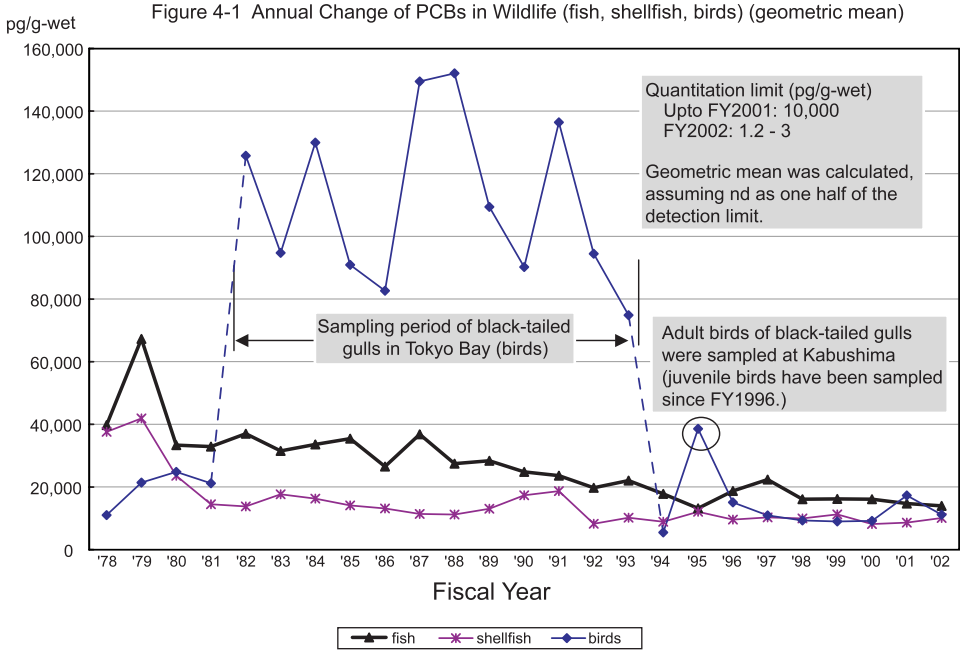
PCBs are substances included in the POPs Treaty, and also from the standpoint of global pollution monitoring, it is necessary to continue the monitoring to trace their fate. As the disposal of PCBs by decomposition has been started, its effects and influences must be taken into account. Furthermore, homologs of PCBs and coplanar PCB have hitherto been conducted at irregular intervals in addition to the total PCBs. These items are scheduled to be monitored on a future annual basis starting in FY2002.

○Survey Results of PCBs

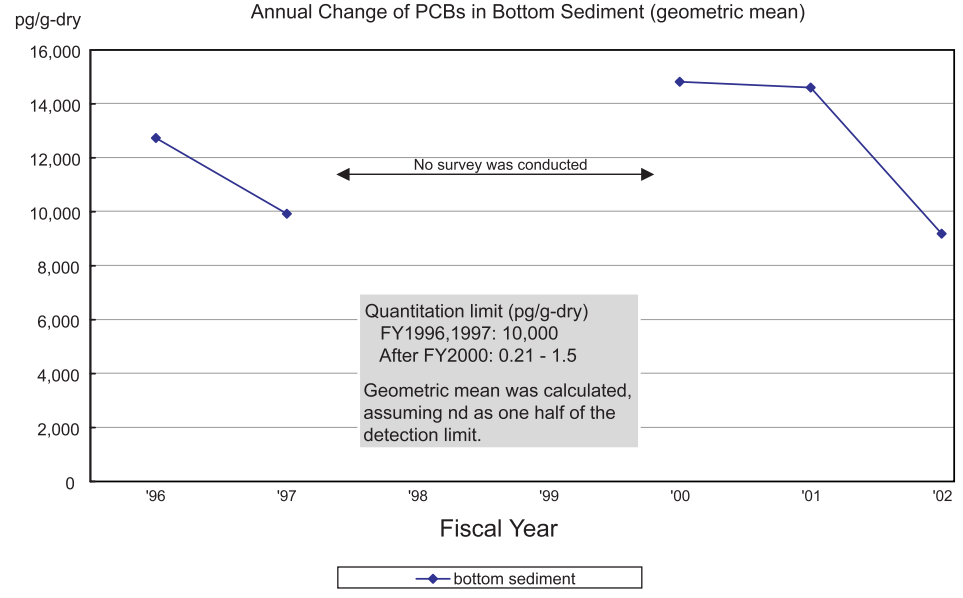
Substance		Unit	Geometric mean	Detected range	MQL	Detection frequency (area)
Surface water		pg/L	460	60 - 11,000	0.18 - 0.9 0.018 - 0.09	38/38
Bottom sediment		pg/g-dry	9,200	39 - 630,000	0.21 - 1.5	63/63
Wildlife	Fish	pg/g-wet	14,000	1,500 - 550,000	1.2 - 3	14/14
	Shellfish	pg/g-wet	10,000	200 - 160,000	1.2 - 3	8/8
	Birds	pg/g-wet	11,000	4,800 - 22,000	1.2 - 3	2/2
Air		pg/m^3	100	16 - 880	0.015 - 90	34/34

Note: Values of MQL for surface water in the upper row are obtained by standard sampling system (sample volume: 30L) and values in the lower row are by high-volume sampling system (sample volume: 100L).

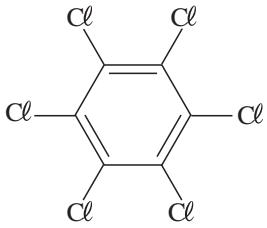
Figure 4-1 Annual Change of PCBs in Wildlife (fish, shellfish, birds) (geometric mean)



Annual Change of PCBs in Bottom Sediment (geometric mean)



[2] HCB (CAS RN: 118-74-1)



Chemical formula / molecular weight: C_6Cl_6 / 284.78

Melting point: 231°C [1], 230°C [2]

Boiling point: 323-326 °C [1], 332°C [2]

Water solubility (Sw): 0.005-0.035 mg/L [1], insoluble 0.0062 mg/L [2]

Specific gravity: 2.044-2.44 [1]

n-Octanol/water partition coefficient (LogPow): 5.23-6.18 [1]

HCB in surface water has mostly been below the MQL (around 10,000 pg/L). However, it was detected in all areas/samples in the FY2002 survey under MQL 0.06 or 0.6 pg/L, indicating that HCB has hitherto been persistent at a concentration below the MQL. Although it is difficult to grasp the tendency of the persistence because of the high MQL in the past years, persistence of HCB in widespread areas is recognized.

Persistence of HCB in bottom sediment from the start of the monitoring to recent years shows a decreasing tendency. However, in the FY2002 survey it was detected in all surveyed areas/samples under MQL 0.9 pg/g-dry, indicating its persistence in widespread areas.

Persistence of HCB in fish from the start of the monitoring shows a decreasing tendency and detected values were mostly below the MQL (1,000 pg/g-wet) in recent years. In FY2002, it was detected in all surveyed areas/samples under MQL of 0.18 pg/g-wet. Although it is difficult to grasp the tendency of persistence because of the high MQL limit in the past years, persistence of HCB in widespread areas is recognized.

Concentrations of HCB in shellfish were mostly below the MQL (1,000 pg/g-wet) until FY2001. However, it was detected in all areas/samples in the FY2002 survey under MQL 0.18 pg/g-wet, indicating that HCB has hitherto been persistent at a concentration below the MQL. Although it is difficult to grasp the tendency of persistence because of the high MQL in the past years, persistence of HCB in widespread areas is recognized.

It is difficult to grasp the tendency of persistence of HCB in birds from the initial years of the survey because of the change of survey areas, in addition to the fact that only 2 areas were surveyed. Little change is observed in the persistence in recent years and the persistence of HCB in birds is still recognized.

Although it is difficult to grasp the tendency of its persistence in air as the monitoring of HCB in air was only initiated in FY2002, persistence of HCB in widespread areas is recognized.

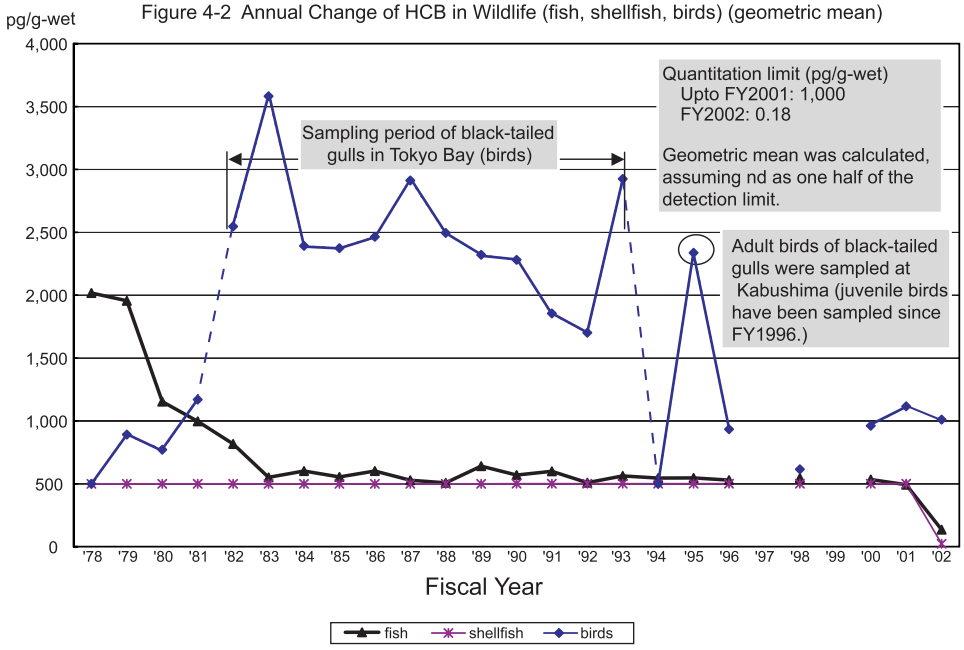
As HCB is one of the substances included in the POPs Treaty and it is persistent in widespread areas, successive monitoring is necessary for the purpose of tracing its fate, mainly from the standpoint of global pollution monitoring.

○Survey Results of HCB

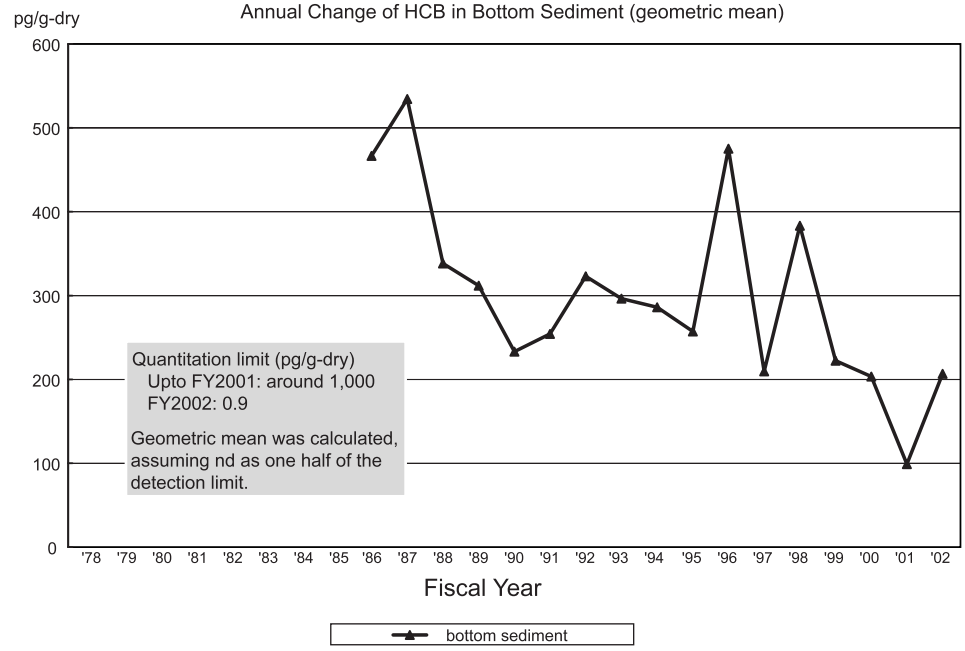
Substance		Unit	Geometric mean	Detected range	MQL	Detection frequency (area)
Surface water		pg/L	36	9.8 - 1,400	0.6 0.06	38/38
Bottom sediment		pg/g-dry	210	7.6 - 19,000	0.9	63/63
Wildlife	Fish	pg/g-wet	140	19 - 910	0.18	14/14
	Shellfish	pg/g-wet	23	2.4 - 330	0.18	8/8
	Birds	pg/g-wet	1,000	560 - 16,000	0.18	2/2
Air		pg/m^3	99	57 - 3,000	0.9	34/34

Note: Values of MQL for surface water in the upper row are obtained by standard sampling system (sample volume: 30L) and values in the lower row are by high-volume sampling system (sample volume: 100L).

Figure 4-2 Annual Change of HCB in Wildlife (fish, shellfish, birds) (geometric mean)

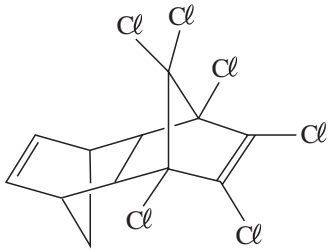


Annual Change of HCB in Bottom Sediment (geometric mean)



[3] Drins (Aldrin, Dieldrin, Endrin)

(Aldrin, CAS RN: 309-00-2)



Chemical formula / molecular weight: $C_{12}H_8Cl_6$ / 364.91

Melting point: 101-105°C [1], 104°C [2]

Boiling point: 145°C [2]

Water solubility (Sw): 0.2-17 mg/L (25°C)[1], insoluble 0.18 mg/L[2]

Specific gravity: 1.65[1]

n-Octanol/water partition coefficient (LogPow): 3.01-6.75[1]

Monitoring of aldrin in surface water and bottom sediment was started in FY2002 and its persistence in these media in widespread areas is recognized.

Concentrations of aldrin in fish were mostly below the MQL (1,000 pg/g-wet) until FY1993 and no monitoring has been conducted since FY1994. In FY2002, monitoring was conducted under MQL 4.2 pg/g-wet; however, all of the data was below the MQL, indicating no significant increase in the persistent concentrations.

Concentrations of aldrin in shellfish were mostly below the MQL (1,000 pg/g-wet) until FY1993 and no monitoring has been conducted since FY1994. However, it was detected under MQL 4.2 pg/g-wet, indicating that aldrin has hitherto been persistent at a concentration below the MQL. Although it is difficult to grasp the tendency of persistence because of the high MQL in the past years, persistence of aldrin in widespread areas is recognized.

Concentrations of aldrin in birds were mostly below the MQL (1,000 pg/g-wet) until FY1993, with its first detection in 1978, and no monitoring has been conducted since FY1994. In FY2002, monitoring was conducted under MQL 4.2 pg/g-wet; however, all of the data was below the MQL, indicating no significant increase in the persistent concentrations.

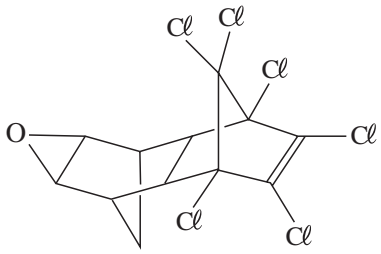
Concentration of aldrin in air was initiated in FY2002 and its persistence was detected in widespread areas.

○Survey Results of Aldrin

Substance		Unit	Geometric mean	Detected range	Quantitation limi	Detection frequency (area)
Surface water		pg/L	0.69	tr(0.04) - 18	0.6 0.06	37/38
Bottom sediment		pg/g-dry	12	tr(2) - 570	6	56/63
Wildlife	Fish	pg/g-wet	ND	tr(2.0)	4.2	1/14
	Shellfish	pg/g-wet	tr(1.7)	tr(1.7) - 34	4.2	4/8
	Birds	pg/g-wet	ND	---	4.2	0/2
Air		pg/m^3	tr(0.030)	tr(0.029) - 3.2	0.060	19/34

Note: Values of MQL for surface water in the upper row are obtained by standard sampling system (sample volume: 30L) and values in the lower row are by high-volume sampling system (sample volume: 100L).

(Dieldrin, CAS RN: 60-57-1)



Chemical formula / molecular weight: $C_{12}H_8Cℓ_6O$ / 380.91

Melting point: 150-175°C [1)], 176°C [2)]

Boiling point: 385°C [2)]

Water solubility (Sw): 0.022-0.25 mg/L (25°C)[1)], insoluble 0.2 mg/L[2)]

Specific gravity: 1.75[1)]

n-Octanol/water partition coefficient (LogPow): 4.7-5.61[1)]

Concentrations of dieldrin in surface water were below the MQL (around 10,000 pg/L) until FY2001. However, it was detected in all areas/samples in the FY2002 survey under MQL 0.18-1.8 pg/L, indicating that dieldrin has hitherto been persistent at a concentration below the MQL. Although it is difficult to grasp the tendency of persistence because of the high MQL in the past years, persistence of dieldrin in widespread areas is recognized.

Concentrations of dieldrin in bottom sediment were mostly below the MQL (around 10,000 pg/L) until FY2001. However, it was detected in all areas/samples in the FY2002 survey under MQL 3 pg/g-dry, indicating that dieldrin has hitherto been persistent at a concentration below the MQL. Although it is difficult to grasp the tendency of persistence because of the high quantitation limit in the past years, persistence of dieldrin in widespread areas is recognized.

Persistence of dieldrin in fish and shellfish shows a decreasing tendency from the start of the monitoring to recent years. However, it was detected in all surveyed areas/samples under MQL 12 pg/g-wet, indicating its persistence in widespread areas.

It is difficult to grasp the tendency of persistence of dieldrin in birds since the initiation of the survey because survey areas were changed, in addition to the fact that only 2 areas were surveyed. Little change is observed in the persistence in recent years and the persistence of dieldrin is still recognized.

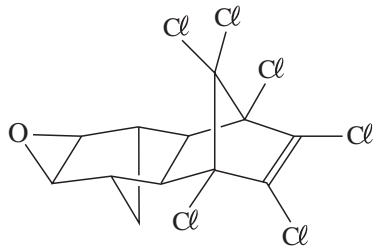
Monitoring of dieldrin in air was initiated in FY2002 and its persistence was detected in widespread areas.

○Survey Results of Dieldrin

Substance		Unit	Geometric mean	Detected range	MQL	Detection frequency (area)
Surface water		pg/L	41	3.3 - 640	1.8 0.18	38/38
Bottom sediment		pg/g-dry	63	4 - 2,300	3	63/63
Wildlife	Fish	pg/g-wet	280	46 - 2,400	12	14/14
	Shellfish	pg/g-wet	490	tr(7) - 190,000	12	8/8
	Birds	pg/g-wet	1,200	820 - 1,700	12	2/2
Air		pg/m^3	5.6	0.73 - 110	0.60	34/34

Note: Values of MQL for surface water in the upper row are obtained by standard sampling system (sample volume: 30L) and values in the lower row are by high-volume sampling system (sample volume: 100L).

(Endrin, CAS RN: 72-20-8)



Chemical formula / molecular weight: $C_{12}H_8C\ell_6O$ / 380.91

Melting point: 200-230°C [1], 200°C [2]

Boiling point: 245°C [2]

Water solubility (Sw): 0.024 mg/L[1], 0.26 mg/L[2]

Specific gravity: Unknown

n-Octanol/water partition coefficient (LogPow): 5.22[1]

Monitoring of endrin in surface water and bottom sediment was started in FY2002 and its persistence in these media in widespread areas was recognized.

Concentrations of endrin in fish were mostly below the MQL (around 1,000 pg/g-wet) until FY1993 and no monitoring has been conducted since FY1994. In FY2002, it was detected under MQL 18 pg/g-wet, indicating that endrin has hitherto been persistent at a concentration below the MQL. Although it is difficult to grasp the tendency of persistence because of the high MQL in the past years, persistence of endrin in widespread areas is recognized.

Endrin had been detected in shellfish in a specific area (Naruto: mussel) under MQL 1,000 pg/g-wet until FY1993; however, no monitoring has been conducted since FY1994. In FY2002, it was detected in 7 areas out of 8 under MQL 18 pg/g-wet, indicating that endrin is widely persistent in other areas.

Concentrations of endrin in birds were below the MQL (around 1,000 pg/g-wet) until FY1993 and no monitoring has been conducted since FY1994. In FY2002, it was detected in all surveyed areas under MQL 18 pg/g-wet, indicating that endrin had been persistent at a concentration below the MQL until FY1993. Although it is difficult to grasp the tendency of persistence because of the high MQL in the past years, persistence of endrin in widespread areas is recognized.

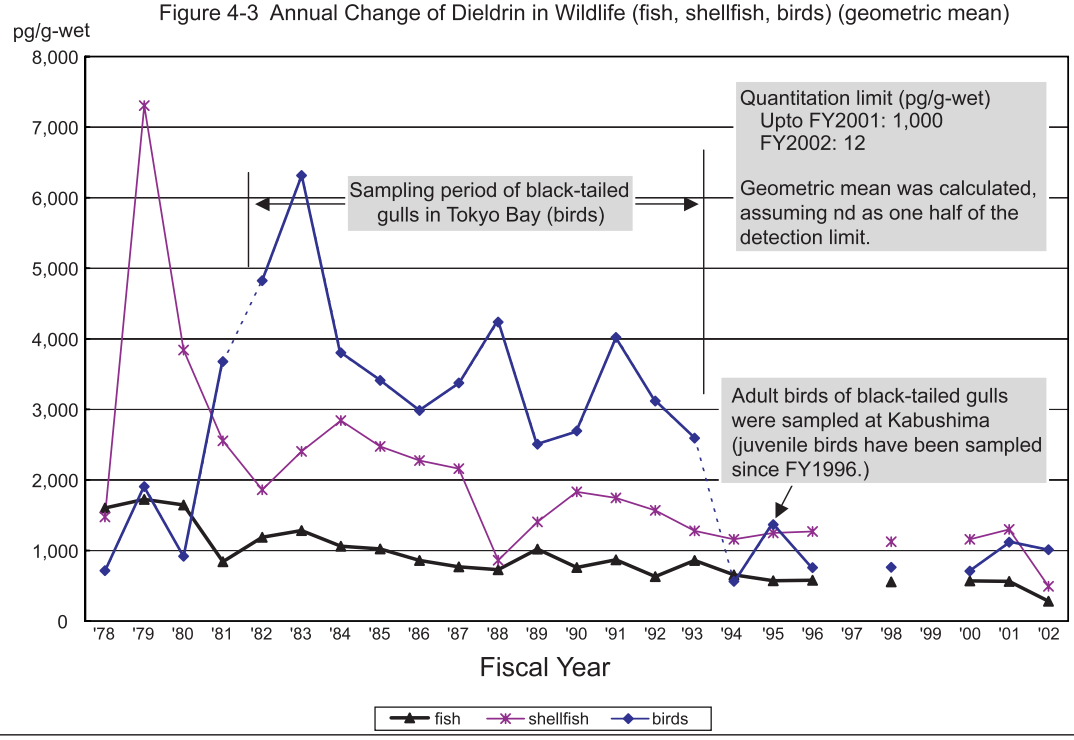
○Survey Results of Endrin

Substance		Unit	Geometric mean	Detected range	MQL	Detection frequency (area)
Surface water		pg/L	4.7	tr(0.6) - 31	6.0 0.60	36/38
Bottom sediment		pg/g-dry	9	tr(2) - 19,000	6	54/63
Wildlife	Fish	pg/g-wet	19	tr(6) - 180	18	13/14
	Shellfish	pg/g-wet	44	tr(8) - 12,000	18	7/8
	Birds	pg/g-wet	22	tr(8) - 99	18	2/2
Air		pg/m^3	0.22	tr(0.051) - 2.5	0.090	32/34

Note: Values of MQL for surface water in the upper row are obtained by standard sampling system (sample volume: 30L) and values in the lower row are by high-volume sampling system (sample volume: 100L).

Aldrin, dieldrin and endrin are target substances included in the POPs Treaty, and also from the standpoint of global pollution monitoring, it is necessary to continue the monitoring to trace their fate.

Figure 4-3 Annual Change of Dieldrin in Wildlife (fish, shellfish, birds) (geometric mean)



Annual Change of Dieldrin in Bottom Sediment (geometric mean)

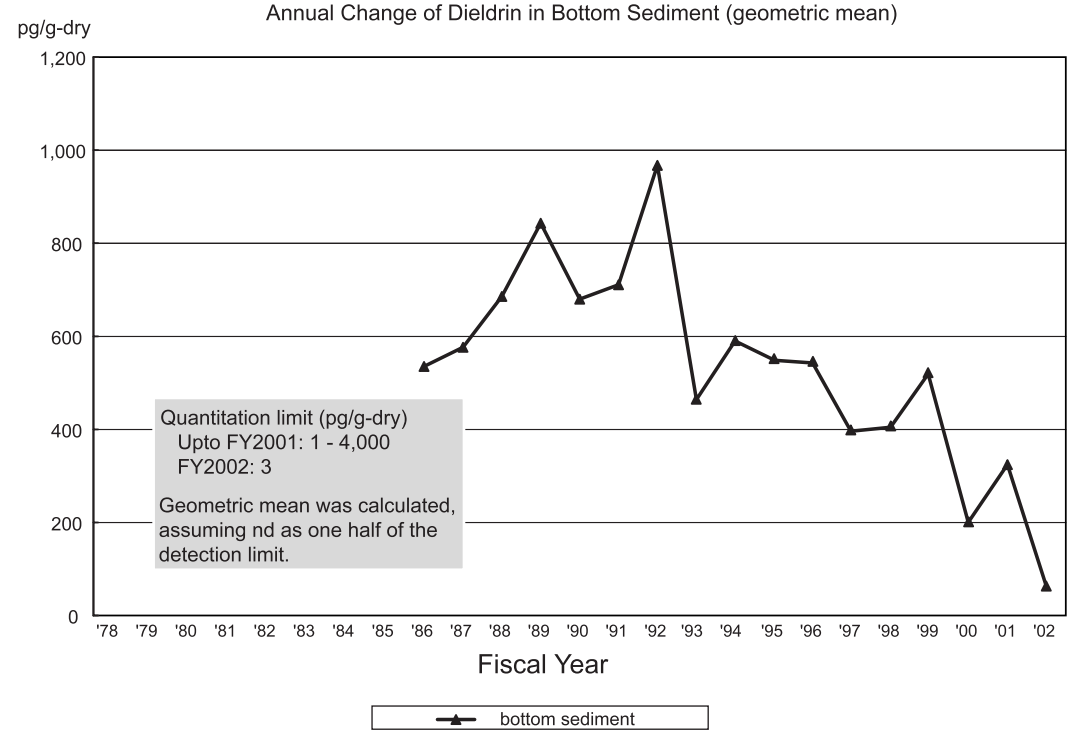
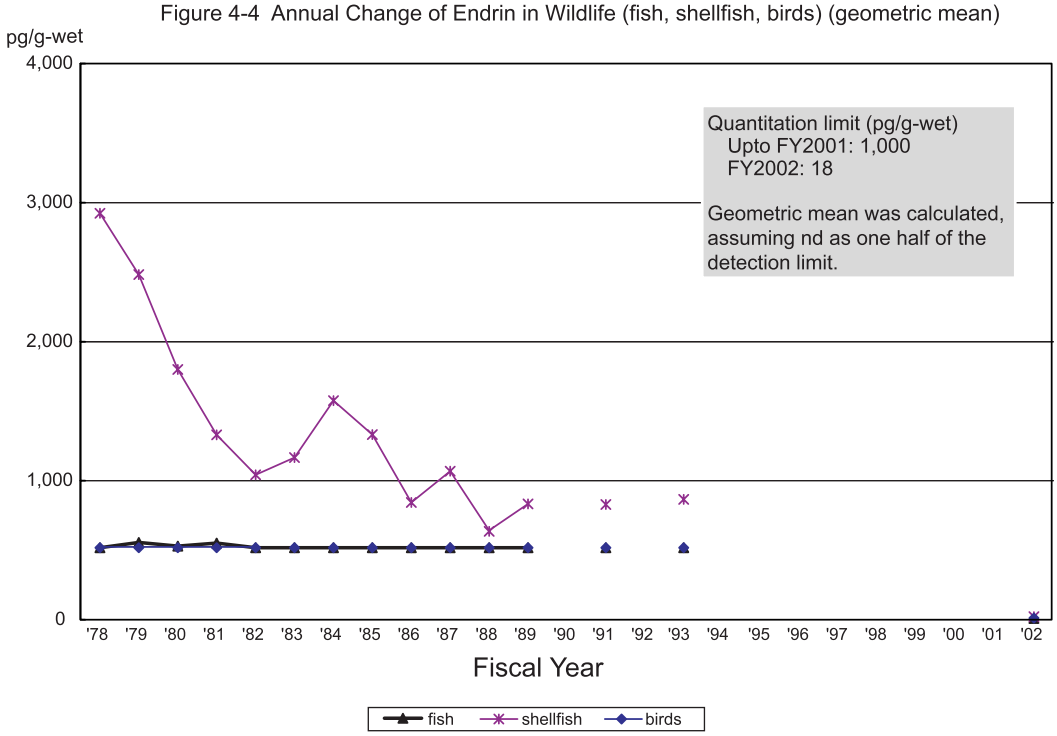
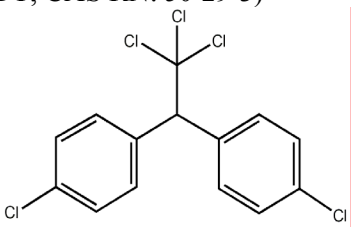


Figure 4-4 Annual Change of Endrin in Wildlife (fish, shellfish, birds) (geometric mean)



[4] DDTs

(*p,p'*-DDT, CAS RN: 50-29-3)



Chemical formula / molecular weight: $C_{14}H_9Cl_5$ / 354.49

Melting point: 108.5-109°C [1)]

Boiling point: Unknown

Water solubility (Sw): 0.0012-0.0031 mg/L (25°C)[1)]

Specific gravity: Unknown

n-Octanol/water partition coefficient (LogPow): 6.19-6.38[1)]

Concentrations of *p,p'*-DDT in surface water were below the MQL (10,000 pg/L) until FY2001. However, it was detected in all areas/samples in the FY2002 survey under MQL 0.06 or 0.6 pg/L, indicating that *p,p'*-DDT has hitherto been persistent at a concentration below the MQL. Although it is difficult to grasp the tendency of persistence because of the high MQL in the past years, persistence of *p,p'*-DDT in widespread areas is recognized.

No considerable change had been observed in the persistence of *p,p'*-DDT in bottom sediment until FY1996; however, a decreasing tendency has been observed since FY1997. However, in the FY2002 survey, it was detected in all surveyed areas/samples under MQL 6 pg/g-dry, indicating its persistence in widespread areas.

Persistence of *p,p'*-DDT in fish shows a decreasing tendency from the start of the monitoring to recent years. However, in the FY2002 survey, it was detected in all surveyed areas/samples under MQL 4.2 pg/g-wet, indicating its persistence in widespread areas.

Persistence of *p,p'*-DDT in shellfish shows a decreasing tendency in initial years and detected values were mostly below the MQL (1,000 pg/g-wet) in recent years. In FY2002, it was detected in all surveyed areas/samples under MQL 4.2 pg/g-wet. Although it is difficult to grasp the tendency of the persistence because of the high MQL in the past years, persistence of *p,p'*-DDT in widespread area is recognized.

It is difficult to grasp the tendency of persistence of *p,p'*-DDT in birds from the start of the survey because survey areas were changed, in addition to the fact that only 2 areas were surveyed. Little change is observed in the persistence in recent years and the persistence of *p,p'*-DDT is still recognized.

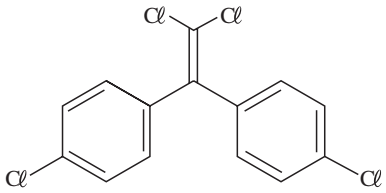
Monitoring of *p,p'*-DDT in air was initiated in FY2002 and its persistence was recognized in widespread areas.

○ Survey Results of *p,p'*-DDT

Substance		Unit	Geometric mean	Detected range	MQL	Detection frequency (area)
Surface water		pg/L	12	0.25 - 440	0.6 0.06	38/38
Bottom sediment		pg/g-dry	270	tr(5) - 97,000	6	63/63
Wildlife	Fish	pg/g-wet	330	6.8 - 24,000	4.2	14/14
	Shellfish	pg/g-wet	200	38 - 1,200	4.2	8/8
	Birds	pg/g-wet	380	76 - 1,300	4.2	2/2
Air		pg/m^3	1.9	0.25 - 22	0.24	34/34

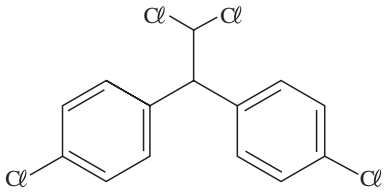
Note: Values of MQL for surface water in the upper row are obtained by standard sampling system (sample volume: 30L) and values in the lower row are by high-volume sampling system (sample volume: 100L).

(*p*,*p*'-DDE, CAS RN: 72-55-9)



Chemical formula / molecular weight: $C_{14}H_8C\ell_4$ / 318.03
Melting point: Unknown
Boiling point: Unknown
Water solubility (Sw): Unknown
Specific gravity: Unknown
n-Octanol/water partition coefficient (LogPow): 6.51[1)]

(*p*,*p*'-DDD, CAS RN: 72-54-8)



Chemical formula / molecular weight: $C_{14}H_{10}C\ell_4$ / 320.04
Melting point: 110°C [1)], 109°C [2)]
Boiling point: 193°C [2)]
Water solubility (Sw): 0.16 mg/L[2)]
Specific gravity: 1.385[2)]
n-Octanol/water partition coefficient (LogPow): 6.02[1)]

p,*p*'-DDE and *p*,*p*'-DDD in surface water had been surveyed under MQL around 10,000 pg/L and *p*,*p*'-DDE was detected in FY1987 only in one area. In FY2002, they were detected in all areas/samples under MQL 0.06 or 0.6 pg/L for *p*,*p*'-DDE and 0.024 or 0.24 pg/L for *p*,*p*'-DDD, indicating that they have hitherto been persistent at a concentration below the MQL. Although it is difficult to grasp the tendency of persistence because of the high MQL in the past years, their persistence in widespread areas is recognized.

In the early years of the monitoring, little change was observed in their persistence in bottom sediment and a decreasing tendency was observed in recent years. In FY2002, they were detected in all areas/samples under MQL 2.7 pg/g-dry for *p*,*p*'-DDE and 2.4 pg/g-dry for *p*,*p*'-DDD, indicating that both substances are still persistent in widespread areas.

Persistence of both substances in fish shows a slightly decreasing tendency from the initial year of the monitoring to recent years. However, in the FY2002 survey, they were detected in all surveyed areas/samples under MQL 2.4 pg/g-wet for *p*,*p*'-DDE and 5.4 pg/g-wet for *p*,*p*'-DDD, indicating that they are still persistent in widespread areas.

Persistence of *p*,*p*'-DDE in shellfish showed a decreasing tendency in initial years; however, no tendency is observed in recent years. And, no change is observed in the persistence of *p*,*p*'-DDD from the initial years to recent years. However, in the FY2002 survey, they were detected in all surveyed

areas/samples under MQL 2.4 pg/g-wet for *p,p'*-DDE and 5.4 pg/g-wet for *p,p'*-DDD, indicating that they are still persistent in widespread areas.

It is difficult to grasp the tendency of persistence of both substances in birds from the initial year of the survey because survey areas were changed, in addition to the fact that only 2 areas were surveyed. Little change is observed in the persistence in recent years and their persistence is still recognized. Further, *p,p'*-DDE has been detected in birds, the same as in the past, at higher concentration than other DDTs.

Monitoring in air was initiated in FY2002 and their persistence was recognized in widespread areas.

○Survey Results of *p,p'*-DDE

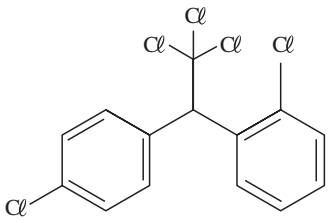
Substance		Unit	Geometric mean	Detected range	MQL	Detection frequency (area)
Surface water		pg/L	24	1.3 - 760	0.6 0.06	38/38
Bottom sediment		pg/g-dry	660	8.4 - 23,000	2.7	63/63
Wildlife	Fish	pg/g-wet	2,500	510 - 98,000	2.4	14/14
	Shellfish	pg/g-wet	1,100	140 - 6,000	2.4	8/8
	Birds	pg/g-wet	36,000	8,100 - 170,000	2.4	2/2
Air		pg/m^3	2.8	0.56 - 28	0.09	34/34

○Survey Results of *p,p'*-DDD

Substance		Unit	Geometric mean	Detected range	MQL	Detection frequency (area)
Surface water		pg/L	15	0.57 - 190	0.9 0.09	38/38
Bottom sediment		pg/g-dry	540	tr(2.2) - 51,000	2.4	63/63
Wildlife	Fish	pg/g-wet	610	80 - 14,000	5.4	14/14
	Shellfish	pg/g-wet	340	11 - 3,200	5.4	8/8
	Birds	pg/g-wet	560	140 - 3,900	5.4	2/2
Air		pg/m^3	0.13	tr(0.024) - 0.76	0.018	34/34

Note: Values of MQL for surface water in the upper row are obtained by standard sampling system (sample volume: 30L) and values in the lower row are by high-volume sampling system (sample volume: 100L).

(*o,p'*-DDT, CAS RN: 789-02-6)



Chemical formula / molecular weight: $C_{14}H_9C\ell_5$ / 354.49

Melting point: 74-74.5°C [1)]

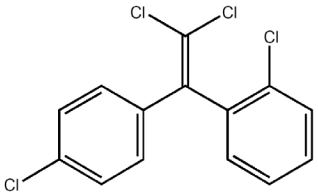
Boiling point: Unknown

Water solubility (Sw): 0.0012-0.0017 mg/L [1)]

Specific gravity: Unknown

n-Octanol/water partition coefficient (LogPow): 5.98 [1)]

(*o p'*- DDE, CAS RN: 3424-82-6,)



Chemical formula / molecular weight: $C_{14}H_8Cl_4$ / 318.03

Melting point: Unknown

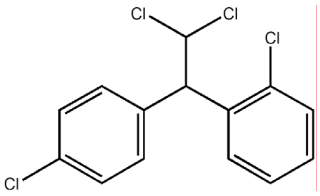
Boiling point: Unknown

Water solubility (Sw): Unknown

Specific gravity: Not known

n-Octanol/water partition coefficient (LogPow): Unknown

(*o,p'*-DDD, CAS RN: 53-19-0)



Chemical formula / molecular weight: $C_{14}H_{10}Cl_4$ / 320.04

Melting point: 76°C [2)]

Boiling point: Unknown

Water solubility (Sw): <0.1 g/100 mL (24°C)[2)]

Specific gravity: Unknown

n-Octanol/water partition coefficient (LogPow): Unknown

Monitoring of *o,p*'-DDT, *o,p*'-DDE and *o,p'*-DDD in surface water and bottom sediment was started in FY2002 and their widespread persistence was recognized.

No change had been observed in their persistence in fish and shellfish from the initial years to recent years, and detected values were mostly below the MQL (1,000 pg/g-wet). In FY2002, they were detected in all surveyed areas/samples under MQL 12 pg/g-wet for *o,p*'-DDT, 3.6 pg/g-wet for *o,p*'- DDE, and 12 pg/g-wet for *o,p'*-DDD, indicating that they have hitherto been persistent at a concentration below the MQL. Although it is difficult to grasp the tendency of persistence because of the high MQL in the past years, their persistence in widespread areas is recognized.

It is difficult to grasp the tendency of persistence of these substances in birds from the start of the survey because survey areas were changed, in addition to the fact that only 2 areas were surveyed. Little change is observed in the persistence in recent years and their persistence is still recognized.

Monitoring in air was initiated in FY2002 and their persistence was recognized in widespread areas.

○Survey Results of *o,p'*-DDT

Substance		Unit	Geometric mean	Detected range	MQL	Detection frequency (area)
Surface water		pg/L	5.1	0.19 - 77	1.2 0.12	38/38
Bottom sediment		pg/g-dry	57	tr(2) - 27,000	6	62/63
Wildlife	Fish	pg/g-wet	110	tr(6) - 2,300	12	14/14
	Shellfish	pg/g-wet	100	22 - 480	12	8/8
	Birds	pg/g-wet	tr(10)	tr(5) - 58	12	2/2
Air		pg/m^3	2.2	0.41 - 40	0.15	34/34

○Survey Results of *o,p'*-DDE

Substance		Unit	Geometric mean	Detected range	MQL	Detection frequency (area)
Surface water		pg/L	2.3	0.25 - 680	0.9 0.09	38/38
Bottom sediment		pg/g-dry	46	tr(1) - 16,000	3	63/63
Wildlife	Fish	pg/g-wet	77	3.6 - 13,000	3.6	14/14
	Shellfish	pg/g-wet	88	13 - 1,100	3.6	8/8
	Birds	pg/g-wet	28	20 - 49	3.6	2/2
Air		pg/m^3	0.60	0.11 - 8.5	0.03	34/34

○Survey Results of *o,p'*-DDD

Substance		Unit	Geometric mean	Detected range	MQL	Detection frequency (area)
Surface water		pg/L	5.5	0.21 - 110	0.6 0.06	38/38
Bottom sediment		pg/g-dry	140	tr(2) - 14,000	6	62/63
Wildlife	Fish	pg/g-wet	83	tr(5) - 1,100	12	14/14
	Shellfish	pg/g-wet	130	tr(9) - 2,900	12	8/8
	Birds	pg/g-wet	15	tr(8) - 23	12	2/2
Air		pg/m^3	0.14	0.027 - 0.85	0.021	33/34

Note: Values of MQL for surface water in the upper row are obtained by standard sampling system (sample volume: 30L) and values in the lower row are by high-volume sampling system (sample volume: 100L).

DDTs are target substances included in the POPs Treaty, and also from the standpoint of global pollution monitoring, it is necessary to continue the monitoring to trace their fate.

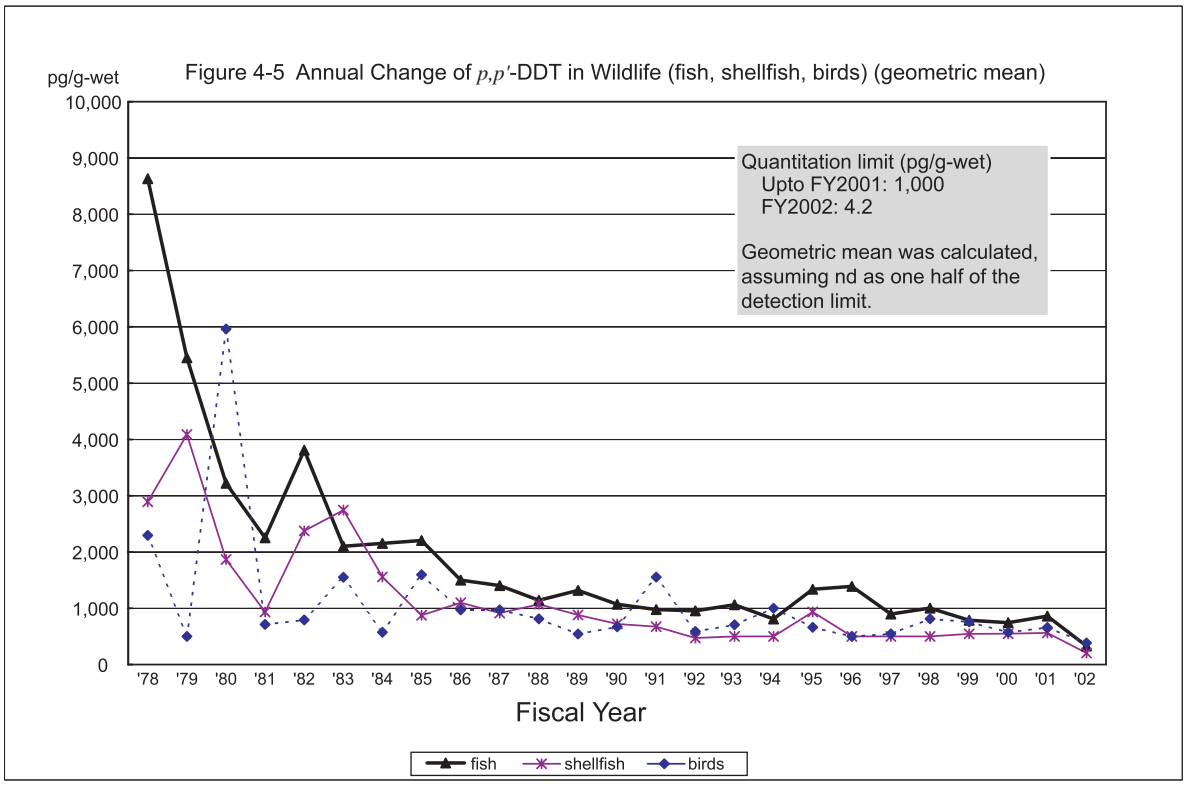
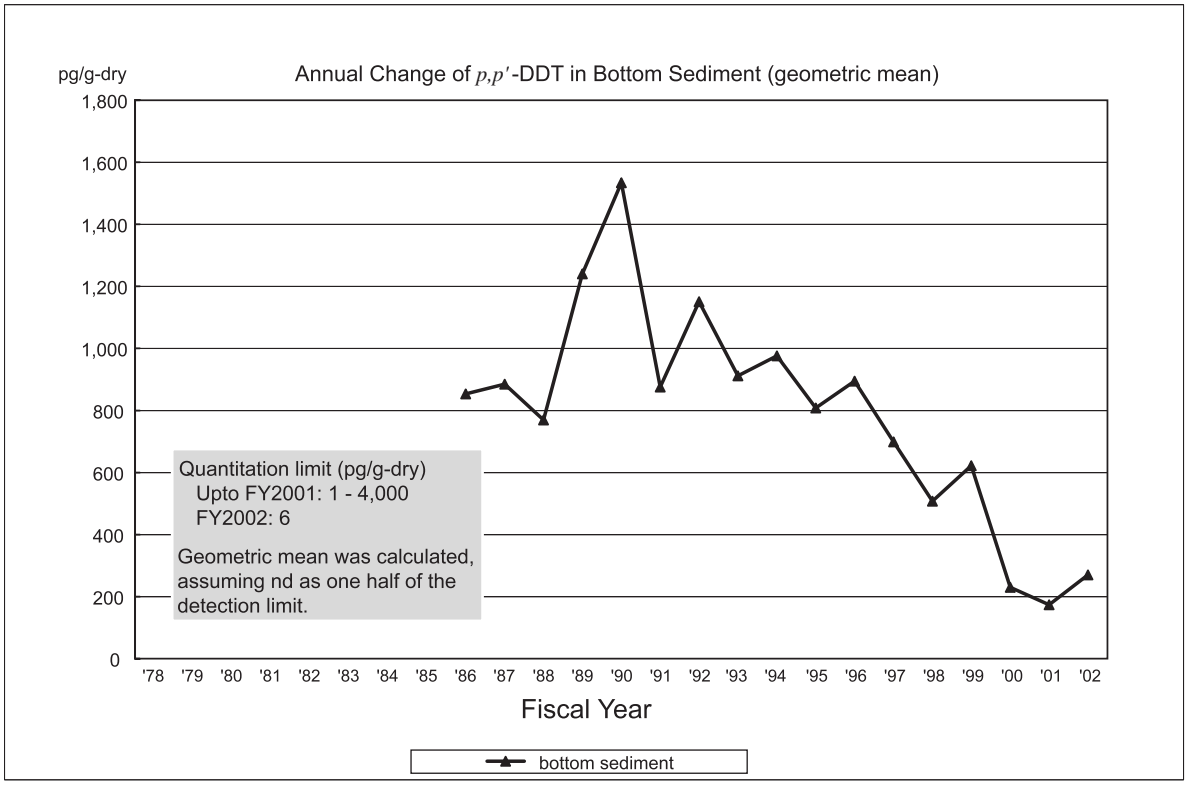


Figure 4-5 Annual Change of *p,p'*-DDT in Wildlife (fish, shellfish, birds) (geometric mean)



Annual Change of *p,p'*-DDT in Bottom Sediment (geometric mean)

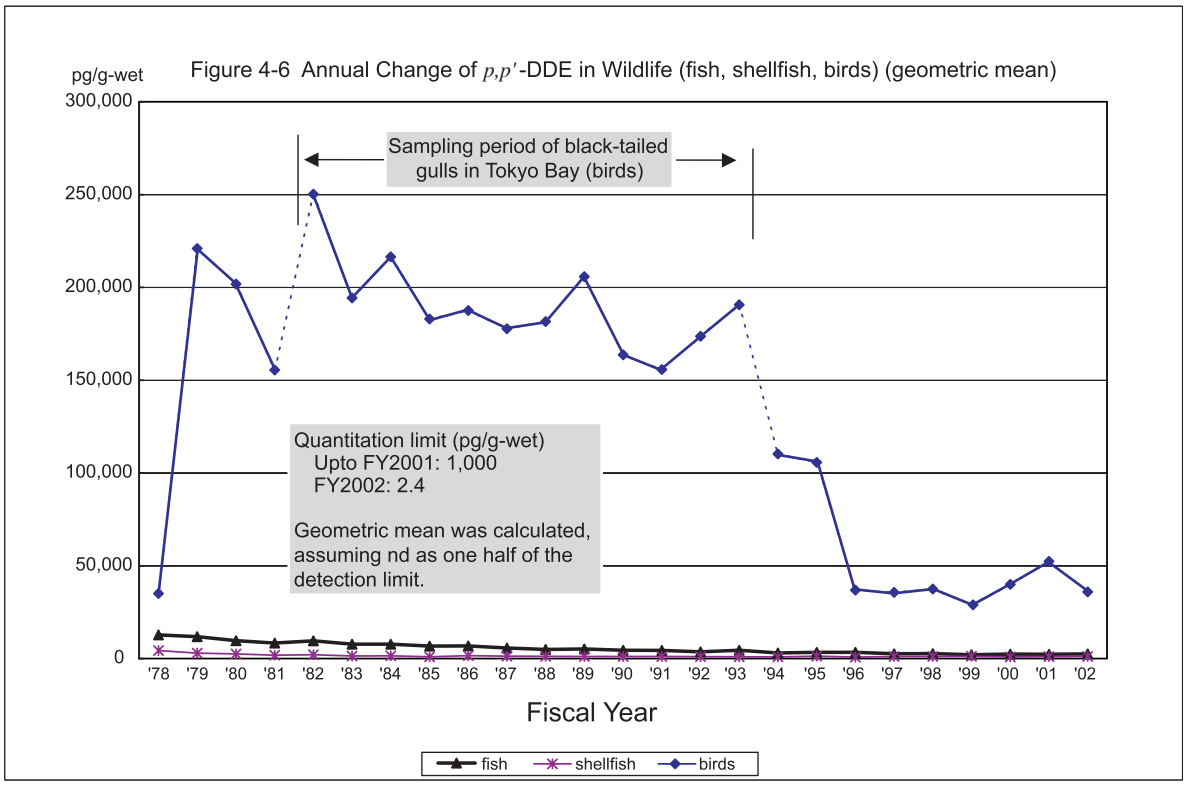
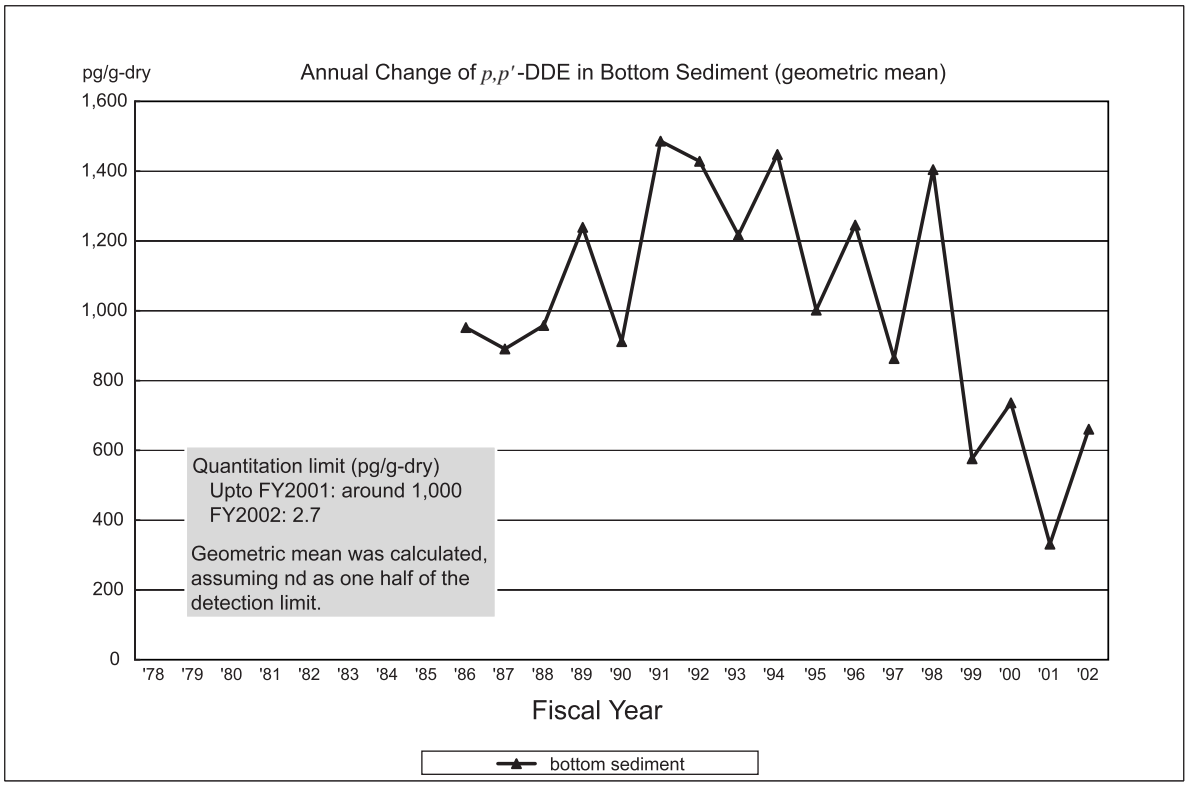
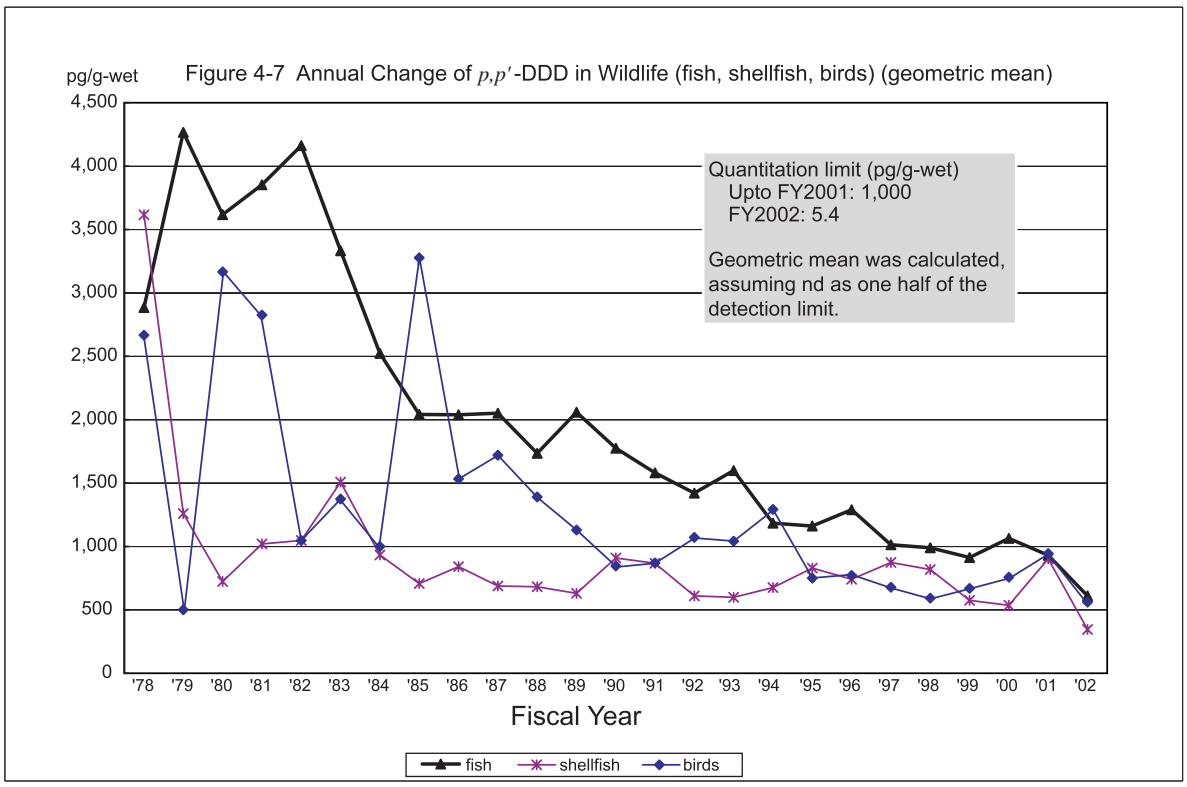
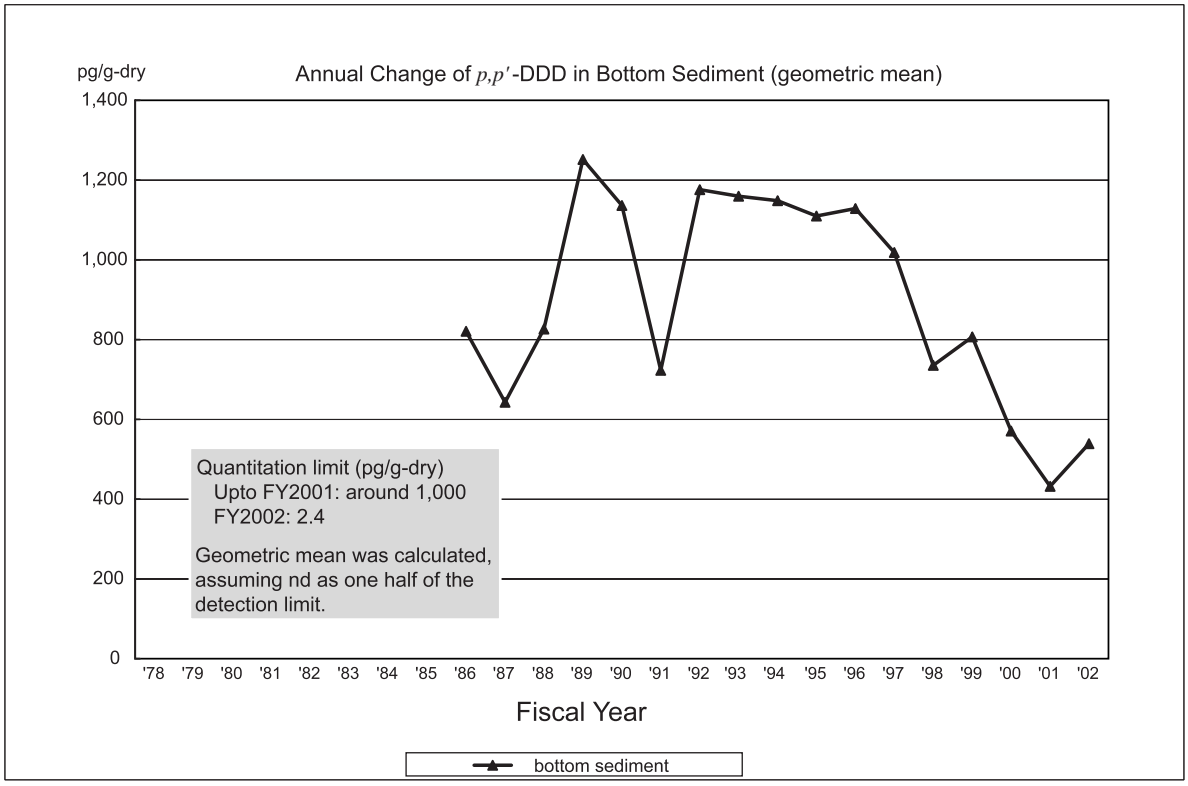


Figure 4-6 Annual Change of p,p'-DDE in Wildlife (fish, shellfish, birds) (geometric mean)



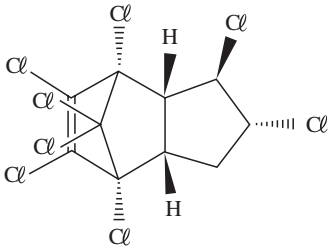
Annual Change of p,p'-DDE in Bottom Sediment (geometric mean)


pg/g-wet
Figure 4-7 Annual Change of p,p'-DDD in Wildlife (fish, shellfish, birds) (geometric mean)
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Quantitation limit (pg/g-wet)
Upto FY2001: 1,000
FY2002: 5.4
Geometric mean was calculated, assuming nd as one half of the detection limit.
'78 '79 '80 '81 '82 '83 '84 '85 '86 '87 '88 '89 '90 '91 '92 '93 '94 '95 '96 '97 '98 '99 '00 '01 '02
Fiscal Year
fish
shellfish
birds


pg/g-dry
Annual Change of p,p'-DDD in Bottom Sediment (geometric mean)
1,400
1,200
1,000
800
600
400
200
0
Quantitation limit (pg/g-dry)
Upto FY2001: around 1,000
FY2002: 2.4
Geometric mean was calculated, assuming nd as one half of the detection limit.
'78 '79 '80 '81 '82 '83 '84 '85 '86 '87 '88 '89 '90 '91 '92 '93 '94 '95 '96 '97 '98 '99 '00 '01 '02
Fiscal Year
bottom sediment

[5] Chlordanes

(*trans*-Chlordane, CAS RN: 5103-74-2)



Chemical formula / molecular weight: $C_{10}H_6C\ell_8$ / 409.78

Melting point: Unknown

Boiling point: 175°C [3)]

Water solubility (Sw): Insoluble (0.27 kPa)[3)]

Specific gravity: 1.59-1.63[3)]

n-Octanol/water partition coefficient (LogPow): Unknown

Concentrations of *trans*-chlordane in surface water had been below the MQL (10,000 pg/L), with the exception of its detection in 1987 and 1993 in one sample each. In FY2002, *trans*-chlordane was detected in all surveyed areas/samples under MQL 0.15 or 1.5 pg/L, indicating that it has hitherto been persistent at a concentration below the MQL. Although it is difficult to grasp the tendency of persistence because of the high MQL in the past years, its persistence in widespread areas is recognized.

Persistence of *trans*-chlordane in bottom sediment shows a decreasing tendency from the start of the monitoring to recent years and most of the detected values were around the MQL (1,000 pg/g-dry). However, in the FY2002 survey, it was detected in all surveyed areas/samples under MQL 1.8 pg/g-dry. Although it is difficult to grasp the tendency of persistence because of the high MQL in the past years, its persistence in widespread areas is recognized.

Persistence of *trans*-chlordane in fish and shellfish shows a slightly decreasing tendency from the start of the monitoring to recent years and most of the detected values were below the MQL (1,000 pg/g-wet). However, in the FY2002 survey, it was detected in all surveyed areas/samples under MQL 2.4 pg/g-wet. Although it is difficult to grasp the tendency of persistence because of the high MQL in the past years, its persistence in widespread areas is recognized.

It is difficult to grasp the tendency of persistence of *trans*-chlordane in birds from the start of the survey because survey areas were changed, in addition to the fact that only 2 areas were surveyed. Concentrations of *trans*-chlordane in birds had been below the MQL (1,000 pg/g-wet) from FY1987 to FY2001. In the FY2002 survey, it was detected in all surveyed areas/samples under MQL 2.4 pg/g-wet, indicating that *trans*-chlordane has been persistent at a concentration below the MQL. Although it is difficult to grasp the tendency of persistence because of the high MQL in the past years, its persistence in widespread areas is recognized.

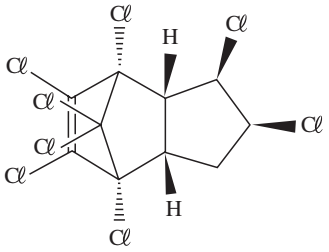
Monitoring in air was initiated in FY2002 and its persistence was recognized in widespread areas.

○Survey Results of *trans*-Chlordane

Substance		Unit	Geometric mean	Detected range	MQL	Detection frequency (area)
Surface water		pg/L	32	3.1 - 780	1.5 0.15	38/38
Bottom sediment		pg/g-dry	130	2.1 - 16,000	1.8	63/63
Wildlife	Fish	pg/g-wet	180	20 - 2,700	2.4	14/14
	Shellfish	pg/g-wet	420	33 - 2,300	2.4	8/8
	Birds	pg/g-wet	14	8.9 - 26	2.4	2/2
Air		pg/m^3	36	0.62 - 820	0.60	34/34

Note: Values of MQL for surface water in the upper row are obtained by standard sampling system (sample volume: 30L) and values in the lower row are by high-volume sampling system (sample volume: 100L).

(*cis*-Chlordane, CAS RN: 5103-71-9)



Chemical formula / molecular weight: $C_{10}H_6Cℓ_8$ / 409.78

Melting point: Unknown

Boiling point: Unknown

Water solubility (Sw): Unknown

Specific gravity: Unknown

n-Octanol/water partition coefficient (LogPow): Not known

Concentrations of *cis*-chlordane had mostly been below the MQL (10,000 pg/L) until FY2001. However, it was detected in all areas/samples in the FY2002 survey under MQL 0.09 or 0.9 pg/L, indicating that *cis*-chlordane has hitherto been persistent at a concentration below the MQL. Although it is difficult to grasp the tendency of persistence because of the high MQL in the past years, persistence of *cis*-chlordane in widespread areas is recognized.

Persistence of *cis*-chlordane in bottom sediment shows a decreasing tendency from the start of the monitoring to recent years and most of the detected values were around the MQL (1,000 pg/g-dry). However, in the FY2002 survey, it was detected in all surveyed areas/samples under MQL 0.9 pg/g-dry. Although it is difficult to grasp the tendency of persistence because of the high MQL in the past years, its persistence in widespread areas is recognized.

Persistence of *cis*-chlordane in fish and shellfish shows a slightly decreasing tendency from the start of the monitoring to recent years and most of the detected values were below the MQL (1,000 pg/g-wet). However, in the FY2002 survey, it was detected in all surveyed areas/samples under MQL of 2.4 pg/g-wet. Although it is difficult to grasp the tendency of persistence because of the high MQL in the past years, its persistence in widespread areas is recognized.

It is difficult to grasp the tendency of persistence of *cis*-chlordane in birds since the initial years of the survey because survey areas were changed, in addition to the fact that only 2 areas were surveyed. Concentrations of *cis*-chlordane in birds had been below the MQL (1,000 pg/g-wet) from FY1994 to FY2001. In the FY2002 survey, it was detected in all surveyed areas/samples under MQL 2.4 pg/g-wet, indicating that *cis*-chlordane had been persistent at a concentration below the MQL. Although it is difficult to grasp the tendency of persistence because of the high MQL in the past years, its persistence in widespread areas is recognized.

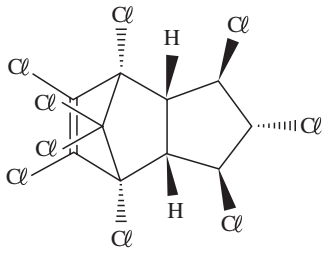
Monitoring in air was initiated in FY2002 and its persistence was recognized in widespread areas.

○Survey Results of *cis*-Chlordane

Substance		Unit	Geometric mean	Detected range	MQL	Detection frequency (area)
Surface water		pg/L	41	2.5 - 880	0.9 0.09	38/38
Bottom sediment		pg/g-dry	120	1.8 -18,000	0.9	63/63
Wildlife	Fish	pg/g-wet	580	57 - 6,900	2.4	14/14
	Shellfish	pg/g-wet	810	24 -26,000	2.4	8/8
	Birds	pg/g-wet	67	10 - 450	2.4	2/2
Air		pg/m^3	31	0.86 - 670	0.60	33/34

Note: Values of MQL for surface water in the upper row are obtained by standard sampling system (sample volume: 30L) and values in the lower row are by high-volume sampling system (sample volume: 100L).

(*trans*-Nonachlor, CAS RN: 39765-80-5)



Chemical formula / molecular weight: $C_{10}H_5C\ell_9$ / 444.23

Melting point: Unknown

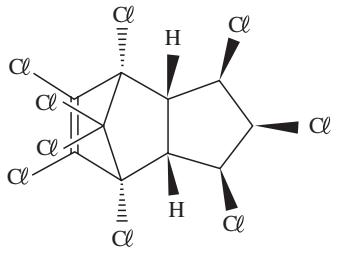
Boiling point: Unknown

Water solubility (Sw): Unknown

Specific gravity: Unknown

n-Octanol/water partition coefficient (LogPow): Unknown

(*cis*-Nonachlor, CAS RN: 5103-73-1)



Chemical formula / molecular weight: $C_{10}H_5C\ell_9$ / 444.23

Melting point: Unknown

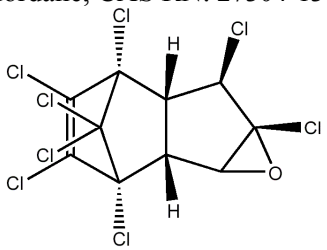
Boiling point: Unknown

Water solubility (Sw): Unknown

Specific gravity: Unknown

n-Octanol/water partition coefficient (LogPow): Unknown

(Oxychlordane, CAS RN: 27304-13-8)



Chemical formula / molecular weight: $C_{10}H_4Cl_8O$ / 423.76

Melting point: Unknown

Boiling point: Unknown

Water solubility (Sw): Unknown

Specific gravity: Unknown

n-Octanol/water partition coefficient (LogPow): Unknown

Concentrations of *trans*-nonachlor and *cis*-nonachlor in surface water had been mostly below the MQL (10,000 pg/L) until FY2001. Concentrations of oxychlordane had been below the MQL (10,000 pg/L) until FY1987 and no survey has been conducted since FY1988. In the FY2002 survey, conducted under MQL 0.12 or 1.2 pg/L for *trans*-nonachlor, 0.18 or 1.8 pg/L for *cis*-nonachlor and 0.12 or 1.2 pg/L for oxychlordane, *trans*-nonachlor and *cis*-nonachlor were detected in all areas/samples and oxychlordane was detected in many areas/samples, indicating that they have hitherto been persistent at a concentration below the MQL. Although it is difficult to grasp the tendency of persistence because of the high MQL in the past years, their persistence in widespread areas is recognized.

Concentrations of *trans*-nonachlor and *cis*-nonachlor in bottom sediment showed a decreasing tendency in initial survey years and in recent years, they were around the MQL (1,000 pg/g-dry). Concentrations of oxychlordane had been below the MQL (1,000 pg/g-dry) until FY1987 and no survey has been conducted since FY1988. In FY2002, survey was conducted under MQL 1.5 pg/g-dry for *trans*-nonachlor, 2.1 pg/g-dry for *cis*-nonachlor and 1.5 pg/g-dry for oxychlordane, and *trans*-nonachlor and *cis*-nonachlor were detected in all areas/samples and oxychlordane was detected in many areas/samples, indicating that they have hitherto been persistent at a concentration below the MQL. Although it is difficult to grasp the tendency of persistence because of the high MQL in the past years, their persistence in widespread areas is recognized.

Persistence of these three substances in fish and shellfish showed a slightly decreasing tendency from the start of the monitoring, and the concentrations of oxychlordane were mostly below the MQL (1,000 pg/g-wet). In FY2002, survey was conducted under MQL 2.4 pg/g-wet for *trans*-nonachlor, 1.2 pg/g-wet for *cis*-nonachlor and 3.6 pg/g-wet for oxychlordane, and *trans*-nonachlor and *cis*-nonachlor were detected in all areas/samples and oxychlordane was also detected in many areas/samples, indicating that they are still persistent in widespread areas.

It is difficult to grasp the tendency of persistence of these three substances in birds from the start of the monitoring, because survey areas were changed, in addition to the fact that only 2 areas were surveyed. In recent years, concentrations of these three substances in birds had mostly been below the MQL (1,000 pg/g-wet) from FY1994 to FY2001. In the FY2002 survey, they were detected in all surveyed areas/samples under MQL 2.4 pg/g-wet for *trans*-nonachlor, 1.2 pg/g-wet for *cis*-nonachlor, and 3.6 pg/g-wet for oxychlordane, and *trans*-nonachlor and *cis*-nonachlor were detected in all areas/samples and oxychlordane was detected in most of the samples from all areas, indicating that they have hitherto been persistent at a concentration below the MQL. Although it is difficult to grasp the tendency of persistence because of the high MQL in the past years, their persistence in widespread areas is recognized.

Monitoring in air was initiated in FY2002 and their persistence was recognized in widespread areas.

○Survey Results of *trans*-Nonachlor

Substance		Unit	Geometric mean	Detected range	MQL	Detection frequency (area)
Surface water		pg/L	29	1.8 - 780	1.2 0.12	38/38
Bottom sediment		pg/g-dry	120	3.1 - 13,000	1.5	63/63
Wildlife	Fish	pg/g-wet	970	98 - 8,300	2.4	14/14
	Shellfish	pg/g-wet	510	21 - 1,800	2.4	8/8
	Birds	pg/g-wet	880	350 - 1,900	2.4	2/2
Air		pg/m^3	24	0.64 - 550	0.30	34/34

○Survey Results of *cis*-Nonachlor

Substance		Unit	Geometric mean	Detected range	MQL	Detection frequency (area)
Surface water		pg/L	7.6	0.23 - 250	1.8 0.18	38/38
Bottom sediment		pg/g-dry	66	tr(1.0) - 7,800	2.1	63/63
Wildlife	Fish	pg/g-wet	420	46 - 5,100	1.2	14/14
	Shellfish	pg/g-wet	190	8.6 - 870	1.2	8/8
	Birds	pg/g-wet	200	68 - 450	1.2	2/2
Air		pg/m^3	3.1	0.071 - 62	0.030	34/34

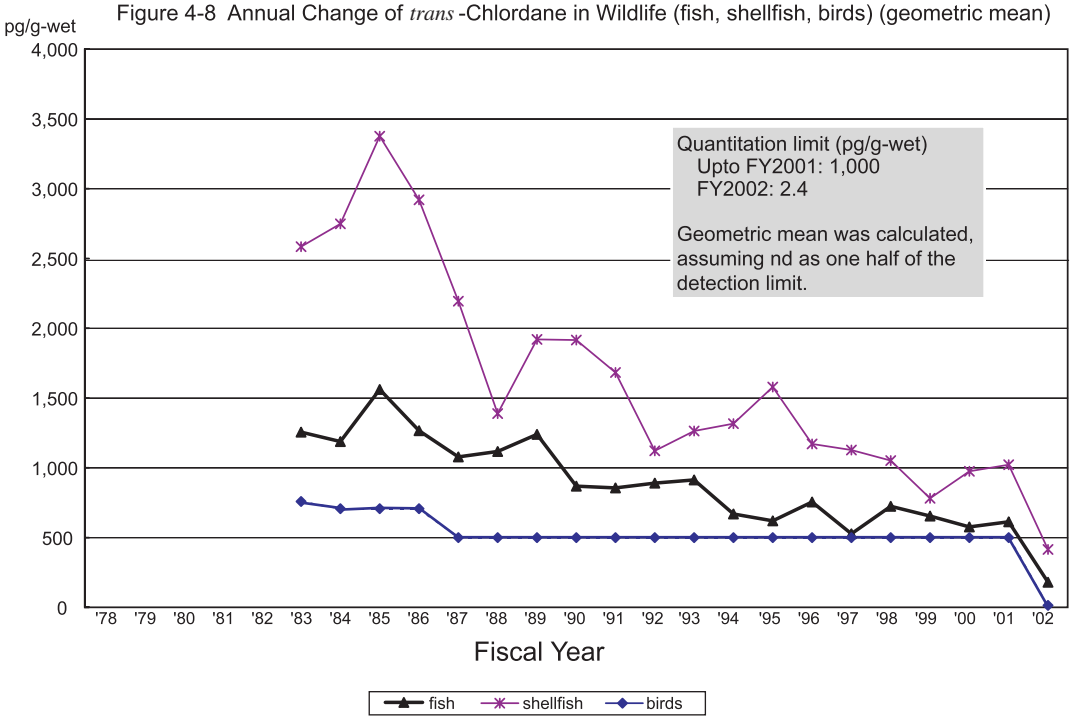
○Survey Results of Oxychlordane

Substance		Unit	Geometric mean	Detected range	MQL	Detection frequency (area)
Surface water		pg/L	2.4	0.13 - 41	1.2 0.12	35/38
Bottom sediment		pg/g-dry	2.2	tr(0.6) - 120	1.5	59/63
Wildlife	Fish	pg/g-wet	160	16 - 3,900	3.6	14/14
	Shellfish	pg/g-wet	78	tr(1.9) - 5,600	3.6	8/8
	Birds	pg/g-wet	640	470 - 890	3.6	2/2
Air		pg/m^3	0.96	0.37 - 8.3	0.024	34/34

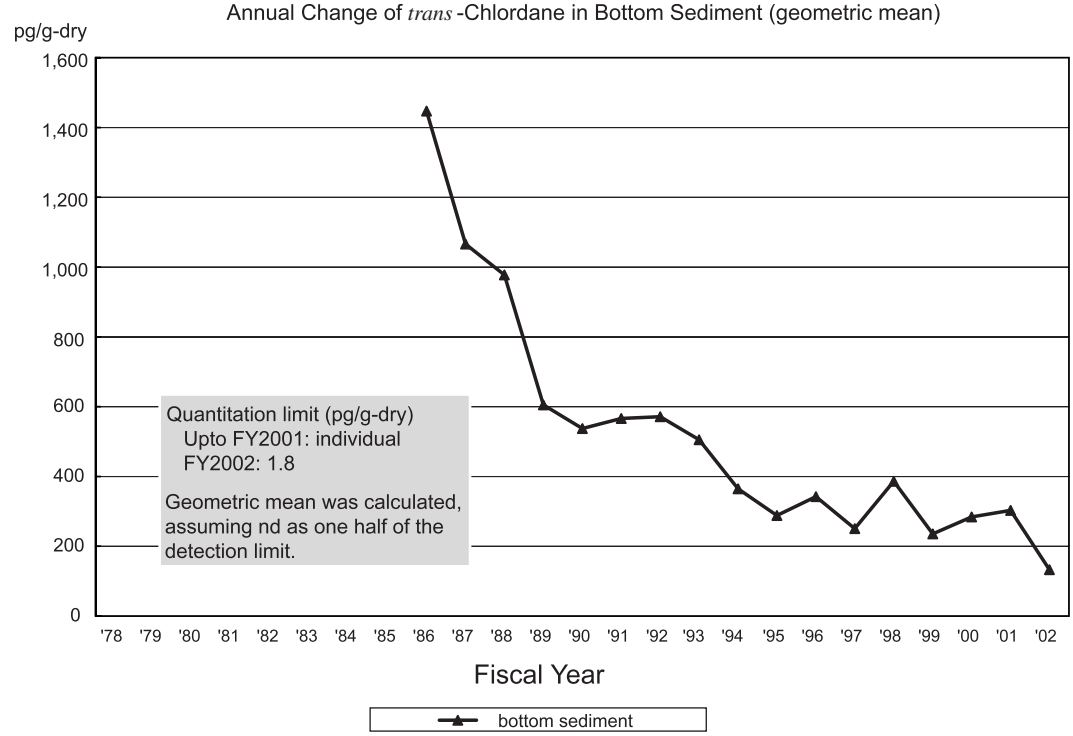
Note: Values of MQL for surface water in the upper row are obtained by standard sampling system (sample volume: 30L) and values in the lower row are by high-volume sampling system (sample volume: 100L).

Chlordanes are target substances included in the POPs Treaty, and also from the standpoint of global pollution monitoring, it is necessary to continue the monitoring to trace their fate.

Figure 4-8 Annual Change of *trans*-Chlordane in Wildlife (fish, shellfish, birds) (geometric mean)



Annual Change of *trans*-Chlordane in Bottom Sediment (geometric mean)



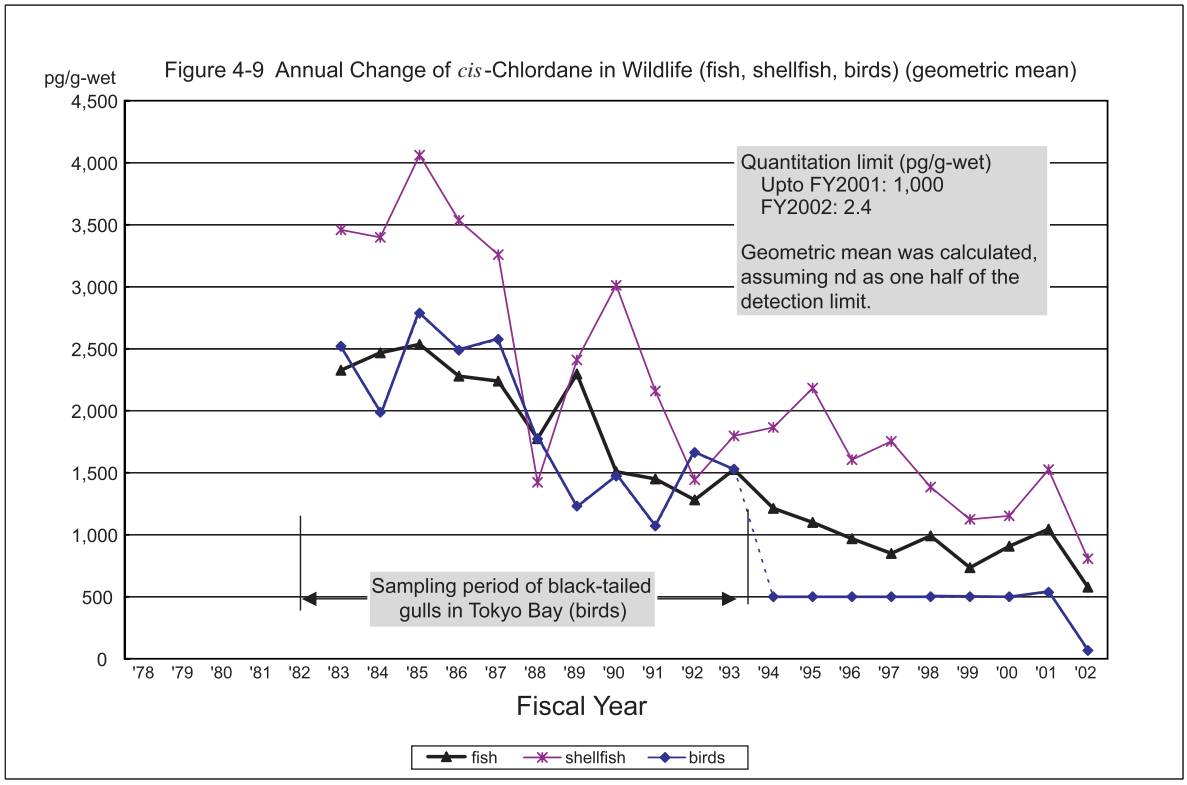


Figure 4-9 Annual Change of *cis*-Chlordane in Wildlife (fish, shellfish, birds) (geometric mean)

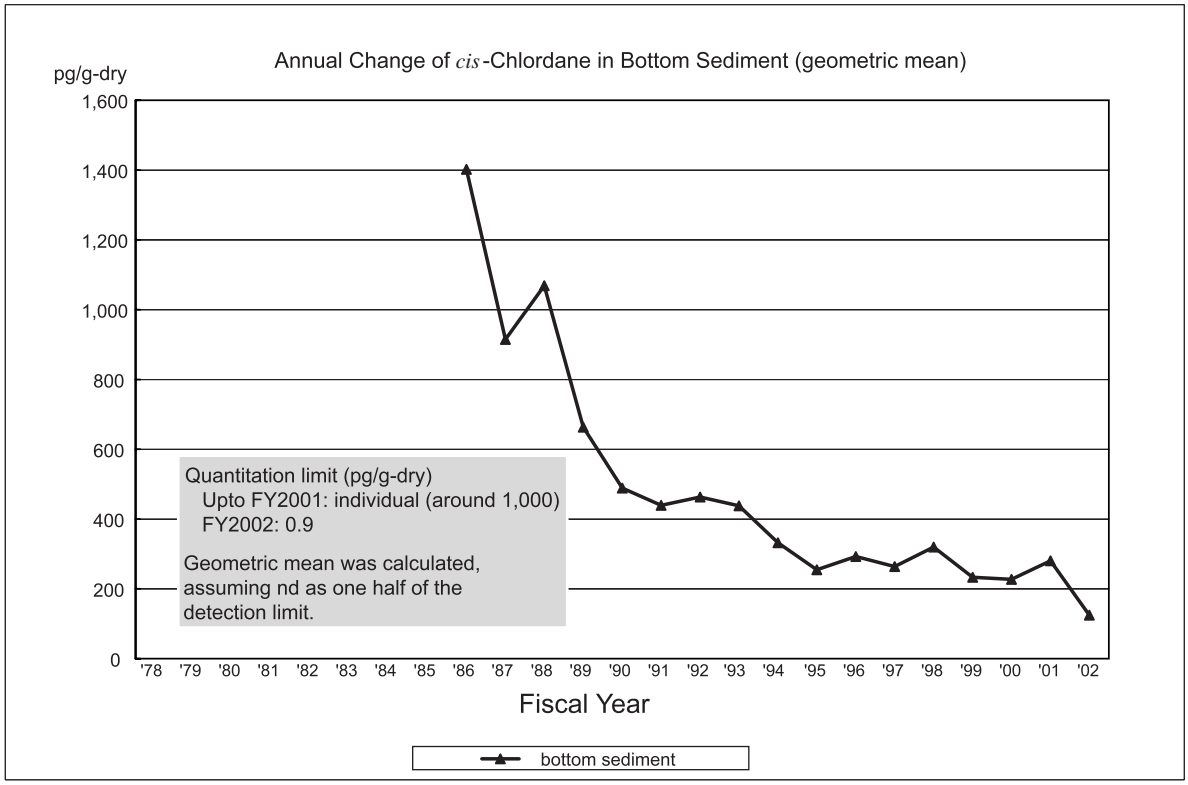
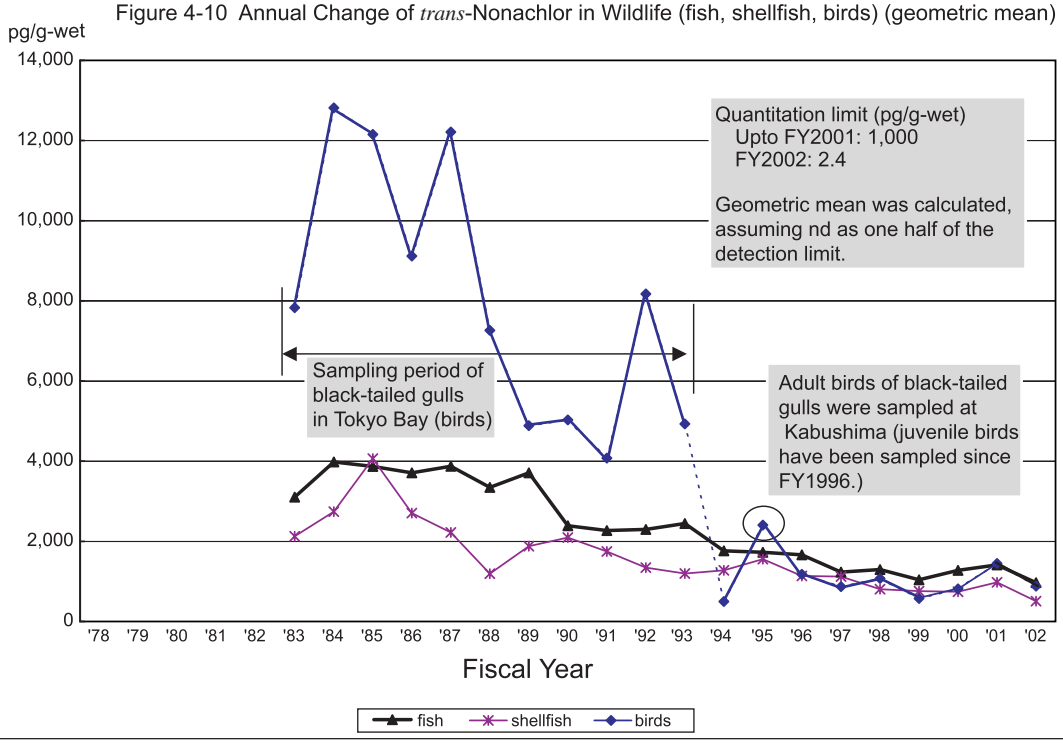


Figure 4-10 Annual Change of *trans*-Nonachlor in Wildlife (fish, shellfish, birds) (geometric mean)



Annual Change of *trans*-Nonachlor in Bottom Sediment (geometric mean)

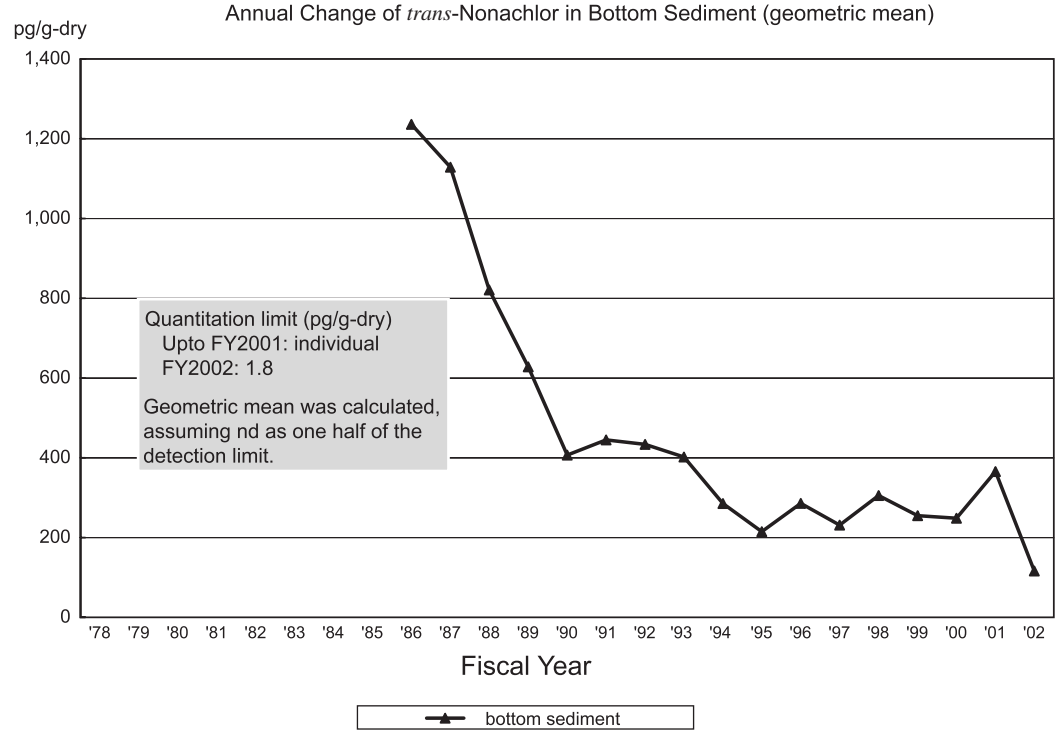
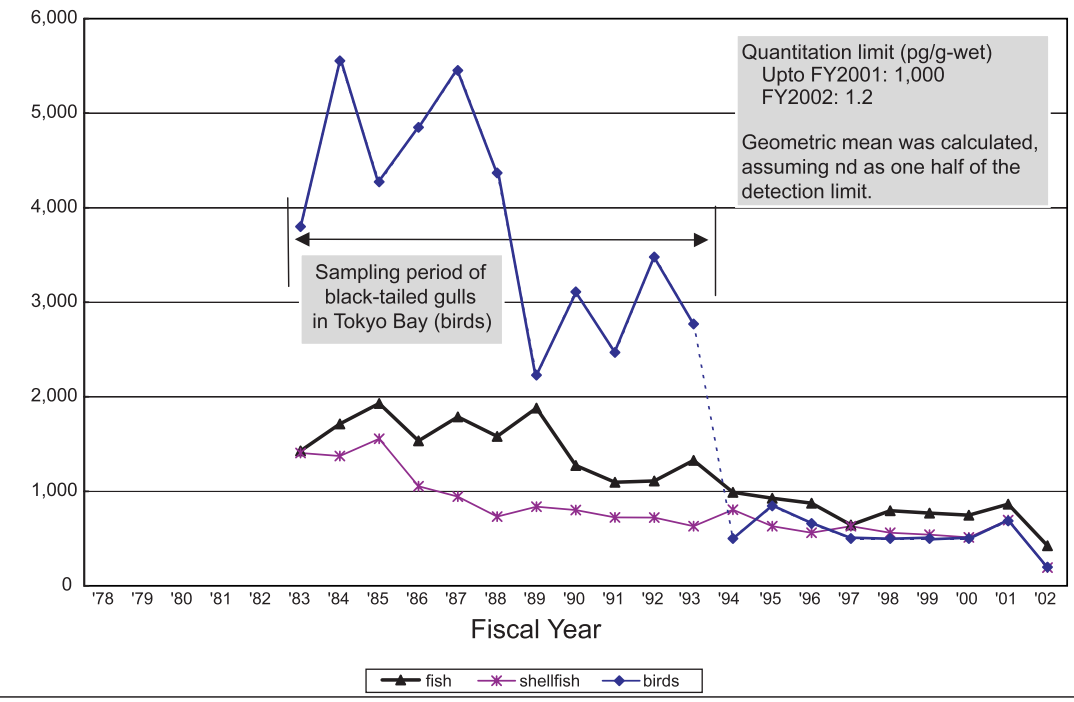


Figure 4-11 Annual Change of *cis*-Nonachlor in Wildlife (fish, shellfish, birds) (geometric mean)



Annual Change of *cis*-Nonachlor in Bottom Sediment (geometric mean)

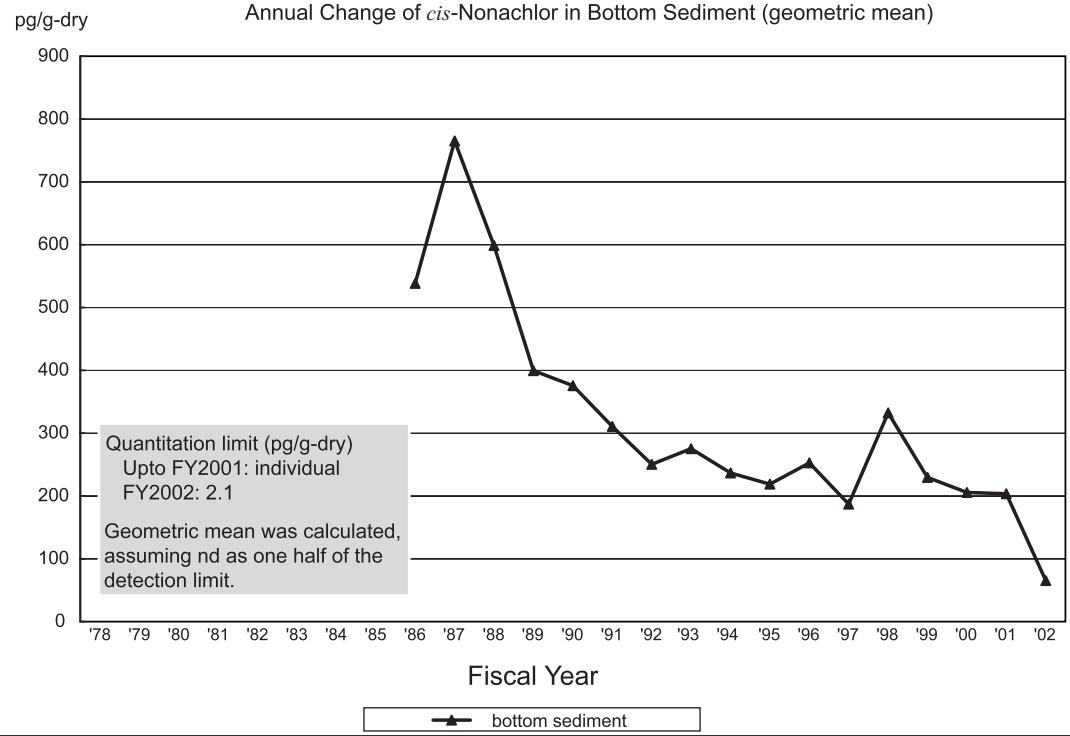
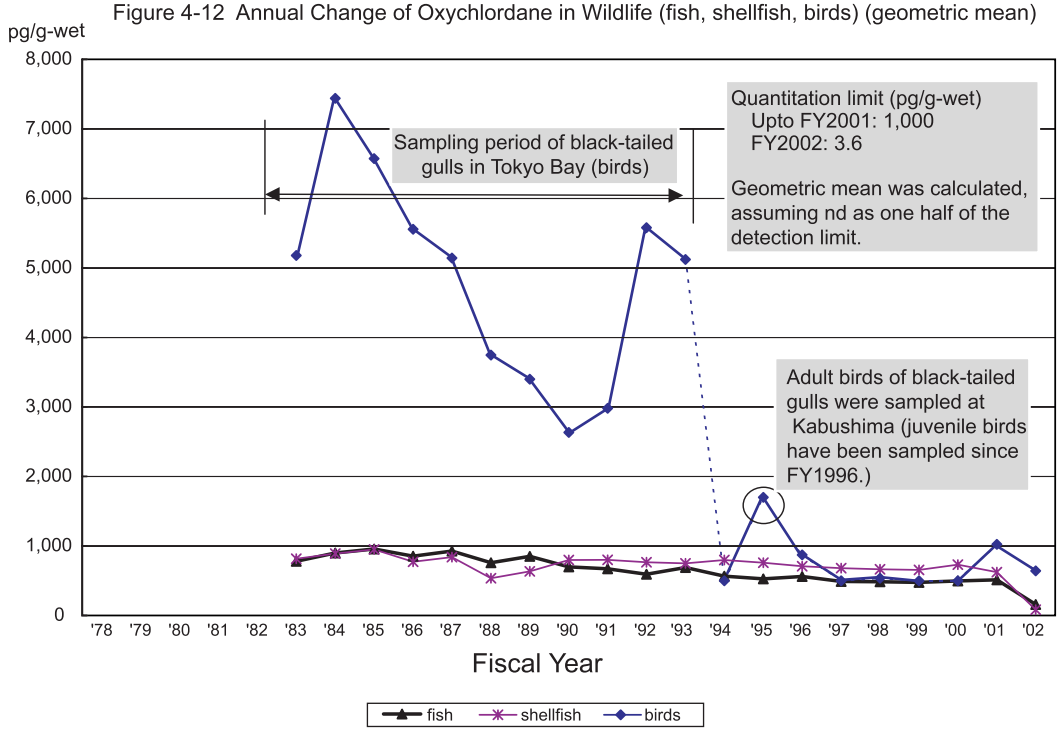
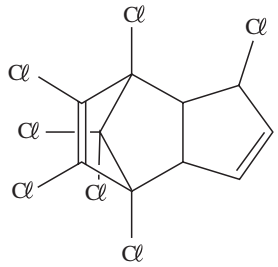


Figure 4-12 Annual Change of Oxychlordane in Wildlife (fish, shellfish, birds) (geometric mean)



[6] Heptachlor (CAS RN: 76-44-8)



Chemical formula / molecular weight: $C_{10}H_5Cl_7$ / 373.32

Melting point: 95-96°C [1], 95°C [2]

Boiling point: 145°C [1], 135°C [2]

Water solubility (Sw): 0.03-0.056 (25°C)[1], insoluble 0.18 mg/L [2]

Specific gravity: 1.58[1] [2]

n-Octanol/water partition coefficient (LogPow): 3.87-6.13[1]

Monitoring of heptachlor was started in FY2002 in all media.

Heptachlor in surface water was surveyed in 38 areas under MQL 0.15 pg/L or 1.5 pg/L and it was detected in all surveyed areas.

As to bottom sediment, it was surveyed in 63 areas under MQL 1.8 pg/g-dry and it was detected in 60 areas.

As to fish, it was surveyed in 14 areas under MQL of 4.2 pg/g-wet and it was detected in 12 areas.

As to shellfish, it was surveyed in 8 areas under MQL 4.2 pg/g-wet and it was detected in 6 areas.

As to birds, it was surveyed in 2 areas under MQL 4.2 pg/g-wet and it was detected in 2 areas.

As to air, it was surveyed in 34 areas under MQL 0.12 pg/m^3 and it was detected in all areas/samples.

○Survey Results of Heptachlor

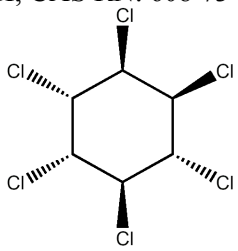
Substance		Unit	Geometric mean	Detected range	MQL	Detection frequency (area)
Surface water		pg/L	tr(1.1)	tr(0.5) - 25	1.5 0.15	38/38
Bottom sediment		pg/g-dry	3.5	tr(0.6) - 120	1.8	60/63
Wildlife	Fish	pg/g-wet	4.0	tr(1.6) - 20	4.2	12/14
	Shellfish	pg/g-wet	3.6	tr(1.9) - 15	4.2	6/8
	Birds	pg/g-wet	tr(2.1)	tr(1.9) - 5.2	4.2	2/2
Air		pg/m^3	11	0.20 - 220	0.12	34/34

Note: Values of MQL for surface water in the upper row are obtained by standard sampling system (sample volume: 30L) and values in the lower row are by high-volume sampling system (sample volume: 100L).

Heptachlor is one of the target substances included in the POPs Treaty, and also from the standpoint of global pollution monitoring, it is necessary to continue the monitoring to trace their fate.

[7] HCHs

(*α*-HCH, CAS RN: 608-73-1)



Chemical formula / molecular weight: $C_6H_6CL_6$ / 290.83

Melting point: Unknown

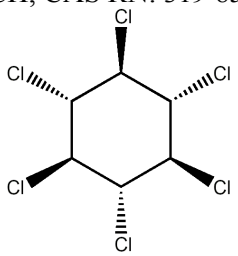
Boiling point: Unknown

Water solubility (Sw): Unknown

Specific gravity: Unknown

n-Octanol/water partition coefficient (LogPow): Unknown

(*β*-HCH, CAS RN: 319-85-7)



Chemical formula / molecular weight: $C_6H_6Cl_6$ / 290.83

Melting point: 309-312°C [1)], 312°C [2)]

Boiling point: 60°C [2)]

Water solubility (Sw): 5 mg/L [2)]

Specific gravity: Unknown

n-Octanol/water partition coefficient (LogPow): 3.78 [1)]

Persistence of both *α*-HCH and *β*-HCH in surface water showed a decreasing tendency, and all of the detected values had been below the MQL (10,000 pg/L) from FY1994 to FY2001. In FY2002, HCHs were detected in all surveyed areas/samples under MQL 0.09 or 0.9 pg/L, indicating that they have hitherto been persistent at a concentration below the MQL. Although it is difficult to grasp the tendency of persistence because of the high MQL in the past years, their persistence in widespread areas is recognized.

Detected values of both *α*-HCH and *β*-HCH in bottom sediment fluctuated so sharply in the past that it is difficult to grasp the tendency of their persistence. In FY2002, HCHs were detected in all surveyed areas/samples under MQL 1.2 pg/g-dry for α-HCH and 0.9 pg/g-dry for β-HCH, indicating that they are still persistent in widespread areas.

Persistence of both α-HCH and β-HCH in fish and shellfish showed a decreasing tendency from the mid-80s to mid-90s and in recent years detected values were mostly below the MQL (1,000 pg/g-wet). In FY2002, HCHs were detected in all surveyed areas/samples under MQL 4.2 pg/g-wet for *α*-HCH and 12

pg/g-wet for β-HCH.

It is difficult to grasp the tendency of persistence of these substances in birds from the initial years of the monitoring, because survey areas were changed, in addition to the fact that only 2 areas were surveyed. Little change is observed in persistence in recent years and their persistence is still recognized.

Isomers of HCHs except γ-isomers are recognized as having high persistence and may possibly be included in the candidate substances for the POPs Treaty. Furthermore, it is necessary to continue the monitoring for the purpose of tracing their fate from the standpoint of global pollution monitoring.

○ Survey Results of α-HCH

Substance		Unit	Geometric mean	Detected range	MQL	Detection frequency (area)
Surface water		pg/L	84	1.9 - 6,500	0.9 0.09	38/38
Bottom sediment		pg/g-dry	130	2.0 - 8,200	1.2	63/63
Wildlife	Fish	pg/g-wet	51	tr(1.9) - 590	4.2	14/14
	Shellfish	pg/g-wet	65	12 - 1,100	4.2	8/8
	Birds	pg/g-wet	160	93 - 360	4.2	2/2

○ Survey Results of β-HCH

Substance		Unit	Geometric mean	Detected range	MQL	Detection frequency (area)
Surface water		pg/L	210	24 - 1,600	0.9 0.09	38/38
Bottom sediment		pg/g-dry	200	3.9 -11,000	0.9	63/63
Wildlife	Fish	pg/g-wet	99	tr(5) - 1,800	12	14/14
	Shellfish	pg/g-wet	89	32 - 1,700	12	8/ 8
	Birds	pg/g-wet	3,000	1,600 - 7,300	12	2/ 2

Note: Values of MQL for surface water in the upper row are obtained by standard sampling system (sample volume: 30L) and values in the lower row are by high-volume sampling system (sample volume: 100L).

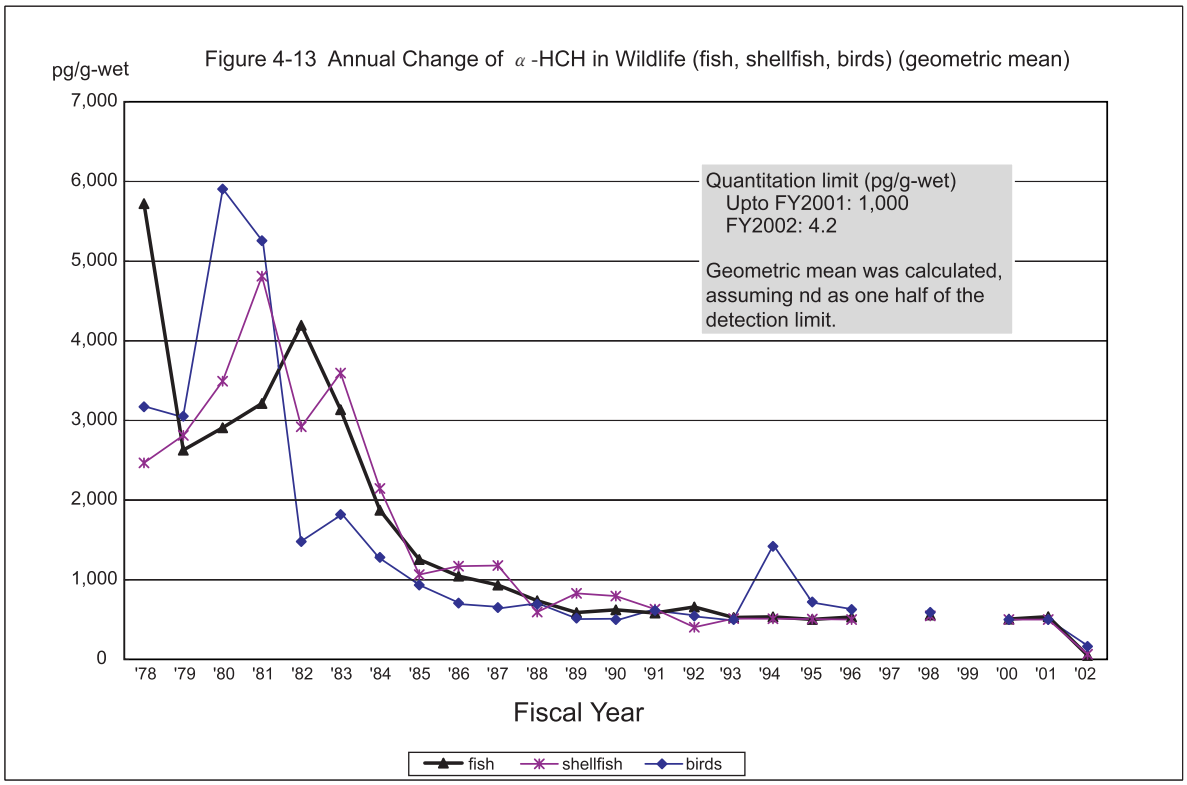


Figure 4-13 Annual Change of α-HCH in Wildlife (fish, shellfish, birds) (geometric mean)
pg/g-wet
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Quantitation limit (pg/g-wet)
Upto FY2001: 1,000
FY2002: 4.2
Geometric mean was calculated, assuming nd as one half of the detection limit.
'78 '79 '80 '81 '82 '83 '84 '85 '86 '87 '88 '89 '90 '91 '92 '93 '94 '95 '96 '97 '98 '99 '00 '01 '02
Fiscal Year
fish
shellfish
birds

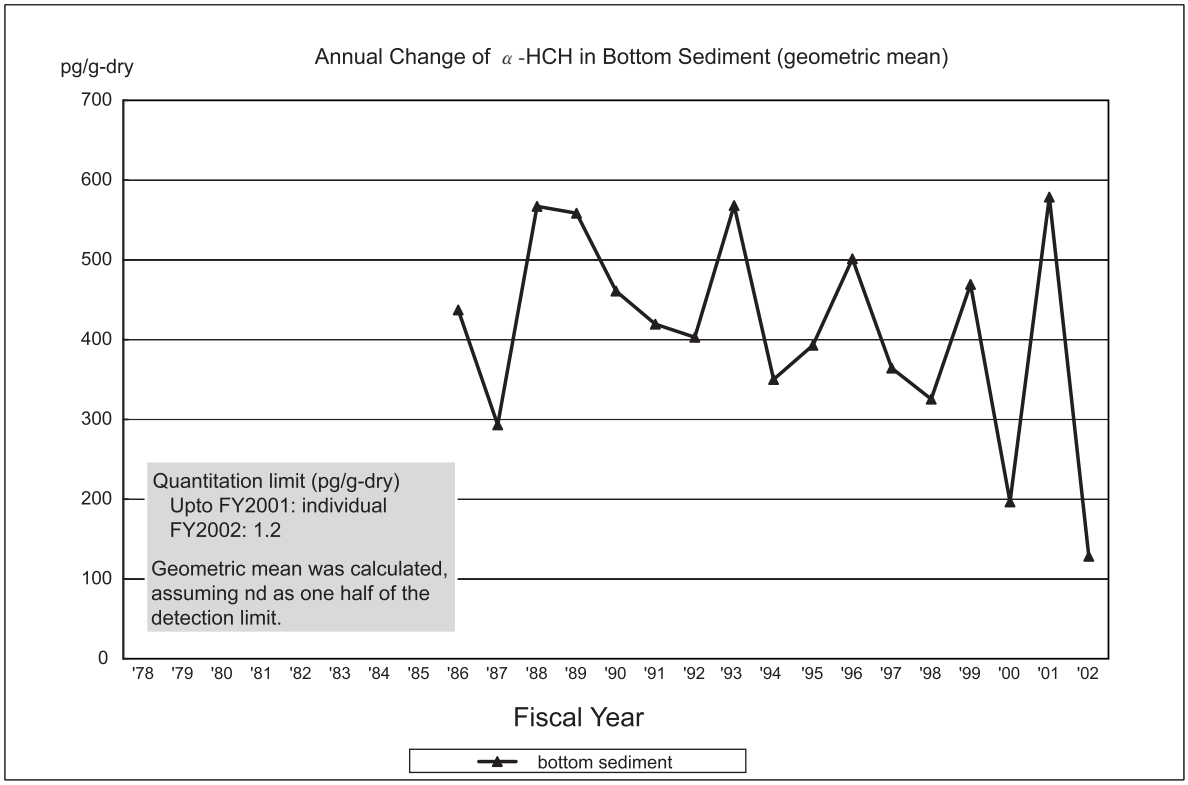
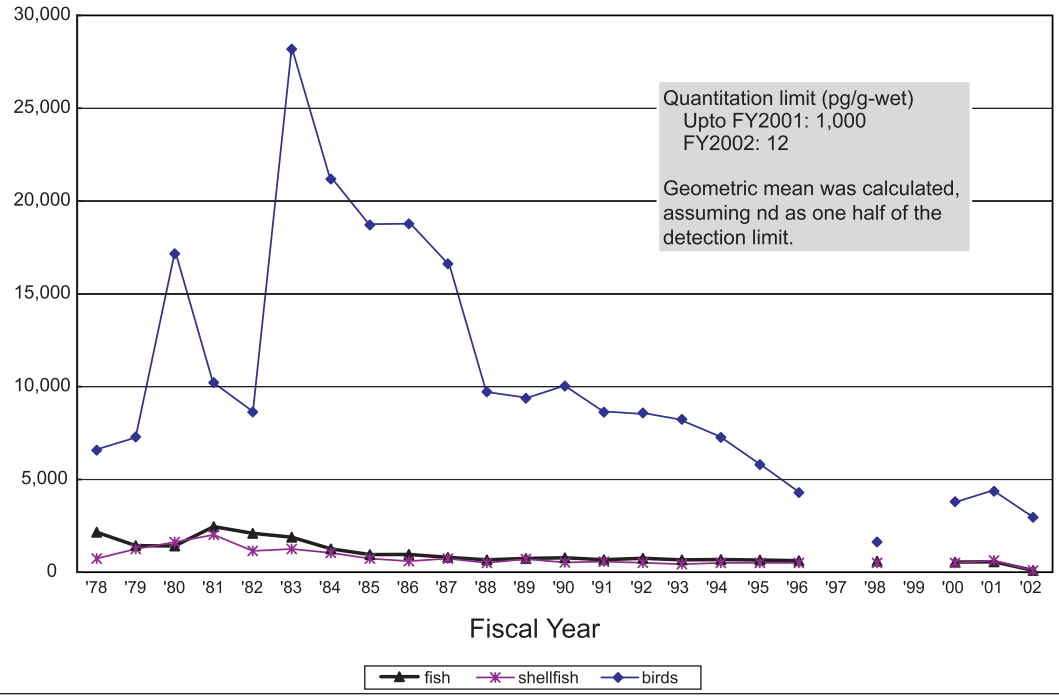
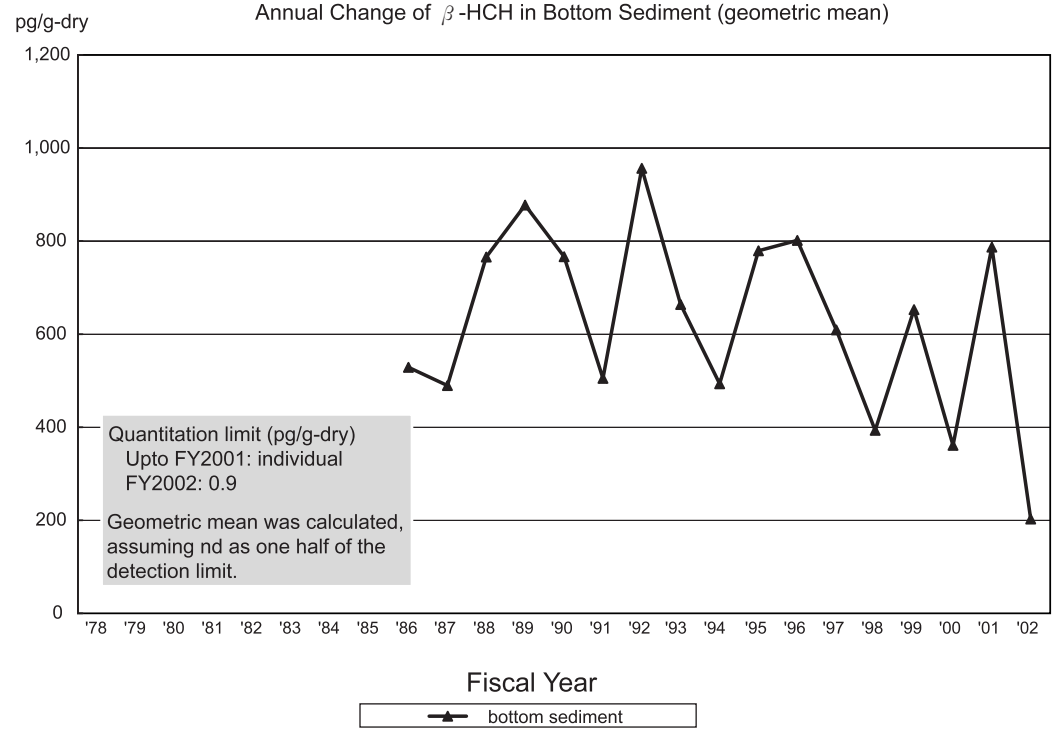

Annual Change of α-HCH in Bottom Sediment (geometric mean)
pg/g-dry
700
600
500
400
300
200
100
0
Quantitation limit (pg/g-dry)
Upto FY2001: individual
FY2002: 1.2
Geometric mean was calculated, assuming nd as one half of the detection limit.
'78 '79 '80 '81 '82 '83 '84 '85 '86 '87 '88 '89 '90 '91 '92 '93 '94 '95 '96 '97 '98 '99 '00 '01 '02
Fiscal Year
bottom sediment

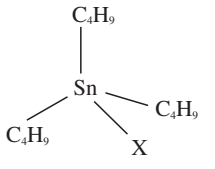
Figure 4-14 Annual Change of β-HCH in Wildlife (fish, shellfish, birds) (geometric mean)





[8] Organotin compounds (TBT, TPT)

TBT (Tributyltin compounds, CAS RN: mixture)



Chemical formula / molecular weight: (mixture)/ (mixture)

Melting point: (mixture)

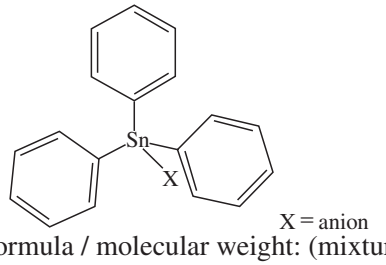
Boiling point: (mixture)

Water solubility (Sw): (mixture)

Specific gravity: (mixture)

n-Octanol/water partition coefficient (LogPow): (mixture)

TPT (Triphenyltin compounds, CAS RN: mixture)



Chemical formula / molecular weight: (mixture) / (mixture)

Melting point: (mixture)

Boiling point: (mixture)

Water solubility (Sw): (mixture)

Specific gravity: (mixture)

n-Octanol/water partition coefficient (LogPow): (mixture)

Persistence of TBT in bottom sediment showed a decreasing tendency from the start of the survey to recent years. Although TPT also showed a decreasing tendency until FY1999, it was detected in high concentrations in FY2000 and FY2002. In FY2002, they were detected under MQL 3.6 ng/g-dry for TBT and 1.6 ng/g-dry for TPT, indicating that both TBT and TPT are still persistent in widespread areas.

Persistence of TBT and TPT in fish showed a decreasing tendency in the initial years of survey. However, no tendency is observed in the change of their persistence in recent years. As the MQL of TBT and TPT in the FY2002 survey decreased to 3/10 and 3/40, respectively, compared with that of the FY2001 survey, detection frequency has increased. However, the 95% value of TBT in FY2001 and FY2002 was 70 ng/g-wet and 83 ng/g-wet, respectively, and that of TPT was 30 ng/g-wet and 28 ng/g-wet, respectively. Thus, no tendency is observed in the change of their persistence.

Persistence of TBT and TPT in shellfish showed a decreasing tendency in the initial years of survey. However, no tendency is observed in the change of their persistence in recent years. As the MQL of TBT and TPT in the FY2002 survey decreased to 3/10 and 3/40 respectively compared with that of the FY2001 survey, detection frequency has increased. However, the 95% value of TBT in FY2001 and

FY2002 was 50 ng/g-wet and 54 ng/g-wet, respectively, and that of TPT was 20 ng/g-wet and 18 ng/g-wet, respectively. Thus, no tendency is observed in the change of their persistence.

Detected values of organotin compounds in birds were all below the MQL (TBT: 10-50 ng/g-wet, TPT: 20 ng/g-wet) with the exception of one area where TPT was detected in FY1989 and FY1990. In FY2002, they were not detected under MQL 3 ng/g-wet for TBT and 1.5 ng/g-wet for TPT, indicating no increase in their persistent concentrations.

Considering the status of TBT and TPT production (seldom produced or used for the domestic open system), the status of pollution will improve further in the future. However, there remains a possibility of pollution related to the existence of unrestricted countries and areas, and it is necessary to successively monitor the status of environmental pollution, as well as to continue providing environmental pollution countermeasures in the future. It is also necessary to collect toxicity-related knowledge and related information since organotin compounds are pointed out as being chemical substances suspected of possessing endocrine disrupting effects.

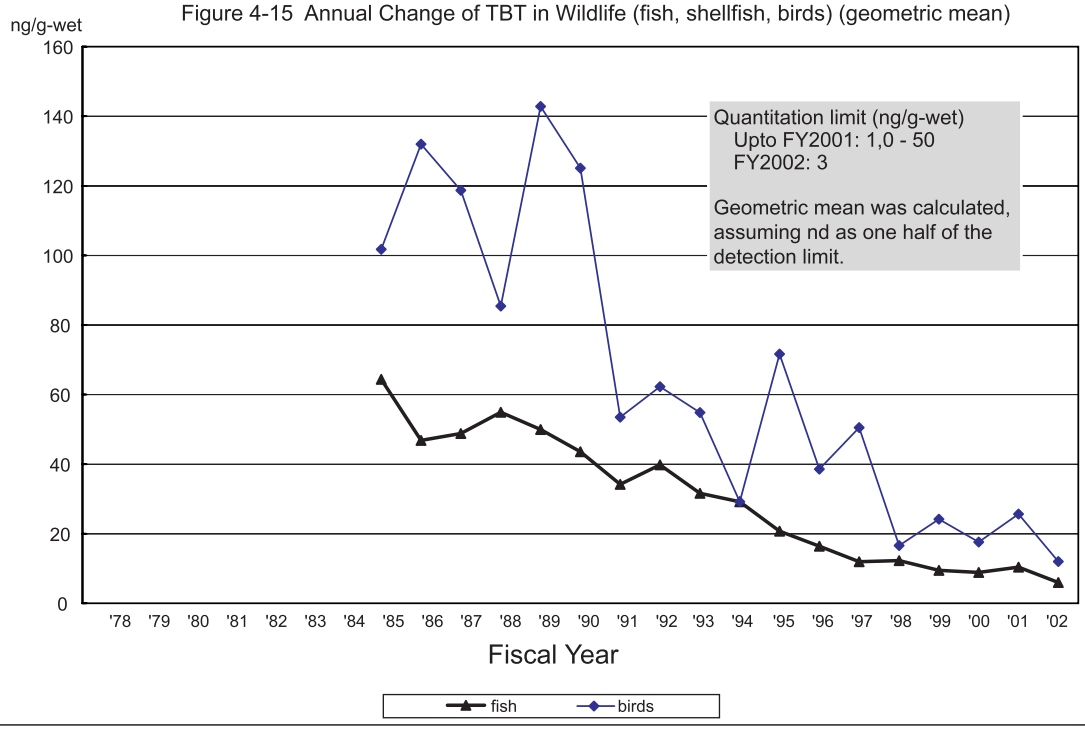
◯Survey Results of TBT

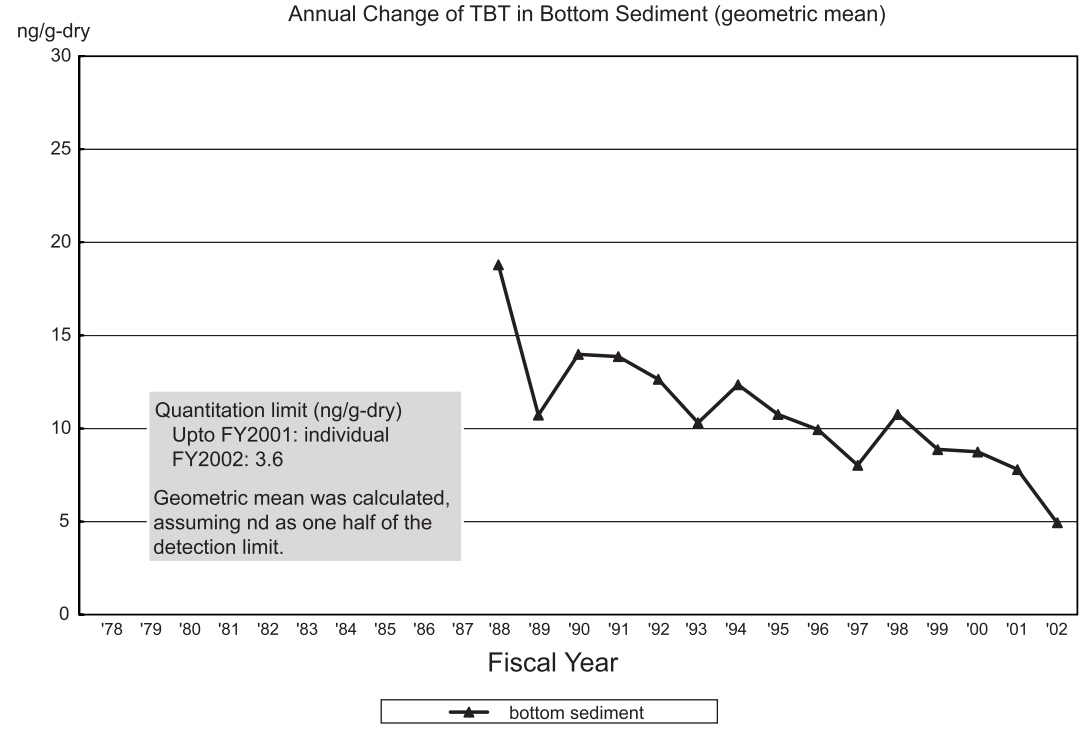
Substance		Unit	Geometric mean	Detected range	MQL	Detection frequency (area)
Bottom sediment		pg/g-dry	4.9	tr(1.2) - 390	3.6	48/63
Wildlife	Fish	pg/g-wet	6	tr(1) - 500	3	13/14
	Shellfish	pg/g-wet	12	tr(1) - 57	3	8/8
	Birds	pg/g-wet	ND	---	3	0/2

◯Survey Results of TPT

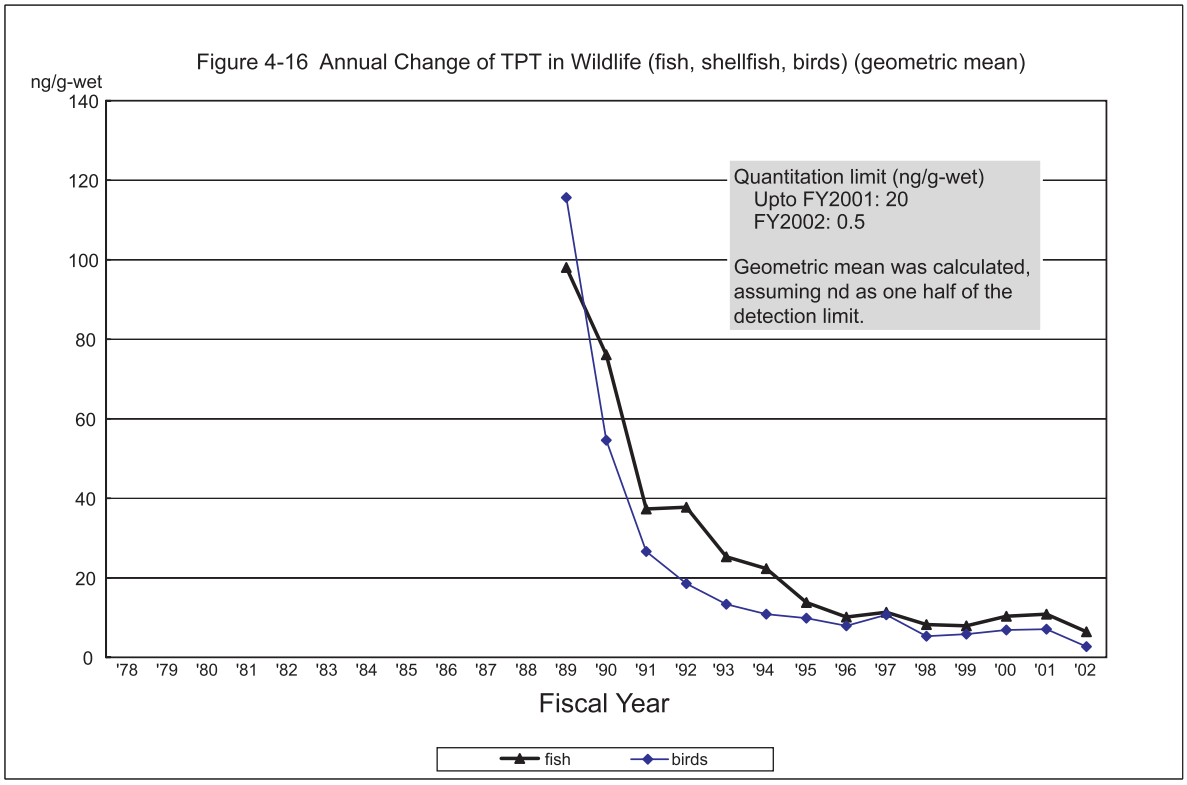
Substance		Unit	Geometric mean	Detected range	MQL	Detection frequency (area)
Bottom sediment		pg/g-dry	tr(0.69)	tr(0.55) - 490	1.6	30/63
Wildlife	Fish	pg/g-wet	6.4	tr(0.7) - 520	1.5	14/14
	Shellfish	pg/g-wet	2.7	tr(0.6) - 25	1.5	7/8
	Birds	pg/g-wet	ND	---	1.5	0/2

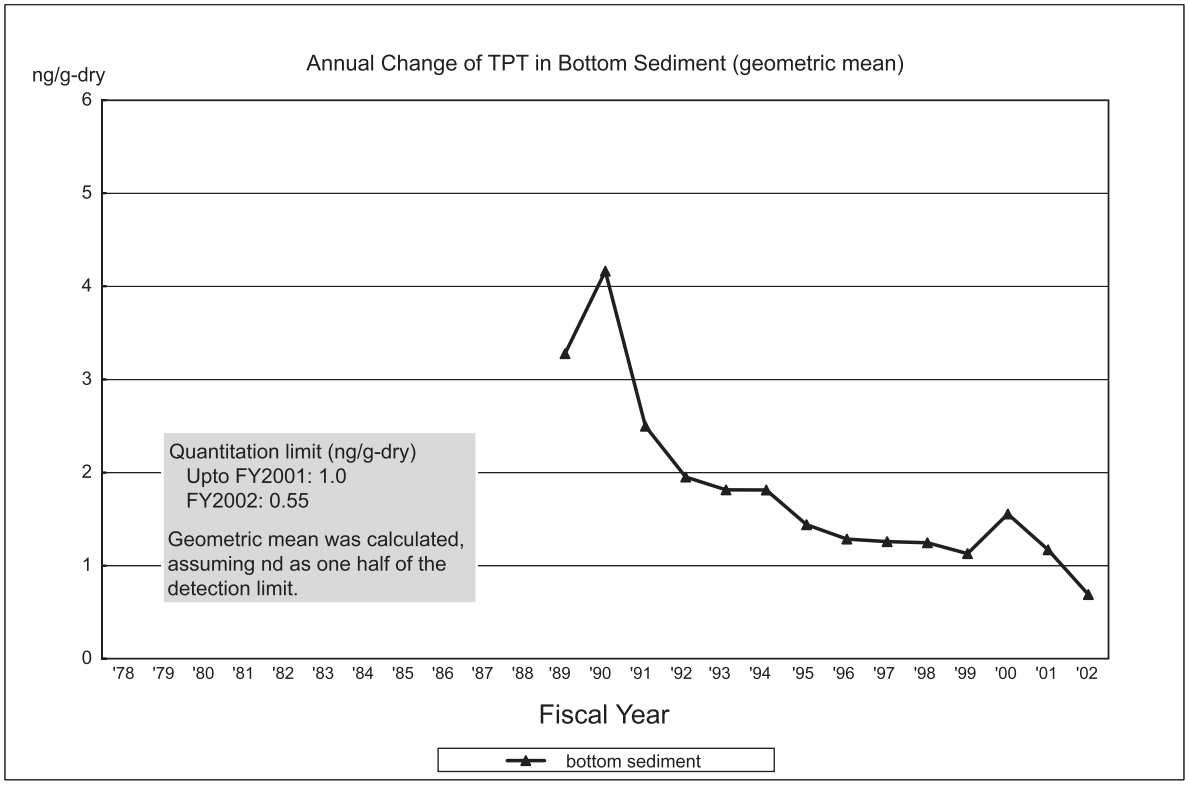
Figure 4-15 Annual Change of TBT in Wildlife (fish, shellfish, birds) (geometric mean)





Note : Geometric mean was calculated based on all of the samples. However, geometric means in the "Chemicals in the Environment" before FY2002 edition were calculated based on the arithmetic means of each area, consequently differing from the values.





Note : Geometric mean was calculated based on all of the samples. However, geometric means in the "Chemicals in the Environment" before FY2002 edition were calculated based on the arithmetic means of each area, consequently differing from the values.

Figure 4-A Locations of the Monitoring Investigation for Surface Water (FY2002)

Figure 4-B Locations of the Monitoring Investigation for Bottom Sediment (FY2002)

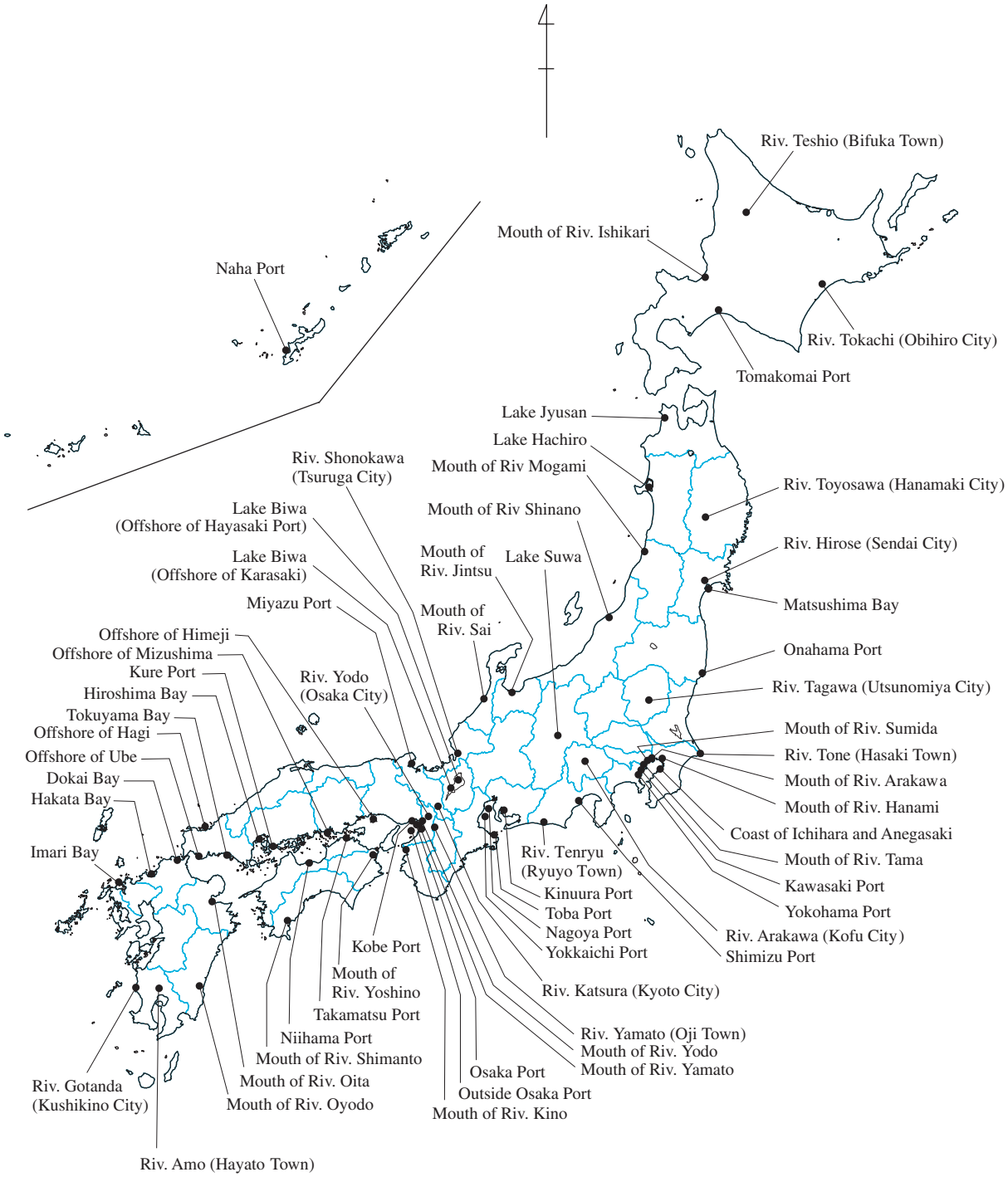


Figure 4-C Locations of the Monitoring Investigation for Wildlife (FY2002)

Note: "( )":Fish, "[ ]":Shellfish, "{ }":Birds

Figure 4-D Locations for the Monitoring Investigation for Air (FY2002)

Table 4-2 Characteristics of Species Subject to Wildlife Monitoring

Species		Characteristics of species	Sampling areas	Object of investigation	Notes
Fish	Greenling *(Hexagrammos otakii)*	1. Distributed from Hokkaido to southern Japan, the Korean Peninsula, and China 2. Lives in shallow seas of 5-50 m	Sea of Japan (offshore of Hokkaido), Yamada Bay in Iwate Prefecture	To grasp the pollution level in specific areas	
	Rock Greenling *(Hexagrammos lagocephalus)*	1. Lives in cold-current areas east of Hidaka (Hokkaido) 2. Larger than greenling and lives in deeper seas; eats fish (smaller than their mouth size) at the sea bottom	Offshore of Kushiro in Hokkaido	To grasp the pollution level in specific areas	
	Pacific Saury *(Cololabis saira)*	1. Distributed widely in the northern Pacific Ocean 2. Goes around the Japanese Archipelagos; in the Kurils in autumn, and offshore Kyushu in winter 3. The bioaccumulation of chemical substances is said to be medium	Pacific Ocean (offshore of Jyoban)	To grasp the pollution level around the Japanese Archipelagos	
	Sea Bass *(Lateolabrax japonicus)*	1. Distributed around the shores of various areas in Japan, the Korean Peninsula, and China 2. In its growing process, sometimes comes to fresh water or mixed sea and fresh water 3. The bioaccumulation of chemical substances is said to be high	Matsushima Bay in Miyagi Prefecture, Tokyo Bay in Tokyo Metropolis, Kawasaki Port in Kanagawa Prefecture, Osaka Bay in Osaka Prefecture, Nakaumi in Tottori Prefecture, Hiroshima Bay of Seto Inland Sea, Shimannto River in Kochi Prefecture, West Coast of Satsuma Peninsula	To grasp the pollution level in specific areas	8 areas with different levels of pollution were investigated
	Black Porgy *(Acanthopagrus sivicolus)*	1. Distributed in the Nansei Islands 2. Lives in coral reef seas and in bays into which rivers flow	Nakagusuku Bay in Okinawa Prefecture	To grasp the pollution level in specific areas	
	Dace *(Tribolodon hakonensis)*	1. Distributed widely in the fresh water throughout Japan 2. Predator of mostly	Lake Biwa in Shiga Prefecture	To grasp the pollution level in specific areas	

Table 4-2 Characteristics of Species Subject to Wildlife Monitoring (Continued)

Species		Characteristics of species	Sampling areas	Object of investigation	Notes
Shell-fish	Common Mussel *(Mytilus edulis galloprovincialis)*	1. Distributed worldwide, excluding tropical zones 2. Sticks to the rocks of inner bays and bridge piers	Yamada Bay in Iwate Prefecture, Miura Peninsula in Kanagawa Prefecture, Yokohama Port in Kanagawa Prefecture, Noto Peninsula in Ishikawa Prefecture, Coast of Shimane Peninsula in Shimane Prefecture, Dokai Bay in Fukuoka Prefecture	To grasp the pollution level in specific areas	6 areas with different levels of pollution were investigated
	Purplish Bifurcate Mussel *(Septifer virgatus)*	1. Distributed widely from southern Hokkaido to Kyushu 2. Mainly lives in natural beach areas with good tidal stream	Mishima in Yamaguchi Prefecture	To grasp the pollution level in specific areas	
	Asiatic Mussel *(Mytilus coruscus)*	1. Distributed in various areas south of southern Hokkaido 2. Sticks to rocks where the current is fast (1-10 m/s)	Naruto in Tokushima Prefecture	To grasp the pollution level in specific area	
Birds	Gray Starling *(Sturnus cineraceus)*	1. Distributed widely in the Far East (The affinity distributed world wide.) 2. Staple food is insects	Suburbs of Morioka City in Iwate Prefecture	To grasp the pollution level in northern Japan	
	Black-tailed Gull	1. Breeds mainly in the sea off Japan 2. Breeds in groups at shore reefs and fields of grass, etc. or coastal	Kabushima in Aomori Prefecture	To grasp the pollution level in specific areas	

Table 4-3 Comparison of Quantitation (Detection) Limit Between FY2001 and FY2002 Surveys

Survey No.	Target substance	Media							
		Surface water (pg/L)		Bottom sediment (pg/g-dry)		Wildlife (pg/g-wet)		Air (pg/m^3)	
		FY2001	FY2002[Note6]	FY2001	FY2002	FY2001	FY2002	FY2001	FY2002
1	PCBs	0.03-30[Note5]	0.18-0.9 (0.018-0.09)	0.03-10[Note5]	0.21-1.5	10,000[Note3] 0.02-0.5[Note5]	1.2-3	0.0004-5[Note5]	0.015-90
2	HCB	10,000[Note4]	0.6 (0.06)	1,000	0.9	1,000	0.18	---	0.9
3	Drins							---	
	Aldrin	---	0.6 (0.06)	---	6	1,000	4.2	---	0.060
	Dieldrin	10,000[Note4]	1.8 (0.18)	1,000	3	1,000	12	---	0.60
	Endrin	---	6.0 (0.60)	---	6	1,000	18	---	0.090
4	DDTs							---	
	p,p'-DDT	10,000[Note4]	0.6 (0.06)	1,000	6	1,000	4.2	---	0.24
	p,p'-DDE	10,000[Note4]	0.6 (0.06)	1,000	2.7	1,000	2.4	---	0.09
	p,p'-DDD	10,000[Note4]	0.24 (0.024)	1,000	2.4	1,000	5.4	---	0.018
	o,p'-DDT	---	1.2 (0.12)	---	6	1,000	12	---	0.15
	o,p'-DDE	---	0.9 (0.09)	---	3	1,000	3.6	---	0.03
	o,p'-DDD	---	0.6 (0.06)	---	6	1,000	12	---	0.021
5	Chlordanes								
	trans-Chlordane	10,000[Note4]	1.5 (0.15)	1,000	1.8	1,000	2.4	---	0.60
	cis-Chlordane	10,000[Note4]	0.9 (0.09)	1,000	0.9	1,000	2.4	---	0.60
	trans-Nonachlor	10,000[Note4]	1.2 (0.12)	1,000	1.5	1,000	2.4	---	0.30
	cis-Nonachlor	10,000[Note4]	1.8 (0.18)	1,000	2.1	1,000	1.2	---	0.030
	Oxychlordane	---	1.2 (0.12)	---	1.5	1,000	3.6	---	0.024
6	Heptachlor	---	1.5 (0.15)	---	1.8	---	4.2	---	0.12
7	HCHs								
	α-HCH	10,000[Note4]	0.9 (0.09)	1,000	1.2	1,000	4.2		
	β-HCH	10,000[Note4]	0.9 (0.09)	1,000	0.9	1,000	12		

Survey No	Target substance	Bottom sediment (ng/g-dry)		Wildlife (ng/g-wet)	
		FY2001	FY2002	FY2001	FY2002
8	Organotin compounds				
	TBT	0.8	3.6	10	3
	TPT	1.0	1.6	20	1.5

(Note 1): Values of FY2001 are the "unified detection limit"(with the exception of the detection limit of PCBs in the Follow-up Survey on the Status of Pollution by Unintentionally Formed Chemical Substances), and the values of FY2002 are the quantitation limit (3 times the detection limit).

(Note 2): "---" indicates that there is no target for comparison.

(Note 3): Quantitation limit for Wildlife Monitoring Survey.

(Note 4): Values of FY1998 are used since no monitoring was conducted for surface water from FY1999 to FY2001.

(Note 5): Range of the quantitation limit for each homolog in the Follow-up Survey on the Status of Pollution by Unintentionally Formed Chemical Substances.

(Note 6): Values of surface water in FY2002 shown in parentheses are the values obtained by high-volume water sampler. Sample volume in the basic sampling system is 30 L, whereas it is 100 L in the high-volume sampling system. As the sample volume for analysis (100 L) is 10 times larger than that of the basic sampling system, the quantitation limit is determined as one-tenth of it. (Adopted in Kyoto Prefecture, Hyogo Prefecture and Saga Prefecture in FY2002).

(Note 7): Halftone screened areas (gray) are not targeted in the FY2002 survey.

Table 4-4 Comparison of Detection Status Between FY2001 and FY2002 Surveys in Successive Survey Areas

Detected areas / Surveyed areas

Survey No.	Target substance	Media							
		Surface water		Bottom sediment		Wildlife		Air	
		FY2001	FY2002	FY2001	FY2002	FY2001	FY2002	FY2001	FY2002
1	PCBs(Note2)	11/11	11/11	25/25	25/25	8/25	21/21	11/11	11/11
2	HCB	0/14(Note3)	14/14	3/19	19/19	2/21	21/21	---	---
3	Drins								
	Aldrin	---	---	---	---	---	---	---	---
	Dieldrin	0/14(Note3)	14/14	1/9	19/19	8/21	21/21	---	---
	Endrin	---	---	---	---	---	---	---	---
4	DDTs							---	---
	p,*p*'-DDT	0/14(Note3)	14/14	3/19	19/19	7/21	21/21	---	---
	p,*p*'-DDE	0/14(Note3)	14/14	8/19	19/19	15/21	21/21	---	---
	p,*p*'-DDD	0/14(Note3)	14/14	7/19	19/19	8/21	21/21	---	---
	o,*p*'-DDT	---	---	---	---	2/21	21/21	---	---
	o,*p*'-DDE	---	---	---	---	1/21	21/21	---	---
	o,*p*'-DDD	---	---	---	---	1/21	21/21	---	---
5	Chlordanes							---	---
	trans-Chlordane	0/14(Note3)	14/14	6/19	19/19	7/21	21/21	---	---
	cis-Chlordane	0/14(Note3)	14/14	4/19	19/19	9/21	21/21	---	---
	trans-Nonachlor	0/14(Note3)	14/14	5/19	19/19	11/21	21/21	---	---
	cis-Nonachlor	0/14(Note3)	14/14	3/19	19/19	9/21	21/21	---	---
	Oxychlordane	---	---	---	---	7/21	21/21	---	---
6	Heptachlor	---	---	---	---	---	---	---	---
7	HCHs								
	α -HCH	0/14(Note3)	14/14	1/19	19/19	1/21	21/21		
	β -HCH	0/14(Note3)	14/14	3/19	19/19	5/21	21/21		
8	Organotin compounds								
	TBT			29/29	26/29	13/21	18/21		
	TPT			16/29	18/29	4/21	19/21		

(Note 1): "---" indicates that there are no successive survey areas.

(Note 2): Values for wildlife in FY2001 were compared with the results of Wildlife Monitoring. Values other than for wildlife were compared with the results of the Follow-up Survey on the Status of Pollution by Unintentionally Formed Chemical Substances.

(Note 3): Values of FY1998 are used since no monitoring was conducted for surface water from FY1999 to FY2001.

(Note 4): Halftone screened areas (gray) are not targeted in the FY2002 survey.

Table 4-5 Quantitation Limit in the FY2002 Monitoring Investigation

Survey No.	Substance	Surface water (pg/L)	Bottom sediment (pg/g-dry)	Wildlife			Air (pg/m^3)
				Fish (pg/g-wet)	Shellfish (pg/g-wet)	Birds (pg/g-wet)	
1	PCBs	0.18 - 0.9 0.018 - 0.09	0.21 - 1.5	1.2 - 3	1.2 - 3	1.2 - 3	0.015 - 90
2	HCB	0.6 0.06	0.9	0.18	0.18	0.18	0.9
3	Drins	0.6 0.06	6	4.2	4.2	4.2	0.060
3-1	Aldrin						
3-2	Dieldrin	1.8 0.18	3	12	12	12	0.60
3-3	Endrin	6.0 0.60	6	18	18	18	0.090
4	DDTs	0.6 0.06	6	4.2	4.2	4.2	0.24
4-1	*p,p*'-DDT						
4-2	*p,p*'-DDE	0.6 0.06	2.7	2.4	2.4	2.4	0.09
4-3	*p,p*'-DDD	0.24 0.024	2.4	5.4	5.4	5.4	0.018
4-4	*o,p*'-DDT	1.2 0.12	6	12	12	12	0.15
4-5	*o,p*'-DDE	0.9 0.09	3	3.6	3.6	3.6	0.03
4-6	*o,p*'-DDD	0.6 0.06	6	12	12	12	0.021
5	Chlordanes	1.5 0.15	1.8	2.4	2.4	2.4	0.60
5-1	*trans*-Chlordane						
5-2	*cis*-Chlordane	0.9 0.09	0.9	2.4	2.4	2.4	0.60
5-3	*trans*-Nonachlor	1.2 0.12	1.5	2.4	2.4	2.4	0.30
5-4	*cis*-Nonachlor	1.8 0.18	2.1	1.2	1.2	1.2	0.030
5-5	Oxychlordane	1.2 0.12	1.5	3.6	3.6	3.6	0.024
6	Heptachlor	1.5 0.15	1.8	4.2	4.2	4.2	0.12
7	HCHs	0.9 0.09	1.2	4.2	4.2	4.2	
7-1	α -HCH						
7-2	β -HCH	0.9 0.09	0.9	12	12	12	
8	Organotin compounds		(ng/g-dry)	(ng/g-wet)	(ng/g-wet)	(ng/g-wet)	
8-1	TBT		3.6	3	3	3	
8-2	TPT		1.6	1.5	1.5	1.5	

(Note 1): Quantitation Limit is defined as tree times the detection limit.
(Note 2): Quantitation limit of PCBs is shown as a range of homologs and isomers.
(Note 3): Two-sampling method was adopted for surface water: Upper and lower values are obtained by basic sampling system (30L) and by high-volume sampling system (100L), respectively.
High-volume sampling system was adopted at 3 areas (Miyazu Bay in Kyoto, Harima-Nada in Hyogo Prefecture and Imari Bay in Saga Prefecture).
(Note 4): Halftone screened areas (gray) are not targeted in the FY2002 survey.

Table 4-6 Survey Results of the FY2002 Monitoring Investigation

Survey No.	Substance	Surface Water 38 areas, 114 samples		Bottom Sediment 63 areas, 189 samples		Wildlife						Air 34 areas, 102 samples	
						Fish 14 areas, 70 samples		Shellfish 8 areas, 38 samples		Birds 2 areas, 10 samples			
		Range (pg/L) (frequency (areas))	Mean (pg/L)	Range (pg/g-dry) (frequency (areas))	Mean (pg/g-dry)	Range (pg/g-wet) (frequency (areas))	Mean (pg/g-wet)	Range (pg/g-wet) (frequency (areas))	Mean (pg/g-wet)	Range (pg/g-wet) (frequency (areas))	Mean (pg/g-wet)	Range (pg/m^3) (frequency (areas))	Mean (pg/m^3)
1	PCBs	60 -11,000 (38/38)	460	39 -630,000 (63/63)	9,200	1,500 -550,000 (14/14)	14,000	200 -160,000 (8/8)	10,000	4,800 -22,000 (2/2)	11,000	16 -880 (34/34)	100
2	HCB	9.8 -1,400 (38/38)	36	7.6 -19,000 (63/63)	210	19 -910 (14/14)	140	2.4 -330 (8/8)	23	560 -1,600 (2/2)	1,000	57 -3,000 (34/34)	99
3	Drins												
3-1	Aldrin	ND -18 (37/38)	0.69	ND -570 (56/63)	12	ND -tr(2.0) (1/14)	nd	ND -34 (4/8)	tr(1.7)	--- (0/2)	nd	ND -3.2 (19/34)	tr(0.030)
3-2	Dieldrin	3.3 -940 (38/38)	41	4 -2,300 (63/63)	63	46 -2,400 (14/14)	280	tr(7) -190,000 (8/8)	490	820 -1,700 (2/2)	1,200	0.73 -110 (34/34)	5.6
3-3	Endrin	ND -31 (36/38)	4.7	ND -19,000 (54/63)	9	ND -180 (13/14)	19	ND -12,000 (7/8)	44	ND -99 (2/2)	22	ND -2.5 (32/34)	0.22
4	DDTs												
4-1	*p,p*'-DDT	0.25 -440 (38/38)	12	tr(5) -97,000 (63/63)	270	6.8 -24,000 (14/14)	330	38 -1,200 (8/8)	200	76 -1,300 (2/2)	380	0.25 -22 (34/34)	1.9
4-2	*p,p*'-DDE	1.3 -760 (38/38)	24	8.4 -23,000 (63/63)	660	510 -98,000 (14/14)	2,500	140 -6,000 (8/8)	1,100	8,100 -170,000 (2/2)	36,000	0.56 -28 (34/34)	2.8
4-3	*p,p*'-DDD	0.57 -190 (38/38)	15	tr(2.2) -51,000 (63/63)	540	80 -14,000 (14/14)	610	11 -3,200 (8/8)	340	140 -3,900 (2/2)	560	ND -0.76 (34/34)	0.13

Table 4-6 Survey Results of the FY2002 Monitoring Investigation (Continued)

Survey No.	Substance	Surface Water		Bottom Sediment		Wildlife						Air	
						Fish		Shellfish		Birds			
		Range (pg/L) (frequency (areas))	Mean (pg/L)	Range (pg/g-dry) (frequency (areas))	Mean (pg/g-dry)	Range (pg/g-wet) (frequency (areas))	Mean (pg/g-wet)	Range (pg/g-wet) (frequency (areas))	Mean (pg/g-wet)	Range (pg/g-wet) (frequency (areas))	Mean (pg/g-wet)	Range (pg/m^3) (frequency (areas))	Mean (pg/m^3)
4-4	*o,p*'-DDT	0.19 -77 (38/38)	5.1	ND -27,000 (62/63)	57	tr(6) -2,300 (14/14)	110	22 -480 (8/8)	110	ND -58 (2/2)	tr(10)	0.41 -40 (34/34)	2.2
4-5	*o,p*'-DDE	ND -680 (38/38)	2.3	ND -16,000 (63/63)	46	3.6 -13,000 (14/14)	77	13 -1,100 (8/8)	88	20 -49 (2/2)	28	0.11 -8.5 (34/34)	0.60
4-6	*o,p*'-DDD	ND -110 (38/38)	5.5	ND -14,000 (62/63)	140	ND -1,100 (14/14)	83	tr(9) -2,900 (8/8)	130	tr(8) -23 (2/2)	15	ND -0.85 (33/34)	0.14
5	Chlordanes												
5-1	*trans*-Chlordane	3.1 -780 (38/38)	32	2.1 -16,000 (63/63)	130	2.0 -2,700 (14/14)	180	33 -2,300 (8/8)	420	8.9 -26 (2/2)	14	0.62 -820 (34/34)	36
5-2	*cis*-Chlordane	2.5 -880 (38/38)	41	1.8 -18,000 (63/63)	120	57 -6,900 (14/14)	580	24 -26,000 (8/8)	810	10 -450 (2/2)	67	0.86 -670 (34/34)	31
5-3	*trans*-Nonachlor	1.8 -780 (38/38)	29	3.1 -13,000 (63/63)	120	98 -8,300 (14/14)	970	21 -1,800 (8/8)	510	350 -1,900 (2/2)	880	0.64 -550 (34/34)	24
5-4	*cis*-Nonachlor	0.23 -250 (38/38)	7.6	ND -7,800 (63/63)	65	46 -5,100 (14/14)	420	8.6 -870 (8/8)	190	68 -450 (2/2)	200	0.071 -62 (34/34)	3.1
5-5	Oxychlordane	ND -41 (35/38)	2.4	ND -120 (59/63)	2.7	16 -3,900 (14/14)	160	ND -5,600 (8/8)	78	470 -890 (2/2)	640	ND -8.3 (34/34)	0.96

Table 4-6 Survey Results of the FY2002 Monitoring Investigation (Continued)

Survey No.	Substance	Surface Water		Bottom Sediment		Wildlife						Air	
						Fish		Shellfish		Birds			
		Range (pg/L) (frequency (areas))	Mean (pg/L)	Range (pg/g-dry) (frequency (areas))	Mean (pg/g-dry)	Range (pg/g-wet) (frequency (areas))	Mean (pg/g-wet)	Range (pg/g-wet) (frequency (areas))	Mean (pg/g-wet)	Range (pg/g-wet) (frequency (areas))	Mean (pg/g-wet)	Range (pg/m^3) (frequency (areas))	Mean (pg/m^3)
6	Heptachlor	tr(0.5) -25 (38/38)	tr(1.1)	tr(0.6) -120 (60/63)	3.5	ND -20 (12/14)	4.0	ND -15 (6/8)	3.6	ND -5.2 (2/2)	tr(2.1)	0.20 -220 (34/34)	11
7	HCHs												
7-1	α -HCH	1.9 -6,500 (38/38)	84	2 -8,200 (63/63)	130	Tr(1.9) -590 (14/14)	51	12 -1,100 (8/8)	65	93 -360 (2/2)	160		
7-2	β -HCH	0.21 -110 (38/38)	210	3.9 -11,000 (63/63)	200	tr(5) -1,800 (14/14)	99	32 -1,700 (8/8)	89	1,600 -7,300 (2/2)	3,000		

Survey No.	Substance	Bottom Sediment		Wildlife					
				Fish		Shellfish		Birds	
		Range (ng/g-dry) (frequency (areas))	Mean (ng/g-dry)	Range (ng/g-wet) (frequency (areas))	Mean (ng/g-wet)	Range (ng/g-wet) (frequency (areas))	Mean (ng/g-wet)	Range (ng/g-wet) (frequency (areas))	Mean (ng/g-wet)
8	Organotin compounds								
8-1	TBT	ND -390 (48/63)	4.9	ND -500 (13/14)	6	tr(2) -57 (8/8)	12	--- (0/2)	ND
8-2	TPT	ND -490 (30/63)	tr(0.69)	ND -520 (13/14)	6.4	ND -25 (7/8)	2.7	--- (0/2)	ND

(Note 1): Halftone screened areas (gray) are not targeted in the FY2002 survey.

(Note 2): (Frequency (areas)) indicates (Number of detected areas / Number of survey areas).

(Note 3): [---] in "Range" indicates that there was no detected sample.

Appendix A

Outline of the Chemical Substances Control Law

Appendix A Outline of the Chemical Substances Control Law

The Chemical Substances Control Law was enacted in October 1973 as a result of the environmental pollution caused by PCB, and was enforced in April 1974. Under this Law, new chemical substances are examined before manufacture or import to determine whether or not they change chemically in nature (low biodegradability), are easily accumulated in biological organisms (high bioaccumulation) or are suspected of having toxicity to human health when consumed for a long period of time (chronic toxicity). (That is, the system of examination of new chemical substances before manufacture or import). Substances with the above properties were designated as Class 1 Specified Chemical Substances, and their manufacture, import and use, etc. were restricted. There have been 7,894 notifications for new chemical substances (as of the end of December 2002).

On the other hand, existing chemical substances have been examined for safety in principle by the government, based on the resolution of the National Diet at the time of the enactment of the Chemical Substances Control Law in 1973, and if necessary, were designated as Class 1 Specified Chemical Substances, etc. Existing chemical substances were investigated by the Ministry of Economy, Trade and Industry for biodegradability by microorganisms and bioaccumulation in fish and shellfish, by the Ministry of Health, Labour and Welfare for toxicity and the status of their persistence in the general environment, and by the MOE for effects to the ecosystem. 13 substances, PCB, HCB, PCN, aldrin, dieldrin, endrin, DDT, chlordanes, bis(tributyltin) oxide, (*N,N′*-ditolyl, *N*-tolyl-*N′*-xylyl, *N,N′*-dixylyl)-*p*-phenylene diamine, 2,4,6-tri-*tert*-butylphenol, toxaphene and mirex, have been designated as Class 1 Specified Chemical Substances (as of the end of January 2004).

The Law was amended in May 1986 as a result of groundwater pollution by TCE, etc. and was enforced in April 1987. Since this amendment, substances with low bioaccumulation, but low biodegradability and suspicion of chronic toxicity, are designated as Designated Chemical Substances, and their production or importation volume are reported. If toxicity to human health is expected by environmental pollution caused by these Designated Chemical Substances, a governmental order of conduct and a report of toxicity test takes place for manufacturers, etc., and if toxicity is observed, these substances are to be designated as Class 2 Specified Chemical Substances and the production or importation volume etc. is regulated. So far, 739 substances including chloroform and 1,2-DCE have been designated as Designated Chemical Substances (as of the end of January 2004). Concerning Class 2 Specified Chemical Substances, 3 substances from Designated Chemical Substances, i.e. carbon tetrachloride, PERC and TCE, were designated as Class 2 Specified Substances in April 1989, which is the first time for such an occurrence. So far, 23 substances have been designated in this manner (as of the end of January 2004).

The system of the Chemical Substances Control Law is displayed in Fig. 1, and within this framework MOE has the following responsibilities and authorities:

[1] To provide testing items and other technical items for the examination of new chemical substances by the Ministerial Ordinances of the Prime Minister's Office, the Ministry of Health, Labour and Welfare and the Ministry of Economy, Trade and Industry (Article 4, Clause 5).

[2] To request necessary explanations and express opinions to the Minister of Health, Labour and Welfare and the Minister of Economy, Trade and Industry through the examination and judgment of new chemical substances (Article 4, Clause 7).

[3] To request that the competent minister take measures (Article 34, Clause 1) following the designation of a Class 1 Specified Chemical Substance (Article 22).

[4] To request that the Ministers of Health, Labour and Welfare and Economy, Trade and Industry (Article 34, No. 2) order toxicity tests concerning Designated Chemical Substances (Article 24, Clause 1).

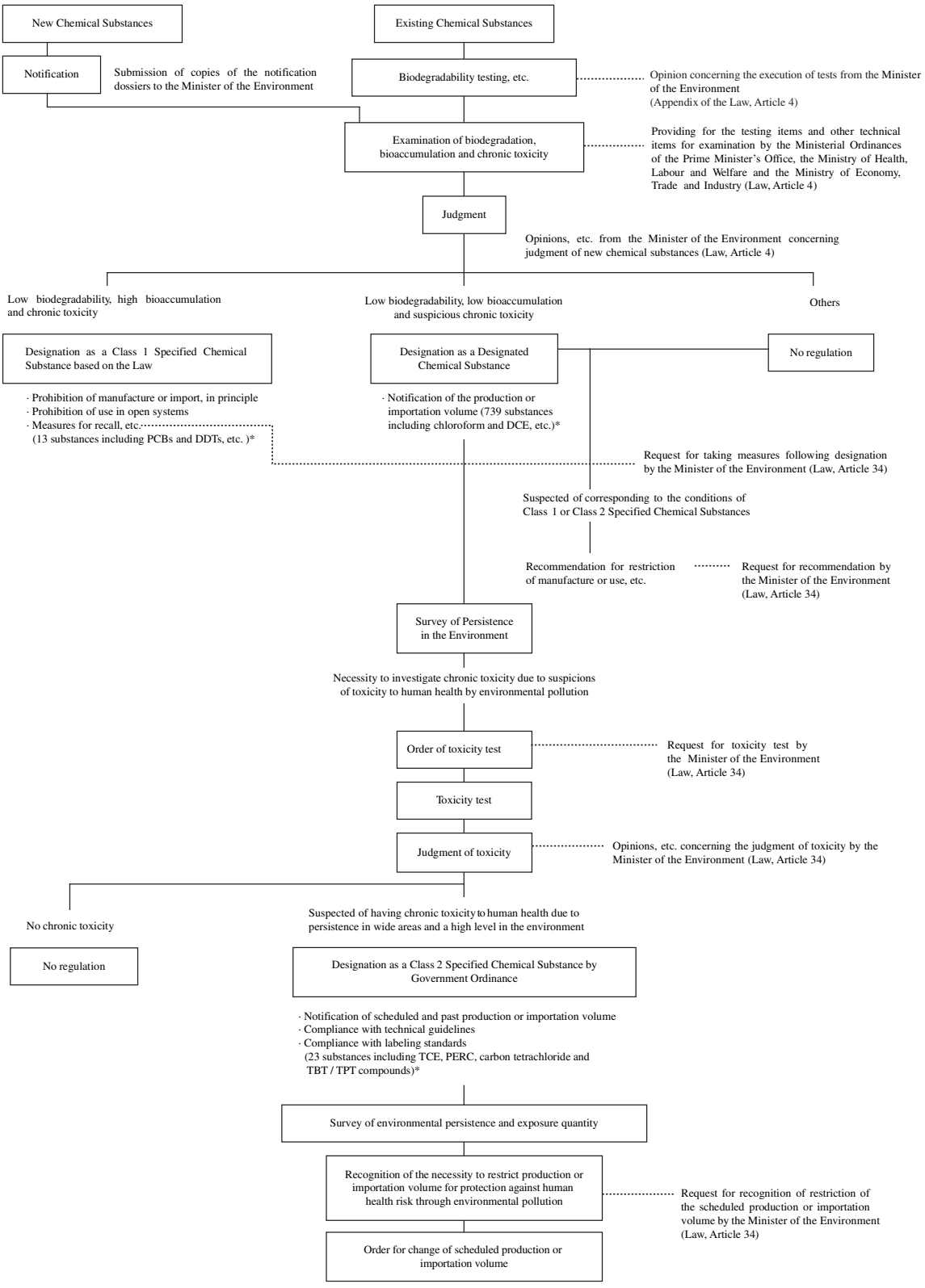
[5] To request that the Ministers of Health, Labour and Welfare and Economy, Trade and Industry (Article 34, No. 3) recognize the necessity to restrict the manufacture, etc. of Class 2 Specified Chemical Substances (Article 26, No. 4).

[6] To request that the competent minister (Article 34, No. 4) make the necessary recommendations concerning the restriction of the manufacture, import and use, etc. of chemical substances (Article 29) for which there is sufficient reason to suspect as Class 1 Specified Substances concerning substances other than Class 1 Specified Chemical Substances, and as Class 2 Specified Chemical Substances concerning those other than Class 2 Specified Chemical Substances.

[7] To express opinions as to whether existing chemical substances correspond to Designated Chemical Substances, etc. when the Ministers of Health, Labour and Welfare and Economy Trade and Industry conduct toxicity tests (Supplementary Regulations, Article 4).

This law was amended (effective in April 2004) in order to introduce evaluation and regulation that could take into account the adverse effects on living organisms in the environment, and to improve the effectiveness and efficiency of the system from the standpoint of risk management.

Figure System of the Law Concerning the Examination and Manufacture, etc. of Chemical Substances



* The numbers of chemical substances are as of January 2004.

Appendix B

Surveyed Chemical Substances and Detected Levels in the Environment (A Cumulative List for Fiscal Years 1974–2002) [Extraction]

The first 2 pages of the 45-page list are included in this document.

The entire list is provided on CD-ROM.

Surveyed Chemical Substances and their Detected Levels in the Environment (A Cumulative List for Fiscal Year 1974 - 2002)

Surveyed Chemical Substances and their Detected Levels in the Environment (A Cumulative List for FY 1974 - 2002)

A/B: Number of detections / Number of samples; C/D: Number of detected stations / Number of sampling stations;
Unit: Surface water ug/L; Bottom sediment ug/g-dry; Fish ug/g-wet; Air ppb or ng/m^3 at 20 ℃ 1atm

#	Substance	CAS RN	FY	Number of detection and range of detection																#
				Surface water (ug/L)				Bottom sediment (ug/g-dry)				Fish (ug/g-wet)				Others A:Air; R:Rain Water; P:Plankton				
				A/B	C/D	Range of detection	Limit of detection	A/B	C/D	Range of detection	Limit of detection	A/B	C/D	Range of detection	Limit of detection	A/B	C/D	Range of detection	Limit of detection	
1	acrylamide	79-06-1	1975	0/95		---	(1)													1
			1991	11/153		0.05 - 0.1	(0.05)	20/150		0.00052 - 0.003	(0.0005)	0/147		---	(0.0013)					
			1998	0/33	0/11	---	(0.15)	0/30	0/10	---	(0.009)									
2	ethyl acrylate	140-88-5	1980	0/51		---	(0.3 - 50)	0/51		---	(0.0041 - 0.12)									2
3	2-ethylhexylacrylate	103-11-7	1980	0/51		---	(1.1 - 12)	0/24		---	(0.04 - 0.13)									3
4	butyl acrylate	141-32-2	1980	0/51		---	(0.7 - 30)	0/51		---	(0.0080 - 0.07)									4
5	methyl acrylate	96-33-3	1980	0/51		---	(0.6 - 50)	0/51		---	(0.0083 - 0.12)									5
6	acrylonitrile	107-13-1	1977	0/ 9		---	(20 - 50)	0/ 9		---	(0.4 - 0.5)									6
			1987	0/75		---	(2)	4/66		0.014 - 0.114	(0.007)					A 16/65		42 - 2,400ng/m^3	(40)	
			1991													A 15/40		46 - 390ng/m^3	(40)	
			1992	0/162		---	(2.2)	8/151		0.007 - 0.016	(0.007)	0/144		---	(0.01)					
7	acrolein	107-02-8	1978	0/21		---	(7 - 10)	0/15		---	(0.02 - 0.1)									7
			1987	0/75		---	(1.9)									A 0/61		--- ng/m^3	(800)	
8	adipic acid	124-04-9	1985	0/27		---	(2)	6/27		0.07 - 0.41	(0.03)									8
9	diisodecyl adipate	6938-94-9	1978	0/30		---	(0.8 - 100)	0/30		---	(0.04 - 5)									9
10	octyl adipate	103-23-1	1978	0/30		---	(0.4 - 25)	0/30		---	(0.02 - 1)									10
			1984													A 47/72		0.23 - 16.7ng/m^3	(0.1 - 0.61)	
			1995	0/33		---	(0.7)	11/29		0.016 - 0.1	(0.012)					A 31/41		1.0 - 22ng/m^3	(1)	
			1998													A 26/33	11/12	1 - 26ng/m^3	(1)	
11	dibutyl adipate	105-99-7	1999	0/36	0/12	–	(0.054)	2/36	1/12	0.022 - 0.023	(0.021)									11
12	dibuthyldiglycol adipate	141-17-3	1978	0/30		---	(0.8 - 50)	0/30		---	(0.04 - 2)									12
13	adiponitrile	111-69-3	1978	0/21		---	(10)	0/21		---	(0.1 - 0.3)									13
14	azinphosmethyl	86-50-0	1993													A 0/24		--- ng/m^3	(21)	14

Surveyed Chemical Substances and their Detected Levels in the Environment
(A Cumulative List for Fiscal Year 1974 - 2002)

#	Substance	CAS RN	FY	Number of detection and range of detection																#
				Surface water (ug/L)				Bottom sediment (ug/g-dry)				Fish (ug/g-wet)				Others A:Air; R:Rain Water; P:Plankton				
				A/B	C/D	Range of detection	Limit of detection	A/B	C/D	Range of detection	Limit of detection	A/B	C/D	Range of detection	Limit of detection	A/B	C/D	Range of detection	Limit of detection	
15	acetaldehyde	75-07-0	1977	0/ 6		---	(10)	3/ 6		2 - 4	(2.5)									15
			1987	0/75		---	(1)									A 43/57		930 - 22,000ng/m^3	(800)	
			1995	0/33		---	(1)									A 46/47		1,80 - 45,000ng/m^3	(500)	
16	acetonitrile	75-05-8	1977	0/9		---	(120 - 200)	0/ 9		---	(2 - 24)									16
			1987	0/72		---	(3)	11/60		0.021 - 0.54	(0.021)					A 44/70		210 - 42,000ng/m^3	(200)	
			1991													A 33/51		200 - 3,700ng/m^3	(200)	
			1992	15/147		1.1 - 7.4	(1)	25/155		0.03 - 1.9	(0.03)									
17	acetone	67-64-1	1995													A 49/49		150 - 31,000ng/m^3	(2)	17
18	acenaphthylene	208-96-8	1983	0/33		---	(0.06 - 0.4)	13/33		0.008 - 0.053	(0.008 - 0.041)									18
			1984	4/138		0.08 - 1.3	(0.002 - 1)	63/138		0.0007 - 0.671	(0.00006 - 0.088)	14/138		0.0008 - 0.024	(0.0002 - 0.05)					
19	acenaphthene	83-32-9	1983	0/33		---	(0.09 - 0.4)	13/33		0.008 - 0.13	(0.008 - 0.041)									19
			1984	3/138		0.05 - 0.1	(0.001 - 1)	58/138		0.00004 - 0.084	(0.00004 - 0.088)	15/138		0.001 - 0.50	(0.0001 - 0.05)					
			1999	1/39	1/13	0.012	(0.011)	35/39	12/13	0.00062 - 0.24	(0.00045)	11/ 39	6/13	0.00081 - 0.0047	(0.00077)					
20	acephate	30560-19-1	1993	0/30		---	(0.2)	0/30		---	(0.02)	0/30		---	(0.01)					20
21	azobisisobutyronitrile	78-67-1	1979	0/15		---	(10)	0/15		---	(0.1)									21
22	o-anisidine	90-04-0	1976	6/68		0.2 - 1.3	(0.2 - 0.8)	27/68		0.003 - 0.079	(0.003 - 0.004)									22
			1990	2/48		0.02 - 0.027	(0.02)	3/41		0.0067 - 0.0073	(0.005)	0/54		---	(0.002)	A 0/51		--- ng/m^3	(500)	
23	m-anisidine	536-90-3	1976	3/68		0.016 - 0.028	(0.01 - 0.2)	6/68		0.0004 - 0.018	(0.0002 - 0.0016)									23
			1990	5/48		0.02 - 0.058	(0.02)	0/57		---	(0.02)	1/54		0.0046	(0.002)	A 0/51		--- ng/m^3	(500)	
24	p-anisidine	104-94-9	1976	4/68		0.06 - 0.72	(0.06 - 0.2)	12/68		0.001 - 0.006	(0.0007 - 0.004)									24
			1990	0/57		---	(0.4)	0/54		---	(0.017)	0/54		---	(0.02)	A 0/51		--- ng/m^3	(1,500)	
25	aniline	62-53-3	1976	40/68		0.02 - 28	(0.04 - 0.2)	48/68		0.0007 - 0.50	(0.0008)									25
			1990	33/104		0.02 - 0.33	(0.02)	81/116		0.003 - 0.24	(0.002)	27/89		0.001 - 0.0077	(0.001)	A 1/48		480ng/m^3	(150)	
			1997													A 1/42		18ng/m^3	(15)	
			1998	1/141	1/47	0.074	(0.06)	95/120	36/43	0.0021 - 0.21	(0.002)									

Appendix C

Suggested Sampling Method for Environmental Surveys Concerning Chemical Substances

Appendix C Suggested Sampling Method for Environmental Surveys Concerning Chemical Substances

1. Sampling method

(1) Water

[1] Sampling time

Water sampling was conducted at a time when the days preceding the day of sampling had been relatively sunny and the water quality was stable.

[2] Sampling depth

The location for sampling was, in principle, the surface water (0–50 cm from the surface) in the centerline of the system of the surveyed point. However, water 1–2 cm in depth was avoided for sampling so that floating garbage and oils were not mixed into the samples.

Note: Sampling and shipping of samples for the analysis of 1,2-dichlorobenzene

A 44-ml glass vial for a Tekmar autosampler or 100-ml screw-cap vial was used as the sampling vessel. Water samples were taken into the sampling vessels and sealed after filling to the brim so that no air bubbles remained. Samples were stored in a dark place at below 4 C and above the freezing point. In addition, sampling vessels were sealed, for instance in polyethylene bags equipped with a fastener, and stored upside down, since the volume change of sample water during storage might cause contamination of the sample. Furthermore, as to the sampling, close contact was maintained with the analytical organizations so that the time between sampling and analysis would be as short as possible. The samples were swiftly shipped to the designated analytical laboratories after packing them in cooler boxes or polystyrene foam boxes containing 1–2 packs of freezing agent so that the samples would not spill over.

[3] Preparation for analysis

Supernatant-removing garbage, etc. was used. In doing so, care was taken not to include the surface water. No filtration or centrifugal separation, etc. was conducted.

(2) Bottom sediments

[1] Bottom sampling method

With consideration to the properties, the bottom sediments collected with the Ekman-Birge bottom sampler or other proportionate bottom samplers were placed in a clean tray and after removing extraneous substances such as pebbles, shells and bits of animals and plants, and then sieving with a 16-mesh sieve (hole diameter of 1 mm), they were provided for analysis. The sludge content (weight of sample through the sieve / weight of original sample) (%) was measured. Dry weight (105±10 ℃ for about 2 hours) and

ignition loss (600 ± 25°C for about 2 hours) was measured for part of the samples.

Note: Sampling and shipping of samples for the analysis of 1,2-dichlorobenzene

Collected samples were immediately transferred to glass bins and sealed so that no void space remained. The samples were swiftly shipped to the designated analytical laboratories after packing them tightly to prevent spillover, and they were placed in cooler boxes or polystyrene foam boxes containing 1-2 packs of refrigerant.

[2] Other points

Samples for analysis were, in principle, air- or heat-dried, and the measured value per dry weight was calculated.

(3) Wildlife

[1] Samples

Samples were those fish reproduced at the place of survey. In the sea areas, sea bass or young sea bass (if not available, goby, striped mullet or flatfish were accepted), and in the lakes, marshes and rivers, dace were used (if not available, then carp or crucian carp was accepted) as standard samples. It was preferable to use a single body for the samples, but the use of several bodies was also allowed. However, a small-bodied sample was used after sufficient cleansing.

[2] Preparation for analysis

(a) Fish

Edible parts (muscles) were used in fish samples. The part to be collected for samples did not matter, but more than approximately 100 g was carved and homogenized for samples. For cases in which the body weight of the fish was under 100 g, the edible parts of several fish were carved and homogenized. In the case of small fish, 100 g was collected by carving the muscles from several bodies, and then homogenized.

(b) Shellfish (for cases in which fish were not available)

For shellfish, the edible parts of the required quantity were collected and homogenized for use as samples. In this case, sludge was removed as much as possible.

[3] Other points

For wildlife samples, lipid weight (%) was calculated by the following method:

Five grams of the sample was placed in a homogenizer cup, after which 20 ml of chloroform and 40 ml of methanol was added, and then the sample was homogenized for 2 minutes. An additional 20 ml of chloroform was added, followed by 2 minutes of homogenizing. The sample was then filtered with a Buchner funnel and the precipitate was homogenized with 80 ml of chloroform: methanol (1:1). The entire chloroform and methanol fraction was placed in the separation funnel, after which 60 ml of distilled water was added and then the mixture was shaken gently. The lower chloroform fraction was collected and after drying with anhydrous sodium sulfate, the solvent was evaporated using a rotary evaporator. The residue was dried using

(4) Air

[1] Sampling time

Sampling took place between September and November when the weather was stable, for 3 continuous days, once a day, beginning at 10 a.m., in principle, for 24 hours.

[2] Sampling method

Samples were collected by adsorption to resin or glass fiber filters, etc.

(5) Diet

[1] Sampling method

Diet samples for the analysis of polychlorinated naphthalene and polybrominated diphenylether (octa-bromide) were collected daily for 3 successive days by duplicate portion sampling method. Daily diet samples were stored in the refrigerator of each household, collecting each meal (breakfast, lunch, diner & snack) in a stainless steel bottle equipped with a screw mouth. The samples were shipped to the analytical laboratories by cool courier on the day after sampling.

2. Sampling sites

(1) The primary purpose of this survey was to investigate the persistence of chemical substances in the environment, and to determine whether they persist in the environment more than usual. Thus, the points where surveyed chemical substances were being released (for example, near the outlet for waste water of a factory, etc. where the substances were being manufactured or used, or near points through which transportation facilities passed, etc.) and points directly affected by pollution were avoided as points for sampling.

(2) Three samples were collected within a range of 500 square meters as a unit in the survey for water and bottom sediments, so that they were collected in as widespread a point as possible. In this case, the sampling for bottom sediments was a mixture of samples from 3 spots in equal quantities within the surrounding 50 m. In the surveys for fish, a collection of 3 samples from the area was considered sufficient. (It was preferable to collect extra samples for frozen preservation in case a problem should arise.)

(3) The points for air sampling were where it was possible to grasp the status of the air. Points strongly affected by a particular source or by transportation facilities, etc. were avoided.

3. Investigation items on the samples

(1) Water samples: temperature, color by visual (eye) observation, transparency and turbidity

(2) Bottom sediment samples: appearance, odor, foreign substance, depth of water at sampling point,

water content, ignition loss and sludge content

(3) Wildlife samples: standard Japanese vernacular name, length of body (excluding tail), body weight and lipid weight.

(4) Air samples: Weather, temperature, humidity, wind direction, wind velocity and surrounding geography and status of roads at the sampling time.

4. Storage, etc. of samples

Collected samples were placed in bags or containers so that the samples would not elute or adsorb, and were analyzed as soon as possible. When preserving samples, they were placed in refrigerators or freezers, etc. to prevent change in quality.

Appendix D

Summary of Analytical Methods for Environmental Surveys

Appendix D Summary of Analytical Methods for Environmental Surveys

1. Initial Environmental Survey

Development and study of analytical methods for the target substances in the FY2002 initial environmental survey was conducted in FY2001. For surface water and bottom sediment, screening tests for degradability were conducted prior to the development of analytical methods by the following procedure to identify the suitability of the method.

(1) Degradability screening test (rapid method)

As some of the chemical substances degrade under various environmental conditions, it was necessary to conduct screening tests for degradability under the assumed environmental condition and develop appropriate analytical methods. Screening tests were conducted establishing water and light conditions simultaneously since both conditions are considered very important in environmental degradation (in the light-related degradation test, only one pH condition was tested). For volatile substances, concentrations of the substances in the void space of the vials were properly measured so as not to misinterpret degradation of the substances.

<Preparation>

A volume of 100 ml of distilled water (pH: 5, 7 and 9) was added to 130-mL vials containing a stir bar (for magnetic stirrer) after which the vials were sealed. Next, a standard solution dissolved in hydrophilic solvent such as acetone (% order concentration recommended) was added to these vials using a microsyringe so that the concentration of the solution would be below 100 ppm, followed by 10 minutes of stirring by magnetic stirrer.

<Experiment>

a) Test solutions with the respective pH values were removed from the vials one hour after the preparation and analyzed immediately (Concentration A).
b) The solutions were analyzed after 5 days of storage in a dark place (Concentration B).
c) In order to examine the occurrence of degradation by light, analysis of the test solution with pH 7 (stored for 5 days) was conducted in a sunny room (Concentration C).

The above experiments were conducted at the temperature of 20 ±5°C.

<Result>

Degradability of the test substances was examined by calculating B/A×100, C/A×100 for the respective pH.

The combinations of experiments are shown below.

pH	Initial concentration (μg/mL)	Residual rate after one hour (%)	Residual rate after 5 days	
			Dark place (%)	Light emission (%)
5	✓	✓	✓	✓
7	✓	✓	✓	✓
9	✓	✓	✓	✓

Furthermore, in the course of development of analytical methods for surface water and bottom sediment, recovery experiments were conducted to determine the detection limit and recovery rate.

(2) Additional recovery experiment at low concentration

<Distilled water>

Calibration curves were obtained setting the sensitivity of the analytical instrument as high as practically allowable.

Samples were prepared by dissolving standard samples of target substances corresponding to three different concentrations including the lowest concentration in the range of a positive linear regression relationship. And, total analysis was conducted four times for each concentration and the measured values were obtained. Based upon the results, the power of test D was calculated by the following equation after obtaining the standard deviation of the measured values at each concentration.

$$D = t(n-1, 0.05) \bullet \frac{\sigma_R}{n} \bullet \frac{dC}{dR}$$

σ_R : standard deviation C: concentration R: measured value (response value)

The power of test D for the established analytical method was obtained by calculating the average value of the power of test D for three different concentrations. The detection limit was defined as three times (3×D) and the quantitation limit was defined as ten times (10×D) the power of the test.

<Bottom sediment>

Assuming a concentration in bottom sediment corresponding to the detection limit (3×D) obtained in the above-mentioned method as the estimated detection limit, a standard sample of the target substance was added to the common bottom sediment so that the concentration would be 2-5 times the estimated detection limit, and the hermetically sealed sample was stored overnight at 4°C. Next, all procedures for the analysis of the bottom sediment sample were conducted and it was confirmed that the target chemical substance would be properly detected. When the substance was detected, 5 additional recovery experiments were conducted at the same concentration and the detection limit of the common bottom sediment was calculated by the following equation based on the total 7 measured values.

Detection limit (DL)= $t\,(n-1, 0.01) \bullet Sc$

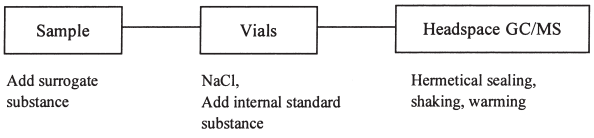
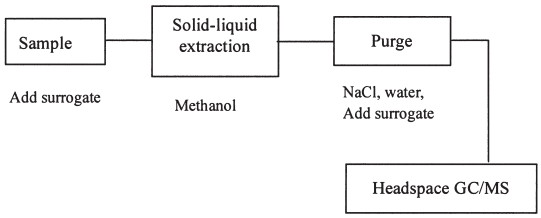
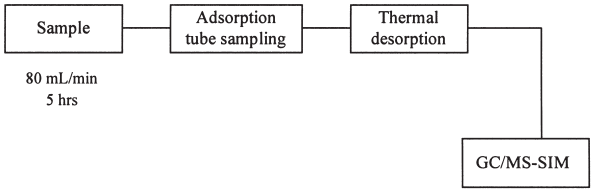
Sc : estimated value of the standard deviation

<River and sea water>

Ten times the detection limit amount of standard substances was added to the river water sample (from the Class B Water Area of Environmental Quality Standards) and the sea water sample (from the Class B of the Environmental Quality Standards, or, when not available, from the Class A Water Area or artificially prepared sea water) and they were analyzed immediately (more than twice). In addition, analysis was conducted on the river water and sea water without the addition of standard substances (more than twice for both samples). Recovery rate was calculated by subtracting the measured value (mean) of the sample water without the addition from the measured value (mean) with the addition.

In the practical survey, various studies such as extraction method, separation method and measurement conditions were conducted in parallel, in consideration of the existence of substances that interfere with the analysis.

Analytical Method for the FY2002 Initial Environmental Survey

Substance	Analytical Method / Flow Chart	Remarks
(1) Isoprene	**Surface water**  **Bottom sediment**  	GC/MS Column: Column length: 25 - 120 m Column I.D.: 0.2 - 0.75 mm Film thickness: 0.1 - 3.0 μm Detection limit: Surface water (μg/L) (1) 0.1 Bottom sediment (ng/g-dry) (1) 10
(2) Epichlorohydrin	**Air**  	GC/MS (SIM) Column: HP-VOC Column length: 60 m Column I.D.: 0.32 mm Film thickness: 1.0 μm Detection limit: Air (ng/m^3) (2) 0.14

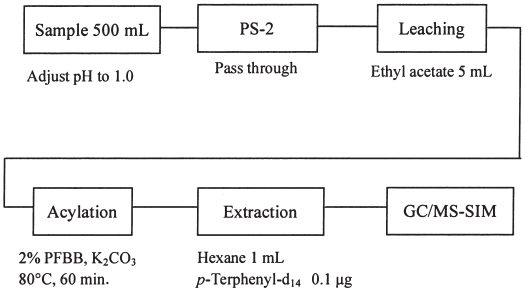
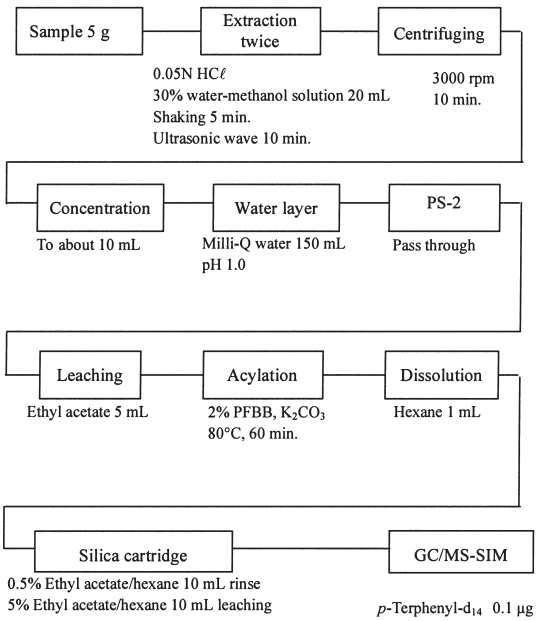
Analytical Method for the FY2002 Initial Environmental Survey (continued)

Substance	Analytical Method / Flow Chart	Remarks
(3) 1-Octanol	**Surface water** Sample 1,000 mL — Add surrogate Extraction — NaCℓ 50 g, Dicyclomethane 50 mL×2 Dehydration/Concentration/Evaporation to dryness — Anhydrous Na_2SO_4, KD Evaporator, Nitrogen stream Derivatization — DMF 0.2 mL, BSTFA 0.2 mL, Room temp.: 30 min Extraction — 5% NaOH 2 mL, *n*-Hexane 2 mL Dehydration/Concentration — Suck up the hexane layer with a Pasteur pipette and concentrate to 0.5 mL in nitrogen stream GC/MS-SIM **Bottom sediment** Sample 10 g — NaCℓ 15 g, Purified water 500 mL, Surrogate solution, Hexane 5 mL Extraction — Methanol 30 mL×2, Ultrasonic wave 10 min., Centrifugation, 3000 rpm 10 min. Redissolution — 5% NaCℓ 100 mL, Dicyclomethane 50 mL×2 Dehydration/Concentration/Evaporation to dryness Derivatization — DMF 0.2 mL, BSTFA 0.2 mL, Room temp.: 30 min Alkali decomposition — 5% NaOH 2 mL, 70°C 1 hr Extraction — *n*-Hexane 2 mL, Suck up the hexane layer with a Pasteur pipette Cleanup — Sep-Pak Florisil, *n*-Hexane 2 mL (discard), 4% ether/hexane 5 mL (collection) Concentration — Until 0.5 mL in nitrogen stream GC/MS-SIM **Wildlife** Sample 10 g — Add surrogate Extraction — Methanol 30 mL×2, Homogenizer, Centrifuging Redissolution — 5% NaCl 100 mL, Dichloromethane 50 mL×2 Dehydration/dry and harden — Anhydrous Na_2SO_4 Derivatization — DMF 0.2 mL, BSTFA 1 mL, Room temperature 30 min Alkali decomposition — 5% NaOH 8 mL, 70°C 1hr Extraction — Hexane 20 mL Dehydration / dry and harden — Na_2SO_4 Hexane dissolution — 1 mL Cleanup — Florisil 7 g (internal diameter 1 cm), 4% Ether/hexane 40 mL (collection) Concentration — 0.5 mL GC/MS-SIM	GC/MS (SIM) Column: Ultra-2 (HP) Column length: 25 m Column I.D.: 0.32 mm Film thickness: 0.52 μm Detection limit: Surface water (μg/L) (3) 0.002 Bottom sediment (ng/g-dry) (3) 0.24 Wildlife (ng/g-wet) (3) 0.77

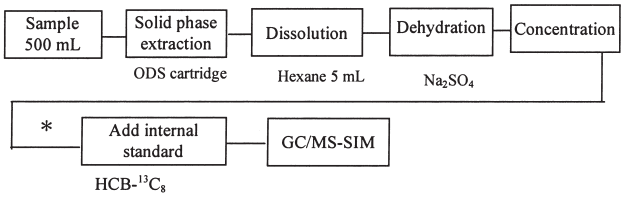
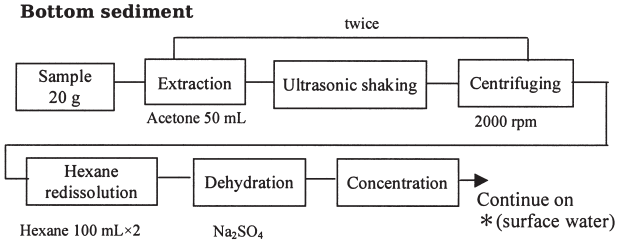
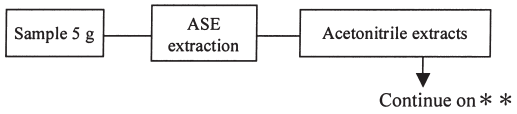
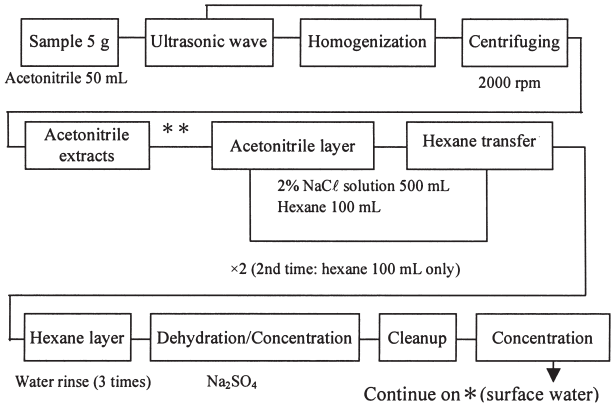
Analytical Method for the FY2002 Initial Environmental Survey (continued)

Substance	Analytical Method / Flow Chart	Remarks
(4) Chlorodifluoromethane	**Air** Canister (6 L) → Collection (3.0 mL/min× 24 hrs) → Pressurized dilution → Low-temperature concentration (Entech 7000) → GC/MS-SIM	GC/MS (SIM) Column: HP-VOC Column length: 60 m Column I.D.: 0.32 mm Film thickness: 1.8 μm Detection limit: Air (ng/m^3) (4) 6
(5) *p*-Chloronitrobenzene	**Wildlife** Sample 10 g (NaCℓ 15 g, Purified water 500 mL, Surrogate solution, Hexane 5 mL) → Extraction by continuous steam distillation (Essential oil measuring apparatus) → Dehydration (Anhydrous Na_2SO_4) → Concentration → Column cleanup (Florisil cartridge column) → Concentration 1 mL (Internal standard solution) → GC/MS-SIM	GC/MS (SIM) Column: DB-17 Column length: 30 m Column I.D.: 0.25 mm Film thickness: 0.5 μm Detection limit: Wildlife (ng/g-wet) (5) 7.8
(6) Dinitrotoluene	**Air** Sample (200 mL/min 24 hrs) → Adsorption tube sampling (Tenax TA (60 - 80 mesh) 200 mg) → Thermal desorption (ATD-400) → GC/MS-SIM	GC/MS (SIM) Column: HP Ultra-2 Column length: 25 m Column I.D.: 0.20 mm Film thickness: 0.33 μm Detection limit: Air (ng/m^3) (6) 2,4-Dinitrotoluene: 0.95 (6) 2,6-Dinitrotoluene: 0.89
(7) Methylbromide	**Surface water** Sample 10 - 100 mL (Add surrogate) → Vials (NaCℓ, Add internal standard) → Headspace GC/MS (Hermetical sealing, shaking, warming)	GC/MS (SIM) Column: Column length: 25 - 120 m Column I.D.: 0.2 - 0.75 mm Film thickness: 0.1 - 3.0 μm Detection limit: Surface water (μg/L) (7) 0.1

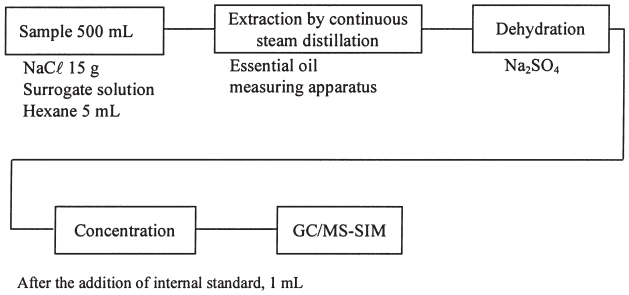
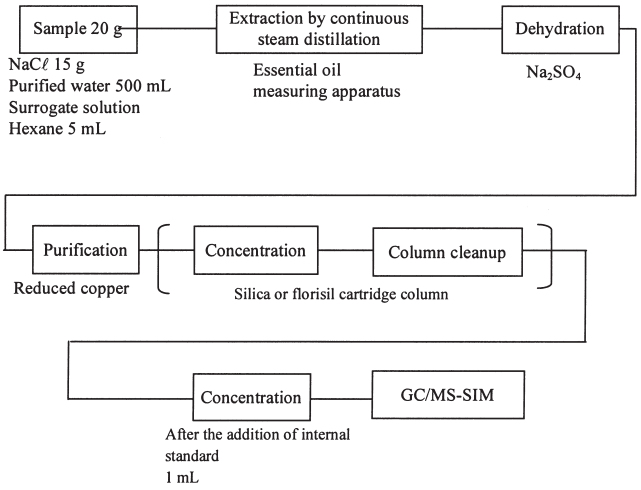
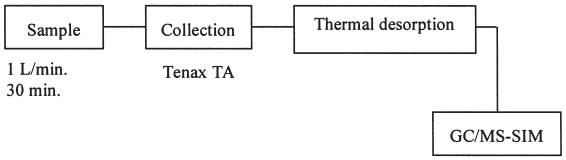
Analytical Method for the FY2002 Initial Environmental Survey (continued)

Substance	Analytical Method / Flow Chart	Remarks
(8) Terephthalic acid	**Surface water**  **Bottom sediment**  	GC/MS (SIM) Column: HP-5 Column length: 30 m Column I.D.: 0.25 mm Film thickness: 0.25 µm Detection limit: Surface water (µg/L) (8) 0.048 Bottom sediment (ng/g-dry) (8) 8.6

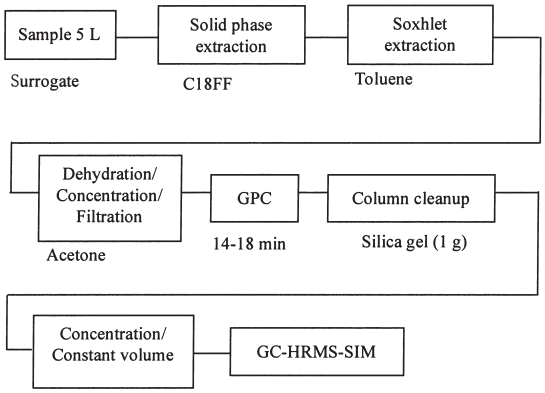
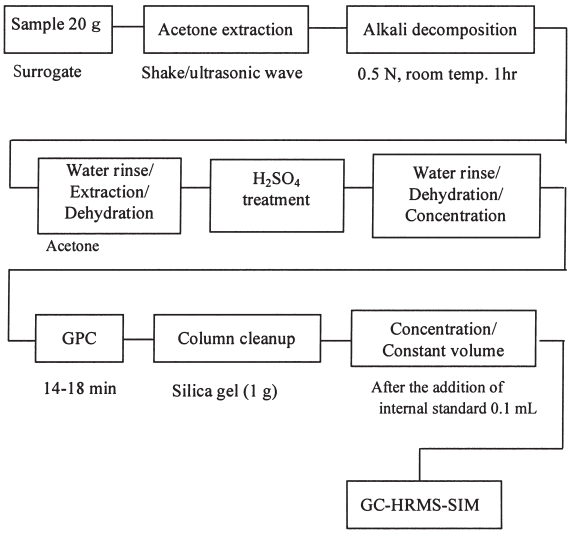
Analytical Method for the FY2002 Initial Environmental Survey (continued)

Substance	Analytical Method / Flow Chart	Remarks
(9) 2,4,6-Tri-*tert*-butylphenol	**Surface water**  **Bottom sediment**  **Wildlife** ・ASE extraction→Acetonitrile extraction  ・Solvent extraction→Acetonitrile extraction ×2  	GC/MS (SIM) Column: Agilent Ultra-2 Column length: 25 m Column I.D.: 0.2 mm Film thickness: 0.33 μm Detection limit: Surface water (μg/L) (9) 0.020 Bottom sediment (ng/g-dry) (9) 6.5 Wildlife (ng/g-wet) ASE extraction (9) 20 Solvent extraction (9) 21

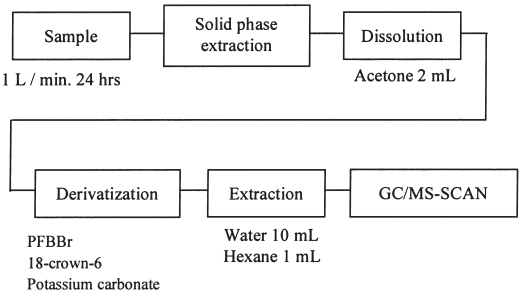
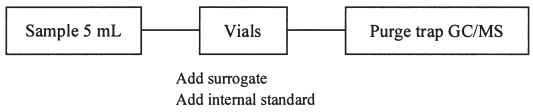
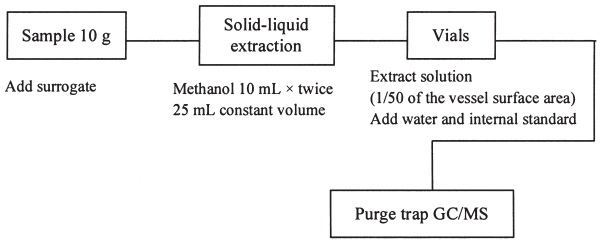
Analytical Method for the FY2002 Initial Environmental Survey (continued)

Substance	Analytical Method / Flow Chart	Remarks
(10) Nitrobenzene	**Surface water**  **Bottom sediment**  **Air**  	GC/MS (SIM) Column: DB-17 Column length: 30 m Column I.D.: 0.25 mm Film thickness: 0.5 μm Detection limit: Surface water (μg/L) (10) 0.037 Bottom sediment (ng/g-dry) (10) 1.4 GC/MS (SIM) Column: DB-17 Column length: 15 m Column I.D.: 0.53 mm Film thickness: 1.0 μm Detection limit: Air (ng/m^3) (10) 0.7

Analytical Method for the FY2002 Initial Environmental Survey (continued)

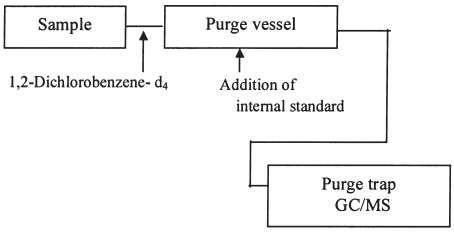
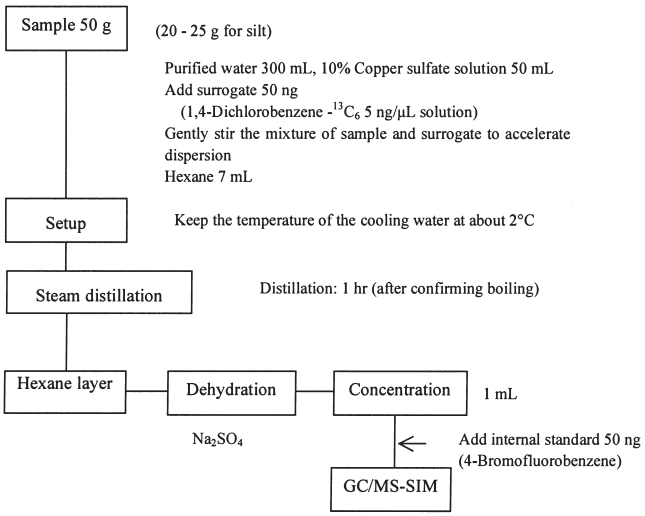
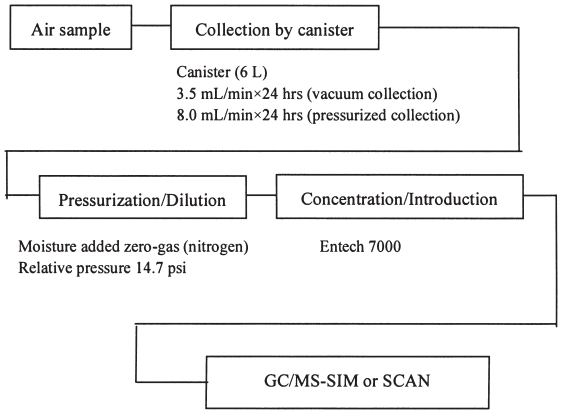
Substance	Analytical Method / Flow Chart	Remarks
(11) Polychlorinated terphenyls (PCT) (11-1) 4-Monochloro-o-terphenyl (11-2) 4-Monochloro-p-terphenyl (11-3) 2,5-Dichloro-o-terphenyl (11-4) 2,5-Dichloro-m-terphenyl (11-5) 2,4-Dichloro-*p*-terphenyl + 2,5-Dichloro-*p*-terphenyl (11-6) 2,4,6-Trichloro-*p*-terphenyl (11-7) 2,3,5,6-Tetrachloro -*p*-terphenyl (11-8) 2,4,4",6-Tetrachloro -*p*-terphenyl (11-9) 2,3,4,5,6-Pentachloro -*p*-terphenyl	**Surface water**  After the addition of internal standard 0.1 mL **Bottom sediment / Wildlife**  	GC-HRMS (SIM) Column: DB-5HT Column length: 15 m Column I.D.: 0.25 mm Film thickness: 0.1 μm Detection limit: Surface water (ng/L) (11-1) 0.023 (11-2) 0.013 (11-3) 0.021 (11-4) 0.016 (11-5) 0.023 (11-6) 0.022 (11-7) 0.024 (11-8) 0.026 (11-9) 0.024 Bottom sediment (ng/g-dry) (11-1) 0.029 (11-2) 0.019 (11-3) 0.019 (11-4) 0.019 (11-5) 0.021 (11-6) 0.0091 (11-7) 0.017 (11-8) 0.019 (11-9) 0.020 Wildlife (ng/g-wet) (11-1) 0.0078 (11-2) 0.026 (11-3) 0.016 (11-4) 0.016 (11-5) 0.016 (11-6) 0.0078 (11-7) 0.020 (11-8) 0.020 (11-9) 0.021

Analytical Method for the FY2002 Initial Environmental Survey (continued)

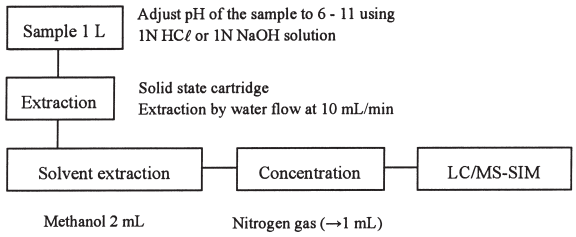
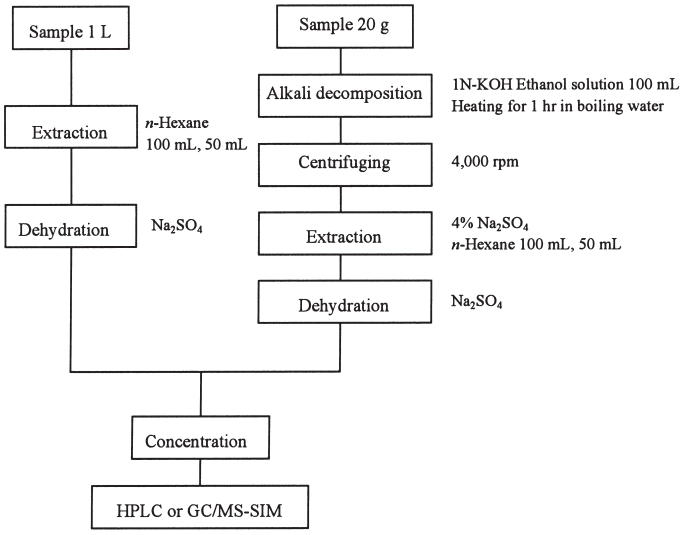
Substance	Analytical Method / Flow Chart	Remarks
(12) Metacrylic acid	**Air**  	GC/MS (SCAN) Column: HP-1MS Column length: 30 m Column I.D.: 0.25 mm Film thickness: 0.25 μm Detection limit: Air (ng/m^3) (12) 0.77
(13) Methyl-*tert*-butylether	**Surface water**  	GC/MS (SIM) Column: DB-VRX Column length: 60 m Column I.D.: 0.25 mm Film thickness: 1.4 μm Detection limit: Surface water (μg/L) (13) 0.006
	Bottom sediment  	Bottom sediment (ng/g-dry) (13) 0.70

2. Environmental Survey for Exposure Study

Analytical Method for the FY2002 Environmental Survey for Exposure Study

Substance	Analytical Method / Flow Chart	Remarks
(1) 1,2-Dichlorobenzene (*o*-Dichlorobenzene)	**Surface water**  **Bottom sediment**  **Air**  	GC/MS-SIM Column: HP-5973 BPX-5 Column length: 60 m Column I.D.: 0.25 mm Film thickness: 0.25 μm Detection limit Bottom sediment (ng/g-dry) (1) 0.02 GC/MS-SIM or SCAN Column: Hp-1 Column length: 60 m Column I.D.: 0.32 mm Film thickness: 1.0 μm Detection limit Air (ng/m^3) (1) 29

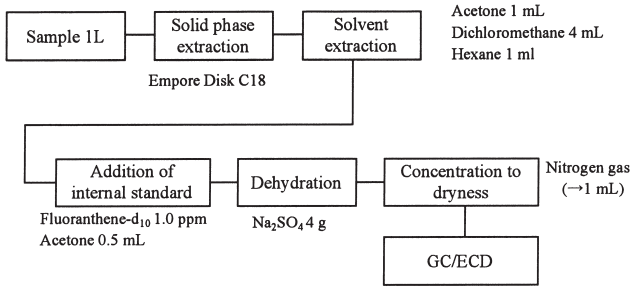
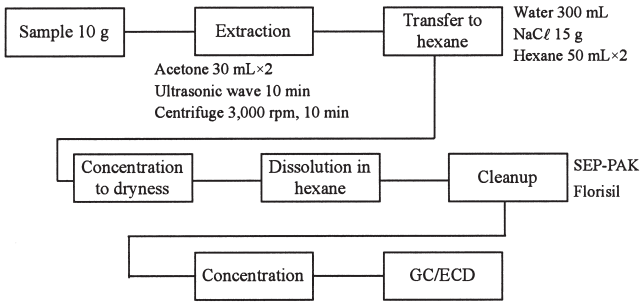
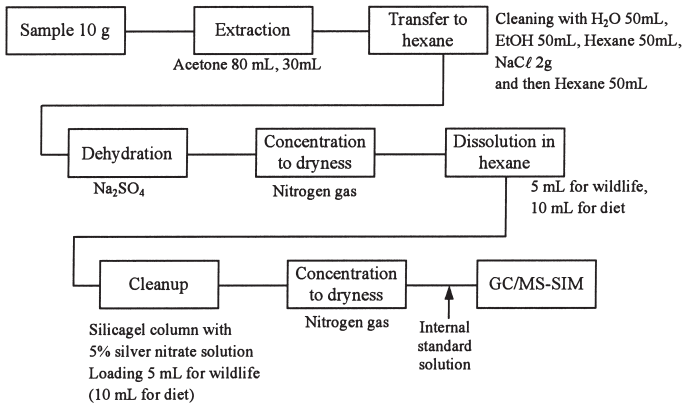
Analytical Method for the FY2002 Environmental Survey for Exposure Study (continued)

Substance	Analytical Method / Flow Chart	Remarks
(2) Perfluorooctane sulfonic acid (PFOS) (3) Perfluorooctanic acid (PFOA)	**Surface water**  	LC/MS-SIM Agilent 1100 Column: Zorbox XDBC-18 3.5 μm 2.1 mm x 150 mm Detection limit Surface water (ng/L) (2) 0.05
(4) Benzo[*a*]pyrene	**Surface water** **Bottom sediment / Wildlife**  	GC/MS-SIM Column: Ultra-2 Column length: 50 m Column I.D.: 0.31 mm Film thickness: 0.52 μm HPLC Column: Perkin Elmer PAH 2.6 mm x 250 mm Guard column: Nucleosil C18 4.6 mm×33 mm Detection limit Surface water (ng/L) (4) HPLC: 50 GC/MS: 60 Bottom sediment (ng/g-dry) / wildlife (ng/g-wet) (4) HPLC: 1 GC/MS: 3

Analytical Method for the FY2002 Environmental Survey for Exposure Study (continued)

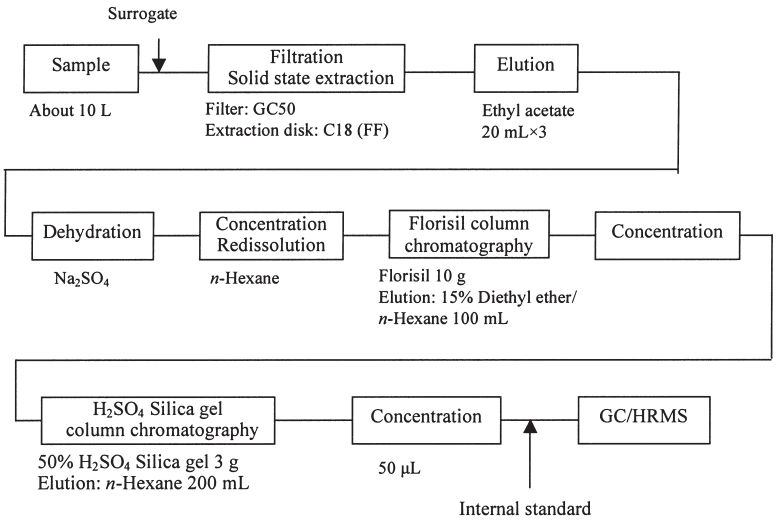
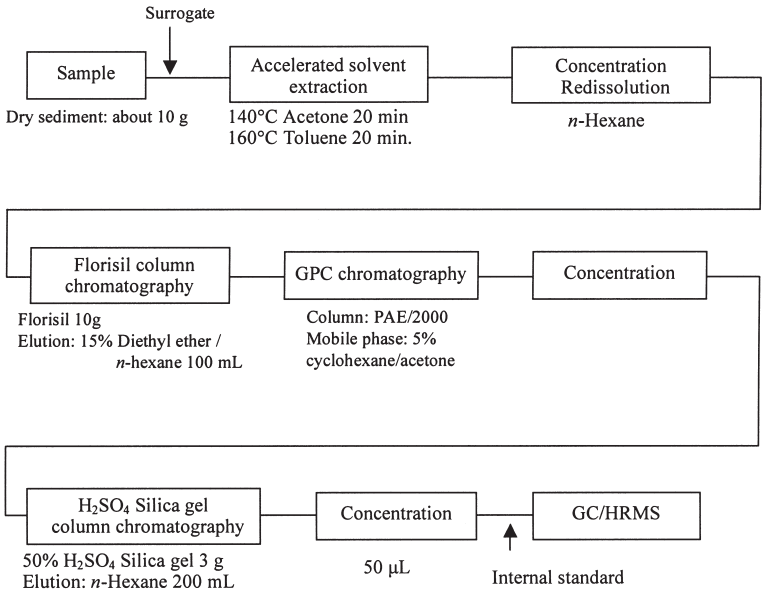
Substance	Analytical Method / Flow Chart	Remarks
(5) Polychlorinated naphthalene	**Wildlife / Diet** ([ ] for diet) Sample 20 g [10 g] → Extraction → Alkali decomposition Homogenization with Hexane, Na_2SO_4 Centrifuging 2,000 rpm, 5 min Extraction twice by hexane 1 mol/L KOH/Ethanol 25 mL 1 hr at room temperature H_2O treatment → Sulfuric acid treatment Dehydration / Concentration Na_2SO_4 Vacuum concentration 10 mL constant volume by acetone GPC CLNpak PAE-2000 Load 5 mL Aceton / cyclohexane (95:5) Column cleanup → Concentration → HRGC/MS-SIM Florisil cartridge column Nitrogen gas, 1mL Add internal standard solution **Air** Air sample High-volume air sampler 1,000 m^3 Particulate: Quartz microfiber filter (QMF) → Soxhlet extraction → Acetone, 24 hrs → Transfer to hexane → Sulfuric acid treatment → Column cleanup → GC/MS-SIM Vapor phase: Polyurethane foam (PUF) → Soxhlet extraction → Hexane, 24 hrs → Sulfuric acid treatment → Column cleanup → GC/MS-SIM	HRGC/MS-SIM Resolution: 10,000 Column: J&W DB-5MS Column length: 60 m Column I.D.: 0.32 mm Film thickness: 0.25 μm Detection limit Wildlife (pg/g-wet) (5) Monochloride: 1 Dichloride: 0.5 Trichloride: 0.5 Tetrachloride: 0.6 Pentachloride: 0.9 Hexachloride: 0.7 Heptachloride: 0.9 Octachloride: 0.8 Diet (pg/g-fresh weight) (5) Monochloride: 5 Dichloride: 1 Trichloride: 1 Tetrachloride: 1 Pentachloride: 1 Hexachloride: 1 Heptachloride: 1 Octachloride: 1 GC/MS-SIM JEOL JMS-700 Column: HP Ultra-2 Column length: 25 m Column I.D.: 0.20 mm Film thickness: 0.33 μm Detection limit Air (pg/m^3) (5) Monochloride: 0.01 Dichloride: 0.04 Trichloride: 0.04 Tetrachloride: 0.03 Pentachloride: 0.1 Hexachloride: 0.1 Heptachloride: 0.1 Octachloride: 0.2

FY2002 Environmental Survey for Exposure Study (continued)

Substance	Analytical Method / Flow Chart	Remarks
(6) Polybrominated diphenylether (6-1) Octabromodiphenyl ether (6-2) Decabromodiphenyl ether	**Surface water**  **Bottom sediment**  **Wildlife / Diet**  	GC/ECD Column: Hp-5890II DB1 Column length: 5 m Column I.D.: 0.32 mm Film thickness: 0.1 μm Detection limit Surface water (ng/L) (6-2) 120 Bottom sediment (ng/g-dry) (6-2) 9.7 Wildlife (ng/g-wet) (6-1) 0.20 Diet (ng/g-fresh weight) (6-2) 0.5

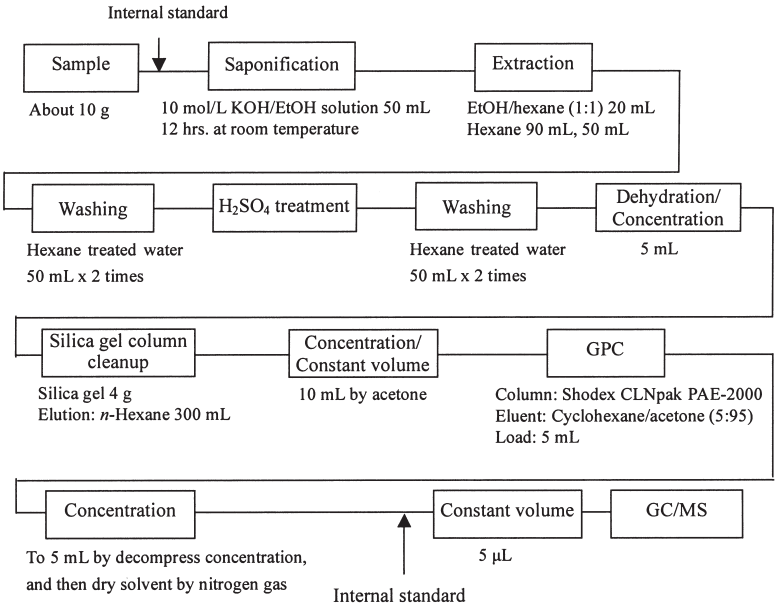
3. Monitoring Investigation

Analytical Method for the FY2002 Monitoring Investigation

Substance	Analytical Method / Flow Chart	Remarks
(1) PCBs	**Surface water**  **Bottom sediment**  	GC/MS Column: HT8-PCB Column length: 30 m Column I.D.: 0.25 mm Film thickness: 0.25 µm Detection/Quantitation limit Surface water (pg/L) (1) Detection limit / Quantitation limit Mono-chloride 0.06 / 0.12 Di-chloride 0.2 / 0.6 Tri-chloride 0.3 / 0.9 Tetra-chloride 0.3 / 0.9 Penta-chloride 0.2 / 0.6 Hexa-chloride 0.3 / 0.9 Hepta-chloride 0.2 / 0.6 Octa-chloride 0.3 / 0.9 Nona-chloride 0.3 / 0.9 Deca-chloride 0.3 / 0.9 Bottom sediment (pg/g-dry) (1) Detection limit / Quantitation limit Mono-chloride 0.06 / 0.12 Di-chloride 0.2 / 0.6 Tri-chloride 0.3 / 0.9 Tetra-chloride 0.3 / 0.9 Penta-chloride 0.2 / 0.6 Hexa-chloride 0.3 / 0.9 Hepta-chloride 0.2 / 0.6 Octa-chloride 0.3 / 0.9 Nona-chloride 0.3 / 0.9 Deca-chloride 0.3 / 0.9

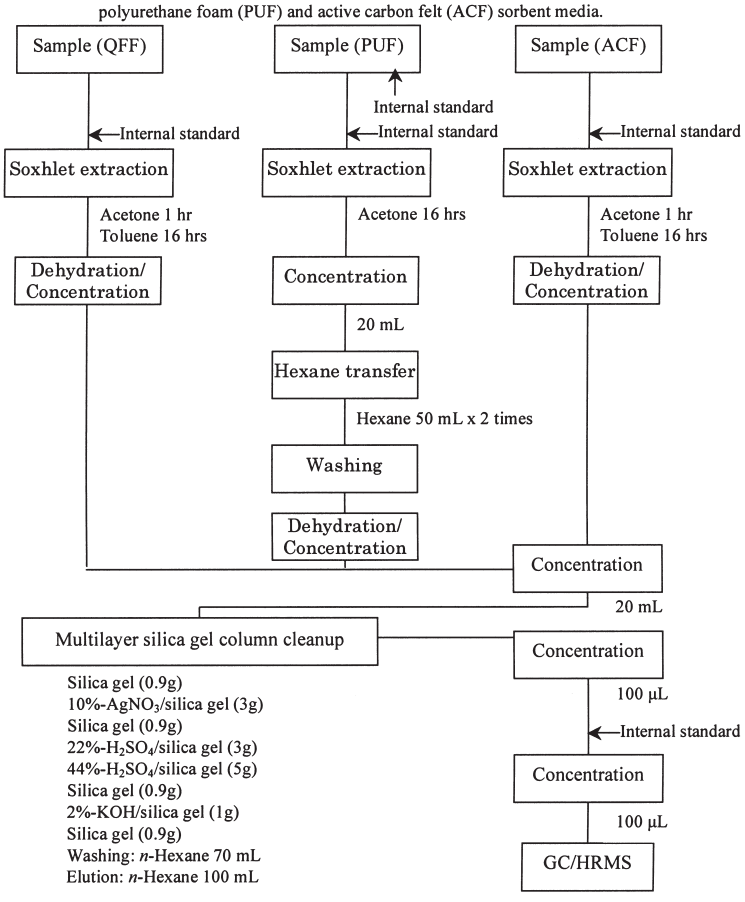
Analytical Method for the FY2002 Monitoring Investigation

Substance	Analytical Method / Flow Chart	Remarks
(1) PCBs (continued)	**Wildlife**	GC/MS Column: HT8-PCB Column length: 50 m Column I.D.: 0.25 mm Film thickness: 0.25 μm Detection/Quantitation limit Wildlife (pg/g-wet)



(1)	Detection limit	Quantitation limit
Mono-chloride	0.7	2.1
Di-chloride	0.9	2.7
Tri-chloride	0.8	2.4
Tetra-chloride	1.0	3.0
Penta-chloride	1.0	3.0
Hexa-chloride	1.0	3.0
Hepta-chloride	1.0	3.0
Octa-chloride	1.0	3.0
Nona-chloride	0.6	1.8
Deca-chloride	0.4	1.2

Air Sampled by high-volume air sampler (HV) with quartz-fiber-filter (QFF), polyurethane foam (PUF) and active carbon felt (ACF) sorbent media.

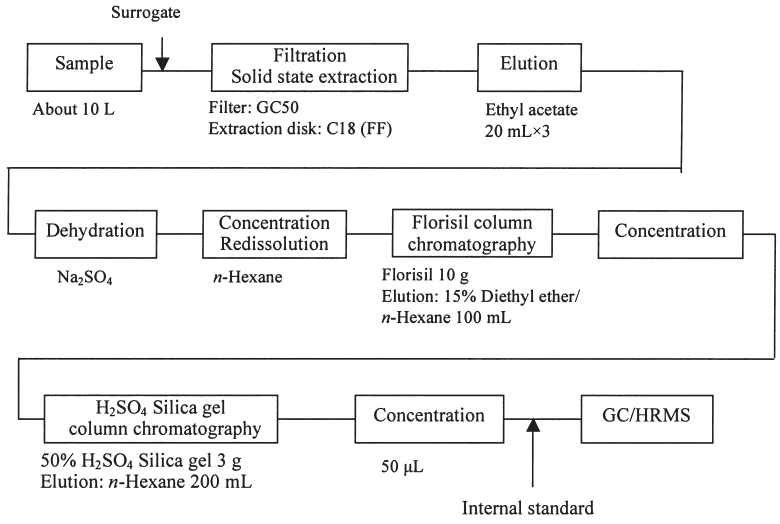
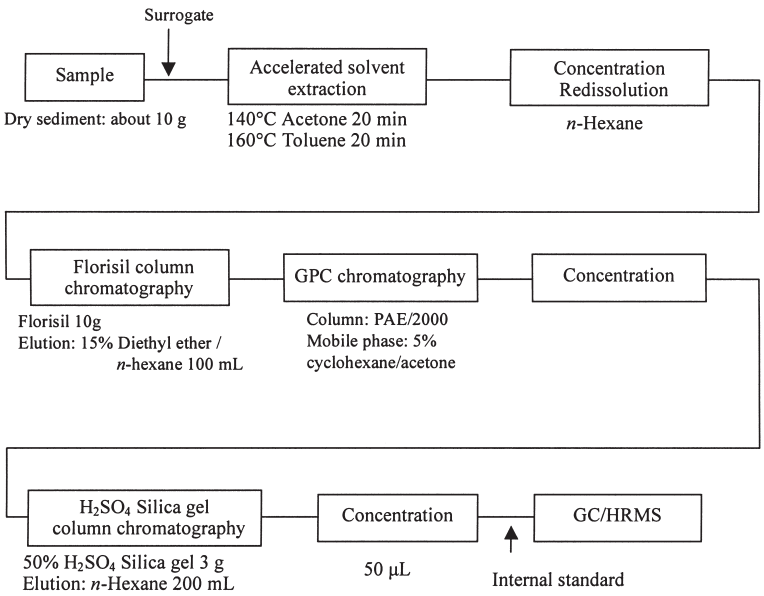


GC/HRMS
Resolution: 10,000
Column: DB-5MS
Column length: 60 m
Column I.D.: 0.32 mm
Film thickness: 0.25 μm

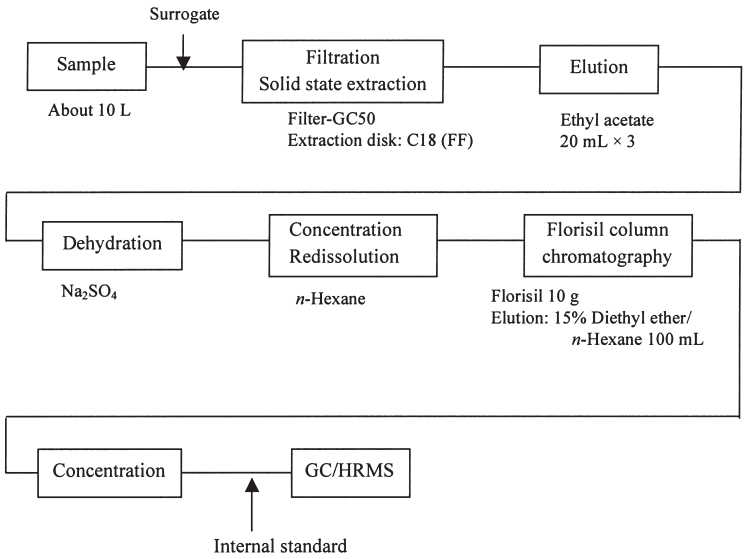
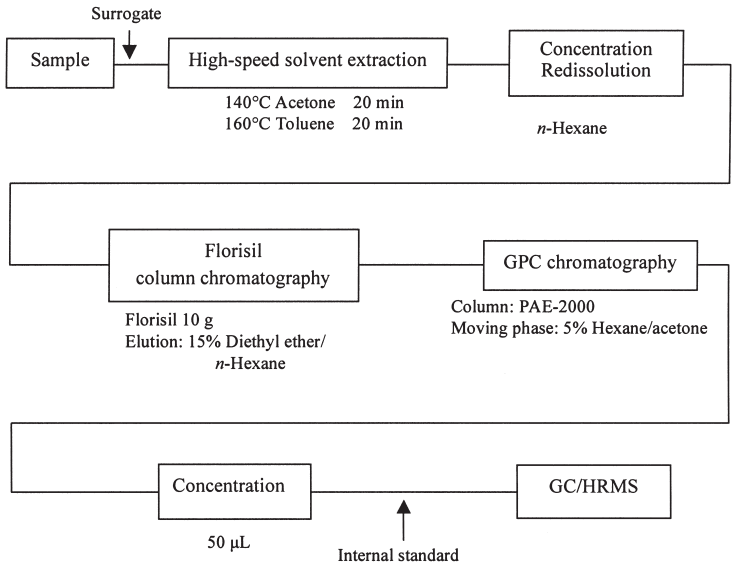
Detection/Quantitation limit
Air (pg/m^3)

(1)	Detection limit	Quantitation limit
Mono-chloride	30	90
Di-chloride	1.0	3.0
Tri-chloride	0.5	1.5
Tetra-chloride	0.9	2.7
Penta-chloride	0.4	1.2
Hexa-chloride	0.2	0.6
Hepta-chloride	0.007	0.021
Octa-chloride	0.01	0.03
Nona-chloride	0.01	0.03
Deca-chloride	0.005	0.015

Analytical Method for the FY2002 Monitoring Investigation

Substance	Analytical Method / Flow Chart	Remarks
(2) HCB (4) DDTs (4-1) *p,p'*-DDT (4-2) *p,p'*-DDE (4-3) *p,p'*-DDD (4-4) *o,p'*-DDT (4-5) *o,p'*-DDE (4-6) *o,p'*-DDD (5) Chlordanes (5-1) *trans*-Chlordane (5-2) *cis*-Chlordane (5-3) *trans*-Nonachlor (5-4) *cis*-Nonachlor (5-5) Oxychlordane (6) Heptachlor (7) HCH (7-1) α-HCH (7-2) β-HCH	**Surface water**  **Bottom sediment**  	GC/MS Column: HT8-PCB Column length: 30 m Column I.D.: 0.25 mm Film thickness: 0.25 µm Column: RH Column length: 30 m Column I.D.: 0.25 mm Film thickness: 250nm Detection/Quantitation limit Surface water (pg/L) (2) 0.2 / 0.6 (4-1) 0.2 / 0.6 (4-2) 0.2 / 0.6 (4-3) 0.08 / 0.24 (4-4) 0.4 / 1.2 (4-5) 0.3 / 0.9 (4-6) 0.2 / 0.6 (5-1) 0.5 / 1.5 (5-2) 0.3 / 0.9 (5-3) 0.4 / 1.2 (5-4) 0.6 / 1.8 (5-5) 0.4 / 1.2 (6) 0.5 / 1.5 (7-1) 0.3 / 0.9 (7-2) 0.3 / 0.9 Bottom sediment (pg/g-dry) (2) 0.3 / 0.9 (4-1) 2 / 6 (4-2) 0.9 / 2.7 (4-3) 0.8 / 2.4 (4-4) 2 / 6 (4-5) 1 / 3 (4-6) 2 / 6 (5-1) 0.6 / 1.8 (5-2) 0.3 / 0.9 (5-3) 0.5 / 1.5 (5-4) 0.7 / 2.1 (5-5) 0.5 / 1.5 (6) 0.6 / 1.8 (7-1) 0.4 / 1.2 (7-2) 0.3 / 0.9 (Detection limit / Quantitation limit)

Analytical Method for the FY2002 Monitoring Investigation

Substance	Analytical Method / Flow Chart	Remarks
(3) Drins (3-1) Aldrin (3-2) Dieldrin (3-3) Endrin	**Surface water**  **Bottom sediment**  	GC/MS Column: HT8-PCB Column length: 30 m Column I.D.: 0.25 mm Film thickness: 0.25 µm Column: RH17 Column length: 30 m Column I.D.: 0.25 mm Film thickness: 250 nm Detection/Quantitation limit Surface water (pg/L) (3-1) Detection limit 0.2, Quantitation limit 0.6 (3-2) Detection limit 0.6, Quantitation limit 1.8 (3-3) Detection limit 2, Quantitation limit 6 Bottom sediment (pg/g-dry) (3-1) Detection limit 2, Quantitation limit 6 (3-2) Detection limit 1, Quantitation limit 3 (3-3) Detection limit 2, Quantitation limit 6

Analytical Method for the FY2002 Monitoring Investigation

Substance	Analytical Method / Flow Chart	Remarks

Substance

(2) HCB

(3) Drins
- (3-1) Aldrin
- (3-2) Dieldrin
- (3-3) Endrin

(4) DDTs
- (4-1) *p,p'*-DDT
- (4-2) *p,p'*-DDE
- (4-3) *p,p'*-DDD
- (4-4) *o,p'*-DDT
- (4-5) *o,p'*-DDE
- (4-6) *o,p'*-DDD

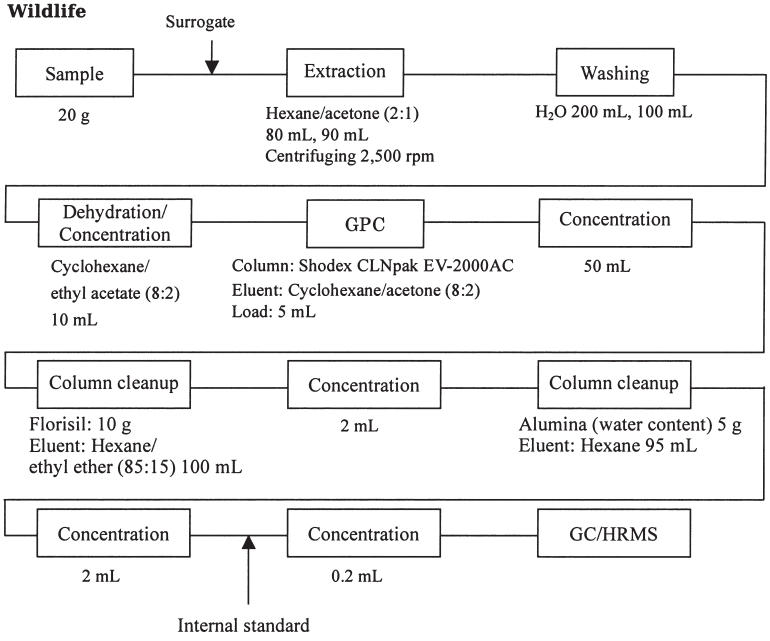
(5) Chlordanes
- (5-1) *trans*-Chlordane
- (5-2) *cis*-Chlordane
- (5-3) *trans*-Nonachlor
- (5-4) *cis*-Nonachlor
- (5-5) Oxychlordane

(6) Heptachlor

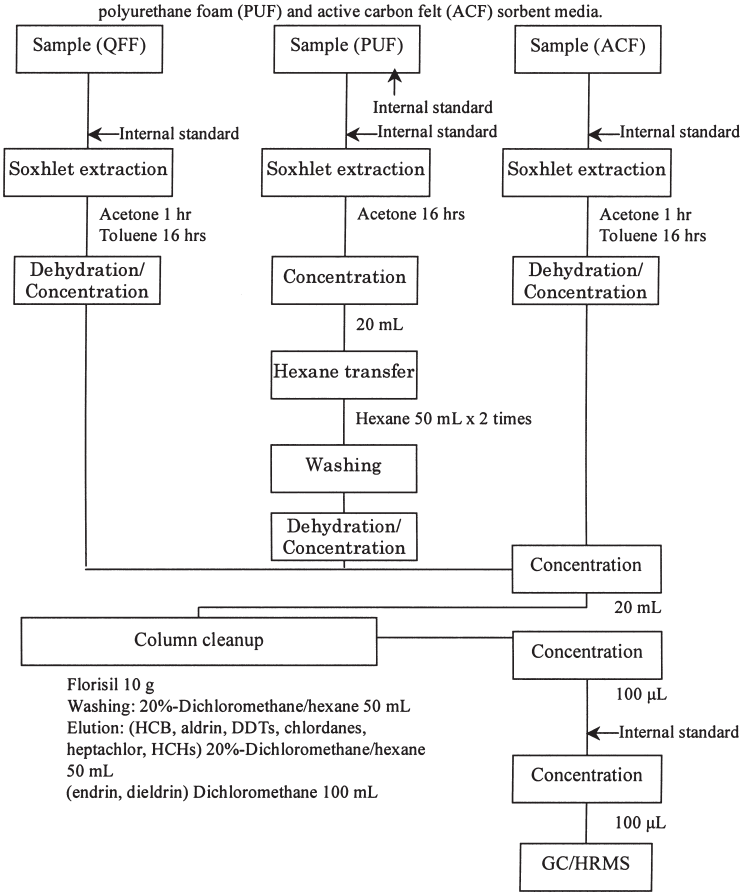
(7) HCH
- (7-1) *α*-HCH
- (7-2) *β*-HCH

Analytical Method / Flow Chart

Wildlife



Air Sampled by high-volume air sampler (HV) with quartz-fiber-filter (QFF), polyurethane foam (PUF) and active carbon felt (ACF) sorbent media.



Remarks

GC/MS
Column: DB-5MS
Column length: 60 m
Column I.D.: 0.25 mm
Film thickness: 0.25 μm

Detection/Quantitation limit
Wildlife (pg/g-wet)

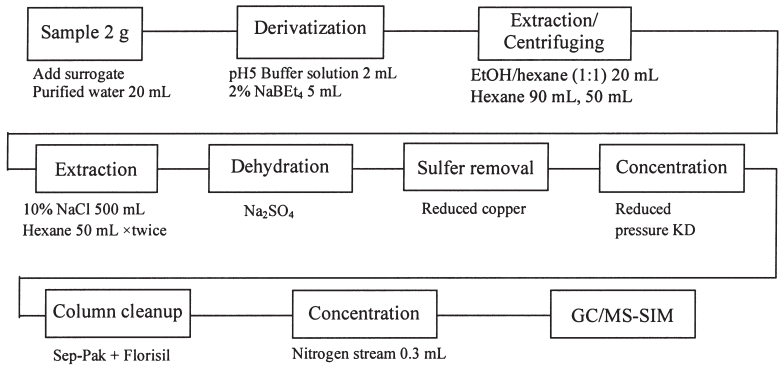
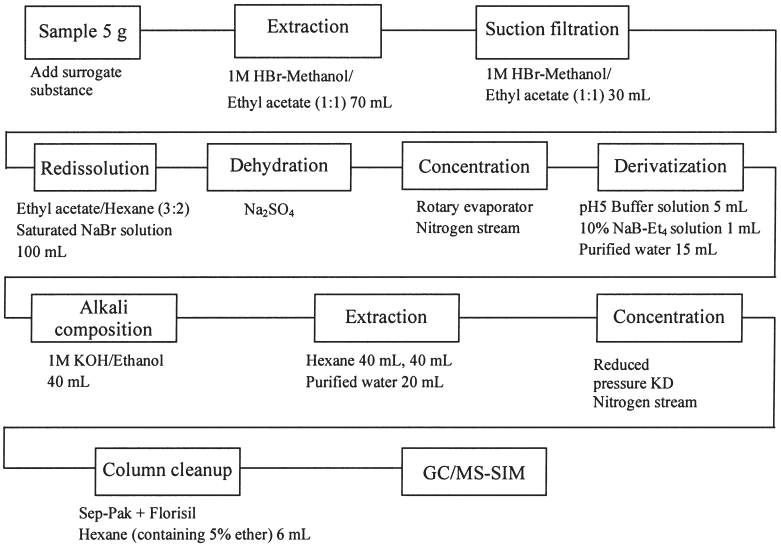
	Detection limit	Quantitation limit
(2)	0.2	0.6
(3-1)	1.4	4.2
(3-2)	4	12
(3-3)	6	18
(4-1)	0.2	0.6
(4-2)	0.2	0.6
(4-3)	0.08	0.24
(4-4)	0.4	1.2
(4-5)	0.3	0.9
(4-6)	0.2	0.6
(5-1)	0.5	1.5
(5-2)	0.3	0.9
(5-3)	0.4	1.2
(5-4)	0.6	1.8
(5-5)	0.4	1.2
(6)	0.5	1.5
(7-1)	0.3	0.9
(7-2)	0.3	0.9

GC/HRMS
Column: DB-17HT
Column length: 30 m
Column I.D.: 0.32 mm
Film thickness: 0.15μm

Detection/Quantitation limit
Air (pg/m^3)

	Detection limit	Quantitation limit
(2)	0.3	0.9
(3-1)	0.02	0.06
(3-2)	0.2	0.6
(3-3)	0.03	0.09
(4-1)	0.08	0.24
(4-2)	0.03	0.09
(4-3)	0.006	0.018
(4-4)	0.05	0.15
(4-5)	0.01	0.03
(4-6)	0.007	0.021
(5-1)	0.2	0.6
(5-2)	0.2	0.6
(5-3)	0.1	0.3
(5-4)	0.01	0.03
(5-5)	0.008	0.024
(6)	0.04	0.12
(7-1)	0.2	0.6
(7-2)	0.03	0.09

Analytical Method for the FY2002 Monitoring Investigation

Substance	Analytical Method / Flow Chart	Remarks
(8) Organotin compounds (8-1) TBT (8-2) TPT	**Bottom sediment**  **Wildlife**  	GC/MS (quadrupole type) Column: Capillary column Column length: 30 m Column I.D.: 0.25 mm Film thickness: 0.25 μm Detection/Quantitation limit Bottom sediment (ng/g-dry) (8-1) Detection limit 0.27, Quantitation limit 0.81 (8-2) Detection limit 0.11, Quantitation limit 0.33 Detection/Quantitation limit Wildlife (ng/g-wet) (8-1) Detection limit 1.3, Quantitation limit 3.9 (8-2) Detection limit 0.16, Quantitation limit 0.48