# Chapter 3 Results of the Environmental Monitoring in FY2020

## 1. Purpose of the monitoring

Environmental Monitoring provides annual surveys of the environmental persistence of target chemicals as listed in the Stockholm Convention, chemicals that while undesignated are still subject to review for potential risk, and/or highly persistent chemicals annotated as Specified Chemical Substances and Monitored Chemical Substances under the Law Concerning the Examination and Regulation of Manufacture, etc. of Chemical Substances (aka, the Chemical Substances Control Law), all target chemicals whose year to year changes in persistence in the environment must be understood.

*POPs: persistent organic pollutants

## 2. Target chemicals

In the FY2020 Environmental Monitoring, 11 chemicals (groups) were designated as target chemical.

4 of the target chemicals (groups) were Polychlorinated biphenyls (Total PCBs), Hexachlorobenzene[1]., Chlordanes[2]., and Heptachlors, which were listed as Persistent Organic Pollutants (POPs) initially in the Stockholm Convention in 2004[3]. 2 of them were Perfluorooctane sulfonic acid (PFOS)[4] and Pentachlorobenzene, which were adopted to be the POPs at fourth meeting of the Conference of the Parties (COP) held 2009. 1 of them was Hexachlorobuta-1,3-diene, which was adopted to be the POPs at seventh meeting of COP held 2015. 1 of them was Short-chain chlorinated paraffins[5], which was adopted to be the POPs at eighth meeting of COP held 2017. 2 were Dicofol and Perfluorooctanoic acid (PFOA)[6], which were adopted to be the POPs at ninth meeting of COP held 2019. Another was Perfluorohexane sulfonic acid (PFHxS), which was decided to recommend to the COP that it consider listing as POPs at fifteenth meeting of the persistent organic pollutants review committee (POPRC) held 2019.

The combinations of target chemicals and the monitoring media are given below.

(Note 1) *cis*-Chlordane and *trans*-Chlordane were adopted as target chemical of the Stockholm convention on Persistent Organic Pollutants. In the survey, Chlordanes including *cis*-Chlordane, *trans*-Chlordane Oxychlordane, *cis*-Nonachlor and *trans*-Nonachlor are target chemicals.

(Note 2) Heptachlor was adopted as target chemical of the Stockholm convention on Persistent Organic Pollutants. In the survey, Heptachlors including *cis*-Heptachlor epoxide and *trans*-Heptachlor epoxide are target chemicals.

(Note 3) Up to FY2009, the 11 target chemicals (groups) were monitored each fiscal year. 10 out of the 11 target chemicals (groups) were exceptions of Polychlorinated dibenzo-p-dioxin (PCDDs) and Polychlorinated dibenzofurans (PCDFs) from 12 chemicals (groups) listed as the POPs initially in the Stockholm Convention. Another was HCHs (Hexachlorohexanes). As of FY2010, chemicals (groups) adopted or considerd to be the POPs in the convention have been monitored too, and adjustments made to implementation frequency. In FY2020, 11 chemicals (groups) that have been designated as target chemicals (groups) in this Environmental Monitoring were not moniterd. They were Aldrin, Dieldrin, Endrin, DDTs[8], Toxaphenes[9], Mirex, HCHs (Hexachlorohexanes)[10], Chlordecone, Hexabromobiphenyls, Polybromodiphenyl ethers ($Br_4$~$Br_{10}$)[11], Endosulfans, 1,2,5,6,9,10-Hexabromocyclododecanes[12], Polychlorinated Naphthalenes[13], and Pentachlorophenol and its salts and esters[14]. Up to the latest results of the 14 chemicals (groups) have been included in this report for purpose of reference.

(Note 4) Perfluorooctane sulfonic acid (PFOS), its salts and Perfluorooctane sulfonyl fluoride were adopted as target chemicals at the COP4 of the Stockholm convention on Persistent Organic Pollutants. The survey of the

Perfluorooctane sulfonic acid (PFOS) only monitored linear octyl Perfluorooctane sulfonic acid (PFOS).

(Note 5) Chlorinated paraffins ($C_{10}$~$C_{13}$) was adopted as target chemicals at the COP8 of the Stockholm convention on Persistent Organic Pollutants. In the survey, Chlorinated paraffins with 5~9 chlorines are target chemicals in surface water, sediment and wildlife, and Chlorinated paraffins with 4~7 chlorines are target chemicals in air.

(Note 6) Perfluorooctanoic acid (PFOA), its salts and PFOA-related compounds were adopted as target chemicals at the COP9 of the Stockholm convention on Persistent Organic Pollutants. The survey of the Perfluorooctanoic acid (PFOA) only monitored linear octyl Perfluorooctanoic acid (PFOA).

(Note 7) Perfluorohexane sulfonic acid (PFHxS), its salts and PFHxS-related compounds were decided to recommend to the COP that it consider listing as POPs at POPRC15. The survey of the Perfluorohexane sulfonic acid (PFHxS) only monitored linear hexyl Perfluorohexane sulfonic acid (PFHxS).

(Note 8) *p,p'*-DDT and *o,p'*-DDT were adopted as target chemicals of the Stockholm convention on Persistent Organic Pollutants. In the survey, DDTs including environmental degraded products *p,p'*-DDT, *o,p'*-DDT, *p,p'*-DDD and *o,p'*-DDD were target chemicals.

(Note 9) Chlorobornane and Chlorocamphene of industrial blended material (about 16,000 congeners or isomer) were adopted as target chemicals of the Stockholm convention on Persistent Organic Pollutants. In the survey, 2-endo,3-exo,5-endo,6-exo,8,8,10,10-octachlorobornane (Parlar-26), 2-endo,3-exo,5-endo,6-exo,8,8,9,10,10-nonachlorobornane (Parlar-50) and 2,2,5,5,8,9,9,10,10-Nonachlorobornane (Parlar-62) are target chemicals.

(Note 10) In the COP4, *α*-HCH, *β*-HCH and *γ*-HCH (synonym: Lindane) were adopted to be POPs among HCHs, but in this Environmental Monitoring, HCHs which were able to include *δ*-HCH were designated as target chemicals.

(Note 11) Tetrabromodiphenyl ethers, Pentabromodiphenyl ethers, Hexabromodiphenyl ethers, and Heptabromodiphenyl ethers were adopted as target chemicals at the COP4 of the Stockholm convention on Persistent Organic Pollutants. Decabromodiphenyl ether was adopted as target chemicals at the COP8 of the Stockholm convention on Persistent Organic Pollutants.In the survey, Polybromodiphenyl ethers including those from 4 to 10 bromines are target chemicals.

(Note 12) *α*-1,2,5,6,9,10-Hexabromocyclododecane, *β*-1,2,5,6,9,10-Hexabromocyclododecane and *γ*-1,2,5,6,9,10-Hexabromocyclododecane were adopted as target chemicals at the COP6 of the Stockholm convention on Persistent Organic Pollutants. In the survey, 1,2,5,6,9,10-Hexabromocyclododecanes including *δ*-1,2,5,6,9,10-Hexabromocyclododecane and *ε*-1,2,5,6,9,10- Hexabromocyclododecane are target chemicals.

(Note 13) PCNs ($Cl_2$~$Cl_8$) was adopted as target chemicals at the COP7 of the Stockholm convention on Persistent Organic Pollutants. In the survey, PCNs including those with one (1) chlorine are target chemicals.

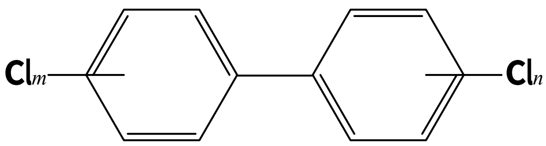
(Note 14) Pentachlorophenol and its salts and esters were adopted as target chemicals at the COP7 of the Stockholm convention on Persistent Organic Pollutants, the survey monitored Pentachlorophenol and Pentachloroanisole.

| No | Name | Monitored media | | | |
|---|---|---|---|---|---|
| | | Surface water | Sediment | Wildlife | Air |
| [1] | Total Polychlorinated biphenyls (Total PCBs)<br>Total PCBs represents the sum of the PCB congeners listed in the table below. “Total PCBs” only indicates the total amount in the following pages, and the measured values of the individual congeners and coplanar PCBs are listed on the website. | ○ | ○ | ○ | ○ |
| | [1-1] Monochlorobiphenyls | | | | |
| | [1-2] Dichlorobiphenyls | | | | |
| | [1-3] Trichlorobiphenyls | | | | |
| | [1-4] Tetrachlorobiphenyls | | | | |
| | [1-4-1] 3,3',4,4'-Tetrachlorobiphenyl (#77) | | | | |
| | [1-4-2] 3,4,4',5-Tetrachlorobiphenyl (#81) | | | | |
| | [1-5] Pentachlorobiphenyls | | | | |
| | [1-5-1] 2,3,3',4,4'-Pentachlorobiphenyl (#105) | | | | |
| | [1-5-2] 2,3,4,4',5-Pentachlorobiphenyl (#114) | | | | |
| | [1-5-3] 2,3',4,4'-5-Pentachlorobiphenyl (#118) | | | | |
| | [1-5-4] 2',3,4,4',5-Pentachlorobiphenyl (#123) | | | | |
| | [1-5-5] 3,3',4,4',5-Pentachlorobiphenyl (#126) | | | | |
| | [1-6] Hexachlorobiphenyls | | | | |
| | [1-6-1] 2,3,3',4,4',5-Hexachlorobiphenyl (#156) | | | | |
| | [1-6-2] 2,3,3',4,4',5'-Hexachlorobiphenyl (#157) | | | | |
| | [1-6-3] 2,3',4,4',5,5'-Hexachlorobiphenyl (#167) | | | | |
| | [1-6-4] 3,3',4,4',5,5'-Hexachlorobiphenyl (#169) | | | | |
| | [1-7] Heptachlorobiphenyls | | | | |
| | [1-7-1] 2,2',3,3',4,4',5-Heptachlorobiphenyl (#170) | | | | |
| | [1-7-2] 2,2',3,4,4',5,5'-Heptachlorobiphenyl (#180) | | | | |
| | [1-7-3] 2,3,3',4,4',5,5'-Heptachlorobiphenyl (#189) | | | | |
| | [1-8] Octachlorobiphenyls | | | | |
| | [1-9] Nonachlorobiphenyls | | | | |
| | [1-10] Decachlorobiphenyl | | | | |
| [2] | Hexachlorobenzene | ○ | ○ | ○ | ○ |
| [3] | Aldrin (reference) | | | | |
| [4] | Dieldrin (reference) | | | | |
| [5] | Endrin (reference) | | | | |
| [6] | DDTs (reference) | | | | |
| | [6-1] *p,p'*-DDT (reference) | | | | |
| | [6-2] *p,p'*-DDE (reference) | | | | |
| | [6-3] *p,p'*-DDD (reference) | | | | |
| | [6-4] *o,p'*-DDT (reference) | | | | |
| | [6-5] *o,p'*-DDE (reference) | | | | |
| | [6-6] *o,p'*-DDD (reference) | | | | |
| [7] | Chlordanes | ○ | ○ | ○ | ○ |
| | [7-1] *cis*-Chlordane | | | | |
| | [7-2] *trans*-Chlordane | | | | |
| | [7-3] Oxychlordane | | | | |
| | [7-4] *cis*-Nonachlor | | | | |
| | [7-5] *trans*-Nonachlor | | | | |
| [8] | Heptachlors | ○ | ○ | ○ | ○ |
| | [8-1] Heptachlor | | | | |
| | [8-2] *cis*-Heptachlor epoxide | | | | |
| | [8-3] *trans*-Heptachlor epoxide | | | | |
| [9] | Toxaphenes (reference) | | | | |
| | [9-1] 2-endo,3-exo,5-endo,6-exo,8,8,10,10-octachlorobornane (Parlar-26) (reference) | | | | |
| | [9-2] 2-endo,3-exo,5-endo,6-exo,8,8,9,10,10-nonachlorobornane (Parlar-50) (reference) | | | | |
| | [9-3] 2,2,5,5,8,9,9,10,10-Nonachlorobornane (Parlar-62) (reference) | | | | |
| [10] | Mirex (reference) | | | | |
| [11] | HCHs (Hexachlorohexanes) (reference) | | | | |
| | [11-1] *α*-HCH (reference) | | | | |
| | [11-2] *β*-HCH (reference) | | | | |
| | [11-3] *γ*-HCH (synonym: Lindane) (reference) | | | | |
| | [11-4] *δ*-HCH (reference) | | | | |
| [12] | Chlordecone (reference) | | | | |
| [13] | Hexabromobiphenyls (reference) | | | | |

| No | Name | Monitored media | | | |
|---|---|---|---|---|---|
| | | Surface water | Sediment | Wildlife | Air |
| [14] | Polybromodiphenyl ethers($Br_4$~$Br_{10}$) (reference)<br>[14-1] Tetrabromodiphenyl ethers (reference)<br>[14-1-1] 2,2’,4,4’-Tetrabromodiphenyl ether (#47) (reference)<br>[14-2] Pentabromodiphenyl ethers (reference)<br>[14-2-1] 2,2’,4,4’,5-Pentabromodiphenyl ether (#99) (reference)<br>[14-3] Hexabromodiphenyl ethers (reference)<br>[14-3-1] 2,2’,4,4’,5,5’-Pentabromodiphenyl ether (#153) (reference)<br>[14-3-2] 2,2’,4,4’,5,6’-Pentabromodiphenyl ether (#154) (reference)<br>[14-4] Heptabromodiphenyl ethers (reference)<br>[14-4-1] 2,2’,3,3’,4,5’,6’-Pentabromodiphenyl ether (#175) (reference)<br>[14-4-2] 2,2’,3,4,4’,5’,6’-Pentabromodiphenyl ether (#183) (reference)<br>[14-5] Octabromodiphenyl ethers (reference)<br>[14-6] Nonabromodiphenyl ethers (reference)<br>[14-7] Decabromodiphenyl ether (reference) | | | | |
| [15] | Perfluorooctane sulfonic acid (PFOS) | ○ | ○ | ○ | ○ |
| [16] | Perfluorooctanoic acid (PFOA) | ○ | ○ | ○ | ○ |
| [17] | Pentachlorobenzene | ○ | ○ | ○ | ○ |
| [18] | Endosulfans (reference)<br>[18-1] *α*-Endosulfan (reference)<br>[18-2] *β*- Endosulfan (reference) | | | | |
| [19] | 1,2,5,6,9,10-Hexabromocyclododecanes (reference)<br>[19-1] *α*-1,2,5,6,9,10-Hexabromocyclododecane (reference)<br>[19-2] *β*-1,2,5,6,9,10-Hexabromocyclododecane (reference)<br>[19-3] *γ*-1,2,5,6,9,10-Hexabromocyclododecane (reference)<br>[19-4] *δ*-1,2,5,6,9,10-Hexabromocyclododecane (reference)<br>[19-5] *ε*-1,2,5,6,9,10-Hexabromocyclododecane (reference) | | | | |
| [20] | Total Polychlorinated naphthalenes (reference)<br>Total Polychlorinated naphthalenes represents the sum of the Polychlorinated naphthalenes congeners. The measured values of the individual congeners are listed on the website. | | | | |
| [21] | Hexachlorobuta-1,3-diene | ○ | ○ | ○ | ○ |
| [22] | Pentachlorophenol and its salts and esters (reference)<br>[22-1] Pentachlorophenol (reference)<br>[22-2] Pentachloroanisole (reference) | | | | |
| [23] | Short-chain chlorinated paraffins<br>[23-1] Chlorinated decanes<br>[23-2] Chlorinated undecanes<br>[23-3] Chlorinated dodecanes<br>[23-4] Chlorinated tridecanes | ○ | ○ | ○ | ○ |
| [24] | Dicofol | ○ | ○ | ○ | ○ |
| [25] | Perfluorohexane sulfonic acid (PFHxS) | ○ | ○ | ○ | ○ |

Chemical and physical properties of target chemicals of the Environmental Monitoring are as follows.

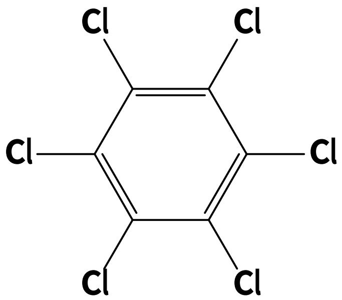
**[1] Total Polychlorinated biphenyls (Total PCBs)**



i = m+n =1~10

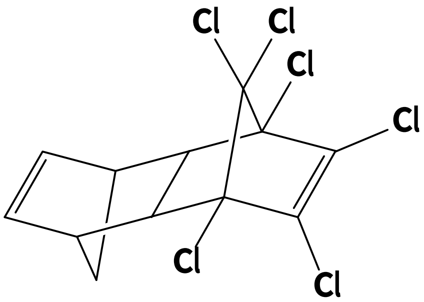
- Molecular formula: $C_{12}H_{(10-i)}Cl_i$ (i = m+n =1~10)
- CAS: 27323-18-8 ($Cl_1$), 22512-42-9 ($Cl_2$), 25323-68-6 ($Cl_3$), 26914-33-0 ($Cl_4$), 25429-29-2 ($Cl_5$), 26601-64-9 ($Cl_6$), 28655-71-2 ($Cl_7$), 31472-83-0 ($Cl_8$), 53742-07-7 ($Cl_9$), 5051-24-3 ($Cl_{10}$)
- ENCS: No pertinence
- MW: 188.65~498.66
- mp: Not specified
- bp: Not specified
- SW: Not specified
- Specific gravity: Not specified
- logPow: Not specified

**[2] HCB (Hexachlorobenzene)**



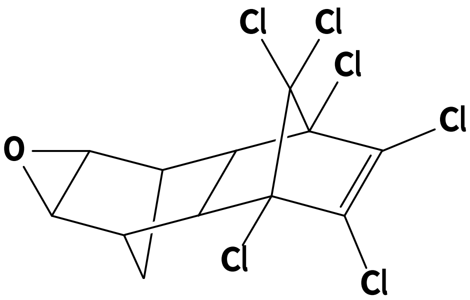
- Molecular formula: $C_6Cl_6$
- CAS: 118-74-1
- ENCS: 3-0076
- MW: 284.78
- mp: 231.8°C [1)]
- bp: 323~326°C [1)]
- SW: 0.0000096g/kg (25°C) [2)]
- Specific gravity: 2.044 (23°C) [1)]
- logPow: 5.73 [3)]

**[3] Aldrin (reference)**



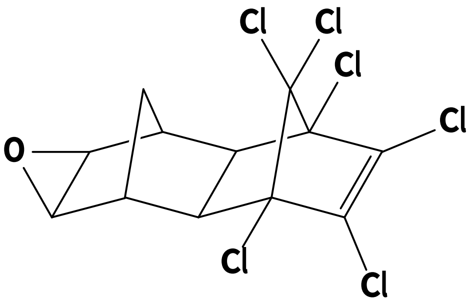
- Molecular formula: $C_{12}H_8Cl_6$
- CAS: 309-00-2
- ENCS: 4-0303
- MW: 364.91
- mp: 104°C[1)]
- bp: 145°C (0.27kPa) [4)]
- SW: 0.0002g/kg (25°C) [2)]
- Specific gravity: 1.6g/cm$^3$ [5)]
- logPow: 6.50 [3)]

**[4] Dieldrin (reference)**



- Molecular formula: $C_{12}H_8Cl_6O$
- CAS: 60-57-1
- ENCS: 4-0299
- MW: 380.91
- mp: 176~177°C [1)]
- bp: 330°C [5)]
- SW: 0.00020g/kg (25°C) [2)]
- Specific gravity: 1.75 (25°C) [2)]
- logPow: 5.40 [3)]

**[5] Endrin (reference)**

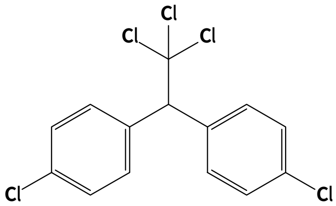


- Molecular formula: $C_{12}H_8Cl_6O$
- CAS: 72-20-8
- ENCS: 4-0299
- MW: 380.91
- mp: 200°C[6)]
- bp: 245°C (Decomposition) [6)]
- SW: 0.00025g/kg [2)]
- Specific gravity: 1.7g/cm$^3$ [6)]
- logPow: 5.20 [3)]

(Abbreviations) CAS: CAS registry number, ENCS: registry number in the Existing and New Chemical Substances List, MW: molecular weight, mp: melting point, bp: boiling point, SW: solubility in water, logPow: *n*-octanol-water partition coefficient, kPa: kilopascal (1 atom approximately equal to 101.3kPa).

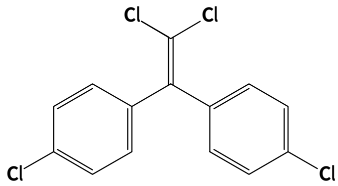
## [6] DDTs (reference)

### [6-1] *p,p′*-DDT (reference)



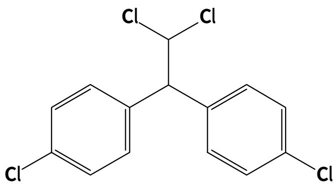
Molecular formula: $C_{14}H_9Cl_5$
CAS: 50-29-3
ENCS: 4-0910
MW: 354.49
mp: 108.5°C [2)]
bp: 260°C [2)]
SW: Insoluble [1)]
Specific gravity: 1.6g/cm$^3$ [7)]
logPow: 6.91 [3)]

### [6-2] *p,p′*-DDE (reference)



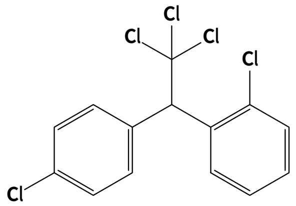
Molecular formula: $C_{14}H_8Cl_4$
CAS: 72-55-9
ENCS: No pertinence
MW: 318.03
mp: 89°C [2)]
bp: 336°C [5)]
SW: 0.12mg/L (25°C) [5)]
Specific gravity: Uncertain
logPow: 6.51 [3)]

### [6-3] *p,p′*-DDD (reference)



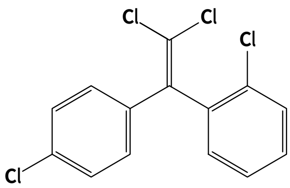
Molecular formula: $C_{14}H_{10}Cl_4$
CAS: 72-54-8
ENCS: No pertinence
MW: 320.04
mp: 109~110°C [1)]
bp: 193°C (1mmHg) [2)]
SW: 0.09mg/L (25°C) [5)]
Specific gravity: Uncertain
logPow: 6.02 [3)]

### [6-4] *o,p′*-DDT (reference)



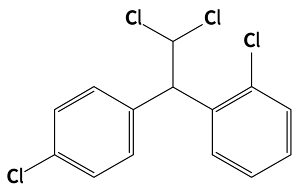
Molecular formula: $C_{14}H_9Cl_5$
CAS: 789-02-6
ENCS: No pertinence
MW: 354.49
mp: Uncertain
bp: Uncertain
SW: Uncertain
Specific gravity: Uncertain
logPow: Uncertain

### [6-5] *o,p′*-DDE (reference)



Molecular formula: $C_{14}H_8Cl_4$
CAS: 3424-82-6
ENCS: No pertinence
MW: 318.03
mp: Uncertain
bp: Uncertain
SW: Uncertain
Specific gravity: Uncertain
logPow: Uncertain

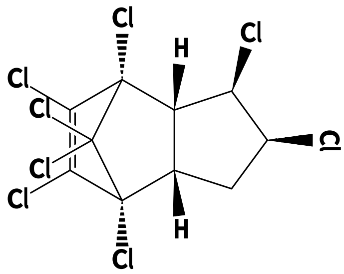
### [6-6] *o,p′*-DDD (reference)



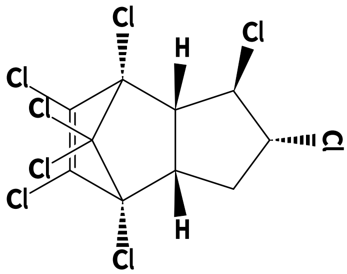
Molecular formula: $C_{14}H_{10}Cl_4$
CAS: 53-19-0
ENCS: No pertinence
MW: 320.04
mp: 76~78°C [1)]
bp: Uncertain
SW: Uncertain
Specific gravity: Uncertain
logPow: Uncertain

## [7] Chlordanes

[7-1] *cis*-Chlordane



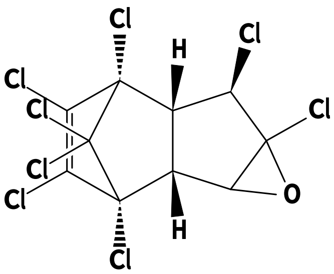
[7-2] *trans*-Chlordane



The following data are for both [7-1] and [7-2].

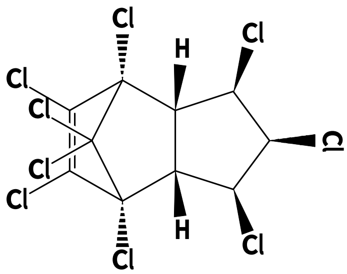
| | |
|---|---|
| Molecular formula: | $C_{10}H_6Cl_8$ |
| CAS: | 5103-71-9 (*cis*), 5103-74-2 (*trans*) |
| ENCS: | 4-637 |
| MW: | 409.78 |
| mp: | 106°C [1] |
| bp: | 175°C (1mmHg) [1] |
| SW: | 0.0006g/kg (25°C) [1] |
| Specific gravity: | 1.59~1.63 (25°C) [2] |
| logPow: | 6.16 [3] |

[7-3] Oxychlordane



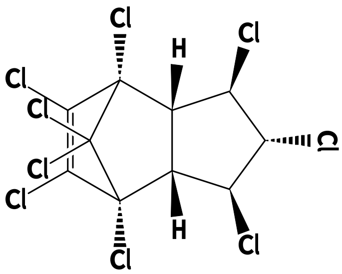
| | |
|---|---|
| Molecular formula: | $C_{10}H_4Cl_8O$ |
| CAS: | 26880-48-8 |
| ENCS: | No pertinence |
| MW: | 423.76 |
| mp: | 100°C [1] |
| bp: | Uncertain |
| SW: | Uncertain |
| Specific gravity: | Uncertain |
| logPow: | 4.76 [3] |

[7-4] *cis*-Nonachlor



| | |
|---|---|
| Molecular formula: | $C_{10}H_5Cl_9$ |
| CAS: | 5103-73-1 |
| ENCS: | No pertinence |
| MW: | 444.22 |
| mp: | Uncertain |
| bp: | Uncertain |
| SW: | Uncertain |
| Specific gravity: | Uncertain |
| logPow: | 5.21 [3] |

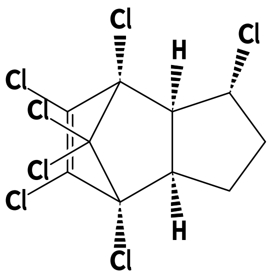
[7-5] *trans*-Nonachlor



| | |
|---|---|
| Molecular formula: | $C_{10}H_5Cl_9$ |
| CAS: | 39765-80-5 |
| ENCS: | No pertinence |
| MW: | 444.22 |
| mp: | Uncertain |
| bp: | Uncertain |
| SW: | Uncertain |
| Specific gravity: | Uncertain |
| logPow: | 5.08 [3] |

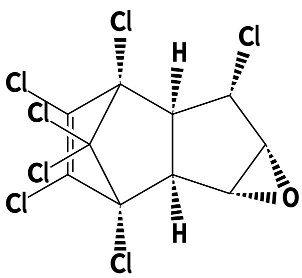
## [8] Heptachlors

[8-1] Heptachlor

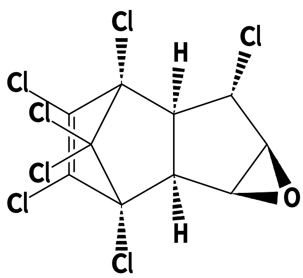


| | |
|---|---|
| Molecular formula: | $C_{10}H_5Cl_7$ |
| CAS: | 76-44-8 |
| ENCS: | 4-637, 9-1646 |
| MW: | 373.32 |
| mp: | 95~96°C [2] |
| bp: | Uncertain |
| SW: | 0.00018g/kg (25°C) [1] |
| Specific gravity: | 1.57 (9°C) [1] |
| logPow: | 6.10 [3] |

[8-2] *cis*-Heptachlor epoxide



[8-3] *trans*-Heptachlor epoxide

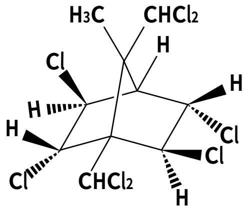


The following data are for both [8-2] and [8-3].

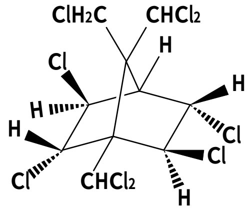
| | |
|---|---|
| Molecular formula: | $C_{10}H_5Cl_7O$ |
| CAS: | 1024-57-3 |
| ENCS: | No pertinence |
| MW: | 389.32 |
| mp: | 160°C [1] |
| bp: | Uncertain |
| SW: | Uncertain |
| Specific gravity: | Uncertain |
| logPow: | 5.40 [3] |

[9] Toxaphenes (reference)

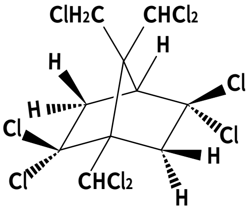
[9-1] 2-Endo,3-exo,5-endo,6-exo,8,8,10,10-octachlorobornane (Parlar-26) (reference)



[9-2] 2-Endo,3-exo,5-endo,6-exo,8,8,9,10,10-nonachlorobornane (Parlar-50) (reference)

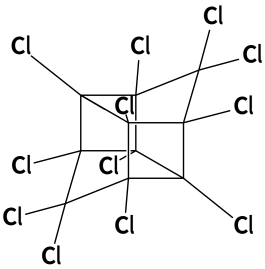


[9-3] 2,2,5,5,8,9,9,10,10-nonachlorobornane (Parlar-62) (reference)



Molecular formula: $C_{10}H_{10}Cl_8$([9-1]), $C_{10}H_9Cl_9$([9-2], [9-3])
CAS: 8001-35-2
ENCS: No pertinence
MW: 413.81 ($Cl_8$), 448.26 ($Cl_9$)
mp: 65~90°C [2)]
bp: Uncertain
SW: 3mg/L [2)]
Specific gravity: 1.630 (25°C) [2)]
logPow: 6.44 [2)]

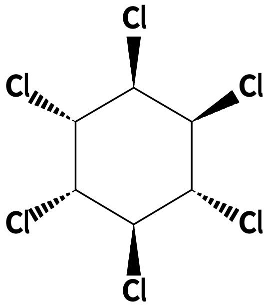
[10] Mirex (reference)



Molecular formula: $C_{10}Cl_{12}$
CAS: 2385-85-5
ENCS: No pertinence
MW: 545.54
mp: 485°C (Decomposition) [2)]
bp: Uncertain
SW: 0.000085g/kg (25°C) [1)]
Specific gravity: Uncertain
logPow: 5.28 [3)]

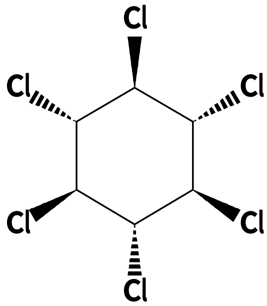
[11] HCHs(Hexachlorohexanes) (reference)

[11-1] *α*-HCH (reference)



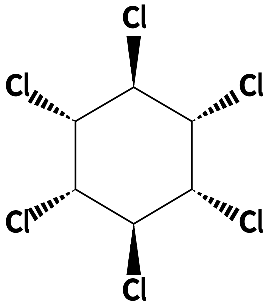
Molecular formula: $C_6H_6Cl_6$
CAS: 319-84-6
ENCS: 3-2250, 9-1652
MW: 290.83
mp: 158°C [1)]
bp: 288°C [9)]
SW: 0.00018g/kg (25°C) [2)]
Specific gravity: 1.87 (20°C) [10)]
logPow: 3.80 [3)]

[11-2] *β*-HCH (reference)



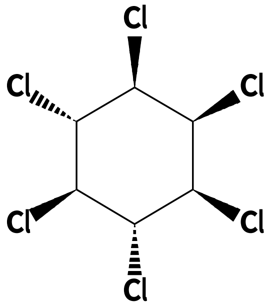
Molecular formula: $C_6H_6Cl_6$
CAS: 319-85-7
ENCS: 3-2250, 9-1652
MW: 290.83
mp: 309°C[11)]
bp: 60°C (0.50mmHg) [1)]
SW: 0.0002g/kg (25°C) [2)]
Specific gravity: 1.87 (20°C) [10)]
logPow: 3.78 [1)]

[11-3] *γ*-HCH (synonym:Lindane) (reference)



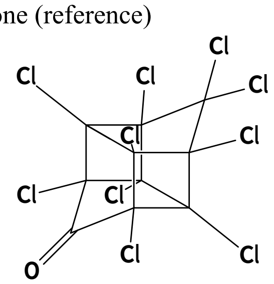
Molecular formula: $C_6H_6Cl_6$
CAS: 58-89-9
ENCS: 3-2250, 9-1652
MW: 290.83
mp: 112.5°C [1)]
bp: 323.4°C [1)]
SW: 0.0078g/kg (25°C) [1)]
Specific gravity: 1.85 (20°C) [10)]
logPow: 3.72 [3)]

[11-4] *δ*-HCH (reference)



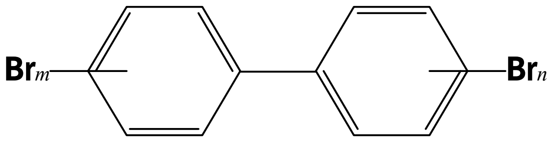
Molecular formula: $C_6H_6Cl_6$
CAS: 319-86-8
ENCS: 3-2250, 9-1652
MW: 290.83
mp: 141.5°C [1)]
bp: 60°C (0.36mmHg) [1)]
SW: Uncertain
Specific gravity: 1.87 (20°C) [10)]
logPow: 4.14 [3)]

[12] Chlordecone (reference)



Molecular formula: $C_{10}Cl_{10}O$
CAS: 143-50-0
ENCS: No pertinence
MW: 490.64
mp: 350°C[2)]
bp: Not specified
sw: 7.6mg/L (24°C) [5)]
Specific gravity: 1.61 (25°C) [1)]
logPow: 3.45 [12)]

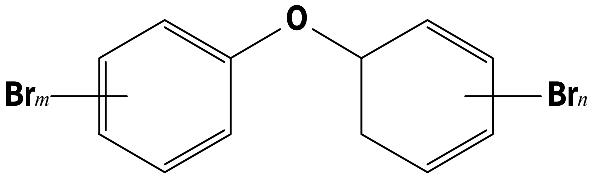
### [13] Hexabromobiphenyls (reference)



m+n =6

Molecular formula: $C_{12}H_4Br_6$
CAS: 36355-01-8
ENCS: No pertinence
MW: 627.58
mp: Not specified
bp: Not specified
sw: Not specified
Specific gravity: Not specified
logPow: Not specified

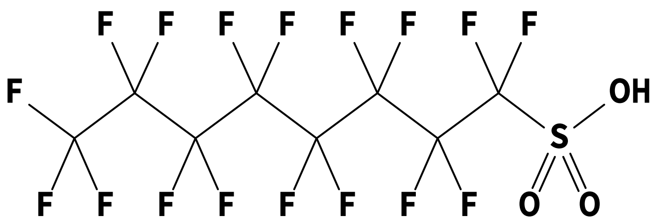
### [14] Polybromodiphenyl ethers ($Br_4$~$Br_{10}$) (reference)



i = m+n =4~10

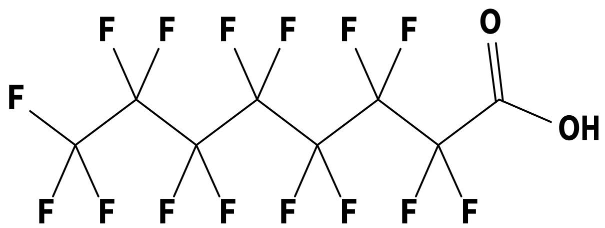
Molecular formula: $C_{12}H_{(10-i)}Br_iO$ (i = m+n =4~10)
CAS: 40088-47-9 ($Br_4$), 32534-81-9 ($Br_5$), 36483-60-0 ($Br_6$), 68928-80-3 ($Br_7$), 32536-52-0 ($Br_8$), 63936-56-1 ($Br_9$), 1163-19-5 ($Br_{10}$)
ENCS: 3-61 ($Br_4$), 3-2845 ($Br_6$)
MW: 485.79~959.17
mp: Not specified
bp: Not specified
sw: Not specified
Specific gravity: Not specified
logPow: Not specified

### [15] Perfluorooctane sulfonic acid (PFOS)



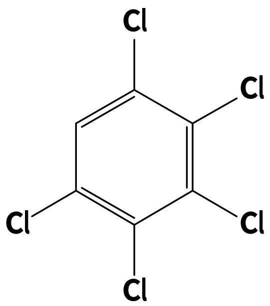
Molecular formula: $C_8HF_{17}O_3S$
CAS: 1763-23-1
ENCS: 2-1595
MW: 500.13
mp: >400°C (Potassium salt) [13]
bp: Uncertain
sw: 519mg/L (20°C, Potassium salt) [13]
Specific gravity: Uncertain
logPow: Uncertain

### [16] Perfluorooctanoic acid (PFOA)



Molecular formula: $C_8HF_{15}O_2$
CAS: 335-67-1
ENCS: 2-1182, 2-2659
MW: 414.07
mp: 54.3°C [1]
bp: 192.4°C [1]
sw: 9.5g/L (20°C) [14]
Specific gravity: 1.79g/cm$^3$ [15]
logPow: 6.3 [15]

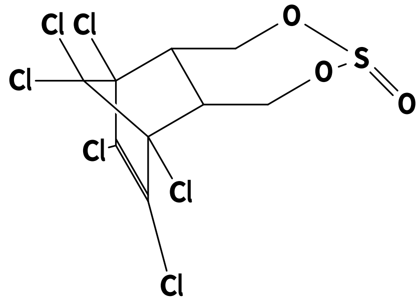
### [17] Pentachlorobenzene



Molecular formula: $C_6HCl_5$
CAS: 608-93-5
ENCS: 3-76
MW: 250.34
mp: 86°C [1]
bp: 277°C [1]
sw: 0.00050g/kg (25°C) [1]
Specific gravity: 1.8342g/cm$^3$ (16°C) [1]
logPow: 5.17 [3]

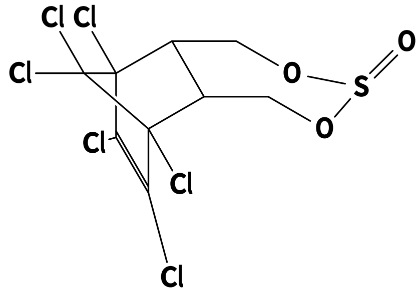
## [18] Endosulfans (reference)

### [18-1] $\alpha$-Endosulfan (reference)




Molecular formula: $C_9H_6Cl_6O_3S$
CAS: 959-98-8
ENCS: No pertinence
MW: 406.93
mp: 109.2°C [16)]
bp: Uncertain
sw: 0.33mg/L (25°C) [16)]
Specific gravity: Uncertain
logPow: 4.7 [16)]

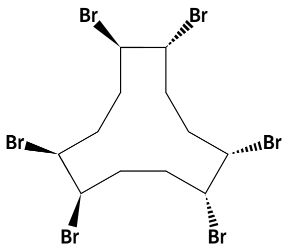
### [18-2] $\beta$-Endosulfan (reference)




Molecular formula: $C_9H_6Cl_6O_3S$
CAS: 33213-65-9
ENCS: No pertinence
MW: 406.93
mp: 213.3°C [16)]
bp: Uncertain
sw: 0.32mg/L (25°C) [16)]
Specific gravity: Uncertain
logPow: 4.7 [16)]

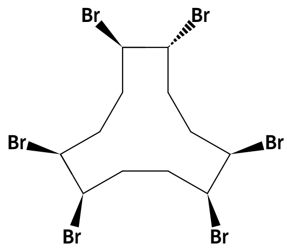
## [19] 1,2,5,6,9,10-Hexabromocyclododecanes (reference)

### [19-1] $\alpha$-1,2,5,6,9,10-Hexabromocyclododecane (reference)



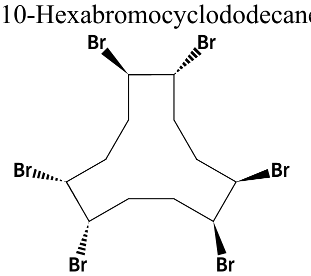

Molecular formula: $C_{12}H_{18}Br_6$
CAS: 134237-50-6
ENCS: 3-2254
MW: 641.70
mp: 179~181°C [17)]
bp: Uncertain
SW: 48.8μg/L [17)]
Specific gravity: Uncertain
logPow: 5.07 [17)]

### [19-2] $\beta$-1,2,5,6,9,10-Hexabromocyclododecane (reference)



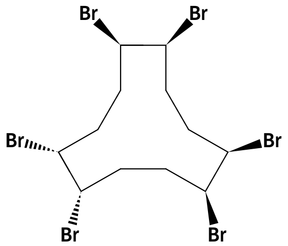

Molecular formula: $C_{12}H_{18}Br_6$
CAS: 134237-51-7
ENCS: 3-2254
MW: 641.70
mp: 170~172°C [17)]
bp: Uncertain
SW: 14.7μg/L [17)]
Specific gravity: Uncertain
logPow: 5.12 [17)]

### [19-3] $\gamma$-1,2,5,6,9,10-Hexabromocyclododecane (reference)



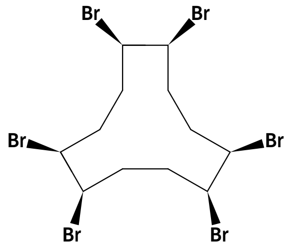

Molecular formula: $C_{12}H_{18}Br_6$
CAS: 134237-52-8
ENCS: 3-2254
MW: 641.70
mp: 207~209°C [17)]
bp: Uncertain
SW: 2.1μg/L [17)]
Specific gravity: Uncertain
logPow: 5.47 [17)]

### [19-4] $\delta$-1,2,5,6,9,10-Hexabromocyclododecane (reference)



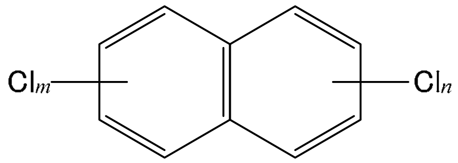

Molecular formula: $C_{12}H_{18}Br_6$
CAS: Uncertain
ENCS: 3-2254
MW: 641.70
mp: Uncertain
bp: Uncertain
SW: Uncertain
Specific gravity: Uncertain
logPow: Uncertain

### [19-5] $\varepsilon$-1,2,5,6,9,10-Hexabromocyclododecane (reference)




Molecular formula: $C_{12}H_{18}Br_6$
CAS: Uncertain
ENCS: 3-2254
MW: 641.70
mp: Uncertain
bp: Uncertain
SW: Uncertain
Specific gravity: Uncertain
logPow: Uncertain

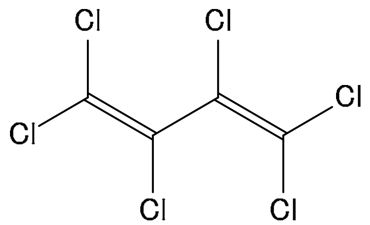
## [20] Total Polychlorinated Naphthalenes (reference)



i = m+n =1～8

| | |
|---|---|
| Molecular formula: | $C_{10}H_{(8-i)}Cl_i$ (i = m+n = 1～8) |
| CAS: | 25586-43-0($Cl_1$), 28699-88-9($Cl_2$), 1321-65-9($Cl_3$), 1335-88-2($Cl_4$), 1321-64-8($Cl_5$), 1335-87-1($Cl_6$), 32241-08-0($Cl_7$), 2234-13-1($Cl_8$) |
| ENCS: | No pertinence |
| MW: | 162.6~403.7 |
| mp: | Not specified |
| bp: | Not specified |
| sw: | Not specified |
| Specific gravity: | Not specified |
| logPow: | Not specified |

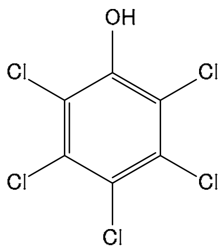
## [21] Hexachlorobuta-1,3-diene



| | |
|---|---|
| Molecular formula: | $C_4Cl_6$ |
| CAS: | 87-68-3 |
| ENCS: | 2-121 |
| MW: | 260.76 |
| mp: | -21°C [2] |
| bp: | 215°C [2] |
| sw: | 0.0005% (20°C) [2] |
| Specific gravity: | 1.682 (20/4°C) [2] |
| logPow: | 4.9 [18] |

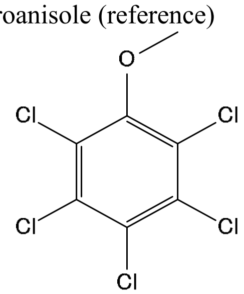
## [22] Pentachlorophenol and its salts and esters (reference)

### [22-1] Pentachlorophenol (reference)



| | |
|---|---|
| Molecular formula: | $C_6HCl_5O$ |
| CAS: | 87-86-5 |
| ENCS: | 3-2850 |
| MW: | 266.35 |
| mp: | 174°C (Monohydrate), 191°C (Anhydrous) [19] |
| bp: | 309~310°C (Decomposition) [2] |
| sw: | 14mg/L (26.7°C) [20] |
| Specific gravity: | 1.978 (22°C) [2] |
| logPow: | 5.12 [21] |

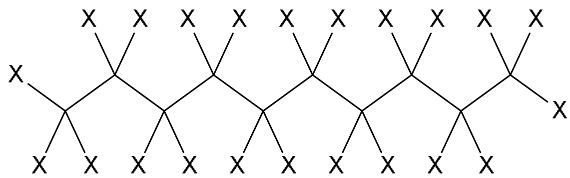
### [22-2] Pentachloroanisole (reference)



| | |
|---|---|
| Molecular formula: | $C_7H_3Cl_5O$ |
| CAS: | 1825-21-4 |
| ENCS: | No pertinence |
| MW: | 280.36 |
| mp: | 233.9°C [1] |
| bp: | Uncertain |
| sw: | Less than 1mg/L [22] |
| Specific gravity: | Uncertain |
| logPow: | 5.45 [22] |

## [23] Short-chain chlorinated paraffins

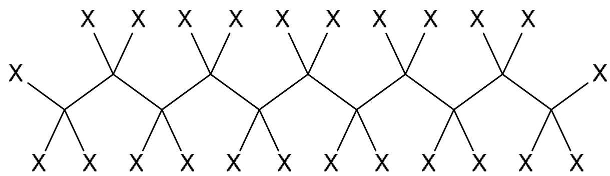
### [23-1] Chlorinated decanes



X = H or Cl

| | |
|---|---|
| Molecular formula: | $C_{10}H_{(22-i)}Cl_i$ (i = 1~22) |
| CAS: | Uncertain |
| ENCS: | 2-68 |
| MW: | 176.73~900.07 |
| mp: | Not specified |
| bp: | Not specified |
| sw: | Not specified |
| Specific gravity: | Not specified |
| logPow: | Not specified |

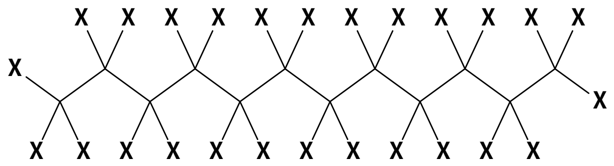
### [23-2] Chlorinated undecanes



X = H or Cl

| | |
|---|---|
| Molecular formula: | $C_{11}H_{(24-i)}Cl_i$ (i = 1~24) |
| CAS: | Uncertain |
| ENCS: | 2-68 |
| MW: | 190.75～982.99 |
| mp: | Not specified |
| bp: | Not specified |
| sw: | Not specified |
| Specific gravity: | Not specified |
| logPow: | Not specified |

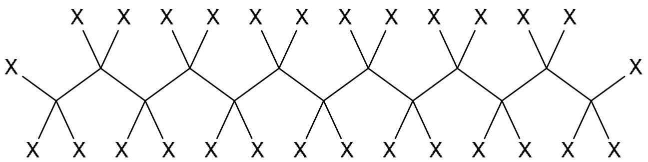
[23-3] Chlorinated dodecanes



X = H or Cl

Molecular formula: $C_{12}H_{(26-i)}Cl_i$ (i = 1~26)
CAS: Uncertain
ENCS: 2-68
MW: 204.78~1065.91
mp: Not specified
bp: Not specified
sw: Not specified
Specific gravity: Not specified
logPow: Not specified

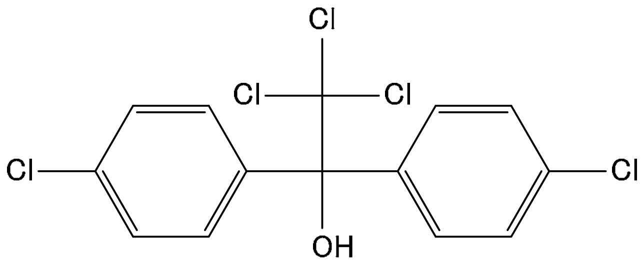
[23-4] Chlorinated tridecanes



X = H or Cl

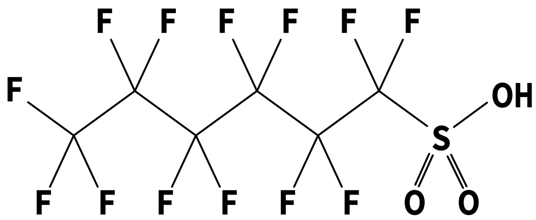
Molecular formula: $C_{13}H_{(28-i)}Cl_i$ (i = 1~28)
CAS: Uncertain
ENCS: 2-68
MW: 218.81~1,148.82
mp: Not specified
bp: Not specified
sw: Not specified
Specific gravity: Not specified
logPow: Not specified

[24] Dicofol (reference)



Molecular formula: $C_{14}H_9Cl_5O$
CAS: 115-32-2
ENCS: 4-226
MW: 370.49
mp: 77.5~79.5°C [23)]
bp: 180~225°C [23)]
sw: 0.8~1.32mg/L (25°C) [23)]
Specific gravity: 1.45g/cm$^3$ [23)]
logPow: 3.8～6.06 [23)]

[25] Perfluorohexane sulfonic acid (PFHxS)



Molecular formula: $C_6HF_{13}O_3S$
CAS: 355-46-4
ENCS: No pertinence
MW: 400.11
mp: 41°C[24)]
bp: 238～239°C[24)]
sw: 1.4g/L (20～25°C, Potassium salt)[24)]
2.3g/L (Non-dissociation)[24)]
Specific gravity: 1.841g/cm$^3$ [25)]
logPow: 5.17 [24)]

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## 3. Monitored site and procedure

In the Environmental Monitoring (of surface water, sediment, wildlife, and air), the sampling of specimens was entrusted to prefectural governments and government-designated cities across Japan and the specimens sampled were analysed by private analytical laboratories.

(1) Organisations responsible for sampling

| Local communities | Organisations responsible for sampling | Monitored media | | | |
|---|---|---|---|---|---|
| | | Surface water | Sediment | Wildlife | Air |
| Hokkaido | Environmental Promotion Section, Environment Division, Department of Environment and Lifestyle, Hokkaido Prefectural Government and Research Institute of Energy, Environment and Geology, Hokkaido Research Organization | ○ | ○ | ○ | ○ |
| Sapporo City | Sapporo City Institute of Public Health | | | | ○ |
| Iwate Pref. | Research Institute for Environmental Sciences and Public Health of Iwate Prefecture | ○ | ○ | ○ | ○ |
| Miyagi Pref. | Miyagi Prefectural Institute of Public Health and Environment | ○ | ○ | ○ | ○ |
| Sendai City | Sendai City Institute of Public Health | | ○ | | |
| Akita Pref. | Akita Research Center for Public Health and Environment | ○ | ○ | | |
| Yamagata Pref. | Yamagata Environmental Science Research Center | ○ | ○ | | ○ |
| Fukushima Pref. | Fukushima Prefectural Environmental Center | ○ | ○ | | |
| Ibaraki Pref. | Ibaraki Kasumigaura Environmental Science Center | ○ | ○ | ○ | ○ |
| Tochigi Pref. | Tochigi Prefectural Institute of Public Health and Environmental Science | ○ | ○ | | |
| Gunma Pref. | Gunma Prefectural Institute of Public Health and Environmental Sciences | ○ | | | |
| Saitama Pref. | Center for Environmental Science in Saitama | ○ | | | |
| Chiba Pref. | Chiba Prefectural Environmental Research Center | | ○ | | ○ |
| Chiba City | Chiba City Institute of Health and Environment | ○ | ○ | | |
| Tokyo Met. | Environmental Improvement Division, Bureau of Environment, Tokyo Metropolitan Government and Tokyo Metropolitan Research Institute for Environmental Protection | ○ | ○ | ○ | ○ |
| Kanagawa Pref. | Kanagawa Environmental Research Center | | | | ○ |
| Yokohama City | Yokohama Environmental Science Research Institute | ○ | ○ | ○ | ○ |
| Kawasaki City | Kawasaki Environment Research Institute | | | ○ | |
| Niigata Pref. | Niigata Prefectural Institute of Public Health and Environmental Sciences | ○ | ○ | | ○ |
| Toyama Pref. | Environment Preservation Division, Living Environmental and Cultural Affairs Department, Toyama Prefectural Government and Toyama Prefectural Environmental Science Research Center | ○ | ○ | | ○ |
| Ishikawa Pref. | Ishikawa Prefectural Institute of Public Health and Environmental Science | ○ | ○ | ○ | ○ |
| Fukui Pref. | Fukui Prefectural Institute of Public Health and Environmental Science | ○ | ○ | | |
| Yamanashi Pref. | Yamanashi Institute for Public Health and Environment | | ○ | ○ | ○ |
| Nagano Pref. | Nagano Environmental Conservation Research Institute | ○ | ○ | | ○ |
| Gifu Pref. | Gifu Prefectural Research Institute for Health and Environmental Sciences | | | | ○ |
| Shizuoka Pref. | Shizuoka Institute of Environment and Hygiene | ○ | ○ | | |
| Aichi Pref. | Aichi Environmental Research Center | ○ | ○ | | |
| Nagoya City | Nagoya City Environmental Science Research Center, Regional Environmental measures Division, Environmental Bureau, Nagoya city | | | ○ | ○ |
| Mie Pref. | Mie Prefecture Health and Environment Research Institute | ○ | ○ | | ○ |
| Shiga Pref. | Lake Biwa Environmental Research Institute | ○ | ○ | ○ | |
| Kyoto City | Kyoto City Institute of Health and Environmental Sciences | ○ | ○ | | |
| Osaka Pref. | Environment Preservation Division, Environment Management Office, Department of Environment, Agriculture, Forestry and Fisheries, Osaka Prefectural Government and Research Institute of Environment, Agriculture and Fisheries, Osaka Prefecture | ○ | ○ | ○ | ○ |
| Osaka City | Osaka City Institute of Public Health and Environmental Sciences | ○ | ○ | | |
| Hyogo Pref. | Water and Air Quality Control Division, Environmental Management Bureau, Agricultural and Environmental Affairs Department, Hyogo Prefectural Government and Hyogo Prefectural Institute of Environmental Sciences, Hyogo Environmental Advancement Association | ○ | ○ | ○ | ○ |

| Local communities | Organisations responsible for sampling | Monitored media | | | |
|---|---|---|---|---|---|
| | | Surface water | Sediment | Wildlife | Air |
| Hyogo Pref. | Water and Air Quality Control Division, Environmental Management Bureau, Agricultural and Environmental Affairs Department, Hyogo Prefectural Government and Green Nature Division, Environmental Policy Office, Department of Citizen Autonomy, Itami City | | | ○* | |
| Kobe City | Natural Environmental Symbiotic Division, Environmental Preservation Branch, Environment Bureau, Kobe City and Kobe Institute of Health, Welfare Bureau, Health Division, Health | ○ | ○ | | ○ |
| Nara Pref. | Nara Prefecture Landscape and Environment Center | | ○ | | ○ |
| Wakayama Pref. | Wakayama Prefectural Research Center of Environment and Public Health | ○ | ○ | | |
| Tottori Pref. | Tottori Prefectural Institute of Public Health and Environmental Science | | | ○ | |
| Shimane Pref. | Shimane Prefectural Institute of Public Health and Environmental Science and Oki Public Health Center | | | | ○ |
| Okayama Pref. | Okayama Prefectural Institute for Environmental Science and Public Health | ○ | ○ | | |
| Hiroshima Pref. | Hiroshima Prefectural Technology Research Institute Health and Environment Center | ○ | ○ | | |
| Hiroshima City | Hiroshima City Institute of Public Health | | | ○ | ○ |
| Yamaguchi Pref. | Environmental Policy Division, Public Environmental Affairs Department, Yamaguchi Prefectural Government and Yamaguchi Prefectural Institute of Public Health and Environment | ○ | ○ | | ○ |
| Tokushima Pref. | Tokushima Prefectural Pablic Health, Pharmaceutical and Environmental Sciences Center | ○ | ○ | | ○ |
| Kagawa Pref. | Kagawa Prefectural Research Institute for Environmental Sciences and Public Health | ○ | ○ | | ○ |
| Ehime Pref. | Ehime Prefectural Institute of Public Health and Environmental Science | | ○ | | ○ |
| Kochi Pref. | Kochi Prefectural Environmental Research Center | ○ | ○ | ○ | |
| Fukuoka Pref. | Fukuoka Institute of Health and Environmental Sciences | | | | ○ |
| Kitakyushu City | Kitakyushu City Institute of Health and Environmental Sciences | ○ | ○ | | |
| Fukuoka City | Fukuoka City Institute for Hygiene and the Environment | | ○ | | |
| Saga Pref. | Saga Prefectural Environmental Research Center | ○ | ○ | | ○ |
| Nagasaki Pref. | Prefectural Living Environment Division, Environment Bureau, Nagasaki Prefecture | ○ | ○ | | |
| Kumamoto Pref. | Kumamoto Prefectural Institute of Public-Health and Environmental Science | ○ | | | ○ |
| Oita Pref. | Environment Preservation Division, Department of Environment, Oita Prefectural Government and Oita Prefectural Institute of Health and Environment | | ○ | ○ | |
| Miyazaki Pref. | Miyazaki Prefectural Institute for Public Health and Environment | ○ | ○ | | ○ |
| Kagoshima Pref. | Kagoshima Prefectural Institute for Environmental Research and Public Health | ○ | ○ | ○ | ○ |
| Okinawa Pref. | Okinawa Prefectural Institute of Health and Environment | ○ | ○ | ○ | ○ |

(Note 1) Organisations responsible for sampling are described by their official names in FY2019

(Note 2) *: Because there were the examples of survey that obtained the eggs in other countries, the eggs of great cormorants were taken in this survey by Yamanashi Prefectural Fisheries Technology Center and Water and Air Quality Control Division, Environmental Management Bureau, Agricultural and Environmental Affairs Department, Hyogo Prefectural Government and Green Nature Division, Environmental Policy Office, Department of Citizen Autonomy, Itami City. The results were treated as the reference values.

(2) Monitored sites (areas)

In the Environmental Monitoring (of surface water, sediment, wildlife, and air), the sampling of specimens was entrusted to prefectural governments and government-designated cities across Japan and the specimens sampled were analysed by private analytical laboratories.

The monitored sites (areas) are shown in Table 3-1-1 and Figure 3-1-1 for surface water, Table 3-1-2 and Figure 3-1-2 for sediment, Table 3-1-3 and Figure 3-1-3 for wildlife and Table 3-1-4 and Figure 3-1-4 for air. The breakdown is summarized as follows.

| Monitored media | Numbers of local communities | Numbers of target chemicals (groups) | Numbers of monitored sites (or areas) | Numbers of samples at a monitored site (or area) |
|---|---|---|---|---|
| Surface water | 41 | 11 | 46 | 1 |
| Sediment | 45 | 11 | 58 | 1* |
| Wildlife (bivalves) | 3 | 11 | 3 | 1** |
| Wildlife (fish) | 17 | 11 | 18 | 1** |
| Wildlife (birds) | 2*** | 11 | 2*** | 1** |
| Air (warm season) | 34 | 11 | 37 | 1 or 3**** |
| All media | 57 | 11 | 118*** | |

(Note 1) "*": For sediment, at each monitoring point, three (3) specimen samples were collected. The target substances were analysed for each place with one(1) specimen sample that is a mixture of equal parts of the three (3) specimen samples.

(Note 2) "**": For wildlife species, at each monitoring point, three (3) specimen samples were collected. The target substance group Total Polychlorinated Naphthalenes were analysed with the three (3) specimen samples for each place. The other substances were analysed for each place with one (1) specimen sample that is a mixture of equal parts of the three (3) specimen samples.

(Note 3) "***": Samples obtained in 1 site of the birds as wildlife eggs of Great Cormorant, and the sample was measured each the egg yolk and the egg white, the results were treated as a reference values.

(Note 4) "****": The target substances other than [21] Hexachlorobuta-1,3-diene were analysed withe one (1) sample for each sit. The target substance [21] Hexachlorobuta-1,3-diene was analysed with the three (3) specimen samples for each site.

(3) Sampling method of specimens

The sampling of specimens and the preparation of samples were carried out following the "Guidelines on Conducting of Environmental Surveys and Monitoring of Chemicals" (published on March 2021) by the Environment Health and Safety Division, Environmental Health Department, Ministry of the Environment of Japan (MOE).

(4) Target species

The species to be monitored among the wildlife media were selected considering the possibility of international comparison, as well as their significance and practicality as indicators: 1 bivalve (blue mussel), 7 fishes (predominantly sea bass), and 1 bird, namely, 9 species in total.

The properties of the species determined as targets in the FY2019 monitoring are shown in Table 3-2. Moreover, Table 3-1-3 summarizes the outline of the samples used for analysis.

Table 3-1-1 List of monitored sites (surface water) in the Environmental Monitoring in FY2020

| Local communities | Monitored sites | Sampling dates |
|---|---|---|
| Hokkaido | Ishikarikakokyo Bridge, Mouth of Riv. Ishikari (Ishikari City) | November 24, 2020 |
| Iwate Pref. | Toyosawa Bridge, Riv. Toyosawa (Hanamaki City) | November 4, 2020 |
| Miyagi Pref. | Sendai Bay (Matsushima Bay) | October 19, 2020 |
| Akita Pref. | Lake Hachiro | September 29, 2020 |
| Yamagata Pref. | Mouth of Riv. Mogami (Sakata City) | October 9, 2020 |
| Fukushima Pref. | Onahama Port | October 16, 2020 |
| Ibaraki Pref. | Tonekamome-ohasi Bridge, Mouth of Riv. Tone (Kamisu City) | November 12, 2020 |
| Tochigi Pref. | Tagawa Kyubun Area Head Works (Utsunomiya City) | October 27, 2020 |
| Gunma Pref. | Tone-ozeki Weir, Riv. Tone (Chiyoda Town) | September 18, 2020 |
| Saitama Pref. | Akigase-shusuizeki Weir, Riv. Arakawa (Shiki City) | November 4, 2020 |
| Chiba City | Mouth of Riv. Hanami (Chiba City) | November 10, 2020 |
| Tokyo Met. | Mouth of Riv. Arakawa (Koto Ward) | November 20, 2020 |
| | Mouth of Riv. Sumida (Minato Ward) | November 20, 2020 |
| Yokohama City | Yokohama Port | November 18, 2020 |
| Niigata Pref. | Lower Riv. Shinano (Niigata City) | November 19, 2020 |
| Toyama Pref. | Hagiura-bashi Bridge, Mouth of Riv. Jintsu (Toyama City) | October 15, 2020 |
| Ishikawa Pref. | Mouth of Riv. Sai (Kanazawa City) | November 6, 2020 |
| Fukui Pref. | Mishima-bashi Bridge, Riv. Shono (Tsuruga City) | October 22, 2020 |
| Nagano Pref. | Lake Suwa (center) | October 19, 2020 |
| Shizuoka Pref. | Kaketsuka-bashi Bridge, Riv. Tenryu (Iwata City) | November 12, 2020 |
| Aichi Pref. | Nagoya Port | November 10, 2020 |
| Mie Pref. | Yokkaichi Port | October 28, 2020 |
| Shiga Pref. | Lake Biwa (center, offshore of Karasaki) | October 28, 2020 |
| Kyoto City | Miyamae-bashi Bridge, Riv. Katsura (Kyoto City) | October 28, 2020 |
| Osaka Pref. | Mouth of Riv. Yamato (Sakai City) | November 25, 2020 |
| Osaka City | Osaka Port | October 27, 2020 |
| Hyogo Pref. | Offshore of Himeji | October 28, 2020 |
| Kobe City | Kobe Port (center) | November 17, 2020 |
| Wakayama Pref. | Kinokawa-ohashi Bridge, Mouth of Riv. Kinokawa (Wakayama City) | November 6, 2020 |
| Okayama Pref. | Offshore of Mizushima | October 26, 2020 |
| Hiroshima Pref. | Kure Port | November 11, 2020 |
| | Hiroshima Bay | November 11, 2020 |
| Yamaguchi Pref. | Tokuyama Bay | October 26, 2020 |
| | Offshore of Ube | October 12, 2020 |
| | Offshore of Hagi | November 13, 2020 |
| Tokushima Pref. | Mouth of Riv. Yoshino (Tokushima City) | October 15, 2020 |
| Kagawa Pref. | Takamatsu Port | October 27, 2020 |
| Kochi Pref. | Mouth of Riv. Shimanto (Shimanto City) | October 2, 2020 |
| Kitakyushu City | Dokai Bay | November 18, 2020 |
| Saga Pref. | Imari Bay | October 28, 2020 |
| Nagasaki Pref. | Omura Bay | October 30, 2020 |
| Kumamoto Pref. | Hiraki-bashi Bridge, Riv. Midori (Uto City) | October 13, 2020 |
| Miyazaki Pref. | Mouth of Riv. Oyodo (Miyazaki City) | October 28, 2020 |
| Kagoshima Pref. | Shinkawa-bashi Bridge, Riv. Amori (Kirishima City) | September 29, 2020 |
| | Gotanda-bashi Bridge, Riv. Gotanda (Ichikikushikino City) | October 12, 2020 |
| Okinawa Pref. | Naha Port | October 14, 2020 |


Figure 3-1-1 Monitored sites (surface water) in the Environmental Monitoring in FY2020

Table 3-1-2 List of monitored sites (sediment) in the Environmental Monitoring in FY2020

| Local communities | Monitored sites | Sampling dates |
|---|---|---|
| Hokkaido | Ishikarikakokyo Bridge, Mouth of Riv. Ishikari (Ishikari City) | November 24, 2020 |
| | Tomakomai Port | September 9, 2020 |
| Iwate Pref. | Toyosawa Bridge, Riv. Toyosawa (Hanamaki City) | November 4, 2020 |
| Miyagi Pref. | Sendai Bay (Matsushima Bay) | October 19, 2020 |
| Sendai City | Hirose-ohashi Bridge, Riv. Hirose (Sendai City) | November 10, 2020 |
| Akita Pref. | Lake Hachiro | September 29, 2020 |
| Yamagata Pref. | Mouth of Riv. Mogami (Sakata City) | October 9, 2020 |
| Fukushima Pref. | Onahama Port | October 16, 2020 |
| Ibaraki Pref. | Tonekamome-ohasi Bridge, Mouth of Riv. Tone (Kamisu City) | November 12, 2020 |
| Tochigi Pref. | Tagawa Kyubun Area Head Works (Utsunomiya City) | October 27, 2020 |
| Chiba Pref. | Coast of Ichihara and Anegasaki | October 27, 2020 |
| Chiba City | Mouth of Riv. Hanami (Chiba City) | November 10, 2020 |
| Tokyo Met. | Mouth of Riv. Arakawa (Koto Ward) | November 20, 2020 |
| | Mouth of Riv. Sumida (Minato Ward) | November 20, 2020 |
| Yokohama City | Yokohama Port | November 18, 2020 |
| Niigata Pref. | Lower Riv. Shinano (Niigata City) | December 3, 2020 |
| Toyama Pref. | Hagiura-bashi Bridge, Mouth of Riv. Jintsu (Toyama City) | October 13, 2020 |
| Ishikawa Pref. | Mouth of Riv. Sai (Kanazawa City) | November 6, 2020 |
| Fukui Pref. | Mishima-bashi Bridge, Riv. Shono (Tsuruga City) | October 22, 2020 |
| Yamanashi Pref. | Senshu-bashi Bridge, Riv. Arakawa (Kofu City) | October 27, 2020 |
| Nagano Pref. | Lake Suwa (center) | October 19, 2020 |
| Shizuoka Pref. | Shimizu Port | October 22, 2020 |
| | Kaketsuka-bashi Bridge, Riv. Tenryu (Iwata City) | November 12, 2020 |
| Aichi Pref. | Kinuura Port | November 10, 2020 |
| | Nagoya Port | November 10, 2020 |
| Mie Pref. | Yokkaichi Port | October 28, 2020 |
| | Toba Port | October 20, 2020 |
| Shiga Pref. | Lake Biwa (center, offshore of Minamihira) | October 28, 2020 |
| | Lake Biwa (center, offshore of Karasaki) | October 28, 2020 |
| Kyoto City | Miyamae-bashi Bridge,Riv. Katsura (Kyoto City) | October 28, 2020 |
| Osaka Pref. | Mouth of Riv. Yamato (Sakai City) | November 25, 2020 |
| Osaka City | Kema-bashi Bridge, Riv. Oh-kawa (Osaka City) | October 28, 2020 |
| | Mouth of Riv. Yodo (Osaka City) | October 27, 2020 |
| | Osaka Port | October 27, 2020 |
| | Outside Osaka Port | October 27, 2020 |
| Hyogo Pref. | Offshore of Himeji | October 28, 2020 |
| Kobe City | Kobe Port (center) | November 17, 2020 |
| Nara Pref. | Taisho-bashi Bridge, Riv. Yamato (Oji Town) | October 21, 2020 |
| Wakayama Pref. | Kinokawa-ohashi Bridge, Mouth of Riv. Kinokawa (Wakayama City) | November 6, 2020 |
| Okayama Pref. | Offshore of Mizushima | October 26, 2020 |
| Hiroshima Pref. | Kure Port | November 11, 2020 |
| | Hiroshima Bay | November 11, 2020 |
| Yamaguchi Pref. | Tokuyama Bay | October 26, 2020 |
| | Offshore of Ube | October 12, 2020 |
| | Offshore of Hagi | November 13, 2020 |
| Tokushima Pref. | Mouth of Riv. Yoshino (Tokushima City) | October 15, 2020 |
| Kagawa Pref. | Takamatsu Port | October 27, 2020 |
| Ehime Pref. | Niihama Port | October 27, 2020 |
| Kochi Pref. | Mouth of Riv. Shimanto (Shimanto City) | October 2, 2020 |
| Kitakyushu City | Dokai Bay | November 18, 2020 |
| Fukuoka City | Hakata Bay | October 20, 2020 |
| Saga Pref. | Imari Bay | October 28, 2020 |
| Nagasaki Pref. | Omura Bay | November 5, 2020 |
| Oita Pref. | Mouth of Riv. Oita (Oita City) | October 26, 2020 |
| Miyazaki Pref. | Mouth of Riv. Oyodo (Miyazaki City) | October 28, 2020 |
| Kagoshima Pref. | Riv. Amori (Kirishima City) | September 29, 2020 |
| | Riv. Gotanda (Ichikikushikino City) | October 12, 2020 |
| Okinawa Pref. | Naha Port | October 14, 2020 |

(Note) *: "Keihin Canal, Port of Kawasaki" of Environmental Monitoring and "Keihin Canal, Port of Kawasaki (front of Ogimachi)" of Detailed Environmental Survey are the same point each.


Figure 3-1-2 Monitored sites (sediment) in the Environmental Monitoring in FY2020

Table 3-1-3 List of monitored areas (wildlife) in the Environmental Monitoring in FY2020

| Local communities | Monitored sites | Sampling dates | Wildlife species | |
|---|---|---|---|---|
| Hokkaido | Offshore of Kushiro | September 24, 2020 | Fish | Rock greenling (*Hexagrammos lagocephalus*) |
| | | September 22, 2020 | Fish | Chum salmon (*Oncorhynchus keta*) |
| Iwate Pref. | Yamada Bay | October 26, 2020 | Bibalves | Blue mussel (*Mytilus galloprovincialis*) |
| | | October 19, 2020 | Fish | Greenling (*Hexagrammos otakii*) |
| Miyagi Pref. | Sendai Bay (Matsushima Bay) | December 16, 2020 | Fish | Greenling (*Hexagrammos otakii*) |
| Ibaraki Pref. | Offshore of Joban | December 10, 2020 | Fish | Chub mackerel (*Scomber japonicus*) |
| Tokyo Met. | Tokyo Bay | September 28, 2020 | Fish | Sea bass (*Lateolabrax japonicus*) |
| Yokohama City | Yokohama Port | October 14, 2020 | Bibalves | Green mussel (*Perna viridis*) |
| Kawasaki City | Offshore of Ogishima Island, Port of Kawasaki | September 14, 2020 | Fish | Sea bass (*Lateolabrax japonicus*) |
| Ishikawa Pref. | Coast of Noto Peninsula | August 24, 2020 | Bibalves | Blue mussel (*Mytilus galloprovincialis*) |
| Nagoya City | Nagoya Port | August 25, 2020 | Fish | Striped mullet (*Mugil cephalus*) |
| Shiga Pref. | Lake Biwa(Lake Kita, offshore of Tikubushima Island) | July 31, 2020 | Birds | Great Cormorant (*Phalacrocorax carbo*) |
| | Lake Biwa, Riv. Ado (Takashima City) | April 2, 2020 | Fish | Dace (*Tribolodon hakonensis*) |
| Osaka Pref. | Osaka Bay | October 23, 2020 | Fish | Sea bass (*Lateolabrax japonicus*) |
| Hyogo Pref. | Offshore of Himeji | December 23, 2020 | Fish | Sea bass (*Lateolabrax japonicus*) |
| Tottori Pref. | Nakaumi | October 15, 2020 | Fish | Sea bass (*Lateolabrax japonicus*) |
| Hiroshima City | Hiroshima Bay | October 29, 2020 | Fish | Sea bass (*Lateolabrax japonicus*) |
| Kagawa Pref. | Takamatsu Port | August 26, 2020 | Fish | Striped mullet (*Mugil cephalus*) |
| Kochi Pref. | Mouth of Riv. Shimanto (Shimanto City) | September ~ November, 2020* | Fish | Sea bass (*Lateolabrax japonicas*) |
| Oita Pref. | Mouth of Riv. Oita (Oita City) | January 22, 2021 | Fish | Sea bass (*Lateolabrax japonicas*) |
| Kagoshima Pref. | West Coast of Satsuma Peninsula | October 22, 2020 | Fish | Sea bass (*Lateolabrax japonicas*) |
| Okinawa Pref. | Nakagusuku Bay | February 2, 2021 | Fish | Okinawa seabeam (*Acanthopagrus sivicolus*) |

(Note) "*" means details of the sampling date unknown.

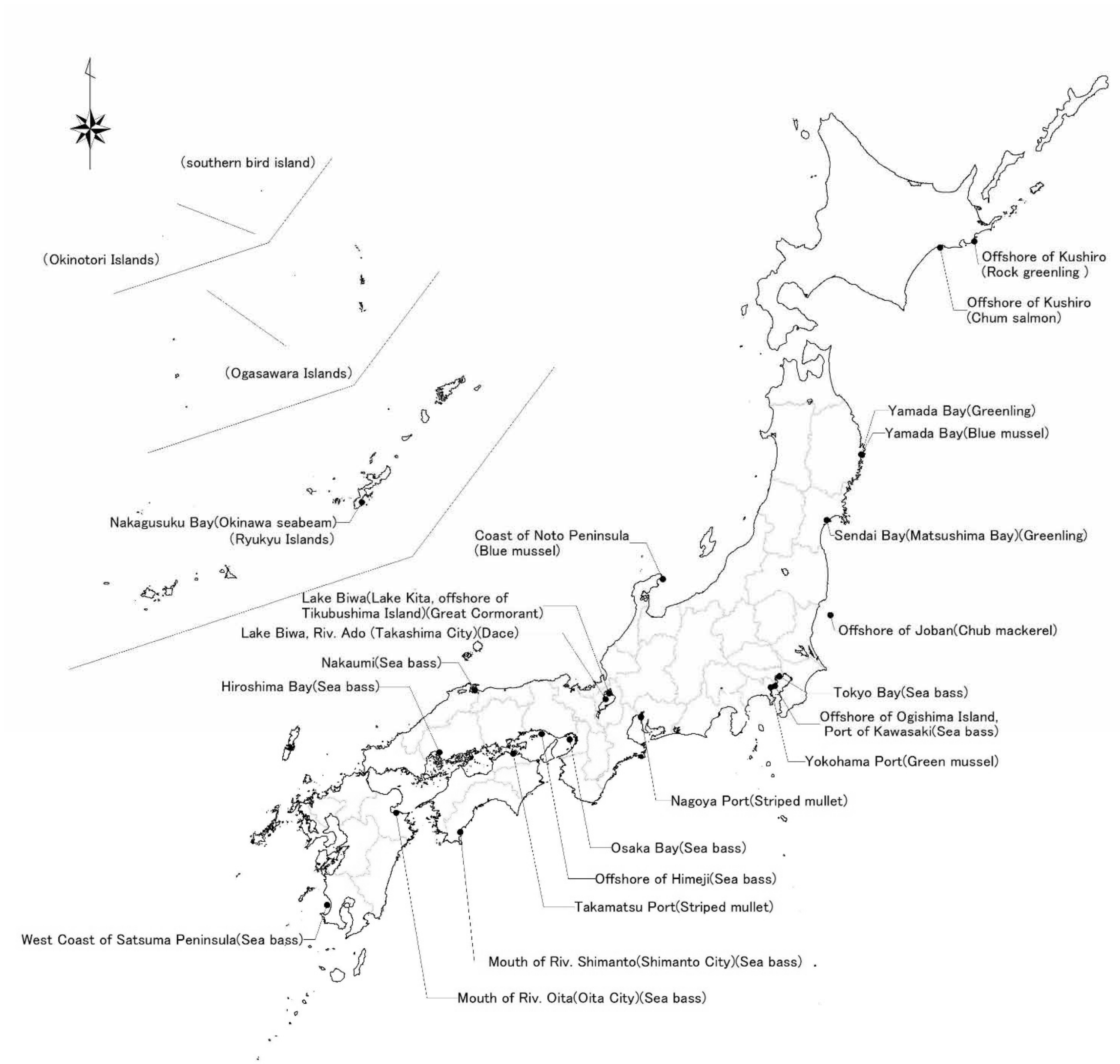


Figure 3-1-3 Monitored areas (wildlife) in the Environmental Monitoring in FY2020

Table 3-1-4 List of monitored sites (air) in the Environmental Monitoring in FY2020

| Local communities | Monitored sites | Sampling dates (Warm season) |
|---|---|---|
| Hokkaido | Kushiro General Subprefectural Bureau (Kushiro City) | October 2 ~ 9** or October 5 ~ 8*, 2020 |
| Sapporo City | Sapporo Art Park (Sapporo City) | September 28 ~ October 1, 2020 |
| Iwate Pref. | Sugo Air Quality Monitoring Station (Takizawa City) | September 28 ~ October 1, 2020 |
| Miyagi Pref. | Miyagi Prefectural Institute of Public Health and Environment (Sendai City) | October 16 ~ 23** or October 19 ~ 22*, 2020 |
| Yamagata Pref. | Yamagata Institute of Environmental Sciences (Murayama City) | September 25 ~ October 2** or September 29 ~ October 2*, 2020 |
| Ibaraki Pref. | Ibaraki Kasumigaura Environmental Science Center (Tsuchiura City) | September 29 ~ October 6** or September 30 ~ October 3*, 2020 |
| Chiba Pref. | Ichihara-Matsuzaki Air Quality Monitoring Station (Ichihara City) | October 5 ~ 12** or October 5 ~ 8*, 2020 |
| Tokyo Met. | Tokyo Metropolitan Research Institute for Environmental Protection (Koto Ward) | October 16 ~ 23** or October 20 ~ 23*, 2020 |
| | Chichijima Island (Ogasawara Village) | October 4 ~ 11** or October 4 ~ 7*, 2020 |
| Kanagawa Pref. | Kanagawa Environmental Research Center (Hiratsuka City) | October 5 ~ 8, 2020 |
| Yokohama City | Yokohama Environmental Science Research Institute (Yokohama City) | October 19 ~ 26** or October 19 ~ 22*, 2020 |
| Niigata Pref. | Oyama Air Quality Monitoring Station (Niigata City) | September 14 ~ 17, 2020 |
| Toyama Pref. | Tonami Air Quality Monitoring Station (Tonami City) | September 15 ~ 18, 2020 |
| Ishikawa Pref. | Ishikawa Prefectural Institute of Public Health and Environmental Science (Kanazawa City) | September 14 ~ 17, 2020 |
| Yamanashi Pref. | Yamanashi Prefectural Institute of Public Health and Environment (Kofu City) | September 14 ~ 17, 2020 |
| Nagano Pref. | Nagano Environmental Conservation Research Institute (Nagano City) | October 20 ~ 27** or October 20 ~ 22 and 23 ~ 24*, 2020 |
| Gifu Pref. | Gifu Prefectural Research Institute for Health and Environmental Sciences (Kakamigahara City) | October 12 ~ 15, 2020 |
| Nagoya City | Chikusa Ward Heiwa Park (Nagoya City) | September 8 ~ 15** or September 8 ~ 11*, 2020 |
| Mie Pref. | Mie Prefecture Health and Environment Research Institute (Yokkaichi City) | September 14 ~ 17, 2020 |
| Osaka Pref. | Osaka Joint Prefectural Government Building, Building 2 Annex (Osaka City) | October 12 ~ 15, 2020 |
| Hyogo Pref. | Hyogo Prefectural Environmental Research Center (Kobe City) | September 28 ~ October 1, 2020 |
| Kobe City | Kobe Institute of Health (Kobe City) | October 26 ~ 29, 2020 |
| Nara Pref. | Tenri Air Quality Monitoring Station (Tenri City) | October 26 ~ 29, 2020 |
| Shimane Pref. | Oki National Acid Rain Observatory (Okinoshima Town) | October 19 ~ 22, 2020 |
| Hiroshima City | Hiroshima City Kokutaiji Junior High School (Hiroshima City) | October 19 ~ 22, 2020 |
| Yamaguchi Pref. | Yamaguchi Prefectural Institute of Public Health and Environment (Yamaguchi City) | September 8 ~ 15** or September 8 ~ 11*, 2020 |
| | Hagi Health and Welfare Center (Hagi City) | November 20 ~ 27** or November 24 ~ 27*, 2020 |
| Tokushima Pref. | Tokushima Prefectural Public Health, Pharmaceutical and Environmental Sciences Center (Tokushima City) | October 19 ~ 22, 2020 |
| Kagawa Pref. | Kagawa Prefectural Research Institute for Environmental Sciences and Public Health (Takamatsu City) | October 14 ~ 21** or October 14 ~ 17*, 2020 |
| | Kagawa Prefectural Public Swimming Pool (Takamatsu City) | October 14 ~ 21** or October 14 ~ 17*, 2020 |
| Ehime Pref. | Ehime Prefectural Government Nanyo Regional Office (Uwajima City) | October 5 ~ 8, 2020 |
| Fukuoka Pref. | Omuta City Government Building (Omuta City) | October 20 ~ 23, 2020 |
| Saga Pref. | Saga Prefectural Environmental Research Center (Saga City) | September 9 ~ 16** or September 9 ~ 12*, 2020 |
| Kumamoto Pref. | Kumamoto Prefectural Institute of Public Health and Environmental Science (Udo City) | October 26 ~ 29, 2020 |
| Miyazaki Pref. | Miyazaki Prefectural Institute for Public Healthand Environment (Miyazaki City) | October 5 ~ 12** or October 5 ~ 8*, 2020 |
| Kagoshima Pref. | Kagoshima Prefectural Institute for Environmental Research and Public Health (Kagoshima City) | October 19 ~ 22, 2020 |
| Okinawa Pref. | Cape Hedo (Kunigami Village) | September 28 ~ October 1, 2020 |

(Note) " * " means sampling except [21] Hexachlorobuta-1,3-diene. " ** " means sampling [21] Hexachlorobuta-1,3-diene.


Figure 3-1-4 Monitored sites (air) in the Environmental Monitoring in FY2019

Table 3-2 Properties of target species

| Species | | Properties | Monitored areas | Aim of monitoring | Notes |
|---|---|---|---|---|---|
| Bibalves | Blue mussel (*Mytilus galloprovincialis*) | Distributed worldwide, excluding tropical zones<br>Adheres to rocks in inner bays and to bridge piers | ・Yamada bay<br>・Coast of Noto Peninsula | Follow-up of the environmental fate and persistency in specific areas | |
| | Greenling (*Hexagrammos otakii*) | Distributed in the worldwide, except in the tropical zones.<br>Adheres to rocks and bridge piers in inner bays | ・Yokohama port | Follow-up of the environmental fate and persistency in specific areas | |
| Fish | Greenling (*Hexagrammos otakki*) | Distributed from Hokkaido to southern Japan, the Korean Peninsula, and China<br>Lives in shallow seas of 5-50 m depth from sea level | ・Offshore of Iwanai<br>・Yamada bay<br>・Sendai Bay | Follow-up of the environmental fate and persistency in specific areas | |
| | Chum salmon (*Oncorhynchus keta*) | Distributed in northern Pacific Ocean, Sea of Japan, Bering Sea, Sea of Okhotsk, the whole of the Gulf of Alaska, and part of the Arctic Ocean<br>Runs the Tone River on the Pacific Ocean side and rivers in Yamaguchi Prefecture and northward on the Sea of Japan side in Japan<br>Bioaccumulation of chemicals is said to be moderate | ・Offshore of Kushiro | Follow-up of the environmental fate and persistency on a global scale | |
| | Rock greenling (*Hexagrammos lagocephalus*) | Lives in cold-current areas of Hidaka and eastward (Hokkaido)<br>Larger than the greenling and eats fish smaller than its mouth size at the sea bottom | ・Offshore of Kushiro | Follow-up of the environmental fate and persistency in specific areas | |
| | Chub mackerel (*Scomber japonicus*) | Ddistributed widely in subtropical zones and temperate zones around the world.<br>Seasonal migration occurs with a northward migration in spring and a southward migration in autumn. | ・Offshore of Joban | Follow-up of the environmental fate and persistency in specific areas | |
| | Sea bass (*Lateolabrax japonicus*) | Distributed around the shores of various areas in Japan, the Korean Peninsula, and the coastal areas of China<br>Sometimes lives in a freshwater environment and brackish-water regions during its life cycle<br>Bioaccumulation of chemicals is said to be high | ・Tokyo Bay<br>・Offshore of Ogishima Island, Port of Kawasaki<br>・Osaka Bay<br>・Offshore of Himeji<br>・Nakaumi<br>・Hiroshima Bay<br>・Mouth of Riv. Shimanto<br>・Mouth of Riv. Oita<br>・West Coast of Satsuma Peninsula | Follow-up of the environmental fate and persistency in specific areas | Monitored in the 9 areas with different levels of persistency |
| | Striped mullet (*Mugil cephalus*) | Distributed widely in the worldwide tropical zones and subtropical zones<br>Sometimes lives in a freshwater environment and brackish-water regions during its life cycle | ・Nagoya Port | Follow-up of the environmental fate and persistency in specific areas | |
| | Okinawa seabeam (*Acanthopagrus sivicolus*) | Distributed around Nansei Shoto (Ryukyu Islands)<br>Lives in coral reefs and in bays into which rivers flow | ・Nakagusuku Bay | Follow-up of the environmental fate and persistency in specific areas | |
| | Dace (*Tribolodon hakonensis*) | Distributed widely in freshwater environments throughout Japan<br>Preys mainly on insects | ・Lake Biwa, Riv. Ado (Takashima City) | Follow-up of the environmental fate and persistency in specific areas | |
| Birds | Great Cormorant (immature)* (*Phalacrocorax carbo*) | Distributed widely throughout Japan<br>Eats primarily fish<br>Bioaccumulation of chemicals is said to be high | ・Lake Biwa, Riv. Ado (Takashima City) | Follow-up of the concentrations of chemicals in top predators | |

* Because there were the examples of survey that obtained the eggs in other countries, the eggs of great cormorants were taken at tow another areas in this survey. The results were treated as the reference values.

Table 3-3-1 Basic data of specimens (bivalves as wildlife) in the Environmental Monitoring in FY 2020

| Bivalve species and Area | No. | Sampling month | Sex | Number of animals | Length (cm) (Average) | Weight (g) (Average) | Water content % | Lipid content % |
|---|---|---|---|---|---|---|---|---|
| Blue mussel | 1 | October, | Uncertain | 106 | 9.3 ~ 13.5 ( 10.4 ) | 56.6 ~ 173.2 ( 97.1 ) | 79 | 1.7 |
| (*Mytilus galloprovincialis*) | 2 | 2020 | Uncertain | 144 | 8.4 ~ 9.0 ( 8.6 ) | 25.1 ~ 80.9 ( 55.4 ) | 80 | 1.7 |
| Yamada Bay | 3 | | Uncertain | 246 | 7.0 ~ 7.9 ( 7.4 ) | 25.1 ~ 49.7 ( 36.7 ) | 78 | 1.8 |
| Green mussel | 1 | October, | Mixed | 41 | 2.5 ~ 3.5 ( 2.9 ) | 1.88 ~ 4.74 ( 2.65 ) | 81 | 1.3 |
| (*Perna viridis*) | 2 | 2020 | Mixed | 45 | 2.3 ~ 3.3 ( 2.8 ) | 1.42 ~ 3.65 ( 2.41 ) | 82 | 1.2 |
| Yokohama Port | 3 | | Mixed | 43 | 2.3 ~ 3.8 ( 2.9 ) | 1.36 ~ 4.01 ( 2.53 ) | 81 | 1.2 |
| Blue mussel | 1 | August, | Uncertain | 39 | 12.4 ~ 15.3 ( 13.8 ) | 161 ~ 258 ( 196 ) | 77 | 2.0 |
| (*Mytilus galloprovincialis*) | 2 | 2020 | Uncertain | 46 | 11.8 ~ 13.8 ( 12.9 ) | 126 ~ 206 ( 157 ) | 77 | 1.9 |
| Coast of Noto Peninsula | 3 | | Uncertain | 50 | 8.4 ~ 13.0 ( 10.6 ) | 67.2 ~ 147 ( 109 ) | 76 | 2.1 |

Table 3-3-2 Basic data of specimens (fish as wildlife) in the Environmental Monitoring in FY 2020

| Fish species and Area | No. | Sampling month | Sex | Number of animals | Length (cm) (Average) | Weight (g) (Average) | Water content % | Lipid content % |
|---|---|---|---|---|---|---|---|---|
| Rock greenling (*Hexagrammos* | 1 | September, | Mixed | 3 | 38.0 ~ 41.0 ( 39.6 ) | 1,060 ~ 1,180 ( 1,080 ) | 74 | 2.3 |
| *lagocephalus*) | 2 | 2020 | Mixed | 3 | 41.0 ~ 44.0 ( 42.3 ) | 1,250 ~ 1,440 ( 1,340 ) | 76 | 1.8 |
| Offshore of Kushiro | 3 | | Mixed | 3 | 41.0 ~ 44.0 ( 43.0 ) | 1,350 ~ 1,360 ( 1,360 ) | 75 | 3.0 |
| Chum salmon | 1 | September, | Female | 1 | 76.0 | 4,300 | 70 | 4.8 |
| (*Oncorhynchus keta*) | 2 | 2020 | Female | 2 | 58.0 ~ 68.0 ( 63.0 ) | 3,600 ~ 4,780 ( 4,190 ) | 70 | 4.1 |
| Offshore of Kushiro | 3 | | Male | 1 | 74.0 | 4,540 | 71 | 2.2 |
| Greenling | 1 | October, | Uncertain | 4 | 47.0 ~ 51.5 ( 49.2 ) | 1,462 ~ 1,957 ( 1,681 ) | 63 | 9.8 |
| (*Hexagrammos otakii*) | 2 | 2020 | Uncertain | 5 | 44.0 ~ 46.2 ( 45.2 ) | 1,249 ~ 1,498 ( 1,401 ) | 69 | 6.1 |
| Yamada Bay | 3 | | Uncertain | 6 | 41.0 ~ 45.5 ( 43.2 ) | 1,056 ~ 1,236 ( 1,130 ) | 67 | 6.6 |
| Greenling | 1 | December, | Mixed | 7 | 29.5 ~ 31.8 ( 30.2 ) | 291.2 ~ 374 ( 317 ) | 78 | 0.2 |
| (*Hexagrammos otakii*) | 2 | 2020 | Mixed | 13 | 21.0 ~ 29.5 ( 24.0 ) | 89.6 ~ 267 ( 166 ) | 78 | 0.5 |
| Sendai Bay (Matsushima Bay) | 3 | | Mixed | 28 | 17.0 ~ 20.5 ( 19.0 ) | 56.0 ~ 108 ( 82.0 ) | 79 | 0.3 |
| Chub mackerel | 1 | December, | Uncertain | 10 | 30.0 ~ 32.0 ( 30.6 ) | 377 ~ 470 ( 413 ) | 47 | 11.1 |
| (*Scomber japonicus*) | 2 | 2020 | Uncertain | 11 | 29.0 ~ 30.0 ( 29.5 ) | 321 ~ 372 ( 353 ) | 25 | 17.0 |
| Offshore of Joban | 3 | | Uncertain | 12 | 25.0 ~ 29.0 ( 27.7 ) | 214 ~ 315 ( 270 ) | 41 | 5.4 |
| Sea bass | 1 | September, | Mixed | 2 | 48.2 ~ 48.5 ( 48.4 ) | 1,581 ~ 1,671 ( 1,626 ) | 77 | 1.5 |
| (*Lateolabrax japonicus*) | 2 | 2020 | Mixed | 2 | 45.6 ~ 46.3 ( 46.0 ) | 1,204 ~ 1,305 ( 1,255 ) | 79 | 1.4 |
| Tokyo Bay | 3 | | Mixed | 3 | 36.3 ~ 43.0 ( 39.5 ) | 679 ~ 1,077 ( 874 ) | 78 | 1.6 |
| Sea bass | 1 | September, | Male | 17 | 31.5 ~ 36.1 ( 34.0 ) | 305 ~ 421 ( 368 ) | 67 | 0.9 |
| (*Lateolabrax japonicus*) | 2 | 2020 | Female | 7 | 29.4 ~ 33.2 ( 32.3 ) | 251 ~ 412 ( 343 ) | 66 | 0.6 |
| Offshore of Ogishima Island, Port of Kawasaki | 3 | | Female | 7 | 33.8 ~ 35.3 ( 34.6 ) | 378 ~ 412 ( 390 ) | 72 | 1.1 |
| Striped mullet | 1 | August, | Uncertain | 6 | 43.8 ~ 49.0 ( 45.2 ) | 755 ~ 1,140 ( 894 ) | 74 | 2.3 |
| (*Mugil cephalus*) | 2 | 2020 | Uncertain | 6 | 44.6 ~ 45.9 ( 45.5 ) | 813 ~ 977 ( 896 ) | | |
| Nagoya Port | 3 | | Uncertain | 6 | 42.0 ~ 45.5 ( 44.1 ) | 742 ~ 888 ( 811 ) | | |
| Dace | 1 | April, | Male | 25 | 22.5 ~ 25.4 ( 24.0 ) | 155 ~ 283 ( 198 ) | 75 | 3.2 |
| (*Tribolodon hakonensis*) | 2 | 2020 | Female | 25 | 21.9 ~ 28.6 ( 24.9 ) | 147 ~ 326 ( 214 ) | 76 | 2.6 |
| Lake Biwa, Riv. Ado (Takashima City) | 3 | | Male | 25 | 22.2 ~ 25.6 ( 24.4 ) | 142 ~ 255 ( 198 ) | 75 | 2.8 |
| Sea bass | 1 | October, | Uncertain | 10 | 42.0 ~ 47.8 ( 45.1 ) | 773 ~ 973 ( 882 ) | 64 | 3.8 |
| (*Lateolabrax japonicus*) | 2 | 2020 | Uncertain | 10 | 43.5 ~ 49.4 ( 46.3 ) | 693 ~ 1,077 ( 910 ) | 69 | 3.5 |
| Osaka Bay | 3 | | Uncertain | 10 | 42.2 ~ 50.5 ( 45.5 ) | 650 ~ 1,043 ( 847 ) | 60 | 4.9 |
| Sea bass | 1 | December, | Male | 1 | 60.0 | 1,642 | 78 | 0.7 |
| (*Lateolabrax japonicus*) | 2 | 2020 | Female | 1 | 62.0 | 2,467 | | |
| Offshore of Himeji | 3 | | Female | 1 | 63.5 | 2,153 | | |
| Sea bass | 1 | October, | Mixed | 10 | 40.5 ~ 44.5 ( 42.5 ) | 829 ~ 1,030 ( 885 ) | 77 | 1.0 |
| (*Lateolabrax japonicus*) | 2 | 2020 | Mixed | 10 | 34.3 ~ 41.8 ( 38.6 ) | 588 ~ 866 ( 671 ) | 77 | 0.8 |
| Nakaumi | 3 | | Mixed | 13 | 30.8 ~ 38.3 ( 34.1 ) | 326 ~ 616 ( 459 ) | 77 | 0.7 |
| Sea bass | 1 | October, | Mixed | 5 | 38.0 ~ 43.0 ( 40.6 ) | 873 ~ 1,096 ( 981 ) | 72 | - |
| (*Lateolabrax japonicus*) | 2 | 2020 | Female | 4 | 40.5 ~ 41.0 ( 40.8 ) | 963 ~ 984 ( 977 ) | 73 | - |
| Hiroshima Bay | 3 | | Female | 3 | 41.0 ~ 42.5 ( 41.8 ) | 1,043 ~ 1,192 ( 1,097 ) | 73 | - |
| Striped mullet | 1 | August, | Uncertain | 2 | 60.0 ~ 62.0 ( 61 ) | 1,100 ~ 1,300 ( 1,200 ) | 57 | 2.8 |
| (*Mugil cephalus*) | 2 | 2020 | Uncertain | 2 | 59.0 ~ 65.0 ( 62.0 ) | 1,000 ~ 1,400 ( 1,200 ) | 60 | 1.1 |
| Takamatsu Port | 3 | | Uncertain | 2 | 60.0 ~ 62.0 ( 61.0 ) | 1,100 ~ 1,200 ( 1,150 ) | 42 | 1.9 |
| Sea bass | 1 | September ~ | Uncertain | 23 | 14.0 ~ 31.0 ( 18.3 ) | 49.0 ~ 551.0 ( 143.9 ) | 72 | 1.1 |
| (*Lateolabrax japonicus*) | 2 | November, | Uncertain | 23 | 13.0 ~ 31.0 ( 18.0 ) | 49.7 ~ 520.7 ( 145.0 ) | 69 | 1.0 |
| Mouth of Riv. Shimanto (Shimanto City) | 3 | 2020 | Uncertain | 24 | 13.0 ~ 28.0 ( 17.8 ) | 40.8 ~ 396.1 ( 139.3 ) | 70 | 1.6 |
| Sea bass | 1 | January, | Fermale | 2 | 51.5 ~ 53.0 ( 52.3 ) | 2,020 ~ 1,640 ( 1,830 ) | 79 | 0.9 |
| (*Lateolabrax japonicus*) | 2 | 2021 | Mixed | 2 | 55.0 ~ 54.5 ( 54.8 ) | 1,860 ~ 1,880 ( 1,870 ) | 80 | 0.7 |
| Mouth of Riv. Oita (Oita City) | 3 | | Mixed | 2 | 57.0 ~ 50.0 ( 53.5 ) | 1,640 ~ 1,920 ( 1,780 ) | 80 | 0.8 |
| Sea bass | 1 | October, | Mixed | 10 | 26.5 ~ 29.0 ( 27.6 ) | 284 ~ 382 ( 336 ) | 78 | 1.2 |
| (*Lateolabrax japonicus*) | 2 | 2020 | Mixed | 11 | 26.5 ~ 29.0 ( 27.5 ) | 294 ~ 397 ( 335 ) | 78 | 1.2 |
| West Coast of Satsuma Peninsula) | 3 | | Mixed | 11 | 26.5 ~ 29.0 ( 27.8 ) | 298 ~ 364 ( 331 ) | 78 | 1.2 |
| Okinawa seabeam | 1 | February, | Female | 3 | 34.5 ~ 36.5 ( 35.3 ) | 1,277 ~ 1,542 ( 1,399 ) | 70 | 2.1 |
| (*Acanthopagrus sivicolus*) | 2 | 2021 | Male | 3 | 29.0 ~ 31.0 ( 30.2 ) | 733 ~ 878 ( 795 ) | 63 | 1.6 |
| Nakagusuku Bay | 3 | | Female | 3 | 29.5 ~ 31.0 ( 30.2 ) | 739 ~ 903 ( 817 ) | 69 | 1.1 |

Table 3-3-3 Basic data of specimens (birds as wildlife) in the Environmental Monitoring in FY 2020

| Bird species (Area) | No. | Sampling month | Sex | Number of animals | Length (cm) | Weight (g) | Water content % | Lipid content % |
|---|---|---|---|---|---|---|---|---|
| Great Cormorant (*Phalacrocorax carbo*) Lake Biwa(Lake Kita, offshore of Tikubushima Island) | 1 | July, 2020 | Male | 3 | 113 ~ 125 ( 120 ) | 1,933 ~ 2,287 ( 2,065 ) | 68 | 3.4 |
| | 2 | | Female | 5 | 110 ~ 120 ( 116 ) | 1,595 ~ 1,999 ( 1,804 ) | | |
| | 3 | | Male | 2 | 112 ~ 120 ( 116 ) | 1,650 ~ 2,039 ( 1,844 ) | | |

(Note) The great cormorants (immature) killed as harmful birds were used as specimens.

## 4. Method for regression analysis and testing

The analysis procedure and the evaluation for the analysis result shown in Fig.2 were carried out by the following method.

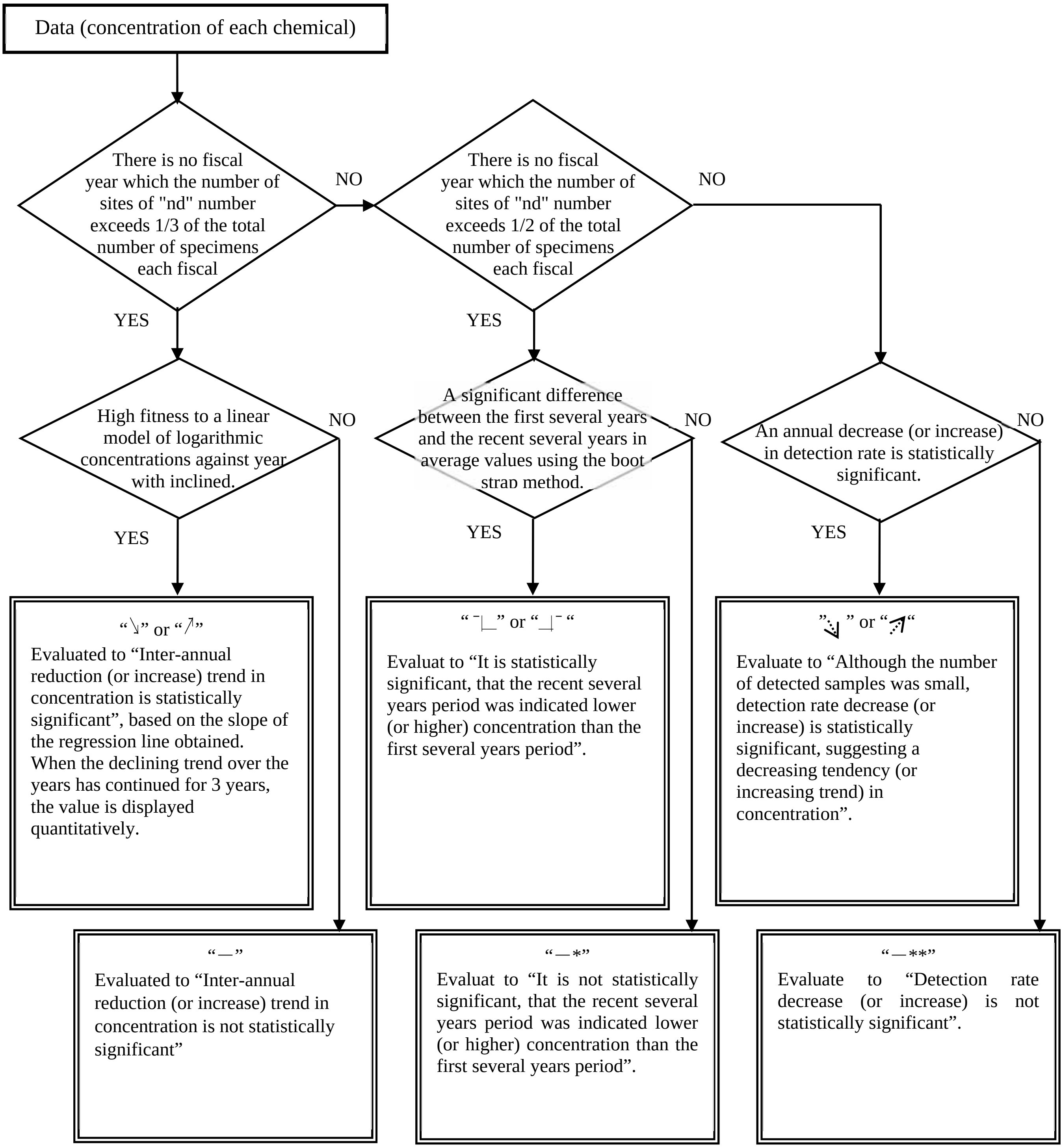


Figure 2 Method for regression analysis and testing

## 5. Summary of monitoring results

The detection ranges are shown in Table 3-4, and the detection limits are shown in Table 3-5.

The substances which were moniterd FY2020 and past years on the same media, were statistically analysed in order to detect inter-annual trends of increase or decrease. The results of the analyses are shown in Table 3-6

〇Data were carefully handled on the basis of following points.

・For sediment

At each monitoring point, three (3) specimen samples were collected. And the substances were analysed for each place with one specimen sample that is a mixture of equal parts of the three (3) specimen samples.

・For wildlife

At each monitoring point, three (3) specimen samples were collected in principle. And the substances were analysed for each place with one specimen sample that is a mixture of equal parts of the three (3) specimen samples.

・For air

At each monitored site, the sampling was for the monitoring in the warm season (September 8, 2020 ~ November 27, 2020).

Table 3-4-1 List of the detection ranges in the Environmental Monitoring in FY2020 (Part 1)

| No. | Target chemicals | Surface water (pg/L) | | Sediment (pg/g-dry) | |
|---|---|---|---|---|---|
| | | Range (Frepuency) | Av. | Range (Frepuency) | Av. |
| [1] | Total PCBs | nd ~ 8,000 (43/46) | 99 | 30 ~ 400,000 (58/58) | 4,600 |
| [2] | HCB | 2.7 ~ 600 (46/46) | 7.9 | 3.9 ~ 9,800 (58/58) | 85 |
| [3] | Aldrin | | | | |
| [4] | Dieldrin | | | | |
| [5] | Endrin | | | | |
| [6] | DDTs | | | | |
| | [6-1] *p,p*'-DDT | | | | |
| | [6-2] *p,p*'-DDE | | | | |
| | [6-3] *p,p*'-DDD | | | | |
| | [6-4] *o,p*'-DDT | | | | |
| | [6-5] *o,p*'-DDE | | | | |
| | [6-6] *o,p*'-DDD | | | | |
| [7] | Chlordanes | | | | |
| | [7-1] *cis*-chlordane | tr(2) ~ 120 (46/46) | 12 | tr(1.1) ~ 4,200 (58/58) | 42 |
| | [7-2] *trans*-chlordane | tr(3) ~ 98 (46/46) | 11 | 1.4 ~ 4,500 (58/58) | 47 |
| | [7-3] Oxychlordane | nd ~ 8 (21/46) | tr(1) | nd ~ 39 (34/58) | tr(1.1) |
| | [7-4] *cis*-Nonachlor | tr(0.6) ~ 39 (46/46) | 3.8 | tr(0.7) ~ 2,100 (58/58) | 31 |
| | [7-5] *trans*-Nonachlor | nd ~ 95 (45/46) | 9 | 1.9 ~ 3,800 (58/58) | 48 |
| [8] | Heptachlors | | | | |
| | [8-1] Heptachlor | nd ~ tr(2) (5/46) | nd | nd ~ 52 (43/58) | 0.7 |
| | [8-2] *cis*-Heptachlor epoxide | nd ~ 36 (44/46) | 4 | nd ~ 110 (40/58) | tr(1.5) |
| | [8-3] *trans*-Heptachlor epoxide | nd (0/46) | nd | nd ~ 1.4 (1/58) | nd |
| [9] | Toxaphenes | | | | |
| | [9-1] Parlar-26 | | | | |
| | [9-2] Parlar-50 | | | | |
| | [9-3] Parlar-62 | | | | |
| [10] | Mirex | | | | |
| [11] | HCHs | | | | |
| | [11-1] $\alpha$-HCH | | | | |
| | [11-2] $\beta$-HCH | | | | |
| | [11-3] $\gamma$-HCH (synonym:Lindane) | | | | |
| | [11-4] $\delta$-HCH | | | | |
| [12] | Chlordecone | | | | |
| [13] | Hexabromobiphenyls | | | | |

(Note 1) "Av." indicates the geometric mean calculated by assuming nd (below the detection limit) to be half the value of the detection limit.
(Note 2) "　" means the medium was not monitored.
(Note 3) "tr(X)" indicates that X was below the quantification limit and over the detection limit.

Table 3-4-2 List of the detection ranges in the Environmental Monitoring in FY2020 (Part 2)

| No. | Target chemicals | Surface water (pg/L) | | Sediment (pg/g-dry) | |
|---|---|---|---|---|---|
| | | Range (Frepuency) | Av. | Range (Frepuency) | Av. |
| [14] | Polybromodiphenyl ethers ($Br_4$ - $Br_{10}$) | | | | |
| | [14-1] Tetrabromodiphenyl ethers | | | | |
| | [14-2] Pentabromodiphenyl ethers | | | | |
| | [14-3] Hexabromodiphenyl ethers | | | | |
| | [14-4] Heptabromodiphenyl ethers | | | | |
| | [14-5] Octabromodiphenyl ethers | | | | |
| | [14-6] Nonabromodiphenyl ethers | | | | |
| | [14-7] Decabromodiphenyl ether | | | | |
| [15] | Perfluorooctane sulfonic acid (PFOS) | tr(52) ~ 3,700 (46/46) | 330 | tr(3) ~ 450 (58/58) | 40 |
| [16] | Perfluorooctanoic acid (PFOA) | 220 ~ 16,000 (46/46) | 1,100 | nd ~ 190 (57/58) | 21 |
| [17] | Pentachlorobenzene | tr(2) ~ 500 (46/46) | 7 | 1.8 ~ 2,900 (58/58) | 63 |
| [18] | Endosulfans | | | | |
| | [18-1] $\alpha$-Endosulfan | | | | |
| | [18-2] $\beta$-Endosulfan | | | | |
| [19] | 1,2,5,6,9,10-Hexabromo cyclododecanes | | | | |
| | [19-1] $\alpha$-1,2,5,6,9,10-Hexabromo cyclododecane | | | | |
| | [19-2] $\beta$-1,2,5,6,9,10-Hexabromo cyclododecane | | | | |
| | [19-3] $\gamma$-1,2,5,6,9,10-Hexabromo cyclododecane | | | | |
| | [19-4] $\delta$-1,2,5,6,9,10-Hexabromo cyclododecane | | | | |
| | [19-5] $\varepsilon$-1,2,5,6,9,10-Hexabromo cyclododecane | | | | |
| [20] | Total Polychlorinated Naphthalenes | | | | |
| [21] | Hexachlorobuta-1,3-diene | nd ~ 490 (1/46) | nd | nd ~ 180 (2/58) | nd |
| [22] | Pentachlorophenol and its salts and esters | | | | |
| | [22-1] Pentachlorophenol | | | | |
| | [22-2] Pentachloroanisole | | | | |
| [23] | Short-chain chlorinated paraffins | | | | |
| | [23-1] Chlorinated decanes | nd ~ 1,800 (16/46) | nd | nd ~ 6,000 (21/58) | nd |
| | [23-2] Chlorinated undecanes | nd ~ 2,400 (4/46) | nd | nd ~ 6,900 (25/58) | tr(600) |
| | [23-3] Chlorinated dodecanes | nd ~ 2,600 (4/46) | nd | nd ~ 18,000 (31/58) | tr(1,300) |
| | [23-4] Chlorinated tridecanes | nd ~ 2,000 (8/46) | nd | nd ~ 26,000 (40/58) | 1,400 |
| [24] | Dicofol | nd ~ 30 (1/46) | nd | nd ~ 77 (23/58) | tr(5) |
| [25] | Perfluorohexane sulfonic acid (PFHxS) | nd ~ 1,500 (44/46) | 160 | nd ~ 10 (13/58) | nd |

(Note 1) "Av." indicates the geometric mean calculated by assuming nd (below the detection limit) to be half the value of the detection limit.
(Note 2) "  " means the medium was not monitored.
(Note 3) "tr(X)" indicates that X was below the quantification limit and over the detection limit.
(Note 4) Chlorinated paraffins with 5 - 9 chlorines are target chemicals. The results of short-chain chlorinated paraffins are tentative values obtained in trials among various problems in the measurement method.

Table 3-4-3 List of the detection ranges in the Environmental Monitoring in FY2020 (Part 3)

| No. | Target chemicals | Wildlife (pg/g-wet) | | | | | | Air (pg/m$^3$) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Bibalves | | Fish | | Bibalves | | Fish | |
| | | Range (Frepuency) | Av. | Range (Frepuency) | Av. | Range (Frepuency) | Av. | Range (Frepuency) | Av. |
| [1] | Total PCBs | 470 ~ 9,900 (3/3) | 1,700 | 690 ~ 85,000 (18/18) | 9,300 | 74,000 (1/1) | --- | 21 ~ 360 (37/37) | 82 |
| [2] | HCB | tr(2) ~ 30 (3/3) | 9 | 15 ~ 1,100 (18/18) | 110 | 2,900 (1/1) | --- | 63 ~ 370 (37/37) | 100 |
| [3] | Aldrin | | | | | | | | |
| [4] | Dieldrin | | | | | | | | |
| [5] | Endrin | | | | | | | | |
| [6] | DDTs | | | | | | | | |
| | [6-1] *p,p'*-DDT | | | | | | | | |
| | [6-2] *p,p'*-DDE | | | | | | | | |
| | [6-3] *p,p'*-DDD | | | | | | | | |
| | [6-4] *o,p'*-DDT | | | | | | | | |
| | [6-5] *o,p'*-DDE | | | | | | | | |
| | [6-6] *o,p'*-DDD | | | | | | | | |
| [7] | Chlordanes | | | | | | | | |
| | [7-1] *cis*-chlordane | 41 ~ 590 (3/3) | 200 | 39 ~ 2,200 (18/18) | 290 | 83 (1/1) | --- | 1.5 ~ 200 (37/37) | 32 |
| | [7-2] *trans*-chlordane | 25 ~ 430 (3/3) | 100 | 11 ~ 780 (18/18) | 90 | 34 (1/1) | --- | 1.5 ~ 230 (37/37) | 35 |
| | [7-3] Oxychlordane | 5 ~ 59 (3/3) | 24 | 24 ~ 2,100 (18/18) | 75 | 820 (1/1) | --- | 0.15 ~ 2.6 (37/37) | 0.79 |
| | [7-4] *cis*-Nonachlor | 20 ~ 200 (3/3) | 53 | 26 ~ 1,600 (18/18) | 230 | 480 (1/1) | --- | 0.13 ~ 24 (37/37) | 3.1 |
| | [7-5] *trans*-Nonachlor | 47 ~ 480 (3/3) | 140 | 95 ~ 5,700 (18/18) | 530 | 81 (1/1) | --- | 1.0 ~ 140 (37/37) | 23 |
| [8] | Heptachlors | | | | | | | | |
| | [8-1] Heptachlor | nd ~ tr(2) (1/3) | nd | nd ~ 6 (6/18) | nd | nd (0/1) | --- | 0.69 ~ 35 (37/37) | 7.6 |
| | [8-2] *cis*-Heptachlor epoxide | 5 ~ 96 (3/3) | 28 | tr(2) ~ 320 (18/18) | 24 | 270 (1/1) | --- | 0.23 ~ 2.9 (37/37) | 1.1 |
| | [8-3] *trans*-Heptachlor epoxide | nd (0/3) | nd | nd (0/18) | nd | nd (0/1) | --- | nd (0/37) | nd |
| [9] | Toxaphenes | | | | | | | | |
| | [9-1] Parlar-26 | | | | | | | | |
| | [9-2] Parlar-50 | | | | | | | | |
| | [9-3] Parlar-62 | | | | | | | | |
| [10] | Mirex | | | | | | | | |
| [11] | HCHs | | | | | | | | |
| | [11-1] $\alpha$-HCH | | | | | | | | |
| | [11-2] $\beta$-HCH | | | | | | | | |
| | [11-3] $\gamma$-HCH (synonym:Lindane) | | | | | | | | |
| | [11-4] $\delta$-HCH | | | | | | | | |
| [12] | Chlordecone | | | | | | | | |
| [13] | Hexabromobiphenyls | | | | | | | | |

(Note 1) “Av.” indicates the geometric mean calculated by assuming nd (below the detection limit) to be half the value of the detection limit.

(Note 2) “ ” means the medium was not monitored.

(Note 3) “tr(X)” indicates that X was below the quantification limit and over the detection limit.

Table 3-4-3 List of the detection ranges in the Environmental Monitoring in FY2020 (Part 4)

| No. | Target chemicals | Wildlife (pg/g-wet) | | | | | | Air (pg/m$^3$) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Bibalves | | Fish | | Bibalves | | Fish | |
| | | Range (Frepuency) | Av. | Range (Frepuency) | Av. | Range (Frepuency) | Av. | Range (Frepuency) | Av. |
| [14] | Polybromodiphenyl ethers ($Br_4$ - $Br_{10}$) | | | | | | | | |
| | [14-1] Tetrabromodiphenyl ethers | | | | | | | | |
| | [14-2] Pentabromodiphenyl ethers | | | | | | | | |
| | [14-3] Hexabromodiphenyl ethers | | | | | | | | |
| | [14-4] Heptabromodiphenyl ethers | | | | | | | | |
| | [14-5] Octabromodiphenyl ethers | | | | | | | | |
| | [14-6] Nonabromodiphenyl ethers | | | | | | | | |
| | [14-7] Decabromodiphenyl ether | | | | | | | | |
| [15] | Perfluorooctane sulfonic acid (PFOS) | tr(4) ~ 130 (3/3) | 16 | 5 ~ 3,000 (18/18) | 76 | 8,500 (1/1) | --- | 1.1 ~ 7.2 (37/37) | 3.4 |
| [16] | Perfluorooctanoic acid (PFOA) | tr(3) ~ 14 (3/3) | 6 | nd ~ 49 (12/18) | tr(4) | 280 (1/1) | --- | 4.9 ~ 55 (37/37) | 13 |
| [17] | Pentachlorobenzene | 8 ~ 9 (3/3) | 9 | nd ~ 120 (14/18) | 11 | 390 (1/1) | --- | 35 ~ 180 (37/37) | 69 |
| [18] | Endosulfans | | | | | | | | |
| | [18-1] $\alpha$-Endosulfan | | | | | | | | |
| | [18-2] $\beta$-Endosulfan | | | | | | | | |
| [19] | 1,2,5,6,9,10-Hexabromo cyclododecanes | | | | | | | | |
| | [19-1] $\alpha$-1,2,5,6,9,10-Hexabromo cyclododecane | | | | | | | | |
| | [19-2] $\beta$-1,2,5,6,9,10-Hexabromo cyclododecane | | | | | | | | |
| | [19-3] $\gamma$-1,2,5,6,9,10-Hexabromo cyclododecane | | | | | | | | |
| | [19-4] $\delta$-1,2,5,6,9,10-Hexabromo cyclododecane | | | | | | | | |
| | [19-5] $\varepsilon$-1,2,5,6,9,10-Hexabromo cyclododecane | | | | | | | | |
| [20] | Total Polychlorinated Naphthalenes | | | | | | | | |
| [21] | Hexachlorobuta-1,3-diene (reference) | nd ~ tr(7) (1/3) | nd | nd ~ 19 (8/18) | nd | nd (0/1) | --- | 1,500 ~ 9,800 (37/37) | 2,500 |
| [22] | Pentachlorophenol and its salts and esters | | | | | | | | |
| | [22-1] Pentachlorophenol | | | | | | | | |
| | [22-2] Pentachloroanisole | | | | | | | | |
| [23] | Short-chain chlorinated paraffins | | | | | | | | |
| | [23-1] Chlorinated decanes | nd ~ tr(700) (2/3) | tr(400) | nd ~ tr(500) (3/18) | nd | nd (0/1) | --- | tr(60) ~ 560 (37/37) | 170 |
| | [23-2] Chlorinated undecanes | nd ~ 1,800 (2/3) | tr(700) | nd ~ 1,400 (4/18) | nd | 1,100 (1/1) | --- | tr(50) ~ 1,900 (37/37) | 220 |
| | [23-3] Chlorinated dodecanes | nd ~ 700 (2/3) | tr(300) | nd ~ 1,400 (2/18) | nd | nd (0/1) | --- | nd ~ 640 (29/37) | tr(80) |
| | [23-4] Chlorinated tridecanes | nd ~ 1,700 (2/3) | tr(400) | nd ~ 1,900 (2/18) | nd | tr(300) (1/1) | --- | nd ~ 360 (23/37) | tr(40) |
| [24] | Dicofol | nd ~ tr(20) (1/3) | nd | nd ~ 330 (8/18) | tr(10) | nd (0/1) | --- | nd ~ tr(0.3) (3/37) | nd |
| [25] | Perfluorohexane sulfonic acid (PFHxS) | nd ~ tr(3) (2/3) | tr(2) | nd ~ 18 (10/18) | tr(3) | 190 (1/1) | --- | 0.7 ~ 6.1 (37/37) | 2.5 |

(Note 1) "Av." indicates the geometric mean calculated by assuming nd (below the detection limit) to be half the value of the detection limit.
(Note 2) "     " means the medium was not monitored.
(Note 3) "tr(X)" indicates that X was below the quantification limit and over the detection limit.
(Note 4) Hexachlorobuta-1,3-diene in air was analysed with the three(3) specimen samples for each place. "Range" is based on the concentrations of the samples and "Frequency" is based on the number of sites or areas.
(Note 5) Chlorinated paraffins with 5 - 9 chlorines are target chemicals in wildlife, and Chlorinated paraffins with 4 - 7 chlorines are target chemicals in air. The results of short-chain chlorinated paraffins are tentative values obtained in trials among various problems in the measurement method.

Table 3-5-1 List of the quantification [detection] limits in the Environmental Monitoring in FY2019 (Part 1)

| No. | Target chemicals | Surface water (pg/L) | Sediment (pg/g-dry) | Wildlife (pg/g-wet) | Air (pg/m$^3$) |
|---|---|---|---|---|---|
| [1] | Total PCBs | 19<br>[6] | 8.2<br>[3.1] | 31<br>[11] | 1.8<br>[0.6] |
| [2] | HCB | 2.0<br>[0.8] | 1.3<br>[0.5] | 3<br>[1] | 0.3<br>[0.1] |
| [3] | Aldrin | | | | |
| [4] | Dieldrin | | | | |
| [5] | Endrin | | | | |
| [6] | DDTs | | | | |
| | [6-1] *p,p'*-DDT | | | | |
| | [6-2] *p,p'*-DDE | | | | |
| | [6-3] *p,p'*-DDD | | | | |
| | [6-4] *o,p'*-DDT | | | | |
| | [6-5] *o,p'*-DDE | | | | |
| | [6-6] *o,p'*-DDD | | | | |
| [7] | Chlordanes | | | | |
| | [7-1] *cis*-chlordane | 5<br>[2] | 1.2<br>[0.5] | 3<br>[1] | 0.09<br>[0.03] |
| | [7-2] *trans*-chlordane | 4<br>[2] | 0.2<br>[0.1] | 6<br>[2] | 0.16<br>[0.06] |
| | [7-3] Oxychlordane | 3<br>[1] | 1.8<br>[0.7] | 3<br>[1] | 0.10<br>[0.04] |
| | [7-4] *cis*-Nonachlor | 1.3<br>[0.5] | 0.8<br>[0.3] | 3<br>[1] | 0.09<br>[0.04] |
| | [7-5] *trans*-Nonachlor | 5<br>[2] | 0.5<br>[0.2] | 4<br>[2] | 0.10<br>[0.04] |
| [8] | Heptachlors | | | | |
| | [8-1] Heptachlor | 3<br>[1] | 0.4<br>[0.2] | 3<br>[1] | 0.10<br>[0.04] |
| | [8-2] *cis*-Heptachlor epoxide | 2.3<br>[0.9] | 1.7<br>[0.7] | 3<br>[1] | 0.11<br>[0.04] |
| | [8-3] *trans*-Heptachlor epoxide | 1.9<br>[0.7] | 1.0<br>[0.4] | 9<br>[4] | 0.13<br>[0.05] |
| [9] | Toxaphenes | | | | |
| | [9-1] Parlar-26 | | | | |
| | [9-2] Parlar-50 | | | | |
| | [9-3] Parlar-62 | | | | |
| [10] | Mirex | | | | |
| [11] | HCHs | | | | |
| | [11-1] *α*-HCH | | | | |
| | [11-2] *β*-HCH | | | | |
| | [11-3] *γ*-HCH (synonym:Lindane) | | | | |
| | [11-4] *δ*-HCH | | | | |
| [12] | Chlordecone | | | | |
| [13] | Hexabromobiphenyls | | | | |

(Note 1) Each quantification limit is shown above the corresponding [detection limit].
(Note 2) “ * ” means the quantification [detection] limit is the sum value of congeners.
(Note 3) The same quantification [detection] limit was employed for bivalves, fish and birds as wildlife for each target chemical.
(Note 4) “ ” means the medium was not monitored.

Table 3-5-2 List of the quantification [detection] limits in the Environmental Monitoring in FY2019 (Part 2)

| No. | Target chemicals | Surface water (pg/L) | Sediment (pg/g-dry) | Wildlife (pg/g-wet) | Air (pg/m$^3$) |
|---|---|---|---|---|---|
| [14] | Polybromodiphenyl ethers ($Br_4$~$Br_{10}$) | | | | |
| | [14-1] Tetrabromodiphenyl ethers | | | | |
| | [14-2] Pentabromodiphenyl ethers | | | | |
| | [14-3] Hexabromodiphenyl ethers | | | | |
| | [14-4] Heptabromodiphenyl ethers | | | | |
| | [14-5] Octabromodiphenyl ethers | | | | |
| | [14-6] Nonabromodiphenyl ethers | | | | |
| | [14-7] Decabromodiphenyl ether | | | | |
| [15] | Perfluorooctane sulfonic acid (PFOS) | 80 [30] | 5 [2] | 5 [2] | 0.3 [0.1] |
| [16] | Perfluorooctanoic acid (PFOA) | 90 [30] | 8 [3] | 6 [2] | 0.8 [0.3] |
| [17] | Pentachlorobenzene | 3 [1] | 0.4 [0.2] | 3 [1] | 0.17 [0.07] |
| [18] | Endosulfans | | | | |
| | [18-1] $\alpha$-Endosulfan | | | | |
| | [18-2] $\beta$-Endosulfan | | | | |
| [19] | 1,2,5,6,9,10-Hexabromo cyclododecanes | | | | |
| | [19-1] $\alpha$-1,2,5,6,9,10-Hexabromo cyclododecane | | | | |
| | [19-2] $\beta$-1,2,5,6,9,10-Hexabromo cyclododecane | | | | |
| | [19-3] $\gamma$-1,2,5,6,9,10-Hexabromo cyclododecane | | | | |
| | [19-4] $\delta$-1,2,5,6,9,10-Hexabromo cyclododecane | | | | |
| | [19-5] $\varepsilon$-1,2,5,6,9,10-Hexabromo cyclododecane | | | | |
| [20] | Total Polychlorinated Naphthalenes | | | | |
| [21] | Hexachlorobuta-1,3-diene (reference) | 100 [40] | 30 [10] | 13 [5] | 30 [10] |
| [22] | Pentachlorophenol and its salts and esters | | | | |
| | [22-1] Pentachlorophenol | | | | |
| | [22-2] Pentachloroanisole | | | | |
| [23] | Short-chain chlorinated paraffins | | | | |
| | [23-1] Chlorinated decanes | 400 [200] | 900 [400] | 900 [300] | 120 [50] |
| | [23-2] Chlorinated undecanes | 900 [300] | 1,200 [500] | 800 [300] | 120 [50] |
| | [23-3] Chlorinated dodecanes | 700 [300] | 2,000 [800] | 600 [200] | 140 [50] |
| | [23-4] Chlorinated tridecanes | 500 [200] | 1,200 [500] | 500 [200] | 100 [40] |
| [24] | Dicofol | 13 [5] | 13 [5] | 30 [10] | 0.5 [0.2] |
| [25] | Perfluorohexane sulfonic acid (PFHxS) | 60 [20] | 6 [3] | 5 [2] | 0.3 [0.1] |

(Note 1) Each quantification limit is shown above the corresponding [detection limit].
(Note 2) " * " means the quantification [detection] limit is the sum value of congeners.
(Note 3) The same quantification [detection] limit was employed for bivalves, fish and birds as wildlife for each target chemical.
(Note 4) "    " means the medium was not monitored.

Table 3-6-1 Results of inter-annual trend analysis from FY2002 to FY2020 (Surface water)

| No | Name | Surface water | | | | |
|---|---|---|---|---|---|---|
| | | | River area | Lake area | Mouth area | Sea area |
| [1] | Total PCBs | ↘<br>Half-life : 7 years<br>[6 ~ 9 years] | ↘<br>Half-life : 6 years<br>[5 ~ 9 years] | ↘<br>Half-life : 7 years<br>[5 ~ 10 years] | ↘<br>Half-life : 11 years<br>[8 ~ 18 years] | - |
| [2] | HCB | ↘<br>Half-life : 12 years<br>[10 ~ 16 years] | ↘ | - | ↘<br>Half-life : 9 years<br>[7 ~ 11 years] | ‾∟ |
| [3] | Aldrin | | | | | |
| [4] | Dieldrin | | | | | |
| [5] | Endrin | | | | | |
| [6] | DDTs | | | | | |
| | [6-1] *p,p′*-DDT | | | | | |
| | [6-2] *p,p′*-DDE | | | | | |
| | [6-3] *p,p′*-DDD | | | | | |
| | [6-4] *o,p′*-DDT | | | | | |
| | [6-5] *o,p′*-DDE | | | | | |
| | [6-6] *o,p′*-DDD | | | | | |
| [7] | Chlordanes | | | | | |
| | [7-1] *cis*-chlordane | ↘<br>Half-life : 8 years<br>[6 ~ 13 years] | ↘<br>Half-life : 7 years<br>[5 ~ 12 years] | - | ↘ | ↘<br>Half-life : 7 years<br>[6 ~ 9 years] |
| | [7-2] *trans*-chlordane | ↘ | - | - | - | - |
| | [7-3] Oxychlordane | -** | ‾∟ | -** | - | -** |
| | [7-4] *cis*-Nonachlor | - | ↘ | - | - | - |
| | [7-5] *trans*-Nonachlor | ↘ | ↘<br>Half-life : 11 years<br>[7 ~ 27 years] | - | - | - |
| [8] | Heptachlors | | | | | |
| | [8-1] Heptachlor | ↘ | -** | -** | -** | -** |
| | [8-2] *cis*-Heptachlor epoxide | ↘ | ↘ | - | - | ↘ |
| | [8-3] *trans*-Heptachlor epoxide | -** | -** | -** | -** | -** |
| [9] | Toxaphenes | | | | | |
| | [9-1] Parlar-26 | | | | | |
| | [9-2] Parlar-50 | | | | | |
| | [9-3] Parlar-62 | | | | | |
| [10] | Mirex | | | | | |
| [11] | HCHs | | | | | |
| | [11-1] $\alpha$-HCH | | | | | |
| | [11-2] $\beta$-HCH | | | | | |
| | [11-3] $\gamma$-HCH (synonym:Lindane) | | | | | |
| | [11-4] $\delta$-HCH | | | | | |

| No | Name | Surface water | River area | Lake area | Mouth area | Sea area |
|---|---|---|---|---|---|---|
| [14] | Polybromodiphenyl ethers(Br$_4$~Br$_{10}$) | | | | | |
| | [14-1] Tetrabromodiphenyl ethers | | | | | |
| | [14-2] Pentabromodiphenyl ethers | | | | | |
| | [14-3] Hexabromodiphenyl ether | | | | | |
| | [14-4] Heptabromodiphenyl ethers | | | | | |
| | [14-5] Octabromodiphenyl ethers | | | | | |
| | [14-6] Nonabromodiphenyl ethers | | | | | |
| | [14-7] Decabromodiphenyl ether | | | | | |
| [15] | Perfluorooctane sulfonic acid (PFOS) | - | - | ↘<br>Half-life : 13 years<br>[8 ~ 25 years] | - | - |
| [16] | Perfluorooctanoic acid (PFOA) | ↘ | - | - | ↘<br>Half-life : 7 years<br>[5 ~ 13 years] | - |
| [17] | Pentachlorobenzene | - | - | - | - | - |

(Note 1) When the posteriori probability from AICs was more than 95%, the measurement results were deemed to be in agreement with the simple log-linear regression model.

(Note 2) " ↘ ": An inter-annual trend of decrease was found.

" ⅂ ": Statistically significant differences between the first several years and the recent several years were found.

"↘": Although the number of detections was small, the detection rate was decreased, it suggested a reduction tendency.

" - ": An inter-annual trend was not found.

"-*": In case of using the bootstrap methods, there was not a significant difference between the first several years and the recent several years.

"-**": The detection rate was not decreased, there was not a reduction tendency.

(Note 3) "■": The inter-annual trend analysis was not analysed because not conducted the survey in FY2020.

(Note 4) The half-life describes the half-life in the environment based on the survey results when the decrease tendency continues for 3 years or more by the maximum likelihood estimation that does not assume parametric residual distribution. The results in [ ] indicate that the values in the 95% confidence interval.

(Note 5) The classification of monitored sites with area are shown in Table 3-7

(Note 6) *cis*-Heptachlor epoxide and *trans*-Heptachlor epoxide: the results of the inter-annual trend analysis from FY2003 to FY2020. Perfluorooctane sulfonic acid (PFOS) and Perfluorooctanoic acid (PFOA): the results of the inter-annual trend analysis from FY2009 to FY2020. Pentachlorobenzene: the results of the inter-annual trend analysis from FY2010 to FY2020

Table 3-6-2 Results of inter-annual trend analysis from FY2002 to FY2020 (Sediment)

| No | Name | Sediment | River area | Lake area | Mouth area | Sea area |
|---|---|---|---|---|---|---|
| [1] | Total PCBs | ↘<br>Half-life : 19 years<br>[14 ~ 35 years] | ↘<br>Half-life : 15 years<br>[10 ~ 25 years] | - | - | ↘<br>Half-life : 21 years<br>[15 ~ 33 years] |
| [2] | HCB | ↘<br>Half-life : 19 years<br>[13 ~ 33 years] | ↘<br>Half-life : 12 years<br>[8 ~ 20 years] | - | - | - |
| [3] | Aldrin | | | | | |
| [4] | Dieldrin | | | | | |
| [5] | Endrin | | | | | |
| [6] | DDTs | | | | | |
| | [6-1] *p,p'*-DDT | | | | | |
| | [6-2] *p,p'*-DDE | | | | | |
| | [6-3] *p,p'*-DDD | | | | | |
| | [6-4] *o,p'*-DDT | | | | | |
| | [6-5] *o,p'*-DDE | | | | | |
| | [6-6] *o,p'*-DDD | | | | | |
| [7] | Chlordanes | | | | | |
| | [7-1] *cis*-chlordane | ↘<br>Half-life : 9 years<br>[7 ~ 13 years] | ↘<br>Half-life : 8 years<br>[6 ~ 12 years] | - | ↘<br>Half-life : 8 years<br>[6 ~ 13 years] | ↘<br>Half-life : 9 years<br>[7 ~ 13 years] |
| | [7-2] *trans*-chlordane | ↘<br>Half-life : 13 years<br>[10 ~ 19 years] | ↘<br>Half-life : 10 years<br>[8 ~ 15 years] | - | ↘ | ↘ |
| | [7-3] Oxychlordane | −∟ | - | -** | −∟ | -** |
| | [7-4] *cis*-Nonachlor | ↘<br>Half-life : 17 years<br>[13 ~ 27 years] | ↘<br>Half-life : 11 years<br>[9 ~ 16 years] | - | - | ↘<br>Half-life : 18 years<br>[14 ~ 25 years] |
| | [7-5] *trans*-Nonachlor | ↘<br>Half-life : 13 years<br>[10 ~ 19 years] | ↘<br>Half-life : 12 years<br>[9 ~ 20 years] | - | ↘<br>Half-life : 11 years<br>[8 ~ 18 years] | ↘<br>Half-life : 13 years<br>[9 ~ 22 years] |
| [8] | Heptachlors | | | | | |
| | [8-1] Heptachlor | ⇘ | ⇘ | -** | −∟ | -** |
| | [8-2] *cis*-Heptachlor epoxide | −∟ | −∟ | -* | - | ⇘ |
| | [8-3] *trans*-Heptachlor epoxide | -** | -** | -** | -** | -** |
| [9] | Toxaphenes | | | | | |
| | [9-1] Parlar-26 | | | | | |
| | [9-2] Parlar-50 | | | | | |
| | [9-3] Parlar-62 | | | | | |
| [10] | Mirex | | | | | |
| [11] | HCHs | | | | | |
| | [11-1] $\alpha$-HCH | | | | | |
| | [11-2] $\beta$-HCH | | | | | |
| | [11-3] $\gamma$-HCH (synonym:Lindane) | | | | | |
| | [11-4] $\delta$-HCH | | | | | |

| No | Name | Sediment | River area | Lake area | Mouth area | Sea area |
|---|---|---|---|---|---|---|
| [14] | Polybromodiphenyl ethers($Br_4$~$Br_{10}$) | | | | | |
| | [14-1] Tetrabromodiphenyl ethers | | | | | |
| | [14-2] Pentabromodiphenyl ethers | | | | | |
| | [14-3] Hexabromodiphenyl ether | | | | | |
| | [14-4] Heptabromodiphenyl ethers | | | | | |
| | [14-5] Octabromodiphenyl ethers | | | | | |
| | [14-6] Nonabromodiphenyl ethers | | | | | |
| | [14-7] Decabromodiphenyl ether | | | | | |
| [15] | Perfluorooctane sulfonic acid (PFOS) | ↘ | - | - | ↘ | ↘ Half-life : 8 years [6 ~ 13 years] |
| [16] | Perfluorooctanoic acid (PFOA) | ↘ | ↘ | - | ↘ Half-life : 5 years [4 ~ 6 years] | - |
| [17] | Pentachlorobenzene | - | - | - | - | ↘ |

(Note 1) When the posteriori probability from AICs was more than 95%, the measurement results were deemed to be in agreement with the simple log-linear regression model.

(Note 2) " ↘ ": An inter-annual trend of decrease was found.
" ⏋ ": Statistically significant differences between the first several years and the recent several years were found.
"↘": Although the number of detections was small, the detection rate was decreased, it suggested a reduction tendency.
" - ": An inter-annual trend was not found.
"-*": In case of using the bootstrap methods, there was not a significant difference between the first several years and the recent several years
. "-**": The detection rate was not decreased, there was not a reduction tendency.

(Note 3) "": The inter-annual trend analysis was not analysed because not conducted the survey in FY2020.

(Note 4) The half-life describes the half-life in the environment based on the survey results when the decrease tendency continues for 3 years or more by the maximum likelihood estimation that does not assume parametric residual distribution. The results in [ ] indicate that the values in the 95% confidence interval.

(Note 5) The classification of monitored sites with area are shown in Table 3-7

(Note 6) *cis*-Heptachlor epoxide and *trans*-Heptachlor epoxide: the results of the inter-annual trend analysis from FY2003 to FY2020. Perfluorooctane sulfonic acid (PFOS) and Perfluorooctanoic acid (PFOA): the results of the inter-annual trend analysis from FY2009 to FY2020. Pentachlorobenzene: the results of the inter-annual trend analysis from FY2010 to FY2020.

Table 3-6-3 Results of inter-annual trend analysis from FY2002 to FY2020 (Wildlife)

| No | Name | Bivalves | Fish |
|---|---|---|---|
| [1] | Total PCBs | ↘<br>Half-life : 15 years<br>[9 ~ 33 years] | ↘ |
| [2] | HCB | - | - |
| [3] | Aldrin | | |
| [4] | Dieldrin | | |
| [5] | Endrin | | |
| [6] | DDTs | | |
| | [6-1] *p,p'*-DDT | | |
| | [6-2] *p,p'*-DDE | | |
| | [6-3] *p,p'*-DDD | | |
| | [6-4] *o,p'*-DDT | | |
| | [6-5] *o,p'*-DDE | | |
| | [6-6] *o,p'*-DDD | | |
| [7] | Chlordanes | | |
| | [7-1] *cis*-chlordane | ↘ | - |
| | [7-2] *trans*-chlordane | - | - |
| | [7-3] Oxychlordane | - | ↘ |
| | [7-4] *cis*-Nonachlor | ↘ | - |
| | [7-5] *trans*-Nonachlor | ↘ | - |
| [8] | Heptachlors | | |
| | [8-1] Heptachlor | -** | ⇘ |
| | [8-2] *cis*-Heptachlor epoxide | - | - |
| | [8-3] *trans*-Heptachlor epoxide | -** | -** |
| [9] | Toxaphenes | | |
| | [9-1] Parlar-26 | | |
| | [9-2] Parlar-50 | | |
| | [9-3] Parlar-62 | | |
| [10] | Mirex | | |
| [11] | HCHs | | |
| | [11-1] *α*-HCH | | |
| | [11-2] *β*-HCH | | |
| | [11-3] *γ*-HCH (synonym:Lindane) | | |
| | [11-4] *δ*-HCH | | |

| No | Name | Bivalves | Fish |
|---|---|---|---|
| [14] | Polybromodiphenyl ethers($Br_4$~$Br_{10}$) | | |
| | [14-1] Tetrabromodiphenyl ethers | | |
| | [14-2] Pentabromodiphenyl ethers | | |
| | [14-3] Hexabromodiphenyl ether | | |
| | [14-4] Heptabromodiphenyl ethers | | |
| | [14-5] Octabromodiphenyl ethers | | |
| | [14-6] Nonabromodiphenyl ethers | | |
| | [14-7] Decabromodiphenyl ether | | |
| [15] | Perfluorooctane sulfonic acid (PFOS) | ⇘ | - |
| [16] | Perfluorooctanoic acid (PFOA) | ⇘ | ⇘ |
| [17] | Pentachlorobenzene | ⇘ | -* |
| [19] | 1,2,5,6,9,10-Hexabromo cyclododecanes | | |
| | [19-1] *α*-1,2,5,6,9,10- Hexabromo cyclododecane | | |
| | [19-2] *β*-1,2,5,6,9,10- Hexabromo cyclododecane | | |
| | [19-3] *γ*-1,2,5,6,9,10- Hexabromo cyclododecane | | |

(Note 1) When the posteriori probability from AICs was more than 95%, the measurement results were deemed to be in agreement with the simple log-linear regression model.

(Note 2) " ↘ ": An inter-annual trend of decrease was found.
" ⅂ ": Statistically significant differences between the first several years and the recent several years were found.
"⇘": Although the number of detections was small, the detection rate was decreased, it suggested a reduction tendency.
" - ": An inter-annual trend was not found.
"-*": In case of using the bootstrap methods, there was not a significant difference between the values of the first several years and the recent several years.
"-**": The detection rate was not decreased, there was not a reduction tendency.

(Note 3) "": The inter-annual trend analysis was not analysed because not conducted the survey in FY2020.

(Note 4) The half-life describes the half-life in the environment based on the survey results when the decrease tendency continues for 3 years or more by the maximum likelihood estimation that does not assume parametric residual distribution. The results in [ ] indicate that the values in the 95% confidence interval.

(Note 5) *cis*-Heptachlor epoxide and *trans*-Heptachlor epoxide: the results of the inter-annual trend analysis from FY2003 to FY2020. Perfluorooctane sulfonic acid (PFOS) and Perfluorooctanoic acid (PFOA): the results of the inter-annual trend analysis from FY2009 to FY2020. Pentachlorobenzene: the results of the inter-annual trend analysis from FY2010 to FY2020.

Table 3-6-4 Results of inter-annual trend analysis from FY2002 to FY2020 (Air)

| No | Name | Air |
|---|---|---|
| | | Warm season |
| [1] | Total PCBs | ↘<br>Half-life : 14 years<br>[10 ~ 23 years] |
| [2] | HCB | - |
| [3] | Aldrin | |
| [4] | Dieldrin | |
| [5] | Endrin | |
| [6] | DDTs | |
| | [6-1] *p,p′*-DDT | |
| | [6-2] *p,p′*-DDE | |
| | [6-3] *p,p′*-DDD | |
| | [6-4] *o,p′*-DDT | |
| | [6-5] *o,p′*-DDE | |
| | [6-6] *o,p′*-DDD | |
| [7] | Chlordanes | |
| | [7-1] *cis*-chlordane | ↘<br>Half-life : 12 years<br>[10 ~ 14 years] |
| | [7-2] *trans*-chlordane | ↘ |
| | [7-3] Oxychlordane | ↘<br>Half-life : 16 years<br>[12 ~ 25 years] |
| | [7-4] *cis*-Nonachlor | ↘ |
| | [7-5] *trans*-Nonachlor | ↘<br>Half-life : 13 years<br>[10 ~ 18 years] |
| [8] | Heptachlors | |
| | [8-1] Heptachlor | ↘<br>Half-life : 9 years<br>[7 ~ 11 years] |
| | [8-2] *cis*-Heptachlor epoxide | ↘<br>Half-life : 16 years<br>[14 ~ 19 years] |
| | [8-3] *trans*-Heptachlor epoxide | ↘ |
| [9] | Toxaphenes | |
| | [9-1] Parlar-26 | |
| | [9-2] Parlar-50 | |
| | [9-3] Parlar-62 | |
| [10] | Mirex | |
| [11] | HCHs | |
| | [11-1] *α*-HCH | |
| | [11-2] *β*-HCH | |
| | [11-3] *γ*-HCH (synonym:Lindane) | |
| | [11-4] *δ*-HCH | |

| No | Name | Air |
| --- | --- | --- |
| | | Warm season |
| [14] | Polybromodiphenyl ethers($Br_4$~$Br_{10}$) | |
| | [14-1] Tetrabromodiphenyl ethers | |
| | [14-2] Pentabromodiphenyl ethers | |
| | [14-3] Hexabromodiphenyl ether | |
| | [14-4] Heptabromodiphenyl ethers | |
| | [14-5] Octabromodiphenyl ethers | |
| | [14-6] Nonabromodiphenyl ethers | |
| | [14-7] Decabromodiphenyl ether | |
| [15] | Perfluorooctane sulfonic acid (PFOS) | ↘<br>Half-life : 22 years<br>[15 ~ 38 years] |
| [16] | Perfluorooctanoic acid (PFOA) | - |
| [17] | Pentachlorobenzene | - |

(Note 1) When the posteriori probability from AICs was more than 95%, the measurement results were deemed to be in agreement with the simple log-linear regression model.

(Note 2) " ↘ ": An inter-annual trend of decrease was found.

" ⏋ ": Statistically significant differences between the first several years and the recent several years were found.

"↘": Although the number of detections was small, the detection rate was decreased, it suggested a reduction tendency.

" - ": An inter-annual trend was not found.

"-*": In case of using the bootstrap methods, there was not a significant difference between the values of the first several years and the recent several years.

"-**": The detection rate was not decreased, there was not a reduction tendency.

(Note 3) " ": The inter-annual trend analysis was not analysed because not conducted the survey in FY2020.

(Note 4) The half-life describes the half-life in the environment based on the survey results when the decrease tendency continues for 3 years or more by the maximum likelihood estimation that does not assume parametric residual distribution. The results in [ ] indicate that the values in the 95% confidence interval.

(Note 5) *cis*-Heptachlor epoxide and *trans*-Heptachlor epoxide: the results of the inter-annual trend analysis from FY2003 to FY2020. Perfluorooctane sulfonic acid (PFOS) and Perfluorooctanoic acid (PFOA): the results of the inter-annual trend analysis from FY2010 to FY2020. Pentachlorobenzene: the results of the inter-annual trend analysis from FY2007 to FY2020.

Table 3-7 The classification of monitored sites with area at inter-annual trend analysis from FY2002 to FY2020

| Classification | Local Communities | Monitored sites | Monitored media | |
|---|---|---|---|---|
| | | | Surface water | Sediment |
| River area | Hokkaido | Suzuran-ohashi Bridge, Riv Tokachi(Obihiro City) | ○ | |
| | | Ishikarikakokyo Bridge, Mouth of Riv. Ishikari(Ishikari City) | ○ | ○ |
| | Iwate Pref. | Riv. Toyosawa(Hanamaki City) | ○ | ○ |
| | Sendai City | Hirose-ohashi Bridge, Riv. Hirose(Sendai City) | | ○ |
| | Yamagata Pref. | Mouth of Riv. Mogami(Sakata City) | ○ | ○ |
| | Ibaraki Pref. | Tonekamome-ohasi Bridge, Mouth of Riv. Tone(Kamisu City) | ○ | ○ |
| | Tochigi Pref. | Riv. Tagawa(Utsunomiya City) | ○ | ○ |
| | Saitama Pref. | Akigaseshusui of Riv. Arakawa | ○ | |
| | Niigata Pref. | Lower Riv. Shinano(Niigata City) | ○ | ○ |
| | Toyama Pref. | Hagiura-bashi Bridge, Mouth of Riv. Jintsu(Toyama City) | ○ | ○ |
| | Fukui Pref. | Mishima-bashi Bridge, Riv. Shono(Tsuruga City) | ○ | ○ |
| | Yamanashi Pref. | Senshu-bashi Bridge, Riv. Arakawa(Kofu City) | | ○ |
| | Shizuoka Pref. | Riv. Tenryu(Iwata City) | ○ | ○ |
| | Kyoto City | Miyamae-bashi Bridge, Riv. Katsura(Kyoto City) | ○ | ○ |
| | Osaka City | Osaka Port | ○ | ○ |
| | | Kema-bashi Bridge, Riv. Oh-kawa (Osaka City) | | ○ |
| | Nara Pref. | Riv. Yamato(Oji Town) | | ○ |
| | Wakayama Pref. | Kinokawa-ohashi Bridge, Mouth of Riv. Kinokawa(Wakayama City) | ○ | ○ |
| | Kochi Pref. | Mouth of Riv. Shimanto(Shimanto City) | ○ | ○ |
| | Kumamoto Pref. | Hiraki-bashi Bridge, Riv. Midori(Uto City) | ○ | |
| | Miyazaki Pref. | Mouth of Riv. Oyodo(Miyazaki City) | ○ | ○ |
| | Kagoshima Pref. | Riv. Amori(Kirishima City) | ○ | ○ |
| | | Gotanda-bashi Bridge, Riv. Gotanda(Ichikikushikino City) | ○ | ○ |
| Lake area | Akita Pref. | Lake Hachiro | ○ | ○ |
| | Nagano Pref. | Lake Suwa(center) | ○ | ○ |
| | Shiga Pref. | Lake Biwa(center, offshore of Minamihira) | | ○ |
| | | Lake Biwa(center, offshore of Karasaki) | ○ | ○ |
| River mouth area | Chiba City | Mouth of Riv. Hanami(Chiba City) | ○ | ○ |
| | Tokyo Met. | Mouth of Riv. Arakawa(Koto Ward) | ○ | ○ |
| | | Mouth of Riv. Sumida(Minato Ward) | ○ | ○ |
| | Ishikawa Pref. | Mouth of Riv. Sai(Kanazawa City) | ○ | ○ |
| | Aichi Pref. | Kinuura Port | | ○ |
| | Mie Pref. | Toba Port | | ○ |
| | Osaka Pref. | Mouth of Riv. Yamato(Sakai City) | ○ | ○ |
| | Osaka City | Mouth of Riv. Yodo(Osaka City) | | ○ |
| | Tokushima Pref. | Mouth of Riv. Yoshino(Tokushima City) | ○ | ○ |
| | Kagawa Pref. | Takamatsu Port | ○ | ○ |
| | Kitakyushu City | Dokai Bay | ○ | ○ |
| | Oita Pref. | Mouth of Riv. Oita(Oita City) | | ○ |
| | Okinawa Pref. | Naha Port | ○ | ○ |
| Sea area | Hokkaido | Tomakomai Port | | ○ |
| | Miyagi Pref. | Sendai Bay(Matsushima Bay) | ○ | ○ |
| | Fukushima Pref. | Onahama Port | ○ | ○ |
| | Chiba Pref. | Coast of Ichihara and Anegasaki | | ○ |
| | Yokohama City | Yokohama Port | ○ | ○ |
| | Shizuoka Pref. | Shimizu Port | | ○ |
| | Aichi Pref. | Nagoya Port | ○ | ○ |
| | Mie Pref. | Yokkaichi Port | ○ | ○ |
| | Osaka City | Outside Osaka Port | | ○ |
| | Hyogo Pref. | Offshore of Himeji | ○ | ○ |
| | Kobe City | Kobe Port(center) | ○ | ○ |
| | Okayama Pref. | Offshore of Mizushima | ○ | ○ |
| | Hiroshima Pref. | Kure Port | ○ | ○ |
| | | Hiroshima Bay | ○ | ○ |
| | Yamaguchi Pref. | Tokuyama Bay | ○ | ○ |
| | | Offshore of Ube | ○ | ○ |
| | | Offshore of Hagi | ○ | ○ |
| | Ehime Pref. | Niihama Port | | ○ |
| | Fukuoka City | Hakata Bay | | ○ |
| | Saga Pref. | Imari Bay | ○ | ○ |
| | Nagasaki Pref. | Omura Bay | ○ | ○ |

(Note) There are monitored sites which were classified in the area unlike these names by the situations.

In the wake of the monitoring surveys of FY2002~2020, high-sensitivity analysis of PCBs, and HCB were conducted. All these chemicals were detected.

High-sensitivity analysis of Chlordanes, Heptachlors, Perfluorooctane sulfonic acid (PFOS), Perfluorooctanoic acid (PFOA), Pentachlorobenzene, Hexachlorobuta-1,3-diene, Short-chain chlorinated paraffins, Dicofol and Perfluorohexane sulfonic acid (PFHxS) were also conducted in FY2020.

Except for cases of undetected Heptachlor in wildlife (birs), *trans*-Heptachlor epoxide in surface water wildlife (bivalves, fish and birs) and air, Hexachlorobuta 1,3-diene in wildlife (birs), Chlorinated decanes and Chlorinated dodecanes in wildlife (birds), Dicofol in wildlife (birds), in all chemicals were detected.

The monitoring results for each chemical (group) are described below.

## [1] Total PCBs

・ History and state of monitoring

Polychlorinated biphenyls (PCBs) were used in industry as heat exchange fluids, etc. and were designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in June 1974, since the substances are persistent, highly accumulative in living organisms, and chronically toxic. Also the substances are one of the original twelve POPs covered by the Stockholm Convention.

In previous monitoring series, the substances were monitored in wildlife (bivalves, fish and birds) during the period of FY1978~2001 under the framework of "the Wildlife Monitoring." Under the framework of "The Follow-up Survey of the Status of Pollution by Unintentionally Formed Chemicals," sediment and wildlife (fish) were the monitored media in FY1996 and FY1997, and surface water, sediment, wildlife (fish) and air were the monitored media in FY2000 and FY2001.

Under the framework of the Environmental Monitoring, the substances in surface water, sediment, wildlife (bivalves, fish and birds) and air have been monitored since FY2002.

・ Monitoring results

<Surface Water>

The presence of the substances in surface water was monitored at 46 sites, and it was detected at 43 of the 46 valid sites adopting the detection limit of 6pg/L, and the detection range was up to 8,000pg/L.

As results of the inter-annual trend analysis from FY2002 to FY2020, reduction tendencies in specimens from river areas, lake areas and river mouth areas were identified as statistically significant and a reduction tendency in specimens from the overall areas in surface water was also identified as statistically significant.

Stocktaking of the detection of Total PCBs (total amount) in surface water during FY2002~2020

| Total PCBs (total amount) | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] Limit** | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Surface water (pg/L) | 2002 | 470 | 330 | 11,000 | 60 | 7.4 [2.5] | 114/114 | 38/38 |
| | 2003 | 530 | 450 | 3,100 | 230 | 9.4 [2.5] | 36/36 | 36/36 |
| | 2004 | 630 | 540 | 4,400 | 140 | 14 [5.0] | 38/38 | 38/38 |
| | 2005 | 520 | 370 | 7,800 | 140 | 10 [3.2] | 47/47 | 47/47 |
| | 2006 | 240 | 200 | 4,300 | 15 | 9 [3] | 48/48 | 48/48 |
| | 2007 | 180 | 140 | 2,700 | 12 | 7.6 [2.9] | 48/48 | 48/48 |
| | 2008 | 260 | 250 | 4,300 | 27 | 7.8 [3.0] | 48/48 | 48/48 |
| | 2009 | 210 | 170 | 3,900 | 14 | 10 [4] | 48/48 | 48/48 |
| | 2010 | 120 | 99 | 2,200 | nd | 73 [24] | 41/49 | 41/49 |
| | 2011 | 150 | 130 | 2,100 | 16 | 4.5 [1.7] | 49/49 | 49/49 |
| | 2012 | 400 | 280 | 6,500 | 72 | 44 [15] | 48/48 | 48/48 |
| | 2013 | 140 | 110 | 2,600 | tr(13) | 25 [8] | 48/48 | 48/48 |
| | 2014 | 150 | 120 | 4,800 | 16 | 8.2 [2.9] | 48/48 | 48/48 |
| | 2015 | 200 | 160 | 4,200 | 34 | 21 [7.3] | 48/48 | 48/48 |
| | 2016 | 140 | 120 | 3,100 | tr(7.2) | 8.4 [2.8] | 48/48 | 48/48 |
| | 2017 | 84 | 79 | 2,400 | nd | 16 [5.5] | 46/47 | 46/47 |
| | 2018 | 150 | 140 | 2,600 | tr(11) | 14 [5] | 47/47 | 47/47 |
| | 2019 | 120 | 90 | 3,400 | tr(6.6) | 12 [4.7] | 48/48 | 48/48 |
| | 2020 | 99 | 90 | 8,000 | nd | 19 [6] | 43/46 | 43/46 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2002.

(Note 2) " ** " indicates the sum value of the Quantification [Detection] limits of each congener.

<Sediment>

The presence of the substances in sediment was monitored at 58 sites, and it was detected at all 58 valid sites adopting the detection limit of 3.1pg/g-dry, and the detection range was 30 ~ 400,000pg/g-dry.

As results of the inter-annual trend analysis from FY2002 to FY2020, reduction tendencies in specimens from river areas and sea areas were identified as statistically significant and a reduction tendency in specimens from the overall areas in sediment was also identified as statistically significant.

Stocktaking of the detection of Total PCBs (total amount) in sediment during FY2002~2020

| Total PCBs (total amount) | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] Limit** | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2002 | 11,000 | 11,000 | 630,000 | 39 | 10 [3.5] | 189/189 | 63/63 |
| | 2003 | 9,400 | 9,500 | 5,600,000 | 39 | 10 [3.2] | 186/186 | 62/62 |
| | 2004 | 8,400 | 7,600 | 1,300,000 | 38 | 7.9 [2.6] | 189/189 | 63/63 |
| | 2005 | 8,600 | 7,100 | 690,000 | 42 | 6.3 [2.1] | 189/189 | 63/63 |
| | 2006 | 8,800 | 6,600 | 690,000 | 36 | 4 [1] | 192/192 | 64/64 |
| | 2007 | 7,400 | 6,800 | 820,000 | 19 | 4.7 [1.5] | 192/192 | 64/64 |
| | 2008 | 8,700 | 8,900 | 630,000 | 22 | 3.3 [1.2] | 192/192 | 64/64 |
| | 2009 | 7,600 | 7,100 | 1,700,000 | 17 | 5.1 [2.1] | 192/192 | 64/64 |
| | 2010 | 6,500 | 7,800 | 710,000 | nd | 660 [220] | 56/64 | 56/64 |
| | 2011 | 6,300 | 7,400 | 950,000 | 24 | 12 [4.5] | 64/64 | 64/64 |
| | 2012 | 5,700 | 6,700 | 640,000 | tr(32) | 51 [18] | 63/63 | 63/63 |
| | 2013 | 6,200 | 8,000 | 650,000 | tr(43) | 44 [13] | 62/62 | 62/62 |
| | 2014 | 4,900 | 5,500 | 440,000 | tr(35) | 61 [21] | 63/63 | 63/63 |
| | 2015 | 6,400 | 7,500 | 1,100,000 | nd | 62 [22] | 61/62 | 61/62 |
| | 2016 | 5,300 | 5,300 | 770,000 | tr(21) | 53 [18] | 62/62 | 62/62 |
| | 2017 | 4,600 | 6,200 | 610,000 | nd | 14 [5.0] | 61/62 | 61/62 |
| | 2018 | 5,900 | 6,500 | 720,000 | nd | 170 [55] | 58/61 | 58/61 |
| | 2019 | 5,700 | 7,900 | 640,000 | 37 | 8.5 [3.3] | 61/61 | 61/61 |
| | 2020 | 4,600 | 6,200 | 400,000 | 30 | 8.2 [3.1] | 58/58 | 58/58 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2002~2009.

(Note 2) " ** " indicates the sum value of the Quantification [Detection] limits of each congener.

<Wildlife>

The presence of the substances in bivalves was monitored in 3 areas, and it was detected at all 3 valid areas adopting the detection limit of 11pg/g-wet, and the detection range was 470 ~ 9,900pg/g-wet. For fish, the presence of the substances was monitored in 18 areas, and it was detected at all 18 valid areas adopting the detection limit of 11pg/g-wet, and the detection range was 690 ~ 85,000pg/g-wet. For birds, the presence of the substances was monitored in 1 area, and detected in the area adopting the detection limit of 11pg/g-wet, and the detected concentration was 74,000pg/g-wet.

As results of the inter-annual trend analysis from FY2002 to FY2020 reduction tendencies in specimens from bivalves and fish were identified as statistically significant.

Stocktaking of the detection of Total PCBs (total amount) in wildlife (bivalves, fish and birds) during FY2002~2020

| Total PCBs (total amount) | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] Limit** | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Bivalves (pg/g-wet) | 2002 | 8,800 | 28,000 | 160,000 | 200 | 25 [8.4] | 38/38 | 8/8 |
| | 2003 | 11,000 | 9,600 | 130,000 | 1,000 | 50 [17] | 30/30 | 6/6 |
| | 2004 | 11,000 | 11,000 | 150,000 | 1,500 | 85 [29] | 31/31 | 7/7 |
| | 2005 | 11,000 | 13,000 | 85,000 | 920 | 69 [23] | 31/31 | 7/7 |
| | 2006 | 8,500 | 8,600 | 77,000 | 690 | 42 [14] | 31/31 | 7/7 |
| | 2007 | 9,000 | 11,000 | 66,000 | 980 | 46 [18] | 31/31 | 7/7 |
| | 2008 | 8,600 | 8,600 | 69,000 | 870 | 47 [17] | 31/31 | 7/7 |
| | 2009 | 8,700 | 11,000 | 62,000 | 780 | 32 [11] | 31/31 | 7/7 |
| | 2010 | 9,200 | 11,000 | 46,000 | 1,500 | 52 [20] | 6/6 | 6/6 |
| | 2011 | 8,900 | 17,000 | 65,000 | 820 | 220 [74] | 4/4 | 4/4 |
| | 2012 | 6,600 | 12,000 | 34,000 | 680 | 34 [11] | 5/5 | 5/5 |
| | 2013 | 5,200 | 7,800 | 44,000 | 730 | 44 [14] | 5/5 | 5/5 |
| | 2014 | 2,900 | 2,600 | 15,000 | 600 | 95 [31] | 3/3 | 3/3 |
| | 2015 | 2,400 | 2,500 | 9,600 | 580 | 52 [17] | 3/3 | 3/3 |
| | 2016 | 2,300 | 2,300 | 12,000 | 420 | 60 [20] | 3/3 | 3/3 |
| | 2017 | 2,500 | 1,600 | 19,000 | 500 | 68 [23] | 3/3 | 3/3 |
| | 2018 | 2,000 | 900 | 12,000 | 740 | 63 [21] | 3/3 | 3/3 |
| | 2019 | 2,200 | 1,900 | 17,000 | 350 | 33 [11] | 3/3 | 3/3 |
| | 2020 | 1,700 | 1,100 | 9,900 | 470 | 31 [11] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2002 | 17,000 | 8,100 | 550,000 | 1,500 | 25 [8.4] | 70/70 | 14/14 |
| | 2003 | 11,000 | 9,600 | 150,000 | 870 | 50 [17] | 70/70 | 14/14 |
| | 2004 | 15,000 | 10,000 | 540,000 | 990 | 85 [29] | 70/70 | 14/14 |
| | 2005 | 14,000 | 8,600 | 540,000 | 800 | 69 [23] | 80/80 | 16/16 |
| | 2006 | 13,000 | 9,000 | 310,000 | 990 | 42 [14] | 80/80 | 16/16 |
| | 2007 | 11,000 | 6,200 | 530,000 | 790 | 46 [18] | 80/80 | 16/16 |
| | 2008 | 12,000 | 9,100 | 330,000 | 1,200 | 47 [17] | 85/85 | 17/17 |
| | 2009 | 12,000 | 12,000 | 290,000 | 840 | 32 [11] | 90/90 | 18/18 |
| | 2010 | 13,000 | 10,000 | 260,000 | 880 | 52 [20] | 18/18 | 18/18 |
| | 2011 | 14,000 | 12,000 | 250,000 | 900 | 220 [74] | 18/18 | 18/18 |
| | 2012 | 13,000 | 14,000 | 130,000 | 920 | 34 [11] | 19/19 | 19/19 |
| | 2013 | 14,000 | 13,000 | 270,000 | 1,000 | 44 [14] | 19/19 | 19/19 |
| | 2014 | 13,000 | 10,000 | 230,000 | 940 | 95 [31] | 19/19 | 19/19 |
| | 2015 | 11,000 | 7,700 | 180,000 | 1,300 | 52 [17] | 19/19 | 19/19 |
| | 2016 | 11,000 | 8,400 | 150,000 | 1,200 | 60 [20] | 19/19 | 19/19 |
| | 2017 | 10,000 | 8,300 | 160,000 | 860 | 68 [23] | 19/19 | 19/19 |
| | 2018 | 12,000 | 12,000 | 280,000 | 1,200 | 63 [21] | 18/18 | 18/18 |
| | 2019 | 12,000 | 12,000 | 160,000 | 1,000 | 33 [11] | 16/16 | 16/16 |
| | 2020 | 9,300 | 12,000 | 85,000 | 690 | 31 [11] | 18/18 | 18/18 |
| Birds*** (pg/g-wet) | 2002 | 12,000 | 14,000 | 22,000 | 4,800 | 25 [8.4] | 10/10 | 2/2 |
| | 2003 | 19,000 | 22,000 | 42,000 | 6,800 | 50 [17] | 10/10 | 2/2 |
| | 2004 | 9,000 | 9,400 | 13,000 | 5,900 | 85 [29] | 10/10 | 2/2 |
| | 2005 | 10,000 | 9,700 | 19,000 | 5,600 | 69 [23] | 10/10 | 2/2 |
| | 2006 | 12,000 | 9,800 | 48,000 | 5,600 | 42 [14] | 10/10 | 2/2 |
| | 2007 | 7,600 | 7,800 | 15,000 | 3,900 | 46 [18] | 10/10 | 2/2 |
| | 2008 | 9,700 | 7,400 | 56,000 | 3,000 | 47 [17] | 10/10 | 2/2 |
| | 2009 | 5,900 | 5,700 | 9,500 | 3,900 | 32 [11] | 10/10 | 2/2 |
| | 2010 | 7,700 | --- | 9,100 | 6,600 | 52 [20] | 2/2 | 2/2 |
| | 2011 | --- | --- | 5,400 | 5,400 | 220 [74] | 1/1 | 1/1 |
| | 2012 | 5,900 | --- | 6,200 | 5,600 | 34 [11] | 2/2 | 2/2 |
| | 2013 | 360,000 | --- | 510,000 | 250,000 | 44 [14] | 2/2 | 2/2 |
| | 2014 | 46,000 | --- | 140,000 | 15,000 | 95 [31] | 2/2 | 2/2 |
| | 2015 | --- | --- | 5,000 | 5,000 | 52 [17] | 1/1 | 1/1 |
| | 2016 | 31,000 | --- | 100,000 | 9,800 | 60 [20] | 2/2 | 2/2 |
| | 2017 | 39,000 | --- | 380,000 | 4,000 | 68 [23] | 2/2 | 2/2 |
| | 2018 | 110,000 | --- | 130,000 | 85,000 | 63 [21] | 2/2 | 2/2 |
| | 2019 | --- | --- | 190,000 | 190,000 | 33 [11] | 1/1 | 1/1 |
| | 2020 | --- | --- | 74,000 | 74,000 | 31 [11] | 1/1 | 1/1 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2002~2009.

(Note 2) “ ** ” indicates the sum value of the Quantification [Detection] limits of each congener.

(Note 3) “ *** ” indicates there is no consistency between the results of the ornithological survey after FY2013 and those in previous years because of the changes in the survey sites and target species.

<Air>

The presence of the substances in air was monitored at 37 sites, and it was detected at all 37 valid sites adopting the detection limit of 0.6pg/m$^3$, and the detection range was 21 ~ 360pg/m$^3$.

As results of the inter-annual trend analysis from FY2003 to FY2020, a reduction tendency in specimens from warm season was identified as statistically significant.

Stocktaking of the detection of Total PCBs (total amount) in air during FY2002~2019

| Total PCBs (total amount) | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit* | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Air (pg/m$^3$) | 2002** | 100 | 100 | 880 | 16 | 99 [33] | 102/102 | 34/34 |
| | 2003 Warm season | 260 | 340 | 2,600 | 36 | 6.6 [2.2] | 35/35 | 35/35 |
| | 2003 Cold season | 110 | 120 | 630 | 17 | | 34/34 | 34/34 |
| | 2004 Warm season | 240 | 250 | 3,300 | 25 | 2.9 [0.98] | 37/37 | 37/37 |
| | 2004 Cold season | 130 | 130 | 1,500 | 20 | | 37/37 | 37/37 |
| | 2005 Warm season | 190 | 210 | 1,500 | 23 | 0.38 [0.14] | 37/37 | 37/37 |
| | 2005 Cold season | 66 | 64 | 380 | 20 | | 37/37 | 37/37 |
| | 2006 Warm season | 170 | 180 | 1,500 | 21 | 0.8 [0.3] | 37/37 | 37/37 |
| | 2006 Cold season | 82 | 90 | 450 | 19 | | 37/37 | 37/37 |
| | 2007 Warm season | 250 | 290 | 980 | 37 | 0.37 [0.13] | 24/24 | 24/24 |
| | 2007 Cold season | 72 | 76 | 230 | 25 | | 22/22 | 22/22 |
| | 2008 Warm season | 200 | 170 | 960 | 52 | 0.8 [0.3] | 22/22 | 22/22 |
| | 2008 Cold season | 93 | 86 | 1,500 | 21 | | 36/36 | 36/36 |
| | 2009 Warm season | 200 | 190 | 1,400 | 43 | 0.75 [0.26] | 34/34 | 34/34 |
| | 2009 Cold season | 85 | 78 | 380 | 20 | | 34/34 | 34/34 |
| | 2010 Warm season | 160 | 150 | 970 | 36 | 7.3 [2.5] | 35/35 | 35/35 |
| | 2010 Cold season | 84 | 86 | 630 | 19 | | 35/35 | 35/35 |
| | 2011 Warm season | 150 | 160 | 660 | 32 | 18 [5.9] | 35/35 | 35/35 |
| | 2011 Cold season | 76 | 66 | 320 | tr(17) | | 37/37 | 37/37 |
| | 2012 Warm season | 130 | 130 | 840 | 27 | 26 [8.5] | 35/35 | 35/35 |
| | 2012 Cold season | 54 | 62 | 280 | tr(16) | | 35/35 | 35/35 |
| | 2013 Warm season | 140 | 130 | 1,100 | 24 | 20 [6.5] | 35/35 | 35/35 |
| | 2013 Cold season | 57 | 55 | 300 | tr(19) | | 35/35 | 35/35 |
| | 2014 Warm season | 140 | 150 | 1,300 | 28 | 4.1 [1.4] | 36/36 | 36/36 |
| | 2015 Warm season | 98 | 110 | 950 | 17 | 5.9 [2.0] | 35/35 | 35/35 |
| | 2016 Warm season | 130 | 140 | 1,300 | 16 | 7.8 [2.7] | 37/37 | 37/37 |
| | 2017 Warm season | 120 | 110 | 3,300 | 26 | 7.0 [2.3] | 37/37 | 37/37 |
| | 2018 Warm season | 110 | 100 | 750 | 20 | 2.4 [0.8] | 37/37 | 37/37 |
| | 2019 Warm season | 89 | 90 | 340 | 27 | 2.1 [0.8] | 36/36 | 36/36 |
| | 2020 Warm season | 82 | 82 | 360 | 21 | 1.8 [0.6] | 37/37 | 37/37 |

(Note 1) “ * ” :The sum value of the Quantification [Detection] limits of each congener.

(Note 2) “ ** ” :In 2002, there was a technical problem in the measuring method for lowly chlorinated congeners, and therefore the values are shown just as reference.

## [2] Hexachlorobenzene

・ History and state of monitoring

Hexachlorobenzene was used as pesticidal material and was designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in August 1979. Also the substance is one of the original twelve POPs covered by the Stockholm Convention.

In previous monitoring series, the substance was monitored in wildlife (bivalves, fish and birds) during the period of FY1978~1996 and in FY1998, FY2000 and FY2001 under the framework of “the Wildlife Monitoring.” Under the framework of “the Surface Water/Sediment Monitoring,” the substance in surface water and sediment was monitored during the period of FY1986~1998 and FY1986~2001, respectively.

Under the framework of the Environmental Monitoring, the substance in surface water, sediment, wildlife (bivalves, fish and birds) and air has been monitored since FY2002.

・ Monitoring results

<Surface Water>

The presence of the substance in surface water was monitored at 46 sites, and it was detected at all 46 valid sites adopting the detection limit of 0.8pg/L, and the detection range was 2.7 ~ 600pg/L.

As results of the inter-annual trend analysis from FY2002 to FY2020, reduction tendencies in specimens from river areas and river mouth areas were identified as statistically significant, and the recent 6 years period was indicated lower concentration than the first 6 years period in specimens from sea areas in surface water as statistically significant. And a reduction tendency in specimens from the overall areas in surface water was also identified as statistically significant.

Stocktaking of the detection of Hexachlorobenzene in surface water during FY2002~2020

| HCB | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface water (pg/L) | 2002 | 37 | 28 | 1,400 | 9.8 | 0.6 [0.2] | 114/114 | 38/38 |
| | 2003 | 29 | 24 | 340 | 11 | 5 [2] | 36/36 | 36/36 |
| | 2004 | 30 | tr(29) | 180 | tr(11) | 30 [8] | 38/38 | 38/38 |
| | 2005 | 21 | 17 | 210 | tr(6) | 15 [5] | 47/47 | 47/47 |
| | 2006 | 16 | tr(12) | 190 | nd | 16 [5] | 46/48 | 46/48 |
| | 2007 | 17 | 14 | 190 | tr(4) | 8 [3] | 48/48 | 48/48 |
| | 2008 | 16 | 13 | 480 | 4 | 3 [1] | 48/48 | 48/48 |
| | 2009 | 15 | 17 | 180 | 2.4 | 0.5 [0.2] | 49/49 | 49/49 |
| | 2010 | tr(10) | tr(8) | 120 | nd | 13 [4] | 39/49 | 39/49 |
| | 2011 | 13 | 12 | 140 | tr(3) | 5 [2] | 49/49 | 49/49 |
| | 2012 | 29 | 23 | 330 | 8.1 | 2.2 [0.7] | 48/48 | 48/48 |
| | 2013 | 14 | 11 | 260 | tr(4) | 7 [2] | 48/48 | 48/48 |
| | 2014 | 12 | 9.7 | 200 | 2.7 | 0.9 [0.4] | 48/48 | 48/48 |
| | 2015 | 15 | 13 | 140 | 4.2 | 1.8 [0.6] | 48/48 | 48/48 |
| | 2016 | 13 | 11 | 130 | 4.2 | 0.9 [0.3] | 48/48 | 48/48 |
| | 2017 | 12 | 10 | 180 | 2.9 | 2.1 [0.8] | 47/47 | 47/47 |
| | 2018 | 16 | 11 | 380 | 4.0 | 1.5 [0.6] | 47/47 | 47/47 |
| | 2019 | 10 | 10 | 630 | nd | 8 [3] | 46/48 | 46/48 |
| | 2020 | 7.9 | 6.1 | 600 | 2.7 | 2.0 [0.8] | 46/46 | 46/46 |

(Note) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2002.

<Sediment>

The presence of the substance in sediment was monitored at 58 sites, and it was detected at all 58 valid sites adopting the detection limit of 0.5pg/g-dry, and the detection range was 3.9 ~ 9,800pg/g-dry.

As results of the inter-annual trend analysis from FY2002 to FY2020, a reduction tendency in specimens from river areas was identified as statistically significant and a reduction tendency in specimens from the overall areas in sediment water was also identified as statistically significant.

Stocktaking of the detection of Hexachlorobenzene in sediment during FY2002~2020

| HCB | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Sediment (pg/g-dry) | 2002 | 240 | 200 | 19,000 | 7.6 | 0.9 [0.3] | 189/189 | 63/63 |
| | 2003 | 160 | 120 | 42,000 | 5 | 4 [2] | 186/186 | 62/62 |
| | 2004 | 140 | 100 | 25,000 | tr(6) | 7 [3] | 189/189 | 63/63 |
| | 2005 | 170 | 130 | 22,000 | 13 | 3 [1] | 189/189 | 63/63 |
| | 2006 | 180 | 120 | 19,000 | 10 | 2.9 [1.0] | 192/192 | 64/64 |
| | 2007 | 140 | 110 | 65,000 | nd | 5 [2] | 191/192 | 64/64 |
| | 2008 | 160 | 97 | 29,000 | 4.4 | 2.0 [0.8] | 192/192 | 64/64 |
| | 2009 | 150 | 120 | 34,000 | nd | 1.8 [0.7] | 190/192 | 64/64 |
| | 2010 | 130 | 96 | 21,000 | 4 | 3 [1] | 64/64 | 64/64 |
| | 2011 | 150 | 110 | 35,000 | 11 | 7 [3] | 64/64 | 64/64 |
| | 2012 | 100 | 110 | 12,000 | 3 | 3 [1] | 63/63 | 63/63 |
| | 2013 | 120 | 91 | 6,600 | 7.2 | 5.3 [1.8] | 63/63 | 63/63 |
| | 2014 | 95 | 85 | 5,600 | tr(4) | 6 [2] | 63/63 | 63/63 |
| | 2015 | 100 | 90 | 17,000 | 4 | 3 [1] | 62/62 | 62/62 |
| | 2016 | 84 | 74 | 6,400 | 4 | 3 [1] | 62/62 | 62/62 |
| | 2017 | 82 | 65 | 11,000 | 3 | 3 [1] | 62/62 | 62/62 |
| | 2018 | 100 | 79 | 8,900 | 3.1 | 1.3 [0.5] | 61/61 | 61/61 |
| | 2019 | 88 | 85 | 10,000 | 4.5 | 0.9 [0.4] | 61/61 | 61/61 |
| | 2020 | 85 | 78 | 9,800 | 3.9 | 1.3 [0.5] | 58/58 | 58/58 |

(Note) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived during FY2002~2009.

<Wildlife>

The presence of the substance in bivalves was monitored in 3 areas, and it was detected at all 3 valid areas adopting the detection limit of 1pg/g-wet, and the detection range was tr(2) ~ 30pg/g-wet. For fish, the presence of the substance was monitored in 18 areas, and it was detected at all 18 valid areas adopting the detection limit of 1pg/g-wet, and the detection range was 15 ~ 1,100pg/g-wet. For birds, the presence of the substance was monitored in 1 area, and detected in the area adopting the detection limit of 1pg/g-wet, and the detected concentration was 2,900pg/g-wet.

Stocktaking of the detection of Hexachlorobenzene in wildlife (bivalves, fish and birds) during FY2002~2020

| HCB | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] Limit** | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2002 | 21 | 22 | 330 | 2.4 | 0.18 [0.06] | 38/38 | 8/8 |
| | 2003 | 44 | 27 | 660 | tr(21) | 23 [7.5] | 30/30 | 6/6 |
| | 2004 | 32 | 31 | 80 | 14 | 14 [4.6] | 31/31 | 7/7 |
| | 2005 | 51 | 28 | 450 | 19 | 11 [3.8] | 31/31 | 7/7 |
| | 2006 | 46 | 28 | 340 | 11 | 3 [1] | 31/31 | 7/7 |
| | 2007 | 37 | 22 | 400 | 11 | 7 [3] | 31/31 | 7/7 |
| | 2008 | 38 | 24 | 240 | 13 | 7 [3] | 31/31 | 7/7 |
| | 2009 | 34 | 32 | 200 | 12 | 4 [2] | 31/31 | 7/7 |
| | 2010 | 34 | 48 | 210 | tr(4) | 5 [2] | 6/6 | 6/6 |
| | 2011 | 45 | 34 | 920 | 4 | 4 [1] | 4/4 | 4/4 |
| | 2012 | 39 | 38 | 340 | 10 | 8.4 [2.8] | 5/5 | 5/5 |
| | 2013 | 32 | 39 | 250 | nd | 31 [10] | 4/5 | 4/5 |
| | 2014 | 34 | 26 | 100 | 15 | 10 [3] | 3/3 | 3/3 |
| | 2015 | 35 | 26 | 120 | tr(14) | 20 [6.5] | 3/3 | 3/3 |
| | 2016 | 38 | 22 | 150 | 17 | 8.1 [2.7] | 3/3 | 3/3 |
| | 2017 | 41 | 26 | 99 | 26 | 3.9 [1.3] | 3/3 | 3/3 |
| | 2018 | 21 | 23 | 28 | 14 | 3.3 [1.1] | 3/3 | 3/3 |
| | 2019 | 23 | 16 | 65 | 12 | 3 [1] | 3/3 | 3/3 |
| | 2020 | 9 | 14 | 30 | tr(2) | 3 [1] | 3/3 | 3/3 |

| HCB | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] Limit** | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Fish (pg/g-wet) | 2002 | 140 | 180 | 910 | 19 | 0.18 [0.06] | 70/70 | 14/14 |
| | 2003 | 180 | 170 | 1,500 | 28 | 23 [7.5] | 70/70 | 14/14 |
| | 2004 | 230 | 210 | 1,800 | 26 | 14 [4.6] | 70/70 | 14/14 |
| | 2005 | 180 | 160 | 1,700 | 29 | 11 [3.8] | 80/80 | 16/16 |
| | 2006 | 180 | 220 | 1,400 | 25 | 3 [1] | 80/80 | 16/16 |
| | 2007 | 160 | 140 | 1,500 | 17 | 7 [3] | 80/80 | 16/16 |
| | 2008 | 170 | 210 | 1,500 | 25 | 7 [3] | 85/85 | 17/17 |
| | 2009 | 210 | 180 | 30,000 | 29 | 4 [2] | 90/90 | 18/18 |
| | 2010 | 240 | 280 | 1,700 | 36 | 5 [2] | 18/18 | 18/18 |
| | 2011 | 260 | 320 | 1,500 | 34 | 4 [1] | 18/18 | 18/18 |
| | 2012 | 200 | 300 | 1,100 | 33 | 8.4 [2.8] | 19/19 | 19/19 |
| | 2013 | 240 | 220 | 1,500 | 36 | 31 [10] | 19/19 | 19/19 |
| | 2014 | 280 | 340 | 1,900 | 37 | 10 [3] | 19/19 | 19/19 |
| | 2015 | 170 | 150 | 1,700 | 43 | 20 [6.5] | 19/19 | 19/19 |
| | 2016 | 150 | 150 | 1,300 | 24 | 8.1 [2.7] | 19/19 | 19/19 |
| | 2017 | 190 | 180 | 1,100 | 33 | 3.9 [1.3] | 19/19 | 19/19 |
| | 2018 | 140 | 150 | 900 | 25 | 3.3 [1.1] | 18/18 | 18/18 |
| | 2019 | 100 | 99 | 1,100 | 12 | 3 [1] | 16/16 | 16/16 |
| | 2020 | 110 | 58 | 1,100 | 15 | 3 [1] | 18/18 | 18/18 |
| Birds** (pg/g-wet) | 2002 | 1,000 | 1,200 | 1,600 | 560 | 0.18 [0.06] | 10/10 | 2/2 |
| | 2003 | 1,800 | 2,000 | 4,700 | 790 | 23 [7.5] | 10/10 | 2/2 |
| | 2004 | 980 | 1,300 | 2,200 | 410 | 14 [4.6] | 10/10 | 2/2 |
| | 2005 | 1,000 | 1,100 | 2,500 | 400 | 11 [3.8] | 10/10 | 2/2 |
| | 2006 | 970 | 1,100 | 2,100 | 490 | 3 [1] | 10/10 | 2/2 |
| | 2007 | 960 | 1,100 | 2,000 | 420 | 7 [3] | 10/10 | 2/2 |
| | 2008 | 880 | 1,100 | 2,500 | 240 | 7 [3] | 10/10 | 2/2 |
| | 2009 | 850 | 910 | 1,500 | 400 | 4 [2] | 10/10 | 2/2 |
| | 2010 | 970 | --- | 1,900 | 500 | 5 [2] | 2/2 | 2/2 |
| | 2011 | --- | --- | 460 | 460 | 4 [1] | 1/1 | 1/1 |
| | 2012 | 840 | --- | 1,500 | 470 | 8.4 [2.8] | 2/2 | 2/2 |
| | 2013 | 3,900 | --- | 5,200 | 2,900 | 31 [10] | 2/2 | 2/2 |
| | 2014 | 420 | --- | 5,600 | 32 | 10 [3] | 2/2 | 2/2 |
| | 2015 | --- | --- | 760 | 760 | 20 [6.5] | 1/1 | 1/1 |
| | 2016 | 1,700 | --- | 5,300 | 550 | 8.1 [2.7] | 2/2 | 2/2 |
| | 2017 | 1,100 | --- | 4,900 | 230 | 3.9 [1.3] | 2/2 | 2/2 |
| | 2018 | 2,800 | --- | 3,100 | 2,600 | 3.3 [1.1] | 2/2 | 2/2 |
| | 2019 | --- | --- | 3,200 | 3,200 | 3 [1] | 1/1 | 1/1 |
| | 2020 | --- | --- | 2,900 | 2,900 | 3 [1] | 1/1 | 1/1 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived during FY2002~2009.

(Note 2) " ** " indicates there is no consistency between the results of the ornithological survey after FY2013 and those in previous years because of the changes in the survey sites and target species.

<Air>

The presence of the substance in air was monitored at 37 sites, and it was detected at all 37 valid sites adopting the detection limit of 0.1pg/m$^3$, and the detection range was 63 ~ 370pg/m$^3$.

Stocktaking of the detection of Hexachlorobenzene in air during FY2002~2020

| HCB | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air ($pg/m^3$) | 2002 | 99 | 93 | 3,000 | 57 | 0.9 [0.3] | 102/102 | 34/34 |
| | 2003 Warm season | 150 | 130 | 430 | 81 | 2.3 [0.78] | 35/35 | 35/35 |
| | 2003 Cold season | 94 | 90 | 320 | 64 | | 34/34 | 34/34 |
| | 2004 Warm season | 130 | 130 | 430 | 47 | 1.1 [0.37] | 37/37 | 37/37 |
| | 2004 Cold season | 98 | 89 | 390 | 51 | | 37/37 | 37/37 |
| | 2005 Warm season | 88 | 90 | 250 | 27 | 0.14 [0.034] | 37/37 | 37/37 |
| | 2005 Cold season | 77 | 68 | 180 | 44 | | 37/37 | 37/37 |
| | 2006 Warm season | 83 | 89 | 210 | 23 | 0.21 [0.07] | 37/37 | 37/37 |
| | 2006 Cold season | 65 | 74 | 170 | 8.2 | | 37/37 | 37/37 |
| | 2007 Warm season | 110 | 100 | 230 | 72 | 0.09 [0.03] | 24/24 | 24/24 |
| | 2007 Cold season | 77 | 72 | 120 | 55 | | 22/22 | 22/22 |
| | 2008 Warm season | 120 | 110 | 260 | 78 | 0.22 [0.08] | 22/22 | 22/22 |
| | 2008 Cold season | 87 | 83 | 160 | 58 | | 36/36 | 36/36 |
| | 2009 Warm season | 110 | 110 | 210 | 78 | 0.6 [0.2] | 34/34 | 34/34 |
| | 2009 Cold season | 87 | 87 | 150 | 59 | | 34/34 | 34/34 |
| | 2010 Warm season | 120 | 120 | 160 | 73 | 1.8 [0.7] | 37/37 | 37/37 |
| | 2010 Cold season | 100 | 96 | 380 | 56 | | 37/37 | 37/37 |
| | 2011 Warm season | 120 | 110 | 180 | 87 | 2.3 [0.75] | 35/35 | 35/35 |
| | 2011 Cold season | 96 | 96 | 160 | 75 | | 37/37 | 37/37 |
| | 2012 Warm season | 120 | 110 | 150 | 84 | 4.3 [1.4] | 36/36 | 36/36 |
| | 2012 Cold season | 97 | 95 | 150 | 68 | | 36/36 | 36/36 |
| | 2013 Warm season | 110 | 110 | 180 | 52 | 3.8 [1.3] | 36/36 | 36/36 |
| | 2013 Cold season | 97 | 97 | 180 | 73 | | 36/36 | 36/36 |
| | 2014 Warm season | 150 | 160 | 240 | 84 | 1.4 [0.5] | 36/36 | 36/36 |
| | 2015 Warm season | 120 | 130 | 170 | 74 | 0.5 [0.2] | 35/35 | 35/35 |
| | 2016 Warm season | 130 | 130 | 220 | 79 | 0.8 [0.3] | 37/37 | 37/37 |
| | 2017 Warm season | 130 | 120 | 550 | 73 | 0.5 [0.2] | 37/37 | 37/37 |
| | 2018 Warm season | 100 | 100 | 140 | 72 | 0.4 [0.2] | 37/37 | 37/37 |
| | 2019 Warm season | 96 | 99 | 130 | 67 | 0.14 [0.06] | 36/36 | 36/36 |
| | 2020 Warm season | 100 | 94 | 370 | 63 | 0.3 [0.1] | 37/37 | 37/37 |

## [3] Aldrin (references)

・ History and state of monitoring

Aldrin had been used as a soil insecticide until FY1971 when the application of the substance was substantially stopped. Its registration under the Agricultural Chemicals Regulation Law was expired in FY1975. It was designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in October 1981. Also the substance is the initial POPs under the Stockholm Convention since 2004.

In previous monitoring series until FY2001, the substance was monitored in wildlife (bivalves, fish and birds) during the period of FY1978~1989, FY1991 and FY1993 under the framework of "the Wildlife Monitoring."

Under the framework of the Environmental Monitoring, the substance had been monitored in surface water, sediment, wildlife (bivalves, fish and birds) and air from FY2002 to FY2009, in wildlife (bivalves, fish and birds) and air in FY2014, in sediment in FY2018.

No monitoring was conducted in FY2019. For reference, the monitoring results up to FY2018 are given below.

・ Monitoring results until FY2018

<Surface Water>

Stocktaking of the detection of Aldrin in surface water during FY2002~2009

| Aldrin | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2002 | 0.8 | 0.9 | 18 | nd | 0.6 [0.2] | 93/114 | 37/38 |
| | 2003 | 0.9 | 0.9 | 3.8 | nd | 0.6 [0.2] | 34/36 | 34/36 |
| | 2004 | tr(1.5) | tr(1.8) | 13 | nd | 2 [0.4] | 33/38 | 33/38 |
| | 2005 | tr(0.6) | tr(0.7) | 5.7 | nd | 0.9 [0.3] | 32/47 | 32/47 |
| | 2006 | nd | nd | 4.4 | nd | 1.7 [0.6] | 18/48 | 18/48 |
| | 2007 | tr(0.6) | tr(0.6) | 9.5 | nd | 1.0 [0.3] | 34/48 | 34/48 |
| | 2008 | tr(0.8) | tr(0.7) | 21 | nd | 1.4 [0.6] | 26/48 | 26/48 |
| | 2009 | 0.7 | 0.9 | 22 | nd | 0.7 [0.3] | 32/49 | 32/49 |

(Note) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2002.

<Sediment>

Stocktaking of the detection of Aldrin in sediment during FY2002~2018

| Aldrin | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2002 | 14 | 12 | 570 | nd | 6 [2] | 149/189 | 56/63 |
| | 2003 | 19 | 18 | 1,000 | nd | 2 [0.6] | 178/186 | 60/62 |
| | 2004 | 10 | 10 | 390 | nd | 2 [0.6] | 170/189 | 62/63 |
| | 2005 | 8.4 | 7.1 | 500 | nd | 1.4 [0.5] | 173/189 | 62/63 |
| | 2006 | 10 | 9.3 | 330 | nd | 1.9 [0.6] | 184/192 | 64/64 |
| | 2007 | 7.5 | 6.7 | 330 | nd | 1.8 [0.6] | 172/192 | 60/64 |
| | 2008 | 6 | 6 | 370 | nd | 3 [1] | 153/192 | 56/64 |
| | 2009 | 8.9 | 7.8 | 540 | nd | 0.5 [0.2] | 180/192 | 64/64 |
| | 2018 | 3.7 | 3.8 | 270 | nd | 1.6 [0.6] | 50/61 | 50/61 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived during FY2002~2009.

(Note 2) No monitoring was conducted in FY2010 ~2017.

<Wildlife>

Stocktaking of the detection of Aldrin in wildlife (bivalves, fish and birds) during FY2002~2014

| Aldrin | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2002 | tr(1.6) | nd | 34 | nd | 4.2 [1.4] | 12/38 | 4/8 |
| | 2003 | tr(1.7) | tr(0.85) | 51 | nd | 2.5 [0.84] | 15/30 | 3/6 |
| | 2004 | tr(2.5) | tr(1.6) | 46 | nd | 4.0 [1.3] | 16/31 | 4/7 |
| | 2005 | tr(1.8) | nd | 84 | nd | 3.5 [1.2] | 11/31 | 3/7 |
| | 2006 | tr(2) | nd | 19 | nd | 4 [2] | 11/31 | 3/7 |
| | 2007 | tr(2) | nd | 26 | nd | 5 [2] | 5/31 | 2/7 |
| | 2008 | tr(2) | nd | 20 | nd | 5 [2] | 5/31 | 3/7 |
| | 2009 | tr(1.6) | tr(0.8) | 89 | nd | 2.1 [0.8] | 16/31 | 6/7 |
| | 2014 | nd | nd | nd | nd | 1.8 [0.7] | 0/3 | 0/3 |
| Fish (pg/g-wet) | 2002 | nd | nd | tr(2.0) | nd | 4.2 [1.4] | 1/70 | 1/14 |
| | 2003 | nd | nd | tr(1.9) | nd | 2.5 [0.84] | 16/70 | 7/14 |
| | 2004 | nd | nd | tr(2.4) | nd | 4.0 [1.3] | 5/70 | 2/14 |
| | 2005 | nd | nd | 6.4 | nd | 3.5 [1.2] | 11/80 | 5/16 |
| | 2006 | nd | nd | tr(2) | nd | 4 [2] | 2/80 | 2/16 |
| | 2007 | nd | nd | tr(2) | nd | 5 [2] | 2/80 | 2/16 |
| | 2008 | nd | nd | tr(2) | nd | 5 [2] | 1/85 | 1/17 |
| | 2009 | nd | nd | 3.1 | nd | 2.1 [0.8] | 22/90 | 7/18 |
| | 2014 | nd | nd | 2.4 | nd | 1.8 [0.7] | 4/19 | 4/19 |
| Birds** (pg/g-wet) | 2002 | nd | nd | nd | nd | 4.2 [1.4] | 0/10 | 0/2 |
| | 2003 | nd | nd | nd | nd | 2.5 [0.84] | 0/10 | 0/2 |
| | 2004 | nd | nd | nd | nd | 4.0 [1.3] | 0/10 | 0/2 |
| | 2005 | nd | nd | nd | nd | 3.5 [1.2] | 0/10 | 0/2 |
| | 2006 | nd | nd | nd | nd | 4 [2] | 0/10 | 0/2 |
| | 2007 | nd | nd | nd | nd | 5 [2] | 0/10 | 0/2 |
| | 2008 | nd | nd | nd | nd | 5 [2] | 0/10 | 0/2 |
| | 2009 | nd | nd | nd | nd | 2.1 [0.8] | 0/10 | 0/2 |
| | 2014 | nd | --- | nd | nd | 1.8 [0.7] | 0/2 | 0/2 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived during FY2002~2009.

(Note 2) “ ** ” indicates there is no consistency between the results of the ornithological survey in FY2014 and those in previous years because of the changes in the survey sites and target species.

(Note 3) No monitoring was conducted during FY2010~2013.

<Air>

Stocktaking of the detection of Aldrin in air during FY2002~2014

| Aldrin | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Site |
|---|---|---|---|---|---|---|---|---|
| Air (pg/m$^3$) | 2002 | tr(0.030) | nd | 3.2 | nd | 0.060 [0.020] | 41/102 | 19/34 |
| | 2003 Warm season | 1.5 | 1.9 | 28 | nd | 0.023 [0.0077] | 34/35 | 34/35 |
| | 2003 Cold season | 0.55 | 0.44 | 6.9 | 0.030 | | 34/34 | 34/34 |
| | 2004 Warm season | tr(0.12) | nd | 14 | nd | 0.15 [0.05] | 15/37 | 15/37 |
| | 2004 Cold season | tr(0.08) | nd | 13 | nd | | 14/37 | 14/37 |
| | 2005 Warm season | 0.33 | 0.56 | 10 | nd | 0.08 [0.03] | 29/37 | 29/37 |
| | 2005 Cold season | tr(0.04) | nd | 1.8 | nd | | 9/37 | 9/37 |
| | 2006 Warm season | 0.30 | 0.35 | 8.5 | nd | 0.14 [0.05] | 31/37 | 31/37 |
| | 2006 Cold season | tr(0.05) | nd | 1.1 | nd | | 16/37 | 16/37 |
| | 2007 Warm season | 0.58 | 0.48 | 19 | nd | 0.05 [0.02] | 35/36 | 35/36 |
| | 2007 Cold season | 0.14 | 0.15 | 2.1 | nd | | 34/36 | 34/36 |
| | 2008 Warm season | 0.27 | 0.30 | 9.4 | tr(0.02) | 0.04 [0.02] | 25/25 | 25/25 |
| | 2008 Cold season | 0.09 | 0.08 | 1.3 | nd | | 22/25 | 22/25 |
| | 2009 Warm season | 0.07 | nd | 10 | nd | 0.04 [0.02] | 10/25 | 10/25 |
| | 2009 Cold season | tr(0.03) | nd | 1.8 | nd | | 8/24 | 8/24 |
| | 2014 Warm season | nd | nd | 17 | nd | 12 [4] | 6/34 | 6/34 |

(Note) No monitoring was conducted during FY2010~2013.

## [4] Dieldrin (references)

・ History and state of monitoring

Dieldrin was used as a pesticide and its application culminated during the period of 1955~1964. The substance had been used as termitecides as a Soil-Residue-Prone Pesticide under the Agricultural Chemicals Regulation Law in 1971, but its registration under the Agricultural Chemicals Regulation Law was expired in FY1975. It had been used for termite control and was designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in October 1981. Also the substance is one of the original twelve POPs covered by the Stockholm Convention.

In previous monitoring series until FY2001, the substance was monitored in wildlife (bivalves, fish and birds) during the period of FY1978~1996, FY1998, FY2000 and FY2001 under the framework of "the Wildlife Monitoring." Under the framework of "the Surface Water/Sediment Monitoring," the substance in surface water and sediment was monitored during the period of FY1986~1998 and FY1986~2001, respectively.

Under the framework of the Environmental Monitoring, the substance had been monitored in surface water, sediment, wildlife (bivalves, fish and birds) and air from FY2002 to FY2009 and in FY2011 and in surface water, wildlife (bivalves, fish and birds) and air in FY2014, in sediment in FY2018.

No monitoring was conducted after FY2019. For reference, the monitoring results up to FY2018 are given below.

・ Monitoring results until FY2018

<Surface Water>

Stocktaking of the detection of Dieldrin in surface water during FY2002~2014

| Dieldrin | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2002 | 42 | 41 | 940 | 3.3 | 1.8 [0.6] | 114/114 | 38/38 |
| | 2003 | 57 | 57 | 510 | 9.7 | 0.7 [0.3] | 36/36 | 36/36 |
| | 2004 | 55 | 51 | 430 | 9 | 2 [0.5] | 38/38 | 38/38 |
| | 2005 | 39 | 49 | 630 | 4.5 | 1.0 [0.34] | 47/47 | 47/47 |
| | 2006 | 36 | 32 | 800 | 6 | 3 [1] | 48/48 | 48/48 |
| | 2007 | 38 | 36 | 750 | 3.1 | 2.1 [0.7] | 48/48 | 48/48 |
| | 2008 | 36 | 37 | 450 | 3.6 | 1.5 [0.6] | 48/48 | 48/48 |
| | 2009 | 36 | 32 | 650 | 2.7 | 0.6 [0.2] | 49/49 | 49/49 |
| | 2011 | 33 | 38 | 300 | 2.1 | 1.6 [0.6] | 49/49 | 49/49 |
| | 2014 | 28 | 27 | 200 | 2.7 | 0.5 [0.2] | 48/48 | 48/48 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2002.
(Note 2) No monitoring was conducted in FY2010, FY2012 and FY2013.

<Sediment>

Stocktaking of the detection of Dieldrin in sediment during FY2002~2018

| Dieldrin | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2002 | 70 | 51 | 2,300 | 4 | 3 [1] | 189/189 | 63/63 |
| | 2003 | 66 | 56 | 9,100 | nd | 4 [2] | 184/186 | 62/62 |
| | 2004 | 65 | 62 | 3,700 | tr(1.9) | 3 [0.9] | 189/189 | 63/63 |
| | 2005 | 61 | 55 | 4,200 | tr(2) | 3 [1] | 189/189 | 63/63 |
| | 2006 | 61 | 54 | 1,500 | tr(1.7) | 2.9 [1.0] | 192/192 | 64/64 |
| | 2007 | 49 | 40 | 2,700 | tr(1.2) | 2.7 [0.9] | 192/192 | 64/64 |
| | 2008 | 48 | 43 | 2,900 | tr(0.7) | 1.2 [0.5] | 192/192 | 64/64 |
| | 2009 | 51 | 47 | 3,000 | 1.1 | 0.8 [0.3] | 192/192 | 64/64 |
| | 2011 | 47 | 44 | 2,200 | 2 | 5 [2] | 64/64 | 64/64 |
| | 2018 | 33 | 33 | 860 | nd | 1.6 [0.6] | 60/61 | 60/61 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived during FY2002~2009.
(Note 2) No monitoring was conducted in FY2010.

<Wildlife>

Stocktaking of the detection of Dieldrin in wildlife (bivalves, fish and birds) during FY2002~2014

| Dieldrin | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2002 | 440 | 390 | 190,000 | tr(7) | 12 [4] | 38/38 | 8/8 |
| | 2003 | 440 | 160 | 78,000 | 46 | 4.8 [1.6] | 30/30 | 6/6 |
| | 2004 | 630 | 270 | 69,000 | 42 | 31 [10] | 31/31 | 7/7 |
| | 2005 | 500 | 140 | 39,000 | 34 | 9.4 [3.4] | 31/31 | 7/7 |
| | 2006 | 450 | 120 | 47,000 | 30 | 7 [3] | 31/31 | 7/7 |
| | 2007 | 380 | 110 | 77,000 | 37 | 9 [3] | 31/31 | 7/7 |
| | 2008 | 430 | 150 | 24,000 | 47 | 9 [3] | 31/31 | 7/7 |
| | 2009 | 490 | 230 | 28,000 | 48 | 7 [2] | 31/31 | 7/7 |
| | 2011 | 390 | 690 | 3,800 | 16 | 3 [1] | 4/4 | 4/4 |
| | 2014 | 180 | 300 | 490 | 41 | 3 [1] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2002 | 290 | 270 | 2,400 | 46 | 12 [4] | 70/70 | 14/14 |
| | 2003 | 220 | 200 | 1,000 | 29 | 4.8 [1.6] | 70/70 | 14/14 |
| | 2004 | 250 | 230 | 2,800 | tr(23) | 31 [10] | 70/70 | 14/14 |
| | 2005 | 230 | 250 | 1,400 | 21 | 9.4 [3.4] | 80/80 | 16/16 |
| | 2006 | 230 | 220 | 1,400 | 19 | 7 [3] | 80/80 | 16/16 |
| | 2007 | 250 | 210 | 1,900 | 23 | 9 [3] | 80/80 | 16/16 |
| | 2008 | 240 | 240 | 1,300 | 15 | 9 [3] | 85/85 | 17/17 |
| | 2009 | 240 | 190 | 1,400 | 29 | 7 [2] | 90/90 | 18/18 |
| | 2011 | 270 | 340 | 1,100 | 17 | 3 [1] | 18/18 | 18/18 |
| | 2014 | 270 | 310 | 1,000 | 27 | 3 [1] | 19/19 | 19/19 |
| Birds** (pg/g-wet) | 2002 | 1,100 | 1,100 | 1,700 | 820 | 12 [4] | 10/10 | 2/2 |
| | 2003 | 1,300 | 1,400 | 2,200 | 790 | 4.8 [1.6] | 10/10 | 2/2 |
| | 2004 | 600 | 610 | 960 | 370 | 31 [10] | 10/10 | 2/2 |
| | 2005 | 830 | 740 | 1,800 | 500 | 9.4 [3.4] | 10/10 | 2/2 |
| | 2006 | 700 | 690 | 1,300 | 440 | 7 [3] | 10/10 | 2/2 |
| | 2007 | 710 | 710 | 910 | 560 | 9 [3] | 10/10 | 2/2 |
| | 2008 | 680 | 620 | 1,300 | 260 | 9 [3] | 10/10 | 2/2 |
| | 2009 | 470 | 420 | 890 | 330 | 7 [2] | 10/10 | 2/2 |
| | 2011 | --- | --- | 770 | 770 | 3 [1] | 1/1 | 1/1 |
| | 2014 | 320 | --- | 530 | 190 | 3 [1] | 2/2 | 2/2 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived during FY2002~2009.
(Note 2) " ** " indicates there is no consistency between the results of the ornithological survey in FY2014 and those in previous years because of the changes in the survey sites and target species.
(Note 3) No monitoring was conducted in FY2010, FY2012 and FY2013.

<Air>

Stocktaking of the detection of Dieldrin in air during FY2002~2014

| Dieldrin | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air (pg/m³) | 2002 | 5.6 | 5.4 | 110 | 0.73 | 0.60 [0.20] | 102/102 | 34/34 |
| | 2003 Warm season | 19 | 22 | 260 | 2.1 | 2.1 [0.70] | 35/35 | 35/35 |
| | 2003 Cold season | 5.7 | 5.2 | 110 | tr(0.82) | | 34/34 | 34/34 |
| | 2004 Warm season | 17 | 22 | 280 | 1.1 | 0.33 [0.11] | 37/37 | 37/37 |
| | 2004 Cold season | 5.5 | 6.9 | 76 | 0.81 | | 37/37 | 37/37 |
| | 2005 Warm season | 14 | 12 | 200 | 1.5 | 0.54 [0.24] | 37/37 | 37/37 |
| | 2005 Cold season | 3.9 | 3.6 | 50 | 0.88 | | 37/37 | 37/37 |
| | 2006 Warm season | 15 | 14 | 290 | 1.5 | 0.3 [0.1] | 37/37 | 37/37 |
| | 2006 Cold season | 4.5 | 4.2 | 250 | 0.7 | | 37/37 | 37/37 |
| | 2007 Warm season | 19 | 22 | 310 | 1.3 | 0.18 [0.07] | 36/36 | 36/36 |
| | 2007 Cold season | 4.5 | 3.7 | 75 | 0.96 | | 36/36 | 36/36 |
| | 2008 Warm season | 14 | 16 | 220 | 1.6 | 0.24 [0.09] | 37/37 | 37/37 |
| | 2008 Cold season | 4.9 | 3.8 | 72 | 0.68 | | 37/37 | 37/37 |
| | 2009 Warm season | 13 | 13 | 150 | 0.91 | 0.06 [0.02] | 37/37 | 37/37 |
| | 2009 Cold season | 4.5 | 4.0 | 80 | 0.52 | | 37/37 | 37/37 |
| | 2011 Warm season | 12 | 15 | 230 | 0.80 | 0.42 [0.14] | 35/35 | 35/35 |
| | 2011 Cold season | 4.3 | 4.9 | 96 | 0.52 | | 37/37 | 37/37 |
| | 2014 Warm season | 11 | 9.9 | 160 | 0.89 | 0.34 [0.11] | 36/36 | 36/36 |

(Note) No monitoring was conducted in FY2010, FY2012 and FY2013.

## [5] Endrin (references)

・ History and state of monitoring

Endrin was used as an insecticide and a rodenticide, but its registration under the Agricultural Chemicals Regulation Law was expired in FY1975. It was designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in October 1981. Also the substance is one of the original twelve POPs covered by the Stockholm Convention.

In previous monitoring series until FY2001, the substance was monitored in wildlife (bivalves, fish and birds) during the periods of FY1978~1989 and FY1991~1993 under the framework of "the Wildlife Monitoring".

Under the framework of the Environmental Monitoring, the substance has been monitored in surface water, sediment, wildlife (bivalves, fish and birds) and air from FY2002 to FY2009, and in surface water, wildlife (bivalves, fish and birds) and air in FY2014, in sediment in FY2018.

No monitoring was conducted after FY2019. For reference, the monitoring results up to FY2018 are given below.

・ Monitoring results until FY2018

<Surface Water>

Stocktaking of the detection of Endrin in surface water during FY2002~2014

| Endrin | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2002 | tr(4.8) | tr(5.5) | 31 | nd | 6.0 [2.0] | 101/114 | 36/38 |
| | 2003 | 5.7 | 6.0 | 78 | 0.7 | 0.7 [0.3] | 36/36 | 36/36 |
| | 2004 | 7 | 7 | 100 | tr(0.7) | 2 [0.5] | 38/38 | 38/38 |
| | 2005 | 4.0 | 4.5 | 120 | nd | 1.1 [0.4] | 45/47 | 45/47 |
| | 2006 | 3.1 | 3.5 | 26 | nd | 1.3 [0.4] | 44/48 | 44/48 |
| | 2007 | 3.5 | 3.4 | 25 | nd | 1.9 [0.6] | 46/48 | 46/48 |
| | 2008 | 3 | 4 | 20 | nd | 3 [1] | 45/48 | 45/48 |
| | 2009 | 2.0 | 2.3 | 67 | nd | 0.7 [0.3] | 39/49 | 39/49 |
| | 2011 | 3.8 | 4.6 | 71 | nd | 1.6 [0.6] | 47/49 | 47/49 |
| | 2014 | 2.5 | 2.2 | 25 | tr(0.4) | 0.5 [0.2] | 48/48 | 48/48 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2002.

(Note 2) No monitoring was conducted in FY2010, FY2012 and FY2013.

<Sediment>

Stocktaking of the detection of Endrin in sediment during FY2002~2018

| Endrin | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2002 | 10 | 10 | 19,000 | nd | 6 [2] | 141/189 | 54/63 |
| | 2003 | 12 | 11 | 29,000 | nd | 5 [2] | 150/186 | 53/62 |
| | 2004 | 15 | 13 | 6,900 | nd | 3 [0.9] | 182/189 | 63/63 |
| | 2005 | 12 | 11 | 19,000 | nd | 2.6 [0.9] | 170/189 | 61/63 |
| | 2006 | 12 | 10 | 61,000 | nd | 4 [1] | 178/192 | 63/64 |
| | 2007 | 11 | 9 | 61,000 | nd | 5 [2] | 151/192 | 55/64 |
| | 2008 | 11 | 11 | 38,000 | nd | 1.9 [0.7] | 168/192 | 61/64 |
| | 2009 | 9.6 | 8.4 | 11,000 | nd | 1.6 [0.6] | 168/192 | 63/64 |
| | 2011 | 8.8 | 14 | 1,100 | nd | 1.1 [0.4] | 59/64 | 59/64 |
| | 2018 | 6.4 | 5.9 | 7,500 | nd | 2.4 [0.9] | 48/61 | 48/61 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived during FY2002~2009.

(Note 2) No monitoring was conducted in FY2010, FY2012~2017.

<Wildlife>

Stocktaking of the detection of Endrin in wildlife (bivalves, fish and birds) during FY2002~2014

| Endrin | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2002 | 42 | 27 | 12,000 | nd | 18 [6] | 35/38 | 7/8 |
| | 2003 | 38 | 21 | 5,000 | 6.3 | 4.8 [1.6] | 30/30 | 6/6 |
| | 2004 | 65 | 25 | 4,600 | tr(5.7) | 12 [4.2] | 31/31 | 7/7 |
| | 2005 | 39 | 19 | 2,100 | nd | 17 [5.5] | 27/31 | 7/7 |
| | 2006 | 40 | 15 | 3,100 | tr(5) | 11 [4] | 31/31 | 7/7 |
| | 2007 | 28 | 12 | 3,000 | tr(6) | 9 [3] | 31/31 | 7/7 |
| | 2008 | 30 | 10 | 1,500 | tr(6) | 8 [3] | 31/31 | 7/7 |
| | 2009 | 38 | 19 | 1,400 | tr(5) | 7 [3] | 31/31 | 7/7 |
| | 2011 | 33 | 62 | 110 | tr(3) | 4 [2] | 4/4 | 4/4 |
| | 2014 | 23 | 17 | 84 | 8 | 3 [1] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2002 | 20 | 24 | 180 | nd | 18 [6] | 54/70 | 13/14 |
| | 2003 | 14 | 10 | 180 | nd | 4.8 [1.6] | 67/70 | 14/14 |
| | 2004 | 18 | 24 | 220 | nd | 12 [4.2] | 57/70 | 13/14 |
| | 2005 | 19 | tr(16) | 2,100 | nd | 17 [5.5] | 58/80 | 12/16 |
| | 2006 | 13 | tr(10) | 150 | nd | 11 [4] | 66/80 | 16/16 |
| | 2007 | 13 | 12 | 170 | nd | 9 [3] | 69/80 | 15/16 |
| | 2008 | 11 | 10 | 200 | nd | 8 [3] | 63/85 | 14/17 |
| | 2009 | 17 | 12 | 270 | nd | 7 [3] | 86/90 | 18/18 |
| | 2011 | 18 | 19 | 160 | nd | 4 [2] | 16/18 | 16/18 |
| | 2014 | 16 | 16 | 140 | nd | 3 [1] | 18/19 | 18/19 |
| Birds** (pg/g-wet) | 2002 | 28 | 52 | 99 | nd | 18 [6] | 7/10 | 2/2 |
| | 2003 | 22 | 30 | 96 | 5.4 | 4.8 [1.6] | 10/10 | 2/2 |
| | 2004 | tr(11) | 25 | 62 | nd | 12 [4.2] | 5/10 | 1/2 |
| | 2005 | 18 | 28 | 64 | nd | 17 [5.5] | 7/10 | 2/2 |
| | 2006 | 16 | 23 | 57 | tr(4) | 11 [4] | 10/10 | 2/2 |
| | 2007 | 17 | 28 | 55 | nd | 9 [3] | 9/10 | 2/2 |
| | 2008 | 10 | 26 | 83 | nd | 8 [3] | 5/10 | 1/2 |
| | 2009 | 11 | 17 | 43 | tr(3) | 7 [3] | 10/10 | 2/2 |
| | 2011 | --- | --- | tr(3) | tr(3) | 4 [2] | 1/1 | 1/1 |
| | 2014 | 4 | --- | 5 | 4 | 3 [1] | 2/2 | 2/2 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived during FY2002~2009.

(Note 2) “ ** ” indicates there is no consistency between the results of the ornithological survey in FY2014 and those in previous years because of the changes in the survey sites and target species.

(Note 3) No monitoring was conducted in FY2010, FY2012 and FY2013.

<Air>

Stocktaking of the detection of Endrin in air during FY2002~2014

| Endrin | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Site |
|---|---|---|---|---|---|---|---|---|
| Air ($pg/m^3$) | 2002 | 0.22 | 0.28 | 2.5 | nd | 0.090 [0.030] | 90/102 | 32/34 |
| | 2003 Warm season | 0.74 | 0.95 | 6.2 | 0.081 | 0.042 [0.014] | 35/35 | 35/35 |
| | 2003 Cold season | 0.23 | 0.20 | 2.1 | 0.042 | | 34/34 | 34/34 |
| | 2004 Warm season | 0.64 | 0.68 | 6.5 | tr(0.054) | 0.14 [0.048] | 37/37 | 37/37 |
| | 2004 Cold season | 0.23 | 0.26 | 1.9 | nd | | 36/37 | 36/37 |
| | 2005 Warm season | tr(0.4) | tr(0.3) | 2.9 | nd | 0.5 [0.2] | 27/37 | 27/37 |
| | 2005 Cold season | nd | nd | 0.7 | nd | | 8/37 | 8/37 |
| | 2006 Warm season | 0.31 | 0.32 | 5.4 | nd | 0.30 [0.10] | 32/37 | 32/37 |
| | 2006 Cold season | nd | nd | 5.0 | nd | | 7/37 | 7/37 |
| | 2007 Warm season | 0.69 | 0.73 | 6.3 | tr(0.06) | 0.09 [0.04] | 36/36 | 36/36 |
| | 2007 Cold season | 0.16 | 0.13 | 1.5 | nd | | 33/36 | 33/36 |
| | 2008 Warm season | 0.53 | 0.68 | 4.6 | tr(0.06) | 0.10 [0.04] | 37/37 | 37/37 |
| | 2008 Cold season | 0.18 | 0.18 | 1.8 | nd | | 35/37 | 35/37 |
| | 2009 Warm season | 0.49 | 0.51 | 3.4 | nd | 0.09 [0.04] | 36/37 | 36/37 |
| | 2009 Cold season | 0.17 | 0.15 | 1.8 | nd | | 36/37 | 36/37 |
| | 2011 Warm season | 0.46 | 0.62 | 5.1 | nd | 0.09 [0.04] | 34/35 | 34/35 |
| | 2011 Cold season | 0.16 | 0.16 | 1.8 | nd | | 33/37 | 33/37 |
| | 2014 Warm season | 0.39 | 0.48 | 2.9 | nd | 0.20 [0.07] | 32/36 | 32/36 |

(Note) No monitoring was conducted in FY2010, FY2012 and FY2013.

## [6] DDTs (references)

・ History and state of monitoring

DDT, along with hexachlorocyclohexanes (HCHs) and drins, was used as insecticides in high volume. Its registration under the Agricultural Chemicals Regulation Law was expired in FY1971. *p,p'*-DDT was designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in October 1981. Also the substances are one of the original twelve POPs covered by the Stockholm Convention.

Among several DDT isomers with chlorine at various positions on the aromatic ring, not only *p,p'*-DDT and *o,p'*-DDT as active substances but also *p,p'*-DDE, *o,p'*-DDE, *p,p'*-DDD and *o,p'*-DDD as the environmentally degraded products of DDTs have been the target chemicals in monitoring series since FY1978.

In previous monitoring series, *p,p'*-DDT, *p,p'*-DDE and *p,p'*-DDD had been monitored in wildlife (bivalves, fish and birds) during the period of FY1978~2001 under the framework of "the Wildlife Monitoring." Under the framework of "the Surface Water/Sediment Monitoring," surface water and sediment had been the monitored media during the period of FY1986~1998 and FY1986~2001, respectively. Similarly, *o,p'*-DDT, *o,p'*-DDE and *o,p'*-DDD had been monitored in wildlife (bivalves, fish and birds) during the period of FY1978~1996 and in FY1998, FY2000 and FY2001 under the framework of "the Wildlife Monitoring."

Under the framework of the Environmental Monitoring, *p,p'*-DDT, *p,p'*-DDE, *p,p'*-DDD, *o,p'*-DDT, *o,p'*-DDE and *o,p'*-DDD have been monitored in surface water, sediment, wildlife (bivalves, fish and birds) and air from FY2002 to FY2010, wildlife (bivalves, fish and birds) and air in FY2013, surface water and sediment in FY2014 and air in FY2015, wildlife (bivalves, fish and birds) and air in FY2018.

No monitoring was conducted after FY2019. For reference, the monitoring results up to FY2018 are given below.

・ Monitoring results until FY2018

○ *p,p'*-DDT, *p,p'*-DDE and *p,p'*-DDD

<Surface Water>

Stocktaking of the detection of *p,p'*-DDT, *p,p'*-DDE and *p,p'*-DDD in surface water during FY2002~2014

| *p,p'*-DDT | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Surface Water (pg/L) | 2002 | 13 | 11 | 440 | 0.25 | 0.6 [0.2] | 114/114 | 38/38 |
| | 2003 | 14 | 12 | 740 | tr(2.8) | 3 [0.9] | 36/36 | 36/36 |
| | 2004 | 15 | 14 | 310 | nd | 6 [2] | 36/38 | 36/38 |
| | 2005 | 8 | 9 | 110 | 1 | 4 [1] | 47/47 | 47/47 |
| | 2006 | 9.1 | 9.2 | 170 | tr(1.6) | 1.9 [0.6] | 48/48 | 48/48 |
| | 2007 | 7.3 | 9.1 | 670 | nd | 1.7 [0.6] | 46/48 | 46/48 |
| | 2008 | 11 | 11 | 1,200 | nd | 1.2 [0.5] | 47/48 | 47/48 |
| | 2009 | 9.2 | 8.4 | 440 | 0.81 | 0.15 [0.06] | 49/49 | 49/49 |
| | 2010 | 8.5 | 7.6 | 7,500 | tr(1.0) | 2.4 [0.8] | 49/49 | 49/49 |
| | 2014 | 4.4 | 3.9 | 380 | nd | 0.4 [0.1] | 47/48 | 47/48 |
| ***p,p'*-DDE** | **Monitored year** | **Geometric mean*** | **Median** | **Maximum** | **Minimum** | **Quantification [Detection] limit** | **Detection Frequency Sample** | **Detection Frequency Site** |
| Surface Water (pg/L) | 2002 | 25 | 26 | 760 | 1.3 | 0.6 [0.2] | 114/114 | 38/38 |
| | 2003 | 26 | 22 | 380 | 5 | 4 [2] | 36/36 | 36/36 |
| | 2004 | 36 | 34 | 680 | tr(6) | 8 [3] | 38/38 | 38/38 |
| | 2005 | 26 | 24 | 410 | 4 | 6 [2] | 47/47 | 47/47 |
| | 2006 | 24 | 24 | 170 | tr(4) | 7 [2] | 48/48 | 48/48 |
| | 2007 | 22 | 23 | 440 | tr(2) | 4 [2] | 48/48 | 48/48 |
| | 2008 | 27 | 28 | 350 | 2.5 | 1.1 [0.4] | 48/48 | 48/48 |
| | 2009 | 23 | 23 | 240 | 3.4 | 1.1 [0.4] | 49/49 | 49/49 |
| | 2010 | 14 | 12 | 1,600 | 2.4 | 2.3 [0.8] | 49/49 | 49/49 |
| | 2014 | 16 | 17 | 610 | 1.9 | 0.5 [0.2] | 48/48 | 48/48 |

| *p,p'*-DDD | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2002 | 16 | 18 | 190 | 0.57 | 0.24 [0.08] | 114/114 | 38/38 |
| | 2003 | 19 | 18 | 410 | 4 | 2 [0.5] | 36/36 | 36/36 |
| | 2004 | 19 | 18 | 740 | tr(2.4) | 3 [0.8] | 38/38 | 38/38 |
| | 2005 | 17 | 16 | 130 | tr(1.8) | 1.9 [0.64] | 47/47 | 47/47 |
| | 2006 | 16 | 17 | 99 | 2.0 | 1.6 [0.5] | 48/48 | 48/48 |
| | 2007 | 15 | 12 | 150 | tr(1.5) | 1.7 [0.6] | 48/48 | 48/48 |
| | 2008 | 22 | 20 | 850 | 2.0 | 0.6 [0.2] | 48/48 | 48/48 |
| | 2009 | 14 | 13 | 140 | 1.4 | 0.4 [0.2] | 49/49 | 49/49 |
| | 2010 | 12 | 10 | 970 | 1.6 | 0.20 [0.08] | 49/49 | 49/49 |
| | 2014 | 9.0 | 8.7 | 87 | 1.0 | 1.0 [0.4] | 48/48 | 48/48 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2002.

(Note 2) No monitoring was conducted during FY2011~2013.

<Sediment>

Stocktaking of the detection of *p,p'*-DDT, *p,p'*-DDE and *p,p'*-DDD in sediment during FY2002~2014

| *p,p'*-DDT | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2002 | 380 | 240 | 97,000 | tr(5) | 6 [2] | 189/189 | 63/63 |
| | 2003 | 290 | 220 | 55,000 | 3 | 2 [0.4] | 186/186 | 62/62 |
| | 2004 | 460 | 230 | 98,000 | 7 | 2 [0.5] | 189/189 | 63/63 |
| | 2005 | 360 | 230 | 1,700,000 | 5.1 | 1.0 [0.34] | 189/189 | 63/63 |
| | 2006 | 310 | 240 | 130,000 | 4.5 | 1.4 [0.5] | 192/192 | 64/64 |
| | 2007 | 210 | 150 | 130,000 | 3 | 1.3 [0.5] | 192/192 | 64/64 |
| | 2008 | 270 | 180 | 1,400,000 | 4.8 | 1.2 [0.5] | 192/192 | 64/64 |
| | 2009 | 250 | 170 | 2,100,000 | 1.9 | 1.0 [0.4] | 192/192 | 64/64 |
| | 2010 | 230 | 200 | 220,000 | 9.3 | 2.8 [0.9] | 64/64 | 64/64 |
| | 2014 | 140 | 140 | 12,000 | tr(0.2) | 0.4 [0.2] | 63/63 | 63/63 |

| *p,p'*-DDE | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2002 | 780 | 630 | 23,000 | 8.4 | 2.7 [0.9] | 189/189 | 63/63 |
| | 2003 | 790 | 780 | 80,000 | 9.5 | 0.9 [0.3] | 186/186 | 62/62 |
| | 2004 | 720 | 700 | 39,000 | 8 | 3 [0.8] | 189/189 | 63/63 |
| | 2005 | 710 | 730 | 64,000 | 8.4 | 2.7 [0.94] | 189/189 | 63/63 |
| | 2006 | 710 | 820 | 49,000 | 5.8 | 1.0 [0.3] | 192/192 | 64/64 |
| | 2007 | 670 | 900 | 61,000 | 3.2 | 1.1 [0.4] | 192/192 | 64/64 |
| | 2008 | 920 | 940 | 96,000 | 9.0 | 1.7 [0.7] | 192/192 | 64/64 |
| | 2009 | 700 | 660 | 50,000 | 6.7 | 0.8 [0.3] | 192/192 | 64/64 |
| | 2010 | 680 | 790 | 40,000 | 11 | 5 [2] | 64/64 | 64/64 |
| | 2014 | 530 | 610 | 64,000 | 11 | 1.8 [0.6] | 63/63 | 63/63 |

| *p,p'*-DDD | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2002 | 640 | 690 | 51,000 | tr(2.2) | 2.4 [0.8] | 189/189 | 63/63 |
| | 2003 | 670 | 580 | 32,000 | 3.7 | 0.9 [0.3] | 186/186 | 62/62 |
| | 2004 | 650 | 550 | 75,000 | 4 | 2 [0.7] | 189/189 | 63/63 |
| | 2005 | 600 | 570 | 210,000 | 5.2 | 1.7 [0.64] | 189/189 | 63/63 |
| | 2006 | 560 | 540 | 53,000 | 2.2 | 0.7 [0.2] | 192/192 | 64/64 |
| | 2007 | 520 | 550 | 80,000 | 3.5 | 1.0 [0.4] | 192/192 | 64/64 |
| | 2008 | 740 | 660 | 300,000 | 2.8 | 1.0 [0.4] | 192/192 | 64/64 |
| | 2009 | 540 | 560 | 300,000 | 3.9 | 0.4 [0.2] | 192/192 | 64/64 |
| | 2010 | 510 | 510 | 78,000 | 4.4 | 1.4 [0.5] | 64/64 | 64/64 |
| | 2014 | 330 | 410 | 21,000 | 4.9 | 4.2 [1.4] | 63/63 | 63/63 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived during FY2002~2009.

(Note 2) No monitoring was conducted during FY2011~2013.

<Wildlife>

Stocktaking of the detection of *p,p'*-DDT, *p,p'*-DDE and *p,p'*-DDD in wildlife (bivalves, fish and birds) during FY2002~2018

| *p,p'*-DDT | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2002 | 200 | 200 | 1,200 | 38 | 4.2 [1.4] | 38/38 | 8/8 |
| | 2003 | 290 | 290 | 1,800 | 49 | 11 [3.5] | 30/30 | 6/6 |
| | 2004 | 360 | 340 | 2,600 | 48 | 3.2 [1.1] | 31/31 | 7/7 |
| | 2005 | 240 | 170 | 1,300 | 66 | 5.1 [1.7] | 31/31 | 7/7 |
| | 2006 | 250 | 220 | 1,100 | 56 | 6 [2] | 31/31 | 7/7 |
| | 2007 | 240 | 150 | 1,200 | 49 | 5 [2] | 31/31 | 7/7 |
| | 2008 | 160 | 100 | 1,400 | 12 | 5 [2] | 31/31 | 7/7 |
| | 2009 | 240 | 170 | 9,600 | 46 | 3 [1] | 31/31 | 7/7 |
| | 2010 | 180 | 280 | 470 | 43 | 3 [1] | 6/6 | 6/6 |
| | 2013 | 190 | 210 | 890 | 46 | 3.3 [1.1] | 5/5 | 5/5 |
| | 2018 | 70 | 39 | 280 | 32 | 3 [1] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2002 | 430 | 450 | 24,000 | 6.8 | 4.2 [1.4] | 70/70 | 14/14 |
| | 2003 | 220 | 400 | 1,900 | tr(3.7) | 11 [3.5] | 70/70 | 14/14 |
| | 2004 | 410 | 330 | 53,000 | 5.5 | 3.2 [1.1] | 70/70 | 14/14 |
| | 2005 | 280 | 330 | 8,400 | tr(3.8) | 5.1 [1.7] | 80/80 | 16/16 |
| | 2006 | 300 | 340 | 3,000 | tr(5) | 6 [2] | 80/80 | 16/16 |
| | 2007 | 260 | 320 | 1,800 | 9 | 5 [2] | 80/80 | 16/16 |
| | 2008 | 280 | 310 | 2,900 | 7 | 5 [2] | 85/85 | 17/17 |
| | 2009 | 250 | 300 | 2,000 | 4 | 3 [1] | 90/90 | 18/18 |
| | 2010 | 240 | 280 | 2,100 | 7 | 3 [1] | 18/18 | 18/18 |
| | 2013 | 280 | 250 | 3,300 | 5.2 | 3.3 [1.1] | 19/19 | 19/19 |
| | 2018 | 150 | 150 | 4,800 | tr (2) | 3 [1] | 18/18 | 18/18 |
| Birds** (pg/g-wet) | 2002 | 440 | 510 | 1,300 | 76 | 4.2 [1.4] | 10/10 | 2/2 |
| | 2003 | 610 | 620 | 1,400 | 180 | 11 [3.5] | 10/10 | 2/2 |
| | 2004 | 340 | 320 | 700 | 160 | 3.2 [1.1] | 10/10 | 2/2 |
| | 2005 | 430 | 550 | 900 | 180 | 5.1 [1.7] | 10/10 | 2/2 |
| | 2006 | 580 | 490 | 1,800 | 110 | 6 [2] | 10/10 | 2/2 |
| | 2007 | 480 | 350 | 1,900 | 160 | 5 [2] | 10/10 | 2/2 |
| | 2008 | 160 | 170 | 270 | 56 | 5 [2] | 10/10 | 2/2 |
| | 2009 | 300 | 190 | 2,900 | 85 | 3 [1] | 10/10 | 2/2 |
| | 2010 | 3 | --- | 15 | nd | 3 [1] | 1/2 | 1/2 |
| | 2013 | 14 | --- | 46 | 4.3 | 3.3 [1.1] | 2/2 | 2/2 |
| | 2018 | 43 | --- | 63 | 29 | 3[1] | 2/2 | 2/2 |

| *p,p'*-DDE | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2002 | 1,000 | 1,700 | 6,000 | 140 | 2.4 [0.8] | 38/38 | 8/8 |
| | 2003 | 1,200 | 1,000 | 6,500 | 190 | 5.7 [1.9] | 30/30 | 6/6 |
| | 2004 | 1,300 | 1,400 | 8,400 | 220 | 8.2 [2.7] | 31/31 | 7/7 |
| | 2005 | 1,200 | 1,600 | 6,600 | 230 | 8.5 [2.8] | 31/31 | 7/7 |
| | 2006 | 1,000 | 1,200 | 6,000 | 160 | 1.9 [0.7] | 31/31 | 7/7 |
| | 2007 | 1,100 | 1,200 | 5,600 | 180 | 3 [1] | 31/31 | 7/7 |
| | 2008 | 900 | 1,100 | 5,800 | 120 | 3 [1] | 31/31 | 7/7 |
| | 2009 | 940 | 1,100 | 6,400 | 150 | 4 [1] | 31/31 | 7/7 |
| | 2010 | 1,100 | 1,300 | 6,300 | 230 | 3 [1] | 6/6 | 6/6 |
| | 2013 | 790 | 1,600 | 3,000 | 170 | 4.3 [1.4] | 5/5 | 5/5 |
| | 2018 | 420 | 230 | 2,200 | 150 | 3 [1] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2002 | 2,900 | 2,200 | 98,000 | 510 | 2.4 [0.8] | 70/70 | 14/14 |
| | 2003 | 2,000 | 2,200 | 12,000 | 180 | 5.7 [1.9] | 70/70 | 14/14 |
| | 2004 | 3,000 | 2,100 | 52,000 | 390 | 8.2 [2.7] | 70/70 | 14/14 |
| | 2005 | 2,400 | 2,400 | 73,000 | 230 | 8.5 [2.8] | 80/80 | 16/16 |
| | 2006 | 2,200 | 2,600 | 28,000 | 280 | 1.9 [0.7] | 80/80 | 16/16 |
| | 2007 | 2,200 | 2,000 | 22,000 | 160 | 3 [1] | 80/80 | 16/16 |
| | 2008 | 2,500 | 2,000 | 53,000 | 320 | 3 [1] | 85/85 | 17/17 |
| | 2009 | 2,300 | 2,100 | 20,000 | 260 | 4 [1] | 90/90 | 18/18 |
| | 2010 | 2,300 | 2,100 | 13,000 | 260 | 3 [1] | 18/18 | 18/18 |
| | 2013 | 2,900 | 2,800 | 16,000 | 430 | 4.3 [1.4] | 19/19 | 19/19 |
| | 2018 | 1,900 | 1,700 | 16,000 | 290 | 3 [1] | 18/18 | 18/18 |

| *p,p′*-DDE | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Birds** (pg/g-wet) | 2002 | 36,000 | 60,000 | 170,000 | 8,100 | 2.4 [0.8] | 10/10 | 2/2 |
| | 2003 | 66,000 | 76,000 | 240,000 | 18,000 | 5.7 [1.9] | 10/10 | 2/2 |
| | 2004 | 34,000 | 65,000 | 200,000 | 6,800 | 8.2 [2.7] | 10/10 | 2/2 |
| | 2005 | 44,000 | 86,000 | 300,000 | 7,100 | 8.5 [2.8] | 10/10 | 2/2 |
| | 2006 | 38,000 | 57,000 | 160,000 | 5,900 | 1.9 [0.7] | 10/10 | 2/2 |
| | 2007 | 40,000 | 56,000 | 320,000 | 6,700 | 3 [1] | 10/10 | 2/2 |
| | 2008 | 51,000 | 79,000 | 160,000 | 7,500 | 3 [1] | 10/10 | 2/2 |
| | 2009 | 30,000 | 64,000 | 220,000 | 4,300 | 4 [1] | 10/10 | 2/2 |
| | 2010 | 32,000 | --- | 160,000 | 6,300 | 3 [1] | 2/2 | 2/2 |
| | 2013 | 170,000 | --- | 170,000 | 170,000 | 4.3 [1.4] | 2/2 | 2/2 |
| | 2018 | 80,000 | --- | 290,000 | 22,000 | 3 [1] | 2/2 | 2/2 |

| *p,p′*-DDD | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2002 | 340 | 710 | 3,200 | 11 | 5.4 [1.8] | 38/38 | 8/8 |
| | 2003 | 390 | 640 | 2,600 | tr(7.5) | 9.9 [3.3] | 30/30 | 6/6 |
| | 2004 | 440 | 240 | 8,900 | 7.8 | 2.2 [0.70] | 31/31 | 7/7 |
| | 2005 | 370 | 800 | 1,700 | 13 | 2.9 [0.97] | 31/31 | 7/7 |
| | 2006 | 300 | 480 | 1,400 | 7.3 | 2.4 [0.9] | 31/31 | 7/7 |
| | 2007 | 310 | 360 | 1,500 | 7 | 3 [1] | 31/31 | 7/7 |
| | 2008 | 280 | 280 | 1,300 | 6 | 3 [1] | 31/31 | 7/7 |
| | 2009 | 220 | 170 | 2,400 | 5.8 | 2.4 [0.9] | 31/31 | 7/7 |
| | 2010 | 180 | 330 | 960 | 11 | 1.3 [0.5] | 6/6 | 6/6 |
| | 2013 | 270 | 520 | 1,300 | 19 | 1.9 [0.7] | 5/5 | 5/5 |
| | 2018 | 110 | 93 | 830 | 17 | 1.4 [0.6] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2002 | 750 | 680 | 14,000 | 80 | 5.4 [1.8] | 70/70 | 14/14 |
| | 2003 | 510 | 520 | 3,700 | 43 | 9.9 [3.3] | 70/70 | 14/14 |
| | 2004 | 770 | 510 | 9,700 | 56 | 2.2 [0.70] | 70/70 | 14/14 |
| | 2005 | 510 | 650 | 6,700 | 29 | 2.9 [0.97] | 80/80 | 16/16 |
| | 2006 | 520 | 580 | 4,300 | 60 | 2.4 [0.9] | 80/80 | 16/16 |
| | 2007 | 470 | 490 | 4,100 | 36 | 3 [1] | 80/80 | 16/16 |
| | 2008 | 460 | 440 | 4,100 | 33 | 3 [1] | 85/85 | 17/17 |
| | 2009 | 440 | 460 | 2,500 | 57 | 2.4 [0.9] | 90/90 | 18/18 |
| | 2010 | 560 | 610 | 2,900 | 57 | 1.3 [0.5] | 18/18 | 18/18 |
| | 2013 | 500 | 500 | 4,700 | 68 | 1.9 [0.7] | 19/19 | 19/19 |
| | 2018 | 280 | 250 | 3,100 | 40 | 1.4 [0.6] | 18/18 | 18/18 |
| Birds** (pg/g-wet) | 2002 | 580 | 740 | 3,900 | 140 | 5.4 [1.8] | 10/10 | 2/2 |
| | 2003 | 640 | 860 | 3,900 | 110 | 9.9 [3.3] | 10/10 | 2/2 |
| | 2004 | 330 | 520 | 1,400 | 52 | 2.2 [0.70] | 10/10 | 2/2 |
| | 2005 | 310 | 540 | 1,400 | 45 | 2.9 [0.97] | 10/10 | 2/2 |
| | 2006 | 410 | 740 | 1,800 | 55 | 2.4 [0.9] | 10/10 | 2/2 |
| | 2007 | 440 | 780 | 2,300 | 70 | 3 [1] | 10/10 | 2/2 |
| | 2008 | 240 | 490 | 1,100 | 35 | 3 [1] | 10/10 | 2/2 |
| | 2009 | 280 | 430 | 3,400 | 31 | 2.4 [0.9] | 10/10 | 2/2 |
| | 2010 | 440 | --- | 1,600 | 120 | 1.3 [0.5] | 2/2 | 2/2 |
| | 2013 | 140 | --- | 270 | 70 | 1.9 [0.7] | 2/2 | 2/2 |
| | 2018 | 230 | --- | 260 | 210 | 1.4 [0.6] | 2/2 | 2/2 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived during FY2002~2009.

(Note 2) ”**” There is no consistency between the results of the ornithological survey in FY2013 and those in previous years because of the changes in the survey sites and target species.

(Note 3) No monitoring was conducted in FY2011, FY2012, FY2014~2017.

<Air>

Stocktaking of the detection of *p,p'*-DDT, *p,p'*-DDE and *p,p'*-DDD in air during FY2002~2018

| *p,p'*-DDT | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air ($pg/m^3$) | 2002 | 1.9 | 1.8 | 22 | 0.25 | 0.24 [0.08] | 102/102 | 34/34 |
| | 2003 Warm season | 5.8 | 6.6 | 24 | 0.75 | 0.14 [0.046] | 35/35 | 35/35 |
| | 2003 Cold season | 1.7 | 1.6 | 11 | 0.31 | | 34/34 | 34/34 |
| | 2004 Warm season | 4.7 | 5.1 | 37 | 0.41 | 0.22 [0.074] | 37/37 | 37/37 |
| | 2004 Cold season | 1.8 | 1.7 | 13 | 0.29 | | 37/37 | 37/37 |
| | 2005 Warm season | 4.1 | 4.2 | 31 | 0.44 | 0.16 [0.054] | 37/37 | 37/37 |
| | 2005 Cold season | 1.1 | 0.99 | 4.8 | 0.25 | | 37/37 | 37/37 |
| | 2006 Warm season | 4.2 | 3.8 | 51 | 0.35 | 0.17 [0.06] | 37/37 | 37/37 |
| | 2006 Cold season | 1.4 | 1.2 | 7.3 | 0.29 | | 37/37 | 37/37 |
| | 2007 Warm season | 4.9 | 5.2 | 30 | 0.6 | 0.07 [0.03] | 36/36 | 36/36 |
| | 2007 Cold season | 1.2 | 1.2 | 8.8 | 0.23 | | 36/36 | 36/36 |
| | 2008 Warm season | 3.6 | 3.0 | 27 | 0.76 | 0.07 [0.03] | 37/37 | 37/37 |
| | 2008 Cold season | 1.2 | 1.0 | 15 | 0.22 | | 37/37 | 37/37 |
| | 2009 Warm season | 3.6 | 3.6 | 28 | 0.44 | 0.07 [0.03] | 37/37 | 37/37 |
| | 2009 Cold season | 1.1 | 1.0 | 8.0 | 0.20 | | 37/37 | 37/37 |
| | 2010 Warm season | 3.5 | 3.1 | 56 | 0.28 | 0.10 [0.03] | 37/37 | 37/37 |
| | 2010 Cold season | 1.3 | 0.89 | 16 | 0.30 | | 37/37 | 37/37 |
| | 2013 Warm season | 2.8 | 3.6 | 17 | 0.20 | 0.11 [0.04] | 36/36 | 36/36 |
| | 2013 Cold season | 0.65 | 0.53 | 4.5 | 0.18 | | 36/36 | 36/36 |
| | 2015 Warm season | 1.5 | 1.8 | 13 | 0.18 | 0.15 [0.05] | 35/35 | 35/35 |
| | 2018 Warm season | 1.6 | 2 | 14 | 0.15 | 0.03 [0.01] | 37/37 | 37/37 |

| *p,p'*-DDE | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air ($pg/m^3$) | 2002 | 2.8 | 2.7 | 28 | 0.56 | 0.09 [0.03] | 102/102 | 34/34 |
| | 2003 Warm season | 7.2 | 7.0 | 51 | 1.2 | 0.40 [0.13] | 35/35 | 35/35 |
| | 2003 Cold season | 2.8 | 2.4 | 22 | 1.1 | | 34/34 | 34/34 |
| | 2004 Warm season | 6.1 | 6.3 | 95 | 0.62 | 0.12 [0.039] | 37/37 | 37/37 |
| | 2004 Cold season | 2.9 | 2.6 | 43 | 0.85 | | 37/37 | 37/37 |
| | 2005 Warm season | 5.0 | 5.7 | 42 | 1.2 | 0.14 [0.034] | 37/37 | 37/37 |
| | 2005 Cold season | 1.7 | 1.5 | 9.9 | 0.76 | | 37/37 | 37/37 |
| | 2006 Warm season | 5.0 | 4.7 | 49 | 1.7 | 0.10 [0.03] | 37/37 | 37/37 |
| | 2006 Cold season | 1.9 | 1.7 | 9.5 | 0.52 | | 37/37 | 37/37 |
| | 2007 Warm season | 6.4 | 6.1 | 120 | 0.54 | 0.04 [0.02] | 36/36 | 36/36 |
| | 2007 Cold season | 2.1 | 1.9 | 39 | 0.73 | | 36/36 | 36/36 |
| | 2008 Warm season | 4.8 | 4.4 | 96 | 0.98 | 0.04 [0.02] | 37/37 | 37/37 |
| | 2008 Cold season | 2.2 | 2.0 | 22 | 0.89 | | 37/37 | 37/37 |
| | 2009 Warm season | 4.9 | 4.8 | 130 | 0.87 | 0.08 [0.03] | 37/37 | 37/37 |
| | 2009 Cold season | 2.1 | 1.9 | 100 | 0.60 | | 37/37 | 37/37 |
| | 2010 Warm season | 4.9 | 4.1 | 200 | tr(0.41) | 0.62 [0.21] | 37/37 | 37/37 |
| | 2010 Cold season | 2.2 | 1.8 | 28 | tr(0.47) | | 37/37 | 37/37 |
| | 2013 Warm season | 4.1 | 4.3 | 37 | 0.2 | 0.10 [0.03] | 36/36 | 36/36 |
| | 2013 Cold season | 1.6 | 1.5 | 11 | 0.6 | | 36/36 | 36/36 |
| | 2015 Warm season | 2.4 | 2.6 | 34 | 0.31 | 0.12 [0.04] | 35/35 | 35/35 |
| | 2018 Warm season | 2.6 | 2.5 | 49 | 0.31 | 0.03 [0.01] | 37/37 | 37/37 |

| *p,p′*-DDD | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Site |
|---|---|---|---|---|---|---|---|---|
| Air (pg/m$^3$) | 2002 | 0.12 | 0.13 | 0.76 | nd | 0.018 [0.006] | 101/102 | 34/34 |
| | 2003 Warm season | 0.30 | 0.35 | 1.4 | 0.063 | 0.054 [0.018] | 35/35 | 35/35 |
| | 2003 Cold season | 0.13 | 0.14 | 0.52 | tr(0.037) | | 34/34 | 34/34 |
| | 2004 Warm season | 0.24 | 0.27 | 1.4 | tr(0.036) | 0.053 [0.018] | 37/37 | 37/37 |
| | 2004 Cold season | 0.12 | 0.12 | 0.91 | tr(0.025) | | 37/37 | 37/37 |
| | 2005 Warm season | 0.24 | 0.26 | 1.3 | tr(0.07) | 0.16 [0.05] | 37/37 | 37/37 |
| | 2005 Cold season | tr(0.06) | tr(0.07) | 0.29 | nd | | 28/37 | 28/37 |
| | 2006 Warm season | 0.28 | 0.32 | 1.3 | nd | 0.13 [0.04] | 36/37 | 36/37 |
| | 2006 Cold season | 0.14 | tr(0.12) | 0.99 | nd | | 36/37 | 36/37 |
| | 2007 Warm season | 0.26 | 0.27 | 1.4 | 0.046 | 0.011 [0.004] | 36/36 | 36/36 |
| | 2007 Cold season | 0.093 | 0.087 | 0.5 | 0.026 | | 36/36 | 36/36 |
| | 2008 Warm season | 0.17 | 0.17 | 1.1 | 0.037 | 0.025 [0.009] | 37/37 | 37/37 |
| | 2008 Cold season | 0.091 | 0.081 | 0.31 | 0.036 | | 37/37 | 37/37 |
| | 2009 Warm season | 0.17 | 0.18 | 0.82 | 0.03 | 0.03 [0.01] | 37/37 | 37/37 |
| | 2009 Cold season | 0.08 | 0.08 | 0.35 | tr(0.02) | | 37/37 | 37/37 |
| | 2010 Warm season | 0.20 | 0.17 | 1.7 | 0.04 | 0.02 [0.01] | 37/37 | 37/37 |
| | 2010 Cold season | 0.10 | 0.09 | 0.41 | 0.02 | | 37/37 | 37/37 |
| | 2013 Warm season | 0.16 | 0.18 | 0.80 | 0.027 | 0.018 [0.007] | 36/36 | 36/36 |
| | 2013 Cold season | 0.056 | 0.054 | 0.14 | tr(0.015) | | 36/36 | 36/36 |
| | 2015 Warm season | nd | nd | tr(0.31) | nd | 0.33 [0.11] | 17/35 | 17/35 |
| | 2018 Warm season | 0.13 | 0.16 | 0.72 | nd | 0.07 [0.03] | 36/37 | 36/37 |

(Note) No monitoring was conducted in FY2011, FY2012, FY2014, FY2016 and FY2017.

○ *p,p′*-DDT, *p,p′*-DDE and *p,p′*-DDD

<Surface Water>

Stocktaking of the detection of *o,p′*-DDT, *o,p′*-DDE and *o,p′*-DDD in surface water during FY2002~2014

| *o,p′*-DDT | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Site |
|---|---|---|---|---|---|---|---|---|
| Surface Water (pg/L) | 2002 | 5.4 | 4.6 | 77 | 0.19 | 1.2 [0.4] | 114/114 | 38/38 |
| | 2003 | 6 | 5 | 100 | tr(1.5) | 3 [0.7] | 36/36 | 36/36 |
| | 2004 | tr(4.5) | 5 | 85 | nd | 5 [2] | 29/38 | 29/38 |
| | 2005 | 3 | 3 | 39 | nd | 3 [1] | 42/47 | 42/47 |
| | 2006 | 2.8 | 2.4 | 52 | 0.51 | 2.3 [0.8] | 48/48 | 48/48 |
| | 2007 | tr(2.1) | tr(2.2) | 86 | nd | 2.5 [0.8] | 38/48 | 38/48 |
| | 2008 | 3.1 | 3.0 | 230 | nd | 1.4 [0.5] | 44/48 | 44/48 |
| | 2009 | 2.4 | 2.4 | 100 | 0.43 | 0.16 [0.06] | 49/49 | 49/49 |
| | 2010 | 1.5 | tr(1.2) | 700 | nd | 1.5 [0.5] | 43/49 | 43/49 |
| | 2014 | 1.0 | 1.0 | 63 | nd | 0.4 [0.2] | 42/48 | 42/48 |

| *o,p′*-DDE | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Site |
|---|---|---|---|---|---|---|---|---|
| Surface Water (pg/L) | 2002 | 2.4 | 2.1 | 680 | nd | 0.9 [0.3] | 113/114 | 38/38 |
| | 2003 | 2.2 | 2.0 | 170 | tr(0.42) | 0.8 [0.3] | 36/36 | 36/36 |
| | 2004 | 3 | 2 | 170 | tr(0.6) | 2 [0.5] | 38/38 | 38/38 |
| | 2005 | 2.5 | 2.1 | 410 | 0.4 | 1.2 [0.4] | 47/47 | 47/47 |
| | 2006 | tr(1.6) | tr(1.4) | 210 | nd | 2.6 [0.9] | 28/48 | 28/48 |
| | 2007 | tr(1.5) | tr(1.1) | 210 | nd | 2.3 [0.8] | 29/48 | 29/48 |
| | 2008 | 1.5 | 1.8 | 260 | nd | 0.7 [0.3] | 39/48 | 39/48 |
| | 2009 | 1.3 | 1.1 | 140 | nd | 0.22 [0.09] | 47/49 | 47/49 |
| | 2010 | 0.97 | 0.65 | 180 | tr(0.13) | 0.24 [0.09] | 49/49 | 49/49 |
| | 2014 | 0.6 | 0.6 | 560 | nd | 0.3 [0.1] | 36/48 | 36/48 |

| *o,p'*-DDD | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Surface Water (pg/L) | 2002 | 5.6 | 6.0 | 110 | nd | 0.60 [0.20] | 113/114 | 38/38 |
| | 2003 | 7.1 | 5.0 | 160 | 1.1 | 0.8 [0.3] | 36/36 | 36/36 |
| | 2004 | 6 | 5 | 81 | tr(0.7) | 2 [0.5] | 38/38 | 38/38 |
| | 2005 | 5.2 | 5.4 | 51 | tr(0.5) | 1.2 [0.4] | 47/47 | 47/47 |
| | 2006 | 2.5 | 3.3 | 39 | nd | 0.8 [0.3] | 40/48 | 40/48 |
| | 2007 | 4.6 | 3.9 | 41 | tr(0.3) | 0.8 [0.3] | 48/48 | 48/48 |
| | 2008 | 6.7 | 7.2 | 170 | nd | 0.8 [0.3] | 47/48 | 47/48 |
| | 2009 | 4.4 | 3.8 | 41 | 0.44 | 0.22 [0.09] | 49/49 | 49/49 |
| | 2010 | 4.6 | 3.8 | 170 | tr(0.5) | 0.6 [0.2] | 49/49 | 49/49 |
| | 2014 | 3.7 | 3.2 | 38 | 0.33 | 0.20 [0.08] | 48/48 | 48/48 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2002.
(Note 2) No monitoring was conducted during FY2011~2013.

<Sediment>

Stocktaking of the detection of *o,p'*-DDT, *o,p'*-DDE and *o,p'*-DDD in sediment during FY2002~2014

| *o,p'*-DDT | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Sediment (pg/g-dry) | 2002 | 76 | 47 | 27,000 | nd | 6 [2] | 183/189 | 62/63 |
| | 2003 | 50 | 43 | 3,200 | nd | 0.8 [0.3] | 185/186 | 62/62 |
| | 2004 | 69 | 50 | 17,000 | tr(1.1) | 2 [0.6] | 189/189 | 63/63 |
| | 2005 | 58 | 46 | 160,000 | 0.8 | 0.8 [0.3] | 189/189 | 63/63 |
| | 2006 | 57 | 52 | 18,000 | tr(0.8) | 1.2 [0.4] | 192/192 | 64/64 |
| | 2007 | 38 | 31 | 27,000 | nd | 1.8 [0.6] | 186/192 | 63/64 |
| | 2008 | 51 | 40 | 140,000 | tr(0.7) | 1.5 [0.6] | 192/192 | 64/64 |
| | 2009 | 44 | 30 | 100,000 | nd | 1.2 [0.5] | 190/192 | 64/64 |
| | 2010 | 40 | 33 | 13,000 | 1.4 | 1.1 [0.4] | 64/64 | 64/64 |
| | 2014 | 26 | 24 | 2,400 | nd | 0.4 [0.2] | 62/63 | 62/63 |
| ***o,p'*-DDE** | **Monitored year** | **Geometric mean*** | **Median** | **Maximum** | **Minimum** | **Quantification [Detection] limit** | **Detection Frequency Sample** | **Detection Frequency Site** |
| Sediment (pg/g-dry) | 2002 | 54 | 37 | 16,000 | nd | 3 [1] | 188/189 | 63/63 |
| | 2003 | 48 | 39 | 24,000 | tr(0.5) | 0.6 [0.2] | 186/186 | 62/62 |
| | 2004 | 40 | 34 | 28,000 | nd | 3 [0.8] | 184/189 | 63/63 |
| | 2005 | 40 | 32 | 31,000 | nd | 2.6 [0.9] | 181/189 | 62/63 |
| | 2006 | 42 | 40 | 27,000 | tr(0.4) | 1.1 [0.4] | 192/192 | 64/64 |
| | 2007 | 37 | 41 | 25,000 | nd | 1.2 [0.4] | 186/192 | 63/64 |
| | 2008 | 50 | 48 | 37,000 | nd | 1.4 [0.6] | 186/192 | 63/64 |
| | 2009 | 37 | 31 | 33,000 | nd | 0.6 [0.2] | 191/192 | 64/64 |
| | 2010 | 37 | 32 | 25,000 | tr(0.7) | 1.2 [0.5] | 64/64 | 64/64 |
| | 2014 | 30 | 32 | 41,000 | tr(0.5) | 0.8 [0.3] | 63/63 | 63/63 |
| ***o,p'*-DDD** | **Monitored year** | **Geometric mean*** | **Median** | **Maximum** | **Minimum** | **Quantification [Detection] limit** | **Detection Frequency Sample** | **Detection Frequency Site** |
| Sediment (pg/g-dry) | 2002 | 160 | 150 | 14,000 | nd | 6 [2] | 184/189 | 62/63 |
| | 2003 | 160 | 130 | 8,800 | tr(1.0) | 2 [0.5] | 186/186 | 62/62 |
| | 2004 | 140 | 120 | 16,000 | tr(0.7) | 2 [0.5] | 189/189 | 63/63 |
| | 2005 | 130 | 110 | 32,000 | tr(0.8) | 1.0 [0.3] | 189/189 | 63/63 |
| | 2006 | 120 | 110 | 13,000 | tr(0.3) | 0.5 [0.2] | 192/192 | 64/64 |
| | 2007 | 110 | 130 | 21,000 | tr(0.5) | 1.0 [0.4] | 192/192 | 64/64 |
| | 2008 | 170 | 150 | 50,000 | 0.5 | 0.3 [0.1] | 192/192 | 64/64 |
| | 2009 | 120 | 120 | 24,000 | 0.5 | 0.5 [0.2] | 192/192 | 64/64 |
| | 2010 | 130 | 130 | 6,900 | tr(0.8) | 0.9 [0.4] | 64/64 | 64/64 |
| | 2014 | 74 | 85 | 3,200 | tr(0.7) | 1.2 [0.5] | 63/63 | 63/63 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived during FY2002~2009.
(Note 2) No monitoring was conducted during FY2011~2013.

<Wildlife>

Stocktaking of the detection of *o,p′*-DDT, *o,p′*-DDE and *o,p′*-DDD in wildlife (bivalves, fish and birds) during FY2002~2018

| *o,p′*-DDT | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Bivalves (pg/g-wet) | 2002 | 110 | 83 | 480 | 22 | 12 [4] | 38/38 | 8/8 |
| | 2003 | 130 | 120 | 480 | 35 | 2.9 [0.97] | 30/30 | 6/6 |
| | 2004 | 160 | 140 | 910 | 20 | 1.8 [0.61] | 31/31 | 7/7 |
| | 2005 | 98 | 57 | 440 | 29 | 2.6 [0.86] | 31/31 | 7/7 |
| | 2006 | 92 | 79 | 380 | 24 | 3 [1] | 31/31 | 7/7 |
| | 2007 | 79 | 52 | 350 | 20 | 3 [1] | 31/31 | 7/7 |
| | 2008 | 58 | 37 | 330 | 5 | 3 [1] | 31/31 | 7/7 |
| | 2009 | 74 | 48 | 2,500 | 17 | 2.2 [0.8] | 31/31 | 7/7 |
| | 2010 | 51 | 67 | 160 | 15 | 3 [1] | 6/6 | 6/6 |
| | 2013 | 49 | 51 | 180 | 12 | 3 [1] | 5/5 | 5/5 |
| | 2018 | 24 | 12 | 120 | 10 | 2.7 [0.9] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2002 | 130 | 130 | 2,300 | tr(6) | 12 [4] | 70/70 | 14/14 |
| | 2003 | 85 | 120 | 520 | 2.9 | 2.9 [0.97] | 70/70 | 14/14 |
| | 2004 | 160 | 140 | 1,800 | 3.7 | 1.8 [0.61] | 70/70 | 14/14 |
| | 2005 | 100 | 110 | 1,500 | 5.8 | 2.6 [0.86] | 80/80 | 16/16 |
| | 2006 | 100 | 110 | 700 | 6 | 3 [1] | 80/80 | 16/16 |
| | 2007 | 69 | 90 | 430 | 3 | 3 [1] | 80/80 | 16/16 |
| | 2008 | 72 | 92 | 720 | 3 | 3 [1] | 85/85 | 17/17 |
| | 2009 | 61 | 73 | 470 | 2.4 | 2.2 [0.8] | 90/90 | 18/18 |
| | 2010 | 58 | 71 | 550 | 5 | 3 [1] | 18/18 | 18/18 |
| | 2013 | 58 | 76 | 310 | 4 | 3 [1] | 19/19 | 19/19 |
| | 2018 | 34 | 34 | 1,500 | tr(1.1) | 2.7 [0.9] | 18/18 | 18/18 |
| Birds** (pg/g-wet) | 2002 | 12 | tr(10) | 58 | nd | 12 [4] | 8/10 | 2/2 |
| | 2003 | 24 | 16 | 66 | 8.3 | 2.9 [0.97] | 10/10 | 2/2 |
| | 2004 | 8.5 | 13 | 43 | tr(0.87) | 1.8 [0.61] | 10/10 | 2/2 |
| | 2005 | 11 | 14 | 24 | 3.4 | 2.6 [0.86] | 10/10 | 2/2 |
| | 2006 | 14 | 10 | 120 | 3 | 3 [1] | 10/10 | 2/2 |
| | 2007 | 9 | 9 | 26 | tr(2) | 3 [1] | 10/10 | 2/2 |
| | 2008 | 4 | 6 | 16 | nd | 3 [1] | 8/10 | 2/2 |
| | 2009 | 6.3 | 7.6 | 12 | tr(1.4) | 2.2 [0.8] | 10/10 | 2/2 |
| | 2010 | nd | --- | nd | nd | 3 [1] | 0/2 | 0/2 |
| | 2013 | nd | --- | tr(1) | nd | 3 [1] | 1/2 | 1/2 |
| | 2018 | tr(1.1) | --- | tr(2.5) | nd | 2.7 [0.9] | 1/2 | 1/2 |

| *o,p′*-DDE | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Bivalves (pg/g-wet) | 2002 | 83 | 66 | 1,100 | 13 | 3.6 [1.2] | 38/38 | 8/8 |
| | 2003 | 85 | 100 | 460 | 17 | 3.6 [1.2] | 30/30 | 6/6 |
| | 2004 | 86 | 69 | 360 | 19 | 2.1 [0.69] | 31/31 | 7/7 |
| | 2005 | 70 | 89 | 470 | 12 | 3.4 [1.1] | 31/31 | 7/7 |
| | 2006 | 62 | 81 | 340 | 12 | 3 [1] | 31/31 | 7/7 |
| | 2007 | 56 | 69 | 410 | 8.9 | 2.3 [0.9] | 31/31 | 7/7 |
| | 2008 | 49 | 52 | 390 | 8 | 3 [1] | 31/31 | 7/7 |
| | 2009 | 46 | 58 | 310 | 8 | 3 [1] | 31/31 | 7/7 |
| | 2010 | 46 | 58 | 160 | 7.8 | 1.5 [0.6] | 6/6 | 6/6 |
| | 2013 | 28 | 31 | 260 | 4 | 4 [1] | 5/5 | 5/5 |
| | 2018 | 20 | 15 | 250 | tr(2) | 3 [1] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2002 | 91 | 50 | 13,000 | 3.6 | 3.6 [1.2] | 70/70 | 14/14 |
| | 2003 | 51 | 54 | 2,500 | nd | 3.6 [1.2] | 67/70 | 14/14 |
| | 2004 | 76 | 48 | 5,800 | tr(0.89) | 2.1 [0.69] | 70/70 | 14/14 |
| | 2005 | 54 | 45 | 12,000 | tr(1.4) | 3.4 [1.1] | 80/80 | 16/16 |
| | 2006 | 56 | 43 | 4,800 | tr(1) | 3 [1] | 80/80 | 16/16 |
| | 2007 | 45 | 29 | 4,400 | nd | 2.3 [0.9] | 79/80 | 16/16 |
| | 2008 | 50 | 37 | 13,000 | tr(1) | 3 [1] | 85/85 | 17/17 |
| | 2009 | 46 | 33 | 4,300 | tr(1) | 3 [1] | 90/90 | 18/18 |
| | 2010 | 47 | 37 | 2,800 | tr(1.2) | 1.5 [0.6] | 18/18 | 18/18 |
| | 2013 | 51 | 40 | 3,000 | tr(1) | 4 [1] | 19/19 | 19/19 |
| | 2018 | 32 | 27 | 2,000 | nd | 3 [1] | 17/18 | 17/18 |

| *o,p′*-DDE | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Site |
|---|---|---|---|---|---|---|---|---|
| Birds** (pg/g-wet) | 2002 | 28 | 26 | 49 | 20 | 3.6 [1.2] | 10/10 | 2/2 |
| | 2003 | tr(2.3) | tr(2.0) | 4.2 | nd | 3.6 [1.2] | 9/10 | 2/2 |
| | 2004 | tr(1.0) | tr(1.1) | 3.7 | nd | 2.1 [0.69] | 5/10 | 1/2 |
| | 2005 | tr(1.2) | tr(1.9) | tr(2.9) | nd | 3.4 [1.1] | 7/10 | 2/2 |
| | 2006 | tr(1) | tr(2) | 3 | tr(1) | 3 [1] | 10/10 | 2/2 |
| | 2007 | tr(1.0) | tr(1.4) | 2.8 | nd | 2.3 [0.9] | 6/10 | 2/2 |
| | 2008 | tr(1) | nd | 3 | nd | 3 [1] | 5/10 | 1/2 |
| | 2009 | nd | tr(1) | tr(2) | nd | 3 [1] | 6/10 | 2/2 |
| | 2010 | tr(1.1) | --- | 3.7 | nd | 1.5 [0.6] | 1/2 | 1/2 |
| | 2013 | nd | --- | tr(1) | nd | 4 [1] | 1/2 | 1/2 |
| | 2018 | tr(1) | --- | tr(1) | tr(1) | 3 [1] | 2/2 | 2/2 |

| *o,p′*-DDD | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2002 | 120 | 190 | 2,900 | tr(9) | 12 [4] | 38/38 | 8/8 |
| | 2003 | 200 | 220 | 1,900 | 6.5 | 6.0 [2.0] | 30/30 | 6/6 |
| | 2004 | 220 | 130 | 2,800 | 6.0 | 5.7 [1.9] | 31/31 | 7/7 |
| | 2005 | 170 | 280 | 1,800 | 10 | 3.3 [1.1] | 31/31 | 7/7 |
| | 2006 | 150 | 200 | 1,000 | 7 | 4 [1] | 31/31 | 7/7 |
| | 2007 | 150 | 200 | 1,200 | 6 | 3 [1] | 31/31 | 7/7 |
| | 2008 | 130 | 140 | 1,100 | 5 | 4 [2] | 31/31 | 7/7 |
| | 2009 | 95 | 51 | 1,000 | 5 | 3 [1] | 31/31 | 7/7 |
| | 2010 | 57 | 50 | 400 | 5.8 | 0.6 [0.2] | 6/6 | 6/6 |
| | 2013 | 100 | 74 | 1,800 | 7.8 | 1.8 [0.7] | 5/5 | 5/5 |
| | 2018 | 46 | 27 | 720 | 4.9 | 2.4 [0.9] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2002 | 95 | 90 | 1,100 | nd | 12 [4] | 66/70 | 14/14 |
| | 2003 | 75 | 96 | 920 | nd | 6.0 [2.0] | 66/70 | 14/14 |
| | 2004 | 120 | 96 | 1,700 | nd | 5.7 [1.9] | 68/70 | 14/14 |
| | 2005 | 83 | 81 | 1,400 | nd | 3.3 [1.1] | 79/80 | 16/16 |
| | 2006 | 80 | 86 | 1,100 | tr(1) | 4 [1] | 80/80 | 16/16 |
| | 2007 | 66 | 62 | 1,300 | nd | 3 [1] | 78/80 | 16/16 |
| | 2008 | 65 | 74 | 1,000 | nd | 4 [2] | 80/85 | 16/17 |
| | 2009 | 63 | 64 | 760 | nd | 3 [1] | 87/90 | 18/18 |
| | 2010 | 75 | 99 | 700 | 2.6 | 0.6 [0.2] | 18/18 | 18/18 |
| | 2013 | 70 | 85 | 940 | nd | 1.8 [0.7] | 18/19 | 18/19 |
| | 2018 | 40 | 39 | 1,100 | nd | 2.4 [0.9] | 17/18 | 17/18 |
| Birds** (pg/g-wet) | 2002 | 15 | 15 | 23 | tr(8) | 12 [4] | 10/10 | 2/2 |
| | 2003 | 15 | 14 | 36 | tr(5.0) | 6.0 [2.0] | 10/10 | 2/2 |
| | 2004 | 6.1 | 5.7 | 25 | nd | 5.7 [1.9] | 9/10 | 2/2 |
| | 2005 | 7.3 | 7.5 | 9.7 | 4.7 | 3.3 [1.1] | 10/10 | 2/2 |
| | 2006 | 8 | 8 | 19 | 5 | 4 [1] | 10/10 | 2/2 |
| | 2007 | 7 | 7 | 10 | 5 | 3 [1] | 10/10 | 2/2 |
| | 2008 | 4 | tr(3) | 14 | tr(2) | 4 [2] | 10/10 | 2/2 |
| | 2009 | 6 | 5 | 13 | 3 | 3 [1] | 10/10 | 2/2 |
| | 2010 | 6.3 | --- | 11 | 3.6 | 0.6 [0.2] | 2/2 | 2/2 |
| | 2013 | 5.4 | --- | 12 | 2.4 | 1.8 [0.7] | 2/2 | 2/2 |
| | 2018 | 6.1 | --- | 9.9 | 3.7 | 2.4 [0.9] | 2/2 | 2/2 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived during FY2002~2009.

(Note2)”**” There is no consistency between the results of the ornithological survey in FY2013 and those in previous years because of the changes in the survey sites and target species.

(Note 3) No monitoring was conducted in FY2011, FY2012 and FY2014~2017.

<Air>

Stocktaking of the detection of *o,p'*-DDT, *o,p'*-DDE and *o,p'*-DDD in air during FY2002~2018

| *o,p'*-DDT | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Air ($pg/m^3$) | 2002 | 2.2 | 2.0 | 40 | 0.41 | 0.15 [0.05] | 102/102 | 34/34 |
| | 2003 Warm season | 6.9 | 7.7 | 38 | 0.61 | 0.12 [0.040] | 35/35 | 35/35 |
| | 2003 Cold season | 1.6 | 1.4 | 6.4 | 0.43 | | 34/34 | 34/34 |
| | 2004 Warm season | 5.1 | 5.4 | 22 | 0.54 | 0.093 [0.031] | 37/37 | 37/37 |
| | 2004 Cold season | 1.5 | 1.4 | 9.4 | 0.35 | | 37/37 | 37/37 |
| | 2005 Warm season | 3.0 | 3.1 | 14 | 0.67 | 0.10 [0.034] | 37/37 | 37/37 |
| | 2005 Cold season | 0.76 | 0.67 | 3.0 | 0.32 | | 37/37 | 37/37 |
| | 2006 Warm season | 2.5 | 2.4 | 20 | 0.55 | 0.09 [0.03] | 37/37 | 37/37 |
| | 2006 Cold season | 0.90 | 0.79 | 3.9 | 0.37 | | 37/37 | 37/37 |
| | 2007 Warm season | 2.9 | 2.6 | 19 | 0.24 | 0.03 [0.01] | 36/36 | 36/36 |
| | 2007 Cold season | 0.77 | 0.63 | 3.4 | 0.31 | | 36/36 | 36/36 |
| | 2008 Warm season | 2.3 | 2.1 | 18 | 0.33 | 0.03 [0.01] | 37/37 | 37/37 |
| | 2008 Cold season | 0.80 | 0.62 | 6.5 | 0.32 | | 37/37 | 37/37 |
| | 2009 Warm season | 2.3 | 2.2 | 14 | 0.33 | 0.019 [0.008] | 37/37 | 37/37 |
| | 2009 Cold season | 0.80 | 0.71 | 3.7 | 0.20 | | 37/37 | 37/37 |
| | 2010 Warm season | 2.2 | 1.9 | 26 | 0.19 | 0.14 [0.05] | 37/37 | 37/37 |
| | 2010 Cold season | 0.81 | 0.69 | 5.5 | 0.22 | | 37/37 | 37/37 |
| | 2013 Warm season | 1.7 | 1.7 | 12 | 0.15 | 0.054 [0.018] | 36/36 | 36/36 |
| | 2013 Cold season | 0.47 | 0.44 | 2.4 | 0.20 | | 36/36 | 36/36 |
| | 2015 Warm season | 0.99 | 1.2 | 6.8 | 0.14 | 0.12 [0.04] | 35/35 | 35/35 |
| | 2018 Warm season | 1.0 | 1.1 | 6.3 | 0.08 | 0.03 [0.01] | 37/37 | 37/37 |

| *o,p'*-DDE | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Air ($pg/m^3$) | 2002 | 0.60 | 0.56 | 8.5 | 0.11 | 0.03 [0.01] | 102/102 | 34/34 |
| | 2003 Warm season | 1.4 | 1.5 | 7.5 | 0.17 | 0.020 [0.0068] | 35/35 | 35/35 |
| | 2003 Cold season | 0.50 | 0.47 | 1.7 | 0.18 | | 34/34 | 34/34 |
| | 2004 Warm season | 1.1 | 1.2 | 8.9 | 0.14 | 0.037 [0.012] | 37/37 | 37/37 |
| | 2004 Cold season | 0.53 | 0.49 | 3.9 | 0.14 | | 37/37 | 37/37 |
| | 2005 Warm season | 1.6 | 1.5 | 7.9 | 0.33 | 0.074 [0.024] | 37/37 | 37/37 |
| | 2005 Cold season | 0.62 | 0.59 | 2.0 | 0.24 | | 37/37 | 37/37 |
| | 2006 Warm season | 1.1 | 1.1 | 7.4 | nd | 0.09 [0.03] | 36/37 | 36/37 |
| | 2006 Cold season | 0.65 | 0.56 | 2.6 | 0.19 | | 37/37 | 37/37 |
| | 2007 Warm season | 0.66 | 0.67 | 7 | 0.096 | 0.017 [0.007] | 36/36 | 36/36 |
| | 2007 Cold season | 0.3 | 0.29 | 3.7 | 0.12 | | 36/36 | 36/36 |
| | 2008 Warm season | 0.48 | 0.52 | 5.0 | 0.11 | 0.025 [0.009] | 37/37 | 37/37 |
| | 2008 Cold season | 0.30 | 0.24 | 1.1 | 0.15 | | 37/37 | 37/37 |
| | 2009 Warm season | 0.51 | 0.46 | 6.7 | 0.098 | 0.016 [0.006] | 37/37 | 37/37 |
| | 2009 Cold season | 0.27 | 0.24 | 23 | 0.072 | | 37/37 | 37/37 |
| | 2010 Warm season | 0.49 | 0.41 | 9.0 | 0.09 | 0.04 [0.01] | 37/37 | 37/37 |
| | 2010 Cold season | 0.27 | 0.23 | 2.3 | 0.08 | | 37/37 | 37/37 |
| | 2013 Warm season | 0.38 | 0.35 | 3.3 | 0.051 | 0.023 [0.009] | 36/36 | 36/36 |
| | 2013 Cold season | 0.21 | 0.19 | 0.65 | 0.097 | | 36/36 | 36/36 |
| | 2015 Warm season | 0.25 | 0.24 | 1.1 | nd | 0.18 [0.06] | 34/35 | 34/35 |
| | 2018 Warm season | 0.24 | 0.26 | 1.2 | tr(0.04) | 0.05 [0.02] | 37/37 | 37/37 |

| *o,p′*-DDD | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air ($pg/m^3$) | 2002 | 0.14 | 0.18 | 0.85 | nd | 0.021 [0.007] | 97/102 | 33/34 |
| | 2003 Warm season | 0.37 | 0.42 | 1.3 | 0.059 | 0.042 [0.014] | 35/35 | 35/35 |
| | 2003 Cold season | 0.15 | 0.14 | 0.42 | 0.062 | | 34/34 | 34/34 |
| | 2004 Warm season | 0.31 | 0.33 | 2.6 | tr(0.052) | 0.14 [0.048] | 37/37 | 37/37 |
| | 2004 Cold season | 0.14 | tr(0.13) | 0.86 | nd | | 35/37 | 35/37 |
| | 2005 Warm season | 0.22 | 0.19 | 0.90 | tr(0.07) | 0.10 [0.03] | 37/37 | 37/37 |
| | 2005 Cold season | tr(0.07) | tr(0.07) | 0.21 | nd | | 35/37 | 35/37 |
| | 2006 Warm season | 0.28 | 0.28 | 1.4 | tr(0.05) | 0.10 [0.03] | 37/37 | 37/37 |
| | 2006 Cold season | 0.12 | 0.11 | 0.79 | nd | | 34/37 | 34/37 |
| | 2007 Warm season | 0.28 | 0.29 | 1.9 | 0.05 | 0.05 [0.02] | 36/36 | 36/36 |
| | 2007 Cold season | 0.095 | 0.09 | 0.33 | tr(0.03) | | 36/36 | 36/36 |
| | 2008 Warm season | 0.19 | 0.16 | 1.6 | 0.05 | 0.04 [0.01] | 37/37 | 37/37 |
| | 2008 Cold season | 0.10 | 0.09 | 0.26 | 0.04 | | 37/37 | 37/37 |
| | 2009 Warm season | 0.20 | 0.19 | 0.90 | 0.04 | 0.03 [0.01] | 37/37 | 37/37 |
| | 2009 Cold season | 0.08 | 0.08 | 0.28 | tr(0.02) | | 37/37 | 37/37 |
| | 2010 Warm season | 0.21 | 0.19 | 1.8 | 0.04 | 0.03 [0.01] | 37/37 | 37/37 |
| | 2010 Cold season | 0.10 | 0.09 | 0.48 | tr(0.02) | | 37/37 | 37/37 |
| | 2013 Warm season | 0.17 | 0.18 | 1.2 | tr(0.03) | 0.05 [0.02] | 36/36 | 36/36 |
| | 2013 Cold season | 0.06 | 0.06 | 0.17 | nd | | 35/36 | 35/36 |
| | 2015 Warm season | tr(0.09) | tr(0.10) | 0.37 | nd | 0.20 [0.07] | 25/35 | 25/35 |
| | 2018 Warm season | 0.10 | 0.11 | 0.38 | nd | 0.07 [0.03] | 36/37 | 36/37 |

(Note) No monitoring was conducted in FY2011, FY2012, FY2014, FY2016 and FY2017.

## [7] Chlordanes

・ History and state of monitoring

Chlordane was used as insecticides on a range of agricultural crops, but the registration of Chlordanes under the Agricultural Chemicals Regulation Law was expired in FY1968. The substances were designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in September 1986 because of its properties such as persistency, since it had been used as termitecides for wood products such as primary processed timber, plywood and house. Also *cis*-Chlordane and *trans*-Chlordane are one of the original twelve POPs covered by the Stockholm Convention.

Although manufactured Chlordanes have complicated compositions, Heptachlor, *γ*-Chlordane, Heptachlor epoxide, *cis*-Chlordane, *trans*-Chlordane, Oxychlordane (as a chlordane metabolite), *cis*-Nonachlor (not registrated as an Agricultural Chemical) and *trans*-Nonachlor (not registrated as an Agricultural Chemical) were the original target chemicals in monitoring series. Since FY1983, 5 of those 8 chemicals (*cis*-Chlordane, *trans*-Chlordane, Oxychlordane, *cis*-Nonachlor and *trans*-Nonachlor) have been the target chemicals owning to their high detection frequency in the FY1982 High-Precision Environmental Survey.

In previous monitoring series, Chlordanes had been monitored in wildlife (bivalves, fish and birds) during the period of FY1978~2001 under the framework of "the Wildlife Monitoring." Under the framework of "the Surface Water/Sediment Monitoring", *cis*-Chlordane, *trans*-Chlordane, *cis*-Nonachlor and *trans*-Nonachlor in surface water and sediment have been the monitored during the period of FY1986~1998 and FY1986~2001, respectively.

Under the framework of the Environmental Monitoring, *cis*-Chlordane, *trans*-Chlordane, Oxychlordane (as a Chlordane metabolite), *cis*-Nonachlor (not registrated as an Agricultural Chemical) and *trans*-Nonachlor have been monitored in surface water, sediment, wildlife (bivalves, fish and birds) and air from FY2002~2013, FY2016, FY2017 and FY2020.

・ Monitoring results

○ *cis*-Chlordane and *trans*-Chlordane

<Surface Water>

*cis*-Chlordane: The presence of the substance in surface water was monitored at 46 sites, and it was detected at all 46 valid sites adopting the detection limit of 2pg/L, and the detection range was tr(2) ~ 120pg/L.

As results of the inter-annual trend analysis from FY2002 to FY2020, reduction tendencies in specimens from river areas, river mouth areas and sea areas were identified as statistically significant and a reduction tendency in specimens from the overall areas in surface water was also identified as statistically significant.

*trans*-Chlordane: The presence of the substance in surface water was monitored at 46 sites, and it was detected at all 46 valid sites adopting the detection limit of 2pg/L, and the detection range was tr(3) ~ 98pg/L.

As results of the inter-annual trend analysis from FY2002 to FY2020, a reduction tendency in specimens from the overall areas in surface water was identified as statistically significant.

Stocktaking of the detection of *cis*-Chlordane and *trans*-Chlordane in surface water FY2002~2020

| *cis*-Chlordane | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2002 | 42 | 32 | 880 | 2.5 | 0.9 [0.3] | 114/114 | 38/38 |
| | 2003 | 69 | 51 | 920 | 12 | 3 [0.9] | 36/36 | 36/36 |
| | 2004 | 92 | 87 | 1,900 | 10 | 6 [2] | 38/38 | 38/38 |
| | 2005 | 53 | 54 | 510 | 6 | 4 [1] | 47/47 | 47/47 |
| | 2006 | 31 | 26 | 440 | 5 | 5 [2] | 48/48 | 48/48 |
| | 2007 | 23 | 22 | 680 | nd | 4 [2] | 47/48 | 47/48 |
| | 2008 | 29 | 29 | 480 | 2.9 | 1.6 [0.6] | 48/48 | 48/48 |
| | 2009 | 29 | 26 | 710 | 4.4 | 1.1 [0.4] | 49/49 | 49/49 |
| | 2010 | 19 | 14 | 170 | nd | 11 [4] | 47/49 | 47/49 |
| | 2011 | 20 | 16 | 500 | 3.8 | 1.4 [0.6] | 49/49 | 49/49 |
| | 2012 | 43 | 37 | 350 | 10 | 1.6 [0.6] | 48/48 | 48/48 |
| | 2013 | 18 | 16 | 260 | 2.9 | 2.7 [0.9] | 48/48 | 48/48 |
| | 2017 | 19 | 19 | 210 | 2 | 2 [1] | 47/47 | 47/47 |
| | 2020 | 12 | 10 | 120 | tr(2) | 5 [2] | 46/46 | 46/46 |
| *trans*-Chlordane | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2002 | 33 | 24 | 780 | 3.1 | 1.5 [0.5] | 114/114 | 38/38 |
| | 2003 | 34 | 30 | 410 | 6 | 5 [2] | 36/36 | 36/36 |
| | 2004 | 32 | 26 | 1,200 | 5 | 5 [2] | 38/38 | 38/38 |
| | 2005 | 25 | 21 | 200 | 3 | 4 [1] | 47/47 | 47/47 |
| | 2006 | 24 | 16 | 330 | tr(4) | 7 [2] | 48/48 | 48/48 |
| | 2007 | 16 | 20 | 580 | nd | 2.4 [0.8] | 47/48 | 47/48 |
| | 2008 | 23 | 22 | 420 | 3 | 3 [1] | 48/48 | 48/48 |
| | 2009 | 23 | 18 | 690 | 3.0 | 0.8 [0.3] | 49/49 | 49/49 |
| | 2010 | 15 | tr(11) | 310 | nd | 13 [4] | 44/49 | 44/49 |
| | 2011 | 16 | 13 | 470 | 3.2 | 1.0 [0.4] | 49/49 | 49/49 |
| | 2012 | 41 | 33 | 300 | 12 | 2.5 [0.8] | 48/48 | 48/48 |
| | 2013 | 15 | 13 | 200 | 3 | 3 [1] | 48/48 | 48/48 |
| | 2017 | 15 | 15 | 150 | tr(2) | 3 [1] | 47/47 | 47/47 |
| | 2020 | 11 | 8 | 98 | tr(3) | 4 [2] | 46/46 | 46/46 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2002.

(Note 2) No monitoring was conducted during FY2014~2016, FY2018 and Fy2019.

<Sediment>

*cis*-Chlordane: The presence of the substance in sediment was monitored at 58 sites, and it was detected at all 58 valid sites adopting the detection limit of 0.5pg/g-dry, and the detection range was tr(1.1) ~ 4,200pg/g-dry.

As results of the inter-annual trend analysis from FY2002 to FY2020, reduction tendencies in specimens from river areas, river mouth areas and sea areas were identified as statistically significant and a reduction tendency in specimens from the overall areas in sediment was also identified as statistically significant.

*trans*-Chlordane: The presence of the substance in sediment was monitored at 58 sites, and it was detected at all 58 valid sites adopting the detection limit of 0.1pg/g-dry, and the detection range was 1.4 ~ 4,500pg/g-dry.

As results of the inter-annual trend analysis from FY2002 to FY2020, reduction tendencies in specimens from river areas, river mouth areas and sea areas were identified as statistically significant and a reduction tendency in specimens from the overall areas in sediment was also identified as statistically significant.

Stocktaking of the detection of *cis*-Chlordane and *trans*-Chlordane in sediment FY2002~2020

| *cis*-Chlordane | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Sediment (pg/g-dry) | 2002 | 140 | 98 | 18,000 | 1.8 | 0.9 [0.3] | 189/189 | 63/63 |
| | 2003 | 190 | 140 | 19,000 | tr(3.6) | 4 [2] | 186/186 | 62/62 |
| | 2004 | 160 | 97 | 36,000 | 4 | 4 [2] | 189/189 | 63/63 |
| | 2005 | 150 | 100 | 44,000 | 3.3 | 1.9 [0.64] | 189/189 | 63/63 |
| | 2006 | 100 | 70 | 13,000 | tr(0.9) | 2.4 [0.8] | 192/192 | 64/64 |
| | 2007 | 82 | 55 | 7,500 | nd | 5 [2] | 191/192 | 64/64 |
| | 2008 | 100 | 63 | 11,000 | tr(2.3) | 2.4 [0.9] | 192/192 | 64/64 |
| | 2009 | 84 | 61 | 8,600 | 2.0 | 0.7 [0.3] | 192/192 | 64/64 |
| | 2010 | 82 | 62 | 7,200 | tr(4) | 6 [2] | 64/64 | 64/64 |
| | 2011 | 70 | 58 | 4,500 | 1.7 | 1.1 [0.4] | 64/64 | 64/64 |
| | 2012 | 69 | 61 | 11,000 | tr(2.6) | 2.9 [1.0] | 63/63 | 63/63 |
| | 2013 | 65 | 55 | 5,400 | tr(1.9) | 2.0 [0.8] | 63/63 | 63/63 |
| | 2017 | 47 | 36 | 2,800 | nd | 4.8 [1.6] | 61/62 | 61/62 |
| | 2020 | 42 | 38 | 4,200 | tr(1.1) | 1.2 [0.5] | 58/58 | 58/58 |
| *trans*-Chlordane | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
| Sediment (pg/g-dry) | 2002 | 150 | 110 | 16,000 | 2.1 | 1.8 [0.6] | 189/189 | 63/63 |
| | 2003 | 130 | 100 | 13,000 | tr(2.4) | 4 [2] | 186/186 | 62/62 |
| | 2004 | 110 | 80 | 26,000 | 3 | 3 [0.9] | 189/189 | 63/63 |
| | 2005 | 110 | 81 | 32,000 | 3.4 | 2.3 [0.84] | 189/189 | 63/63 |
| | 2006 | 110 | 76 | 12,000 | 2.2 | 1.1 [0.4] | 192/192 | 64/64 |
| | 2007 | 82 | 58 | 7,500 | nd | 2.2 [0.8] | 191/192 | 64/64 |
| | 2008 | 110 | 66 | 10,000 | 2.4 | 2.0 [0.8] | 192/192 | 64/64 |
| | 2009 | 91 | 68 | 8,300 | 2.1 | 1.7 [0.7] | 192/192 | 64/64 |
| | 2010 | 95 | 69 | 8,000 | tr(4) | 11 [4] | 64/64 | 64/64 |
| | 2011 | 73 | 64 | 4,300 | 3.2 | 1.3 [0.5] | 64/64 | 64/64 |
| | 2012 | 80 | 71 | 13,000 | tr(2.9) | 4.0 [1.3] | 63/63 | 63/63 |
| | 2013 | 74 | 65 | 5,600 | 2.5 | 1.8 [0.7] | 63/63 | 63/63 |
| | 2017 | 53 | 41 | 3,000 | tr(1) | 4 [1] | 62/62 | 62/62 |
| | 2020 | 47 | 44 | 4,500 | 1.4 | 0.2 [0.1] | 58/58 | 58/58 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived during FY2002~2009.

(Note 2) No monitoring was conducted during FY2014~2016, FY2018 and Fy2019.

<Wildlife>

*cis*-Chlordane: The presence of the substance in bivalves was monitored in 3 areas, and it was detected at all 3 valid areas adopting the detection limit of 1pg/g-wet, and the detection range was 41 ~ 590pg/g-wet. For fish, the presence of the substance was monitored in 18 areas, and it was detected at all 18 valid areas adopting the detection limit of 1pg/g-wet, and the detection range was 39 ~ 2,200pg/g-wet. For birds, the presence of the substance was monitored in 1 area, and detected in the area adopting the detection limit of 1pg/g-wet, and the detected concentration was 83pg/g-wet.

As results of the inter-annual trend analysis from FY2002 to FY2020 a reduction tendency in specimens from bivalves was identified as statistically significant.

*trans*-Chlordane: The presence of the substance in bivalves was monitored in 3 areas, and it was detected at all 3 valid areas adopting the detection limit of 2pg/g-wet, and the detection range was 25 ~ 430pg/g-wet. For fish, the presence of the substance was monitored in 18 areas, and it was detected at all 18 valid areas adopting the detection limit of 2pg/g-wet, and the detection range was 11 ~ 780pg/g-wet. For birds, the presence of the substance was monitored in 1 area, and detected in the area adopting the detection limit of 2pg/g-wet, and the detected concentration was 34pg/g-wet.

Stocktaking of the detection of *cis*-Chlordane and *trans*-Chlordane in wildlife (bivalves, fish and birds) FY2002~2020

| *cis*-Chlordane | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2002 | 730 | 1,200 | 26,000 | 24 | 2.4 [0.8] | 38/38 | 8/8 |
| | 2003 | 1,100 | 1,400 | 14,000 | 110 | 3.9 [1.3] | 30/30 | 6/6 |
| | 2004 | 1,300 | 1,600 | 14,000 | 91 | 18 [5.8] | 31/31 | 7/7 |
| | 2005 | 1,000 | 960 | 13,000 | 78 | 12 [3.9] | 31/31 | 7/7 |
| | 2006 | 970 | 1,100 | 18,000 | 67 | 4 [1] | 31/31 | 7/7 |
| | 2007 | 870 | 590 | 19,000 | 59 | 5 [2] | 31/31 | 7/7 |
| | 2008 | 750 | 560 | 11,000 | 85 | 5 [2] | 31/31 | 7/7 |
| | 2009 | 1,200 | 1,100 | 16,000 | 83 | 4 [2] | 31/31 | 7/7 |
| | 2010 | 1,600 | 2,300 | 15,000 | 67 | 4 [2] | 6/6 | 6/6 |
| | 2011 | 790 | 880 | 3,400 | 160 | 3 [1] | 4/4 | 4/4 |
| | 2012 | 710 | 500 | 3,500 | 180 | 5 [2] | 5/5 | 5/5 |
| | 2013 | 410 | 410 | 2,000 | 75 | 13 [4] | 5/5 | 5/5 |
| | 2016 | 220 | 260 | 500 | 80 | 3 [1] | 3/3 | 3/3 |
| | 2020 | 200 | 310 | 590 | 41 | 3 [1] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2002 | 610 | 550 | 6,900 | 57 | 2.4 [0.8] | 70/70 | 14/14 |
| | 2003 | 510 | 400 | 4,400 | 43 | 3.9 [1.3] | 70/70 | 14/14 |
| | 2004 | 620 | 490 | 9,800 | 68 | 18 [5.8] | 70/70 | 14/14 |
| | 2005 | 520 | 600 | 8,000 | 42 | 12 [3.9] | 80/80 | 16/16 |
| | 2006 | 520 | 420 | 4,900 | 56 | 4 [1] | 80/80 | 16/16 |
| | 2007 | 430 | 360 | 5,200 | 30 | 5 [2] | 80/80 | 16/16 |
| | 2008 | 430 | 340 | 3,500 | 36 | 5 [2] | 85/85 | 17/17 |
| | 2009 | 430 | 450 | 3,200 | 41 | 4 [2] | 90/90 | 18/18 |
| | 2010 | 450 | 630 | 3,400 | 51 | 4 [2] | 18/18 | 18/18 |
| | 2011 | 580 | 660 | 3,800 | 79 | 3 [1] | 18/18 | 18/18 |
| | 2012 | 580 | 550 | 3,100 | 98 | 5 [2] | 19/19 | 19/19 |
| | 2013 | 540 | 450 | 5,700 | 65 | 13 [4] | 19/19 | 19/19 |
| | 2016 | 340 | 440 | 2,200 | 67 | 3 [1] | 19/19 | 19/19 |
| | 2020 | 290 | 310 | 2,200 | 39 | 3 [1] | 18/18 | 18/18 |
| Birds** (pg/g-wet) | 2002 | 67 | 180 | 450 | 10 | 2.4 [0.8] | 10/10 | 2/2 |
| | 2003 | 47 | 120 | 370 | 6.8 | 3.9 [1.3] | 10/10 | 2/2 |
| | 2004 | 39 | 110 | 240 | tr(5.8) | 18 [5.8] | 10/10 | 2/2 |
| | 2005 | 53 | 120 | 340 | tr(5.8) | 12 [3.9] | 10/10 | 2/2 |
| | 2006 | 32 | 83 | 250 | 5 | 4 [1] | 10/10 | 2/2 |
| | 2007 | 29 | 83 | 230 | tr(4) | 5 [2] | 10/10 | 2/2 |
| | 2008 | 24 | 87 | 280 | tr(3) | 5 [2] | 10/10 | 2/2 |
| | 2009 | 21 | 48 | 130 | 4 | 4 [2] | 10/10 | 2/2 |
| | 2010 | 27 | --- | 180 | 4 | 4 [2] | 2/2 | 2/2 |
| | 2011 | --- | --- | 6 | 6 | 3 [1] | 1/1 | 1/1 |
| | 2012 | 23 | --- | 110 | 5 | 5 [2] | 2/2 | 2/2 |
| | 2013 | 37 | --- | 140 | tr(10) | 13 [4] | 2/2 | 2/2 |
| | 2016 | 38 | --- | 110 | 13 | 3 [1] | 2/2 | 2/2 |
| | 2020 | --- | --- | 83 | 83 | 3 [1] | 1/1 | 1/1 |

| *trans*-Chlordane | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2002 | 390 | 840 | 2,300 | 33 | 2.4 [0.8] | 38/38 | 8/8 |
| | 2003 | 550 | 840 | 2,800 | 69 | 7.2 [2.4] | 30/30 | 6/6 |
| | 2004 | 560 | 770 | 2,800 | 53 | 48 [16] | 31/31 | 7/7 |
| | 2005 | 470 | 660 | 2,400 | 40 | 10 [3.5] | 31/31 | 7/7 |
| | 2006 | 470 | 580 | 2,800 | 41 | 4 [2] | 31/31 | 7/7 |
| | 2007 | 440 | 460 | 1,500 | 34 | 6 [2] | 31/31 | 7/7 |
| | 2008 | 360 | 410 | 1,300 | 52 | 7 [3] | 31/31 | 7/7 |
| | 2009 | 540 | 560 | 16,000 | 48 | 4 [1] | 31/31 | 7/7 |
| | 2010 | 520 | 640 | 5,500 | 31 | 3 [1] | 6/6 | 6/6 |
| | 2011 | 490 | 470 | 2,900 | 150 | 4 [1] | 4/4 | 4/4 |
| | 2012 | 390 | 310 | 1,300 | 140 | 7 [2] | 5/5 | 5/5 |
| | 2013 | 280 | 230 | 1,700 | 58 | 16 [5.2] | 5/5 | 5/5 |
| | 2016 | 120 | 99 | 330 | 56 | 6 [2] | 3/3 | 3/3 |
| | 2020 | 100 | 97 | 430 | 25 | 6 [2] | 3/3 | 3/3 |

| *trans*-Chlordane | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Fish (pg/g-wet) | 2002 | 190 | 160 | 2,700 | 20 | 2.4 [0.8] | 70/70 | 14/14 |
| | 2003 | 160 | 120 | 1,800 | 9.6 | 7.2 [2.4] | 70/70 | 14/14 |
| | 2004 | 200 | 130 | 5,200 | tr(17) | 48 [16] | 70/70 | 14/14 |
| | 2005 | 160 | 180 | 3,100 | tr(9.8) | 10 [3.5] | 76/80 | 16/16 |
| | 2006 | 150 | 120 | 2,000 | 14 | 4 [2] | 80/80 | 16/16 |
| | 2007 | 130 | 100 | 2,100 | 8 | 6 [2] | 80/80 | 16/16 |
| | 2008 | 120 | 71 | 1,300 | 14 | 7 [3] | 85/85 | 17/17 |
| | 2009 | 130 | 140 | 1,300 | 10 | 4 [1] | 90/90 | 18/18 |
| | 2010 | 120 | 170 | 1,100 | 9 | 3 [1] | 18/18 | 18/18 |
| | 2011 | 180 | 240 | 1,300 | 20 | 4 [1] | 18/18 | 18/18 |
| | 2012 | 170 | 140 | 1,100 | 19 | 7 [2] | 19/19 | 19/19 |
| | 2013 | 160 | 170 | 2,700 | tr(14) | 16 [5.2] | 19/19 | 19/19 |
| | 2016 | 100 | 110 | 800 | 12 | 6 [2] | 19/19 | 19/19 |
| | 2020 | 90 | 110 | 780 | 11 | 6 [2] | 18/18 | 18/18 |
| Birds** (pg/g-wet) | 2002 | 14 | 14 | 26 | 8.9 | 2.4 [0.8] | 10/10 | 2/2 |
| | 2003 | 11 | 12 | 27 | tr(5.9) | 7.2 [2.4] | 10/10 | 2/2 |
| | 2004 | nd | nd | tr(26) | nd | 48 [16] | 5/10 | 1/2 |
| | 2005 | 11 | 12 | 30 | tr(4.5) | 10 [3.5] | 10/10 | 2/2 |
| | 2006 | 7 | 8 | 17 | tr(3) | 4 [2] | 10/10 | 2/2 |
| | 2007 | 7 | 8 | 19 | tr(3) | 6 [2] | 10/10 | 2/2 |
| | 2008 | tr(5) | 9 | 27 | nd | 7 [3] | 7/10 | 2/2 |
| | 2009 | 6 | 7 | 13 | tr(3) | 4 [1] | 10/10 | 2/2 |
| | 2010 | 4 | --- | 10 | tr(2) | 3 [1] | 2/2 | 2/2 |
| | 2011 | --- | --- | 5 | 5 | 4 [1] | 1/1 | 1/1 |
| | 2012 | tr(6) | --- | 10 | tr(4) | 7 [2] | 2/2 | 2/2 |
| | 2013 | 26 | --- | 68 | tr(10) | 16 [5.2] | 2/2 | 2/2 |
| | 2016 | 18 | --- | 46 | 7 | 6 [2] | 2/2 | 2/2 |
| | 2020 | --- | --- | 34 | 34 | 6 [2] | 1/1 | 1/1 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived during FY2002~2009.

(Note 2) “ ** ” : There is no consistency between the results of the ornithological survey after FY2013 and those in previous years because of the changes in the survey sites and target species.

(Note 3) No monitoring was conducted during FY2014, 2015 and FY2017~2019.

<Air>

*cis*-Chlordane: The presence of the substance in air was monitored at 37 sites, and it was detected at all 37 valid sites adopting the detection limit of 0.03pg/m$^3$, and the detection range was 1.5 ~ 200pg/m$^3$.

As results of the inter-annual trend analysis from FY2003 to FY2020, a reduction tendency in specimens from warm season was identified as statistically significant.

*trans*-Chlordane: The presence of the substance in air was monitored at 37 sites, and it was detected at all 37 valid sites adopting the detection limit of 0.06pg/m$^3$, and the detection range was 1.5 ~ 230pg/m$^3$.

As results of the inter-annual trend analysis from FY2003 to FY2020, a reduction tendency in specimens from warm season was identified as statistically significant.

Stocktaking of the detection of *cis*-Chlordane and *trans*-Chlordane in air FY2002~2020

| *cis*-Chlordane | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Air ($pg/m^3$) | 2002 | 31 | 40 | 670 | 0.86 | 0.60 [0.20] | 102/102 | 34/34 |
| | 2003 Warm season | 110 | 120 | 1,600 | 6.4 | 0.51 [0.17] | 35/35 | 35/35 |
| | 2003 Cold season | 30 | 38 | 220 | 2.5 | | 34/34 | 34/34 |
| | 2004 Warm season | 92 | 160 | 1,000 | 2.3 | 0.57 [0.19] | 37/37 | 37/37 |
| | 2004 Cold season | 29 | 49 | 290 | 1.2 | | 37/37 | 37/37 |
| | 2005 Warm season | 92 | 120 | 1,000 | 3.4 | 0.16 [0.054] | 37/37 | 37/37 |
| | 2005 Cold season | 16 | 19 | 260 | 1.4 | | 37/37 | 37/37 |
| | 2006 Warm season | 82 | 110 | 760 | 2.9 | 0.13 [0.04] | 37/37 | 37/37 |
| | 2006 Cold season | 19 | 19 | 280 | 2.0 | | 37/37 | 37/37 |
| | 2007 Warm season | 90 | 120 | 1,100 | 3.3 | 0.10 [0.04] | 36/36 | 36/36 |
| | 2007 Cold season | 17 | 20 | 230 | 1.4 | | 36/36 | 36/36 |
| | 2008 Warm season | 75 | 120 | 790 | 1.9 | 0.14 [0.05] | 37/37 | 37/37 |
| | 2008 Cold season | 21 | 34 | 200 | 1.5 | | 37/37 | 37/37 |
| | 2009 Warm season | 67 | 110 | 790 | 2.7 | 0.16 [0.06] | 37/37 | 37/37 |
| | 2009 Cold season | 19 | 22 | 180 | 0.65 | | 37/37 | 37/37 |
| | 2010 Warm season | 68 | 100 | 700 | 2.2 | 0.9 [0.3] | 37/37 | 37/37 |
| | 2010 Cold season | 20 | 27 | 130 | tr(0.8) | | 37/37 | 37/37 |
| | 2011 Warm season | 66 | 95 | 700 | 1.5 | 1.3 [0.42] | 35/35 | 35/35 |
| | 2011 Cold season | 20 | 31 | 240 | tr(0.88) | | 37/37 | 37/37 |
| | 2012 Warm season | 61 | 98 | 650 | 2.9 | 1.5 [0.51] | 36/36 | 36/36 |
| | 2012 Cold season | 10 | 14 | 74 | nd | | 35/36 | 35/36 |
| | 2013 Warm season | 58 | 97 | 580 | 1.5 | 0.7 [0.2] | 36/36 | 36/36 |
| | 2013 Cold season | 11 | 15 | 86 | tr(0.5) | | 36/36 | 36/36 |
| | 2016 Warm season | 53 | 86 | 810 | 0.9 | 0.9 [0.3] | 37/37 | 37/37 |
| | 2020 Warm season | 32 | 37 | 200 | 1.5 | 0.09 [0.03] | 37/37 | 37/37 |

| *trans*-Chlordane | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Air ($pg/m^3$) | 2002 | 36 | 48 | 820 | 0.62 | 0.60 [0.20] | 102/102 | 34/34 |
| | 2003 Warm season | 130 | 150 | 2,000 | 6.5 | 0.86 [0.29] | 35/35 | 35/35 |
| | 2003 Cold season | 37 | 44 | 290 | 2.5 | | 34/34 | 34/34 |
| | 2004 Warm season | 110 | 190 | 1,300 | 2.2 | 0.69 [0.23] | 37/37 | 37/37 |
| | 2004 Cold season | 35 | 60 | 360 | 1.5 | | 37/37 | 37/37 |
| | 2005 Warm season | 100 | 130 | 1,300 | 3.2 | 0.34 [0.14] | 37/37 | 37/37 |
| | 2005 Cold season | 19 | 23 | 310 | 1.9 | | 37/37 | 37/37 |
| | 2006 Warm season | 96 | 140 | 1,200 | 3.4 | 0.17 [0.06] | 37/37 | 37/37 |
| | 2006 Cold season | 22 | 21 | 350 | 2.0 | | 37/37 | 37/37 |
| | 2007 Warm season | 100 | 140 | 1,300 | 3.8 | 0.12 [0.05] | 36/36 | 36/36 |
| | 2007 Cold season | 20 | 24 | 300 | 1.5 | | 36/36 | 36/36 |
| | 2008 Warm season | 87 | 130 | 990 | 2.5 | 0.17 [0.06] | 37/37 | 37/37 |
| | 2008 Cold season | 25 | 41 | 250 | 1.8 | | 37/37 | 37/37 |
| | 2009 Warm season | 79 | 120 | 960 | 2.6 | 0.12 [0.05] | 37/37 | 37/37 |
| | 2009 Cold season | 23 | 30 | 210 | 0.68 | | 37/37 | 37/37 |
| | 2010 Warm season | 79 | 120 | 820 | 2.0 | 1.2 [0.4] | 37/37 | 37/37 |
| | 2010 Cold season | 24 | 34 | 150 | tr(1.0) | | 37/37 | 37/37 |
| | 2011 Warm season | 76 | 110 | 810 | tr(1.4) | 1.6 [0.53] | 35/35 | 35/35 |
| | 2011 Cold season | 24 | 37 | 290 | tr(0.70) | | 37/37 | 37/37 |
| | 2012 Warm season | 70 | 120 | 780 | 2.8 | 2.1 [0.7] | 36/36 | 36/36 |
| | 2012 Cold season | 12 | 18 | 95 | nd | | 35/36 | 35/36 |
| | 2013 Warm season | 64 | 120 | 690 | 1.7 | 0.8 [0.3] | 36/36 | 36/36 |
| | 2013 Cold season | 13 | 18 | 110 | tr(0.4) | | 36/36 | 36/36 |
| | 2016 Warm season | 61 | 95 | 1,100 | tr(0.7) | 1.0 [0.3] | 37/37 | 37/37 |
| | 2020 Warm season | 35 | 42 | 230 | 1.5 | 0.16 [0.06] | 37/37 | 37/37 |

(Note) No monitoring was conducted in FY2014, 2015 and FY2017~2019.

○ Oxychlordane, *cis*-Nonachlor and *trans*-Nonachlor

<Surface Water>

Oxychlordane: The presence of the substance in surface water was monitored at 46 sites, and it was detected at 21 of the 46 valid sites adopting the detection limit of 1pg/L, and the detection range was up to 8pg/L.

As results of the inter-annual trend analysis from FY2002 to FY2020, the recent 6 years period was indicated lower concentration than the first 6 years period in specimens from river areas in surface water as statistically significant.

*cis*-Nonachlor: The presence of the substance in surface water was monitored at 46 sites, and it was detected at all 46 valid sites adopting the detection limit of 0.5pg/L, and the detection range was tr(0.6) ~ 39pg/L.

As results of the inter-annual trend analysis from FY2002 to FY2020, a reduction tendency in specimens from river areas was identified as statistically significant.

*trans*-Nonachlor: The presence of the substance in surface water was monitored at 46 sites, and it was detected at 45 of the 46 valid sites adopting the detection limit of 2pg/L, and the detection range was up to 95pg/L.

As results of the inter-annual trend analysis from FY2002 to FY2020, a reduction tendency in specimens from river areas was identified as statistically significant and a reduction tendency in specimens from the overall areas in surface water was also identified as statistically significant.

Stocktaking of the detection of Oxychlordane, *cis*-Nonachlor and *trans*-Nonachlor in surface water FY2002~2020

| Oxychlordane | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Surface Water (pg/L) | 2002 | 2.7 | 3.5 | 41 | nd | 1.2 [0.4] | 96/114 | 35/38 |
| | 2003 | 3 | 2 | 39 | tr(0.6) | 2 [0.5] | 36/36 | 36/36 |
| | 2004 | 3.2 | 2.9 | 47 | tr(0.7) | 2 [0.5] | 38/38 | 38/38 |
| | 2005 | 2.6 | 2.1 | 19 | nd | 1.1 [0.4] | 46/47 | 46/47 |
| | 2006 | tr(2.5) | tr(2.4) | 18 | nd | 2.8 [0.9] | 43/48 | 43/48 |
| | 2007 | tr(2) | nd | 41 | nd | 6 [2] | 25/48 | 25/48 |
| | 2008 | 1.9 | 1.9 | 14 | nd | 1.9 [0.7] | 40/48 | 40/48 |
| | 2009 | 2.0 | 1.9 | 19 | nd | 1.1 [0.4] | 45/49 | 45/49 |
| | 2010 | 1.5 | 1.3 | 45 | nd | 0.7 [0.3] | 47/49 | 47/49 |
| | 2011 | 1.9 | 1.8 | 34 | nd | 1.3 [0.5] | 44/49 | 44/49 |
| | 2012 | 2.2 | 2.3 | 17 | nd | 0.9 [0.4] | 44/48 | 44/48 |
| | 2013 | 1.8 | 1.8 | 12 | nd | 0.9 [0.4] | 41/48 | 41/48 |
| | 2017 | nd | nd | 12 | nd | 4 [2] | 19/47 | 19/47 |
| | 2020 | tr(1) | nd | 8 | nd | 3 [1] | 21/46 | 21/46 |
| *cis*-Nonachlor | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
| Surface Water (pg/L) | 2002 | 7.9 | 6.7 | 250 | 0.23 | 1.8 [0.6] | 114/114 | 38/38 |
| | 2003 | 8.0 | 7.0 | 130 | 1.3 | 0.3 [0.1] | 36/36 | 36/36 |
| | 2004 | 7.5 | 6.3 | 340 | 0.8 | 0.6 [0.2] | 38/38 | 38/38 |
| | 2005 | 6.0 | 5.9 | 43 | 0.9 | 0.5 [0.2] | 47/47 | 47/47 |
| | 2006 | 6.6 | 5.6 | 83 | 1.0 | 0.8 [0.3] | 48/48 | 48/48 |
| | 2007 | 5.9 | 6.1 | 210 | nd | 2.4 [0.8] | 43/48 | 43/48 |
| | 2008 | 6.5 | 5.9 | 130 | 0.9 | 0.9 [0.3] | 48/48 | 48/48 |
| | 2009 | 7.1 | 5.5 | 210 | 1.4 | 0.3 [0.1] | 49/49 | 49/49 |
| | 2010 | 5.4 | 3.9 | 40 | tr(0.9) | 1.3 [0.4] | 49/49 | 49/49 |
| | 2011 | 5.0 | 4.3 | 130 | 0.8 | 0.6 [0.2] | 49/49 | 49/49 |
| | 2012 | 6.4 | 5.9 | 58 | 1.1 | 0.8 [0.3] | 48/48 | 48/48 |
| | 2013 | 5.1 | 4.6 | 74 | tr(0.7) | 0.8 [0.3] | 48/48 | 48/48 |
| | 2017 | 4.6 | 4.6 | 36 | tr(0.6) | 1.5 [0.6] | 47/47 | 47/47 |
| | 2020 | 3.8 | 2.8 | 39 | tr(0.6) | 1.3 [0.5] | 46/46 | 46/46 |

| *trans*-Nonachlor | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2002 | 30 | 24 | 780 | 1.8 | 1.2 [0.4] | 114/114 | 38/38 |
| | 2003 | 26 | 20 | 450 | 4 | 2 [0.5] | 36/36 | 36/36 |
| | 2004 | 25 | 19 | 1,100 | tr(3) | 4 [2] | 38/38 | 38/38 |
| | 2005 | 20 | 17 | 150 | 2.6 | 2.5 [0.84] | 47/47 | 47/47 |
| | 2006 | 21 | 16 | 310 | 3.2 | 3.0 [1.0] | 48/48 | 48/48 |
| | 2007 | 17 | 17 | 540 | tr(2) | 5 [2] | 48/48 | 48/48 |
| | 2008 | 18 | 17 | 340 | 1.9 | 1.6 [0.6] | 48/48 | 48/48 |
| | 2009 | 20 | 17 | 530 | 2.7 | 1.0 [0.4] | 49/49 | 49/49 |
| | 2010 | 12 | 11 | 93 | nd | 8 [3] | 45/49 | 45/49 |
| | 2011 | 15 | 12 | 480 | 2.6 | 1.3 [0.5] | 49/49 | 49/49 |
| | 2012 | 30 | 26 | 210 | 7.9 | 1.5 [0.6] | 48/48 | 48/48 |
| | 2013 | 14 | 11 | 170 | 2.3 | 1.5 [0.6] | 48/48 | 48/48 |
| | 2017 | 13 | 14 | 120 | tr(2) | 3 [1] | 47/47 | 47/47 |
| | 2020 | 9 | 8 | 95 | nd | 5 [2] | 45/46 | 45/46 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2002.

(Note 2) No monitoring was conducted in FY2014~2016, FY2018 and 2019.

<Sediment>

Oxychlordane: The presence of the substance in sediment was monitored at 58 sites, and it was detected at 34 of the 58 valid sites adopting the detection limit of 0.7pg/g-dry, and the detection range was up to 39pg/g-dry.

As results of the inter-annual trend analysis from FY2002 to FY2020, the recent 6 years period was indicated lower concentration than the first 6 years period in specimens from river mouth areas and also the overall areas in sediment as statistically significant.

*cis*-Nonachlor: The presence of the substance in sediment was monitored at 58 sites, and it was detected at all 58 valid sites adopting the detection limit of 0.3pg/g-dry, and the detection range was tr(0.7) ~ 2,100pg/g-dry.

As results of the inter-annual trend analysis from FY2002 to FY2020, reduction tendencies in specimens from river areas and sea areas were identified as statistically significant and a reduction tendency in specimens from the overall areas in sediment was also identified as statistically significant.

*trans*-Nonachlor: The presence of the substance in sediment was monitored at 58 sites, and it was detected at all 58 valid sites adopting the detection limit of 0.2pg/g-dry, and the detection range was 1.9 ~ 3,800pg/g-dry.

As results of the inter-annual trend analysis from FY2002 to FY2020, reduction tendencies in specimens from river areas, river mouth areas and sea areas were identified as statistically significant and a reduction tendency in specimens from the overall areas in sediment was also identified as statistically significant.

Stocktaking of the detection of Oxychlordane, *cis*-Nonachlor and *trans*-Nonachlor in sediment FY2002~2020

| Oxychlordane | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2002 | 2.7 | 1.7 | 120 | nd | 1.5 [0.5] | 153/189 | 59/63 |
| | 2003 | 2 | 2 | 85 | nd | 1 [0.4] | 158/186 | 57/62 |
| | 2004 | tr(2.1) | tr(1.3) | 140 | nd | 3 [0.8] | 129/189 | 54/63 |
| | 2005 | 2.3 | tr(1.9) | 160 | nd | 2.0 [0.7] | 133/189 | 51/63 |
| | 2006 | tr(2.5) | tr(1.7) | 280 | nd | 2.9 [1.0] | 141/192 | 54/64 |
| | 2007 | tr(2.1) | tr(1.5) | 76 | nd | 2.5 [0.9] | 117/192 | 46/64 |
| | 2008 | tr(2) | tr(1) | 340 | nd | 3 [1] | 110/192 | 48/64 |
| | 2009 | 2 | tr(1) | 150 | nd | 2 [1] | 97/192 | 45/64 |
| | 2010 | 1.7 | 1.2 | 60 | nd | 1.0 [0.4] | 56/64 | 56/64 |
| | 2011 | tr(1.6) | tr(1.2) | 83 | nd | 2.2 [0.9] | 36/64 | 36/64 |
| | 2012 | tr(1.4) | tr(1.0) | 75 | nd | 1.7 [0.7] | 38/63 | 38/63 |
| | 2013 | 1.5 | 1.3 | 54 | nd | 1.3 [0.5] | 50/63 | 50/63 |
| | 2017 | tr(1) | tr(1) | 78 | nd | 3 [1] | 41/62 | 41/62 |
| | 2020 | tr(1.1) | tr(1.0) | 39 | nd | 1.8 [0.7] | 34/58 | 34/58 |

| *cis*-Nonachlor | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2002 | 76 | 66 | 7,800 | nd | 2.1 [0.7] | 188/189 | 63/63 |
| | 2003 | 66 | 50 | 6,500 | nd | 3 [0.9] | 184/186 | 62/62 |
| | 2004 | 53 | 34 | 9,400 | tr(0.8) | 2 [0.6] | 189/189 | 63/63 |
| | 2005 | 56 | 42 | 9,900 | tr(1.1) | 1.9 [0.64] | 189/189 | 63/63 |
| | 2006 | 58 | 48 | 5,800 | tr(0.6) | 1.2 [0.4] | 192/192 | 64/64 |
| | 2007 | 48 | 35 | 4,200 | nd | 1.6 [0.6] | 191/192 | 64/64 |
| | 2008 | 57 | 42 | 5,100 | 1.1 | 0.6 [0.2] | 192/192 | 64/64 |
| | 2009 | 53 | 38 | 4,700 | 1.4 | 1.0 [0.4] | 192/192 | 64/64 |
| | 2010 | 53 | 45 | 3,600 | 2.3 | 0.9 [0.3] | 64/64 | 64/64 |
| | 2011 | 41 | 38 | 2,900 | nd | 1.1 [0.4] | 63/64 | 63/64 |
| | 2012 | 44 | 35 | 4,900 | tr(1) | 3 [1] | 63/63 | 63/63 |
| | 2013 | 41 | 31 | 3,100 | tr(0.6) | 0.7 [0.3] | 63/63 | 63/63 |
| | 2017 | 31 | 25 | 1,500 | nd | 1.7 [0.7] | 61/62 | 61/62 |
| | 2020 | 31 | 24 | 2,100 | tr(0.7) | 0.8 [0.3] | 58/58 | 58/58 |

| *trans*-Nonachlor | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2002 | 130 | 83 | 13,000 | 3.1 | 1.5 [0.5] | 189/189 | 63/63 |
| | 2003 | 110 | 78 | 11,000 | 2 | 2 [0.6] | 186/186 | 62/62 |
| | 2004 | 94 | 63 | 23,000 | 3 | 2 [0.6] | 189/189 | 63/63 |
| | 2005 | 99 | 72 | 24,000 | 2.4 | 1.5 [0.54] | 189/189 | 63/63 |
| | 2006 | 100 | 65 | 10,000 | 3.4 | 1.2 [0.4] | 192/192 | 64/64 |
| | 2007 | 78 | 55 | 8,400 | tr(1.6) | 1.7 [0.6] | 192/192 | 64/64 |
| | 2008 | 91 | 53 | 8,400 | tr(1.6) | 2.2 [0.8] | 192/192 | 64/64 |
| | 2009 | 85 | 58 | 7,800 | 2.0 | 0.9 [0.3] | 192/192 | 64/64 |
| | 2010 | 80 | 65 | 6,200 | tr(3) | 6 [2] | 64/64 | 64/64 |
| | 2011 | 68 | 52 | 4,500 | 1.7 | 0.8 [0.3] | 64/64 | 64/64 |
| | 2012 | 69 | 62 | 10,000 | 2.5 | 2.4 [0.8] | 63/63 | 63/63 |
| | 2013 | 67 | 54 | 4,700 | 2.2 | 1.2 [0.4] | 63/63 | 63/63 |
| | 2017 | 47 | 39 | 2,600 | nd | 6 [2] | 61/62 | 61/62 |
| | 2020 | 48 | 40 | 3,800 | 1.9 | 0.5 [0.2] | 58/58 | 58/58 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived during FY2002~2009.
(Note 2) No monitoring was conducted in FY2014~2016, FY2018 and 2019.

<Wildlife>

Oxychlordane: The presence of the substance in bivalves was monitored in 3 areas, and it was detected at all 3 valid areas adopting the detection limit of 1pg/g-wet, and the detection range was 5 ~ 59pg/g-wet. For fish, the presence of the substance was monitored in 18 areas, and it was detected at all 18 valid areas adopting the detection limit of 1pg/g-wet, and the detection range was 24 ~ 2,100pg/g-wet. For birds, the presence of the substance was monitored in 1 area, and detected in the area adopting the detection limit of 1pg/g-wet, and the detected concentration was 820pg/g-wet.

As results of the inter-annual trend analysis from FY2002 to FY2020 a reduction tendency in specimens from fish was identified as statistically significant.

*cis*-Nonachlor: The presence of the substance in bivalves was monitored in 3 areas, and it was detected at all 3 valid areas adopting the detection limit of 1pg/g-wet, and the detection range was 20 ~ 200pg/g-wet. For fish, the presence of the substance was monitored in 18 areas, and it was detected at all 18 valid areas adopting the detection limit of 1pg/g-wet, and the detection range was 26 ~ 1,600pg/g-wet. For birds, the presence of the substance was monitored in 1 area, and detected in the area adopting the detection limit of 1pg/g-wet, and the detected concentration was 480pg/g-wet.

As results of the inter-annual trend analysis from FY2002 to FY2020 a reduction tendency in specimens from bivalves was identified as statistically significant.

*trans*-Nonachlor: The presence of the substance in bivalves was monitored in 3 areas, and it was detected at all 3 valid areas adopting the detection limit of 2pg/g-wet, and the detection range was 47 ~ 480pg/g-wet. For fish, the presence of the substance was monitored in 18 areas, and it was detected at all 18 valid areas adopting the detection limit of 2pg/g-wet, and the detection range was 95 ~ 5,700pg/g-wet. For birds, the presence of the substance was monitored in 1 area, and detected in the area adopting the detection limit of 2pg/g-wet, and the detected concentration was 81pg/g-wet.

As results of the inter-annual trend analysis from FY2002 to FY2020 a reduction tendency in specimens from bivalves was identified as statistically significant.

Stocktaking of the detection of Oxychlordane, *cis*-Nonachlor and *trans*-Nonachlor in wildlife (bivalves, fish and birds) FY2002~2020

| Oxychlordane | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Bivalves (pg/g-wet) | 2002 | 71 | 83 | 5,600 | nd | 3.6 [1.2] | 37/38 | 8/8 |
| | 2003 | 93 | 62 | 1,900 | 11 | 8.4 [2.8] | 30/30 | 6/6 |
| | 2004 | 110 | 100 | 1,700 | 14 | 9.2 [3.1] | 31/31 | 7/7 |
| | 2005 | 99 | 79 | 1,400 | 12 | 9.3 [3.1] | 31/31 | 7/7 |
| | 2006 | 91 | 90 | 2,400 | 7 | 7 [3] | 31/31 | 7/7 |
| | 2007 | 70 | 43 | 2,200 | 8 | 6 [2] | 31/31 | 7/7 |
| | 2008 | 64 | 55 | 1,100 | 7 | 7 [2] | 31/31 | 7/7 |
| | 2009 | 100 | 89 | 820 | 10 | 4 [1] | 31/31 | 7/7 |
| | 2010 | 240 | 390 | 3,300 | 11 | 8 [3] | 6/6 | 6/6 |
| | 2011 | 68 | 100 | 260 | 8 | 3 [1] | 4/4 | 4/4 |
| | 2012 | 66 | 80 | 450 | 12 | 3 [1] | 5/5 | 5/5 |
| | 2013 | 42 | 44 | 210 | 8 | 3 [1] | 5/5 | 5/5 |
| | 2016 | 27 | 40 | 43 | 11 | 3 [1] | 3/3 | 3/3 |
| | 2020 | 24 | 45 | 59 | 5 | 3 [1] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2002 | 170 | 140 | 3,900 | 16 | 3.6 [1.2] | 70/70 | 14/14 |
| | 2003 | 150 | 160 | 820 | 30 | 8.4 [2.8] | 70/70 | 14/14 |
| | 2004 | 160 | 140 | 1,500 | 25 | 9.2 [3.1] | 70/70 | 14/14 |
| | 2005 | 150 | 150 | 1,900 | 20 | 9.3 [3.1] | 80/80 | 16/16 |
| | 2006 | 150 | 120 | 3,000 | 28 | 7 [3] | 80/80 | 16/16 |
| | 2007 | 120 | 100 | 1,900 | 17 | 6 [2] | 80/80 | 16/16 |
| | 2008 | 130 | 130 | 2,200 | 15 | 7 [2] | 85/85 | 17/17 |
| | 2009 | 120 | 99 | 2,400 | 23 | 4 [1] | 90/90 | 18/18 |
| | 2010 | 120 | 140 | 1,000 | 33 | 8 [3] | 18/18 | 18/18 |
| | 2011 | 140 | 130 | 2,300 | 33 | 3 [1] | 18/18 | 18/18 |
| | 2012 | 140 | 180 | 390 | 28 | 3 [1] | 19/19 | 19/19 |
| | 2013 | 130 | 130 | 560 | 31 | 3 [1] | 19/19 | 19/19 |
| | 2016 | 96 | 80 | 950 | 31 | 3 [1] | 19/19 | 19/19 |
| | 2020 | 75 | 60 | 2,100 | 24 | 3 [1] | 18/18 | 18/18 |
| Birds** (pg/g-wet) | 2002 | 640 | 630 | 890 | 470 | 3.6 [1.2] | 10/10 | 2/2 |
| | 2003 | 760 | 700 | 1,300 | 610 | 8.4 [2.8] | 10/10 | 2/2 |
| | 2004 | 460 | 450 | 730 | 320 | 9.2 [3.1] | 10/10 | 2/2 |
| | 2005 | 610 | 660 | 860 | 390 | 9.3 [3.1] | 10/10 | 2/2 |
| | 2006 | 510 | 560 | 720 | 270 | 7 [3] | 10/10 | 2/2 |
| | 2007 | 440 | 400 | 740 | 290 | 6 [2] | 10/10 | 2/2 |
| | 2008 | 560 | 530 | 960 | 290 | 7 [2] | 10/10 | 2/2 |
| | 2009 | 300 | 290 | 540 | 190 | 4 [1] | 10/10 | 2/2 |
| | 2010 | 400 | --- | 510 | 320 | 8 [3] | 2/2 | 2/2 |
| | 2011 | --- | --- | 590 | 590 | 3 [1] | 1/1 | 1/1 |
| | 2012 | 250 | --- | 360 | 170 | 3 [1] | 2/2 | 2/2 |
| | 2013 | 2,500 | --- | 3,400 | 1,900 | 3 [1] | 2/2 | 2/2 |
| | 2016 | 580 | --- | 1,400 | 240 | 3 [1] | 2/2 | 2/2 |
| | 2020 | --- | --- | 820 | 820 | 3 [1] | 1/1 | 1/1 |

| *cis*-Nonachlor | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Bivalves (pg/g-wet) | 2002 | 170 | 300 | 870 | 8.6 | 1.2 [0.4] | 38/38 | 8/8 |
| | 2003 | 290 | 260 | 1,800 | 48 | 4.8 [1.6] | 30/30 | 6/6 |
| | 2004 | 320 | 380 | 1,800 | 43 | 3.4 [1.1] | 31/31 | 7/7 |
| | 2005 | 270 | 220 | 1,300 | 27 | 4.5 [1.5] | 31/31 | 7/7 |
| | 2006 | 270 | 180 | 1,500 | 31 | 3 [1] | 31/31 | 7/7 |
| | 2007 | 250 | 250 | 1,000 | 26 | 3 [1] | 31/31 | 7/7 |
| | 2008 | 210 | 210 | 780 | 33 | 4 [1] | 31/31 | 7/7 |
| | 2009 | 300 | 310 | 10,000 | 31 | 3 [1] | 31/31 | 7/7 |
| | 2010 | 280 | 310 | 1,300 | 35 | 3 [1] | 6/6 | 6/6 |
| | 2011 | 250 | 280 | 1,300 | 77 | 1.8 [0.7] | 4/4 | 4/4 |
| | 2012 | 200 | 190 | 670 | 52 | 2 [1] | 5/5 | 5/5 |
| | 2013 | 150 | 140 | 900 | 38 | 2.2 [0.7] | 5/5 | 5/5 |
| | 2016 | 72 | 46 | 220 | 37 | 1.4 [0.6] | 3/3 | 3/3 |
| | 2020 | 53 | 38 | 200 | 20 | 3 [1] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2002 | 460 | 420 | 5,100 | 46 | 1.2 [0.4] | 70/70 | 14/14 |
| | 2003 | 360 | 360 | 2,600 | 19 | 4.8 [1.6] | 70/70 | 14/14 |
| | 2004 | 430 | 310 | 10,000 | 48 | 3.4 [1.1] | 70/70 | 14/14 |
| | 2005 | 380 | 360 | 6,200 | 27 | 4.5 [1.5] | 80/80 | 16/16 |
| | 2006 | 370 | 330 | 3,300 | 33 | 3 [1] | 80/80 | 16/16 |
| | 2007 | 320 | 280 | 3,700 | 16 | 3 [1] | 80/80 | 16/16 |
| | 2008 | 350 | 300 | 3,200 | 46 | 4 [1] | 85/85 | 17/17 |
| | 2009 | 340 | 340 | 2,600 | 27 | 3 [1] | 90/90 | 18/18 |
| | 2010 | 320 | 370 | 2,200 | 23 | 3 [1] | 18/18 | 18/18 |
| | 2011 | 440 | 450 | 2,900 | 45 | 1.8 [0.7] | 18/18 | 18/18 |
| | 2012 | 420 | 450 | 2,200 | 33 | 2 [1] | 19/19 | 19/19 |
| | 2013 | 430 | 420 | 3,000 | 34 | 2.2 [0.7] | 19/19 | 19/19 |
| | 2016 | 300 | 170 | 1,900 | 53 | 1.4 [0.6] | 19/19 | 19/19 |
| | 2020 | 230 | 250 | 1,600 | 26 | 3 [1] | 18/18 | 18/18 |
| Birds** (pg/g-wet) | 2002 | 200 | 240 | 450 | 68 | 1.2 [0.4] | 10/10 | 2/2 |
| | 2003 | 200 | 260 | 660 | 68 | 4.8 [1.6] | 10/10 | 2/2 |
| | 2004 | 140 | 150 | 240 | 73 | 3.4 [1.1] | 10/10 | 2/2 |
| | 2005 | 160 | 180 | 370 | 86 | 4.5 [1.5] | 10/10 | 2/2 |
| | 2006 | 120 | 130 | 270 | 60 | 3 [1] | 10/10 | 2/2 |
| | 2007 | 130 | 140 | 300 | 42 | 3 [1] | 10/10 | 2/2 |
| | 2008 | 140 | 150 | 410 | 37 | 4 [1] | 10/10 | 2/2 |
| | 2009 | 81 | 85 | 160 | 44 | 3 [1] | 10/10 | 2/2 |
| | 2010 | 100 | --- | 190 | 57 | 3 [1] | 2/2 | 2/2 |
| | 2011 | --- | --- | 76 | 76 | 1.8 [0.7] | 1/1 | 1/1 |
| | 2012 | 75 | --- | 100 | 56 | 2 [1] | 2/2 | 2/2 |
| | 2013 | 270 | --- | 970 | 74 | 2.2 [0.7] | 2/2 | 2/2 |
| | 2016 | 240 | --- | 770 | 74 | 1.4 [0.6] | 2/2 | 2/2 |
| | 2020 | --- | --- | 480 | 480 | 3 [1] | 1/1 | 1/1 |
| *trans*-Nonachlor | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
| | | | | | | | Sample | Site |
| Bivalves (pg/g-wet) | 2002 | 450 | 1,100 | 1,800 | 21 | 2.4 [0.8] | 38/38 | 8/8 |
| | 2003 | 800 | 700 | 3,800 | 140 | 3.6 [1.2] | 30/30 | 6/6 |
| | 2004 | 780 | 870 | 3,400 | 110 | 13 [4.2] | 31/31 | 7/7 |
| | 2005 | 700 | 650 | 3,400 | 72 | 6.2 [2.1] | 31/31 | 7/7 |
| | 2006 | 660 | 610 | 3,200 | 85 | 3 [1] | 31/31 | 7/7 |
| | 2007 | 640 | 610 | 2,400 | 71 | 7 [3] | 31/31 | 7/7 |
| | 2008 | 510 | 510 | 2,000 | 94 | 6 [2] | 31/31 | 7/7 |
| | 2009 | 780 | 680 | 33,000 | 79 | 3 [1] | 31/31 | 7/7 |
| | 2010 | 790 | 870 | 6,000 | 84 | 4 [2] | 6/6 | 6/6 |
| | 2011 | 640 | 680 | 3,000 | 200 | 3 [1] | 4/4 | 4/4 |
| | 2012 | 530 | 400 | 1,800 | 190 | 4 [1] | 5/5 | 5/5 |
| | 2013 | 380 | 370 | 2,000 | 98 | 10 [3.4] | 5/5 | 5/5 |
| | 2016 | 200 | 150 | 520 | 97 | 3 [1] | 3/3 | 3/3 |
| | 2020 | 140 | 130 | 480 | 47 | 4 [2] | 3/3 | 3/3 |

| *trans*-Nonachlor | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Fish (pg/g-wet) | 2002 | 1,000 | 900 | 8,300 | 98 | 2.4 [0.8] | 70/70 | 14/14 |
| | 2003 | 920 | 840 | 5,800 | 85 | 3.6 [1.2] | 70/70 | 14/14 |
| | 2004 | 1,100 | 760 | 21,000 | 140 | 13 [4.2] | 70/70 | 14/14 |
| | 2005 | 970 | 750 | 13,000 | 80 | 6.2 [2.1] | 80/80 | 16/16 |
| | 2006 | 940 | 680 | 6,900 | 120 | 3 [1] | 80/80 | 16/16 |
| | 2007 | 800 | 680 | 7,900 | 71 | 7 [3] | 80/80 | 16/16 |
| | 2008 | 860 | 750 | 6,900 | 87 | 6 [2] | 85/85 | 17/17 |
| | 2009 | 810 | 720 | 7,400 | 68 | 3 [1] | 90/90 | 18/18 |
| | 2010 | 800 | 1,000 | 4,700 | 110 | 4 [2] | 18/18 | 18/18 |
| | 2011 | 1,100 | 1,000 | 5,000 | 190 | 3 [1] | 18/18 | 18/18 |
| | 2012 | 1,100 | 1,300 | 4,200 | 140 | 4 [1] | 19/19 | 19/19 |
| | 2013 | 1,100 | 1,100 | 7,800 | 150 | 10 [3.4] | 19/19 | 19/19 |
| | 2016 | 690 | 410 | 3,400 | 170 | 3 [1] | 19/19 | 19/19 |
| | 2020 | 530 | 510 | 5,700 | 95 | 4 [2] | 18/18 | 18/18 |
| Birds** (pg/g-wet) | 2002 | 890 | 980 | 1,900 | 350 | 2.4 [0.8] | 10/10 | 2/2 |
| | 2003 | 1,100 | 1,400 | 3,700 | 350 | 3.6 [1.2] | 10/10 | 2/2 |
| | 2004 | 690 | 780 | 1,200 | 390 | 13 [4.2] | 10/10 | 2/2 |
| | 2005 | 870 | 880 | 2,000 | 440 | 6.2 [2.1] | 10/10 | 2/2 |
| | 2006 | 650 | 620 | 1,500 | 310 | 3 [1] | 10/10 | 2/2 |
| | 2007 | 590 | 680 | 1,400 | 200 | 7 [3] | 10/10 | 2/2 |
| | 2008 | 740 | 850 | 2,600 | 180 | 6 [2] | 10/10 | 2/2 |
| | 2009 | 400 | 430 | 730 | 220 | 3 [1] | 10/10 | 2/2 |
| | 2010 | 510 | --- | 880 | 290 | 4 [2] | 2/2 | 2/2 |
| | 2011 | --- | --- | 400 | 400 | 3 [1] | 1/1 | 1/1 |
| | 2012 | 360 | --- | 480 | 270 | 4 [1] | 2/2 | 2/2 |
| | 2013 | 55 | --- | 170 | 18 | 10 [3.4] | 2/2 | 2/2 |
| | 2016 | 60 | --- | 130 | 28 | 3 [1] | 2/2 | 2/2 |
| | 2020 | --- | --- | 81 | 81 | 4 [2] | 1/1 | 1/1 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived during FY2002~2009.

(Note 2) " ** " : There is no consistency between the results of the ornithological survey after FY2013 and those in previous years because of the changes in the survey sites and target species.

(Note 3) No monitoring was conducted during FY2014, 2015 and FY2017~2019.

<Air>

Oxychlordane: The presence of the substance in air was monitored at 37 sites, and it was detected at all 37 valid sites adopting the detection limit of 0.04pg/m$^3$, and the detection range was 0.15 ~ 2.6pg/m$^3$.

As results of the inter-annual trend analysis from FY2003 to FY2020, a reduction tendency in specimens from warm season was identified as statistically significant.

*cis*-Nonachlor: The presence of the substance in air was monitored at 37 sites, and it was detected at all 37 valid sites adopting the detection limit of 0.04pg/m$^3$, and the detection range was 0.13 ~ 24pg/m$^3$.

As results of the inter-annual trend analysis from FY2003 to FY2020, a reduction tendency in specimens from warm season was identified as statistically significant.

*trans*-Nonachlor: The presence of the substance in air was monitored at 37 sites, and it was detected at all 37 valid sites adopting the detection limit of 0.04pg/m$^3$, and the detection range was 1.0 ~ 140pg/m$^3$.

As results of the inter-annual trend analysis from FY2003 to FY2020, a reduction tendency in specimens from warm season was identified as statistically significant.

Stocktaking of the detection of Oxychlordane, *cis*-Nonachlor and *trans*-Nonachlor in air FY2002~2020

| Oxychlordane | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air ($pg/m^3$) | 2002 | 0.96 | 0.98 | 8.3 | nd | 0.024 [0.008] | 101/102 | 34/34 |
| | 2003 Warm season | 2.5 | 2.7 | 12 | 0.41 | 0.045 [0.015] | 35/35 | 35/35 |
| | 2003 Cold season | 0.87 | 0.88 | 3.2 | 0.41 | | 34/34 | 34/34 |
| | 2004 Warm season | 1.9 | 2.0 | 7.8 | 0.41 | 0.13 [0.042] | 37/37 | 37/37 |
| | 2004 Cold season | 0.80 | 0.76 | 3.9 | 0.27 | | 37/37 | 37/37 |
| | 2005 Warm season | 1.9 | 2.0 | 8.8 | 0.65 | 0.16 [0.054] | 37/37 | 37/37 |
| | 2005 Cold season | 0.55 | 0.50 | 2.2 | 0.27 | | 37/37 | 37/37 |
| | 2006 Warm season | 1.8 | 1.9 | 5.7 | 0.47 | 0.23 [0.08] | 37/37 | 37/37 |
| | 2006 Cold season | 0.54 | 0.56 | 5.1 | tr(0.13) | | 37/37 | 37/37 |
| | 2007 Warm season | 1.9 | 1.8 | 8.6 | 0.56 | 0.05 [0.02] | 36/36 | 36/36 |
| | 2007 Cold season | 0.61 | 0.63 | 2.4 | 0.26 | | 36/36 | 36/36 |
| | 2008 Warm season | 1.7 | 1.7 | 7.1 | 0.50 | 0.04 [0.01] | 37/37 | 37/37 |
| | 2008 Cold season | 0.61 | 0.63 | 1.8 | 0.27 | | 37/37 | 37/37 |
| | 2009 Warm season | 1.7 | 1.8 | 6.5 | 0.38 | 0.04 [0.02] | 37/37 | 37/37 |
| | 2009 Cold season | 0.65 | 0.61 | 2.7 | 0.24 | | 37/37 | 37/37 |
| | 2010 Warm season | 1.5 | 1.5 | 6.2 | 0.44 | 0.03 [0.01] | 37/37 | 37/37 |
| | 2010 Cold season | 0.56 | 0.55 | 2.3 | 0.26 | | 37/37 | 37/37 |
| | 2011 Warm season | 1.5 | 1.5 | 5.2 | 0.28 | 0.07 [0.03] | 35/35 | 35/35 |
| | 2011 Cold season | 0.61 | 0.57 | 2.6 | 0.21 | | 37/37 | 37/37 |
| | 2012 Warm season | 1.4 | 1.6 | 6.7 | 0.34 | 0.08 [0.03] | 36/36 | 36/36 |
| | 2012 Cold season | 0.41 | 0.38 | 1.0 | 0.22 | | 36/36 | 36/36 |
| | 2013 Warm season | 1.4 | 1.5 | 4.7 | 0.36 | 0.03 [0.01] | 36/36 | 36/36 |
| | 2013 Cold season | 0.43 | 0.41 | 1.0 | 0.20 | | 36/36 | 36/36 |
| | 2016 Warm season | 1.4 | 1.4 | 8.9 | 0.19 | 0.16 [0.06] | 37/37 | 37/37 |
| | 2020 Warm season | 0.79 | 0.8 | 2.6 | 0.15 | 0.10 [0.04] | 37/37 | 37/37 |

| *cis*-Nonachlor | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air ($pg/m^3$) | 2002 | 3.1 | 4.0 | 62 | 0.071 | 0.030 [0.010] | 102/102 | 34/34 |
| | 2003 Warm season | 12 | 15 | 220 | 0.81 | 0.026 [0.0088] | 35/35 | 35/35 |
| | 2003 Cold season | 2.7 | 3.5 | 23 | 0.18 | | 34/34 | 34/34 |
| | 2004 Warm season | 10 | 15 | 130 | 0.36 | 0.072 [0.024] | 37/37 | 37/37 |
| | 2004 Cold season | 2.7 | 4.4 | 28 | 0.087 | | 37/37 | 37/37 |
| | 2005 Warm season | 10 | 14 | 160 | 0.30 | 0.08 [0.03] | 37/37 | 37/37 |
| | 2005 Cold season | 1.6 | 1.6 | 34 | 0.08 | | 37/37 | 37/37 |
| | 2006 Warm season | 11 | 12 | 170 | 0.28 | 0.15 [0.05] | 37/37 | 37/37 |
| | 2006 Cold season | 2.4 | 2.0 | 41 | tr(0.14) | | 37/37 | 37/37 |
| | 2007 Warm season | 10 | 14 | 150 | 0.31 | 0.03 [0.01] | 36/36 | 36/36 |
| | 2007 Cold season | 1.6 | 1.7 | 22 | 0.09 | | 36/36 | 36/36 |
| | 2008 Warm season | 7.9 | 12 | 87 | 0.18 | 0.03 [0.01] | 37/37 | 37/37 |
| | 2008 Cold season | 2.0 | 2.7 | 19 | 0.16 | | 37/37 | 37/37 |
| | 2009 Warm season | 7.5 | 10 | 110 | 0.33 | 0.04 [0.02] | 37/37 | 37/37 |
| | 2009 Cold season | 1.9 | 2.1 | 18 | 0.07 | | 37/37 | 37/37 |
| | 2010 Warm season | 7.5 | 10 | 68 | 0.23 | 0.11 [0.04] | 37/37 | 37/37 |
| | 2010 Cold season | 1.8 | 2.1 | 13 | tr(0.06) | | 37/37 | 37/37 |
| | 2011 Warm season | 7.4 | 8.8 | 89 | 0.24 | 0.15 [0.051] | 35/35 | 35/35 |
| | 2011 Cold season | 1.9 | 2.9 | 28 | nd | | 36/37 | 36/37 |
| | 2012 Warm season | 6.9 | 11 | 89 | 0.29 | 0.12 [0.05] | 36/36 | 36/36 |
| | 2012 Cold season | 0.98 | 1.1 | 10 | tr(0.05) | | 36/36 | 36/36 |
| | 2013 Warm season | 6.4 | 10 | 72 | 0.15 | 0.07 [0.02] | 36/36 | 36/36 |
| | 2013 Cold season | 1.0 | 1.4 | 12 | tr(0.06) | | 36/36 | 36/36 |
| | 2016 Warm season | 6.1 | 9.9 | 120 | tr(0.13) | 0.14 [0.05] | 37/37 | 37/37 |
| | 2020 Warm season | 3.1 | 3.4 | 24 | 0.13 | 0.09 [0.04] | 37/37 | 37/37 |

| *trans*-Nonachlor | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air ($pg/m^3$) | 2002 | 24 | 30 | 550 | 0.64 | 0.30 [0.10] | 102/102 | 34/34 |
| | 2003 Warm season | 87 | 100 | 1,200 | 5.1 | 0.35 [0.12] | 35/35 | 35/35 |
| | 2003 Cold season | 24 | 28 | 180 | 2.1 | | 34/34 | 34/34 |
| | 2004 Warm season | 72 | 120 | 870 | 1.9 | 0.48 [0.16] | 37/37 | 37/37 |
| | 2004 Cold season | 23 | 39 | 240 | 0.95 | | 37/37 | 37/37 |
| | 2005 Warm season | 75 | 95 | 870 | 3.1 | 0.13 [0.044] | 37/37 | 37/37 |
| | 2005 Cold season | 13 | 16 | 210 | 1.2 | | 37/37 | 37/37 |
| | 2006 Warm season | 68 | 91 | 800 | 3.0 | 0.10 [0.03] | 37/37 | 37/37 |
| | 2006 Cold season | 16 | 15 | 240 | 1.4 | | 37/37 | 37/37 |
| | 2007 Warm season | 72 | 96 | 940 | 2.5 | 0.09 [0.03] | 36/36 | 36/36 |
| | 2007 Cold season | 13 | 15 | 190 | 1.1 | | 36/36 | 36/36 |
| | 2008 Warm season | 59 | 91 | 650 | 1.5 | 0.09 [0.03] | 37/37 | 37/37 |
| | 2008 Cold season | 17 | 25 | 170 | 1.3 | | 37/37 | 37/37 |
| | 2009 Warm season | 54 | 81 | 630 | 2.2 | 0.07 [0.03] | 37/37 | 37/37 |
| | 2009 Cold season | 16 | 19 | 140 | 0.75 | | 37/37 | 37/37 |
| | 2010 Warm season | 52 | 78 | 520 | 1.7 | 0.8 [0.3] | 37/37 | 37/37 |
| | 2010 Cold season | 15 | 17 | 89 | tr(0.7) | | 37/37 | 37/37 |
| | 2011 Warm season | 53 | 72 | 550 | 1.2 | 1.1 [0.35] | 35/35 | 35/35 |
| | 2011 Cold season | 16 | 24 | 210 | tr(0.70) | | 37/37 | 37/37 |
| | 2012 Warm season | 49 | 79 | 510 | 2.5 | 1.2 [0.41] | 36/36 | 36/36 |
| | 2012 Cold season | 8.1 | 10 | 61 | tr(0.50) | | 36/36 | 36/36 |
| | 2013 Warm season | 46 | 78 | 470 | 1.2 | 0.5 [0.2] | 36/36 | 36/36 |
| | 2013 Cold season | 8.5 | 12 | 75 | 0.5 | | 36/36 | 36/36 |
| | 2016 Warm season | 42 | 69 | 650 | 0.8 | 0.7 [0.2] | 37/37 | 37/37 |
| | 2020 Warm season | 23 | 26 | 140 | 1.0 | 0.10 [0.04] | 37/37 | 37/37 |

(Note) No monitoring was conducted in FY2014 , FY2015 and FY2017~2019.

## [8] Heptachlors

・ History and state of monitoring

Heptachlor and its metabolite, Heptachlor epoxide, used to kill soil insects and termites, heptachlor has also been used more widely to kill cotton insects, grasshoppers, other crop pests, and malaria-carrying mosquitoes. The substances were not registrated under the Agricultural Chemicals Regulation Law in FY1975. The substances were designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in September 1986, since it includes the technical chlordane used as a termitecide. Also Heptachlors are one of the original twelve POPs covered by the Stockholm Convention.

In previous monitoring series before FY2001, Heptachlor and Heptachlor epoxide were measured in FY1982 (in surface water, sediment and fish) and in FY1986 (in air) under the framework of “the Environmental Survey and Monitoring of Chemicals.”

Under the framework of the Environmental Monitoring, Heptachlor in surface water, sediment, wildlife (bibalves, fish and birds) and air had been monitored since FY2002, and *cis*-Heptachlor epoxide and *trans*-Heptachlor epoxide had also been monitored since FY2003. After FY2012, the substances has been monitored in sediment, wildlife (bivalves, fish and birds) and air in FY2012, FY2013, FY2015 and FY2016 and in surface water and sediment in FY2014, FY2017 and FY2020.

・ Monitoring results

<Surface Water>

Heptachlor: The presence of the substance in surface water was monitored at 46 sites, and it was detected at 5 of the 46 valid sites adopting the detection limit of 1pg/L, and the detection range was up to tr(2)pg/L.

Although the number of detections was small, the detection rate of specimens from the overall areas in surface water was decreased, it suggested a reduction tendency of the concentrations.

*cis*-Heptachlor epoxide: The presence of the substance in surface water was monitored at 46 sites, and it was detected at 44 of the 46 valid sites adopting the detection limit of 0.9pg/L, and the detection range was up to 36pg/L.

As results of the inter-annual trend analysis from FY2003 to FY2020, reduction tendencies in specimens from river areas and sea areas were identified as statistically significant and a reduction tendency in specimens from the overall areas in surface water was also identified as statistically significant.

*trans*-Heptachlor epoxide: The presence of the substance in surface water was monitored at 46 sites, and it was not detected at all 46 valid sites adopting the detection limit of 0.7pg/L.

Stocktaking of the detection of Heptachlor, *cis*-Heptachlor epoxide and *trans*-Heptachlor epoxide in surface water during FY2002~2020

| Heptachlor | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2002 | tr(1.2) | tr(1.0) | 25 | nd | 1.5 [0.5] | 97/114 | 38/38 |
| | 2003 | tr(1.8) | tr(1.6) | 7 | tr(1.0) | 2 [0.5] | 36/36 | 36/36 |
| | 2004 | nd | nd | 29 | nd | 5 [2] | 9/38 | 9/38 |
| | 2005 | nd | tr(1) | 54 | nd | 3 [1] | 25/47 | 25/47 |
| | 2006 | nd | nd | 6 | nd | 5 [2] | 5/48 | 5/48 |
| | 2007 | nd | nd | 5.2 | nd | 2.4 [0.8] | 12/48 | 12/48 |
| | 2008 | nd | nd | 4.6 | nd | 2.1 [0.8] | 19/48 | 19/48 |
| | 2009 | tr(0.5) | nd | 17 | nd | 0.8 [0.3] | 20/49 | 20/49 |
| | 2010 | nd | nd | 43 | nd | 2.2 [0.7] | 4/49 | 4/49 |
| | 2011 | nd | nd | 22 | nd | 1.3 [0.5] | 6/49 | 6/49 |
| | 2014 | tr(0.2) | tr(0.2) | 1.5 | nd | 0.5 [0.2] | 28/48 | 28/48 |
| | 2017 | nd | nd | 6 | nd | 3 [1] | 2/47 | 2/47 |
| | 2020 | nd | nd | tr(2) | nd | 3 [1] | 5/46 | 5/46 |

| *cis*-Heptachlor epoxide | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2003 | 9.8 | 11 | 170 | 1.2 | 0.7 [0.2] | 36/36 | 36/36 |
| | 2004 | 10 | 10 | 77 | 2 | 2 [0.4] | 38/38 | 38/38 |
| | 2005 | 7.1 | 6.6 | 59 | 1.0 | 0.7 [0.2] | 47/47 | 47/47 |
| | 2006 | 7.6 | 6.6 | 47 | 1.1 | 2.0 [0.7] | 48/48 | 48/48 |
| | 2007 | 6.1 | 5.8 | 120 | tr(0.9) | 1.3 [0.4] | 48/48 | 48/48 |
| | 2008 | 4.7 | 5.0 | 37 | nd | 0.6 [0.2] | 46/48 | 46/48 |
| | 2009 | 5.5 | 4.2 | 72 | 0.8 | 0.5 [0.2] | 49/49 | 49/49 |
| | 2010 | 5.9 | 3.9 | 710 | 0.7 | 0.4 [0.2] | 49/49 | 49/49 |
| | 2011 | 5.8 | 5.8 | 160 | 0.7 | 0.7 [0.3] | 49/49 | 49/49 |
| | 2014 | 4.9 | 3.4 | 56 | 0.7 | 0.5 [0.2] | 48/48 | 48/48 |
| | 2017 | 4.7 | 3.5 | 83 | nd | 1.6 [0.6] | 46/47 | 46/47 |
| | 2020 | 4.0 | 3.4 | 36 | nd | 2.3 [0.9] | 44/46 | 44/46 |

| *trans*-Heptachlor epoxide | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2003 | nd | nd | 2 | nd | 2 [0.4] | 4/36 | 4/36 |
| | 2004 | nd | nd | nd | nd | 0.9 [0.3] | 0/38 | 0/38 |
| | 2005 | nd | nd | nd | nd | 0.7 [0.2] | 0/47 | 0/47 |
| | 2006 | nd | nd | nd | nd | 1.8 [0.6] | 0/48 | 0/48 |
| | 2007 | nd | nd | tr(0.9) | nd | 2.0 [0.7] | 2/48 | 2/48 |
| | 2008 | nd | nd | nd | nd | 1.9 [0.7] | 0/48 | 0/48 |
| | 2009 | nd | nd | nd | nd | 0.7 [0.3] | 0/49 | 0/49 |
| | 2010 | nd | nd | 8.0 | nd | 1.3 [0.5] | 2/49 | 2/49 |
| | 2011 | nd | nd | 2.8 | nd | 0.8 [0.3] | 3/49 | 3/49 |
| | 2014 | nd | nd | nd | nd | 0.8 [0.3] | 0/48 | 0/48 |
| | 2017 | nd | nd | nd | nd | 2.3 [0.9] | 0/47 | 0/47 |
| | 2020 | nd | nd | nd | nd | 1.9 [0.7] | 0/46 | 0/46 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2002.

(Note 2) No monitoring was conducted in FY2012, 2013, FY2015, FY2016, FY2018 and FY2019.

<Sediment>

Heptachlor: The presence of the substance in sediment was monitored at 58 sites, and it was detected at 43 of the 58 valid sites adopting the detection limit of 0.2pg/g-dry, and the detection range was up to 52pg/g-dry.

As results of the inter-annual trend analysis from FY2002 to FY2020, the recent 6 years period was indicated lower concentration than the first 6 years period in specimens from river mouth areas as statistically significant. Although the number of detections was small, the detection rates of specimens from the river areas and also the overall areas in sediment were decreased, it suggested a reduction tendency of the concentrations.

*cis*-Heptachlor epoxide: The presence of the substance in sediment was monitored at 58 sites, and it was detected at 40 of the 58 valid sites adopting the detection limit of 0.7pg/g-dry, and the detection range was up to 110pg/g-dry.

As results of the inter-annual trend analysis from FY2003 to FY2020, the recent 6 years period was indicated lower concentration than the first 6 years period in specimens from river areas and also the overall areas in sediment as statistically significant. Although the number of detections was small, the detection rate of specimens from the sea areas was decreased, it suggested a reduction tendency of the concentrations.

*trans*-Heptachlor epoxide: The presence of the substance in sediment was monitored at 58 sites, and it was detected at 1 of the 58 valid sites adopting the detection limit of 0.4pg/g-dry, and the detected concentration was 1.4pg/g-dry.

Stocktaking of the detection of Heptachlor, *cis*-Heptachlor epoxide and *trans*-Heptachlor epoxide in sediment during FY2002~2020

| Heptachlor | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Sediment (pg/g-dry) | 2002 | 4.1 | 3.2 | 120 | nd | 1.8 [0.6] | 167/189 | 60/63 |
| | 2003 | tr(2.7) | tr(2.2) | 160 | nd | 3 [1.0] | 138/186 | 53/62 |
| | 2004 | tr(2.8) | tr(2.3) | 170 | nd | 3 [0.9] | 134/189 | 53/63 |
| | 2005 | 3.1 | 2.8 | 200 | nd | 2.5 [0.8] | 120/189 | 48/63 |
| | 2006 | 5.2 | 3.9 | 230 | nd | 1.9 [0.6] | 190/192 | 64/64 |
| | 2007 | tr(1.8) | tr(1.5) | 110 | nd | 3.0 [0.7] | 143/192 | 57/64 |
| | 2008 | tr(1) | nd | 85 | nd | 4 [1] | 59/192 | 27/64 |
| | 2009 | 1.6 | 1.3 | 65 | nd | 1.1 [0.4] | 144/192 | 59/64 |
| | 2010 | 1.2 | tr(0.8) | 35 | nd | 1.1 [0.4] | 51/64 | 51/64 |
| | 2011 | tr(1.3) | tr(1.2) | 48 | nd | 1.8 [0.7] | 40/64 | 40/64 |
| | 2014 | tr(1.0) | tr(0.9) | 49 | nd | 1.5 [0.5] | 38/63 | 38/63 |
| | 2017 | 1.2 | 1.1 | 40 | nd | 0.9 [0.3] | 53/62 | 53/62 |
| | 2020 | 0.7 | 0.6 | 52 | nd | 0.4 [0.2] | 43/58 | 43/58 |
| *cis*-Heptachlor epoxide | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
| Sediment (pg/g-dry) | 2003 | 4 | 3 | 160 | nd | 3 [1] | 153/186 | 55/62 |
| | 2004 | tr(5) | tr(3) | 230 | nd | 6 [2] | 136/189 | 52/63 |
| | 2005 | tr(4) | tr(3) | 140 | nd | 7 [2] | 119/189 | 49/63 |
| | 2006 | 4.0 | 3.2 | 210 | nd | 3.0 [1.0] | 157/192 | 58/64 |
| | 2007 | 3 | tr(2) | 270 | nd | 3 [1] | 141/192 | 53/64 |
| | 2008 | 3 | 2 | 180 | nd | 2 [1] | 130/192 | 51/64 |
| | 2009 | 2.7 | 1.9 | 290 | nd | 0.7 [0.3] | 176/192 | 63/64 |
| | 2010 | 3.1 | 2.4 | 300 | nd | 0.8 [0.3] | 62/64 | 62/64 |
| | 2011 | 2.8 | 2.5 | 160 | nd | 0.6 [0.2] | 63/64 | 63/64 |
| | 2014 | 2.1 | 1.7 | 310 | nd | 0.5 [0.2] | 59/63 | 59/63 |
| | 2017 | 1.9 | 1.6 | 150 | nd | 1.2 [0.5] | 51/62 | 51/62 |
| | 2020 | tr(1.5) | tr(1.2) | 110 | nd | 1.7 [0.7] | 40/58 | 40/58 |
| *trans*-Heptachlor epoxide | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
| Sediment (pg/g-dry) | 2003 | nd | nd | nd | nd | 9 [3] | 0/186 | 0/62 |
| | 2004 | nd | nd | tr(2.5) | nd | 4 [2] | 1/189 | 1/63 |
| | 2005 | nd | nd | nd | nd | 5 [2] | 0/189 | 0/63 |
| | 2006 | nd | nd | 19 | nd | 7 [2] | 2/192 | 2/64 |
| | 2007 | nd | nd | 31 | nd | 10 [4] | 2/192 | 2/64 |
| | 2008 | nd | nd | nd | nd | 1.7 [0.7] | 0/192 | 0/64 |
| | 2009 | nd | nd | nd | nd | 1.4 [0.6] | 0/192 | 0/64 |
| | 2010 | nd | nd | 4 | nd | 3 [1] | 1/64 | 1/64 |
| | 2011 | nd | nd | 2.4 | nd | 2.3 [0.9] | 2/64 | 2/64 |
| | 2014 | nd | nd | 3.6 | nd | 0.7 [0.3] | 1/63 | 1/63 |
| | 2017 | nd | nd | nd | nd | 2.0 [0.8] | 0/62 | 0/62 |
| | 2020 | nd | nd | 1.4 | nd | 1.0 [0.4] | 1/58 | 1/58 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived during FY2002~2009.

(Note 2) No monitoring was conducted in FY2012, 2013, FY2015, FY2016, FY2018 and FY2019.

<Wildlife>

Heptachlor: The presence of the substance in bivalves was monitored in 3 areas, and it was detected at 1 of the 3 valid areas adopting the detection limit of 1pg/g-wet, and the detected concentration was tr(2)pg/g-wet. For fish, the presence of the substance was monitored in 18 areas, and it was detected at 6 of the 18 valid areas adopting the detection limit of 1pg/g-wet, and the detection range was up to 6pg/g-wet. For birds, the presence of the substance was monitored in 1 area, and not detected in the area adopting the detection limit of 1pg/g-wet.

Although the number of detections was small, the detection rate of specimens from the sfish was decreased, it suggested a reduction tendency of the concentrations.

*cis*-Heptachlor epoxide: The presence of the substance in bivalves was monitored in 3 areas, and it was detected at all 3 valid areas adopting the detection limit of 1pg/g-wet, and the detection range was 5 ~ 96pg/g-wet. For fish, the presence of the substance was monitored in 18 areas, and it was detected at all 18 valid areas adopting the detection limit of 1pg/g-wet, and the detection range was tr(2) ~ 320pg/g-wet. For birds, the presence of the substance was monitored in 1 area, and detected in the area adopting the detection limit of 1pg/g-wet, and the detected concentration was 270pg/g-wet.

*trans*-Heptachlor epoxide: The presence of the substance in bivalves was monitored in 3 areas, and it was not detected at all 3 valid areas adopting the detection limit of 4pg/g-wet. For fish, the presence of the substance was monitored in 18 areas, and it was not detected at all 18 valid areas adopting the detection limit of 4pg/g-wet. For birds, the presence of the substance was monitored in 1 area, and not detected in the area adopting the detection limit of 4pg/g-wet.

Stocktaking of the detection of Heptachlor, *cis*-Heptachlor epoxide and *trans*-Heptachlor epoxide in wildlife (bivalves, fish and birds) during FY2002~2020

| Heptachlor | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Bivalves (pg/g-wet) | 2002 | tr(3.5) | 4.6 | 15 | nd | 4.2 [1.4] | 28/38 | 6/8 |
| | 2003 | tr(2.8) | tr(2.4) | 14 | nd | 6.6 [2.2] | 16/30 | 4/6 |
| | 2004 | tr(3.4) | 5.2 | 16 | nd | 4.1 [1.4] | 23/31 | 6/7 |
| | 2005 | tr(2.9) | tr(2.9) | 24 | nd | 6.1 [2.0] | 18/31 | 6/7 |
| | 2006 | tr(4) | tr(4) | 20 | nd | 6 [2] | 23/31 | 6/7 |
| | 2007 | tr(3) | tr(3) | 12 | nd | 6 [2] | 20/31 | 6/7 |
| | 2008 | tr(2) | nd | 9 | nd | 6 [2] | 13/31 | 5/7 |
| | 2009 | tr(4) | nd | 120 | nd | 5 [2] | 14/31 | 4/7 |
| | 2010 | 3 | tr(2) | 78 | nd | 3 [1] | 5/6 | 5/6 |
| | 2011 | 4 | 4 | 51 | nd | 3 [1] | 3/4 | 3/4 |
| | 2012 | tr(3) | tr(3) | 13 | nd | 4 [1] | 4/5 | 4/5 |
| | 2013 | 3 | tr(2) | 19 | nd | 3 [1] | 4/5 | 4/5 |
| | 2015 | nd | nd | tr(1.7) | nd | 3.0 [1.0] | 1/3 | 1/3 |
| | 2016 | nd | nd | tr(1.4) | nd | 2.4 [0.9] | 1/3 | 1/3 |
| | 2020 | nd | nd | tr(2) | nd | 3 [1] | 1/3 | 1/3 |
| Fish (pg/g-wet) | 2002 | 4.2 | 4.8 | 20 | nd | 4.2 [1.4] | 57/70 | 12/14 |
| | 2003 | nd | nd | 11 | nd | 6.6 [2.2] | 29/70 | 8/14 |
| | 2004 | tr(2.3) | tr(2.1) | 460 | nd | 4.1 [1.4] | 50/70 | 11/14 |
| | 2005 | nd | nd | 7.6 | nd | 6.1 [2.0] | 32/80 | 8/16 |
| | 2006 | tr(2) | nd | 8 | nd | 6 [2] | 36/80 | 8/16 |
| | 2007 | tr(2) | nd | 7 | nd | 6 [2] | 28/80 | 6/16 |
| | 2008 | nd | nd | 9 | nd | 6 [2] | 25/85 | 7/17 |
| | 2009 | tr(2) | nd | 8 | nd | 5 [2] | 30/90 | 11/18 |
| | 2010 | tr(2) | tr(2) | 5 | nd | 3 [1] | 12/18 | 12/18 |
| | 2011 | tr(1) | tr(1) | 7 | nd | 3 [1] | 13/18 | 13/18 |
| | 2012 | nd | tr(1) | 5 | nd | 4 [1] | 10/19 | 10/19 |
| | 2013 | nd | nd | 12 | nd | 3 [1] | 9/19 | 9/19 |
| | 2015 | nd | nd | 9.2 | nd | 3.0 [1.0] | 9/19 | 9/19 |
| | 2016 | nd | nd | 5.5 | nd | 2.4 [0.9] | 8/19 | 8/19 |
| | 2020 | nd | nd | 6 | nd | 3 [1] | 6/18 | 6/18 |
| Birds** (pg/g-wet) | 2002 | tr(1.7) | tr(2.8) | 5.2 | nd | 4.2 [1.4] | 7/10 | 2/2 |
| | 2003 | nd | nd | nd | nd | 6.6 [2.2] | 0/10 | 0/2 |
| | 2004 | nd | nd | tr(1.5) | nd | 4.1 [1.4] | 1/10 | 1/2 |
| | 2005 | nd | nd | nd | nd | 6.1 [2.0] | 0/10 | 0/2 |
| | 2006 | nd | nd | nd | nd | 6 [2] | 0/10 | 0/2 |
| | 2007 | nd | nd | nd | nd | 6 [2] | 0/10 | 0/2 |
| | 2008 | nd | nd | nd | nd | 6 [2] | 0/10 | 0/2 |
| | 2009 | nd | nd | nd | nd | 5 [2] | 0/10 | 0/2 |
| | 2010 | nd | --- | tr(1) | nd | 3 [1] | 1/2 | 1/2 |
| | 2011 | --- | --- | nd | nd | 3 [1] | 0/1 | 0/1 |
| | 2012 | nd | --- | nd | nd | 4 [1] | 0/2 | 0/2 |
| | 2013 | nd | --- | nd | nd | 3 [1] | 0/2 | 0/2 |
| | 2015 | --- | --- | nd | nd | 3.0 [1.0] | 0/1 | 0/1 |
| | 2016 | nd | --- | nd | nd | 2.4 [0.9] | 0/2 | 0/2 |
| | 2020 | --- | --- | nd | nd | 3 [1] | 0/1 | 0/1 |

| *cis*-Heptachlor epoxide | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2003 | 44 | 29 | 880 | 9.7 | 6.9 [2.3] | 30/30 | 6/6 |
| | 2004 | 64 | 34 | 840 | tr(9.8) | 9.9 [3.3] | 31/31 | 7/7 |
| | 2005 | 49 | 20 | 590 | 7.4 | 3.5 [1.2] | 31/31 | 7/7 |
| | 2006 | 56 | 23 | 1,100 | 8 | 4 [1] | 31/31 | 7/7 |
| | 2007 | 37 | 20 | 1,100 | 8 | 4 [1] | 31/31 | 7/7 |
| | 2008 | 37 | 19 | 510 | 8 | 5 [2] | 31/31 | 7/7 |
| | 2009 | 59 | 33 | 380 | 10 | 3 [1] | 31/31 | 7/7 |
| | 2010 | 170 | 260 | 1,800 | 9.0 | 2.4 [0.9] | 6/6 | 6/6 |
| | 2011 | 55 | 110 | 320 | 3.9 | 2.0 [0.8] | 4/4 | 4/4 |
| | 2012 | 48 | 120 | 180 | 6.2 | 1.5 [0.6] | 5/5 | 5/5 |
| | 2013 | 28 | 29 | 110 | 4.4 | 2.1 [0.8] | 5/5 | 5/5 |
| | 2015 | 21 | 14 | 91 | 7.2 | 2.1 [0.8] | 3/3 | 3/3 |
| | 2016 | 23 | 18 | 75 | 9.4 | 1.9 [0.7] | 3/3 | 3/3 |
| | 2020 | 28 | 48 | 96 | 5 | 3 [1] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2003 | 43 | 43 | 320 | 7.0 | 6.9 [2.3] | 70/70 | 14/14 |
| | 2004 | 51 | 49 | 620 | tr(3.3) | 9.9 [3.3] | 70/70 | 14/14 |
| | 2005 | 41 | 45 | 390 | 4.9 | 3.5 [1.2] | 80/80 | 16/16 |
| | 2006 | 42 | 48 | 270 | 4 | 4 [1] | 80/80 | 16/16 |
| | 2007 | 43 | 49 | 390 | 4 | 4 [1] | 80/80 | 16/16 |
| | 2008 | 39 | 46 | 350 | tr(3) | 5 [2] | 85/85 | 17/17 |
| | 2009 | 41 | 50 | 310 | 4 | 3 [1] | 90/90 | 18/18 |
| | 2010 | 39 | 49 | 230 | 5.0 | 2.4 [0.9] | 18/18 | 18/18 |
| | 2011 | 50 | 62 | 540 | 3.2 | 2.0 [0.8] | 18/18 | 18/18 |
| | 2012 | 41 | 62 | 120 | 6.9 | 1.5 [0.6] | 19/19 | 19/19 |
| | 2013 | 42 | 46 | 190 | 7.3 | 2.1 [0.8] | 19/19 | 19/19 |
| | 2015 | 33 | 43 | 190 | 3.2 | 2.1 [0.8] | 19/19 | 19/19 |
| | 2016 | 29 | 28 | 130 | 3.6 | 1.9 [0.7] | 19/19 | 19/19 |
| | 2020 | 24 | 32 | 320 | tr(2) | 3 [1] | 18/18 | 18/18 |
| Birds** (pg/g-wet) | 2003 | 540 | 510 | 770 | 370 | 6.9 [2.3] | 10/10 | 2/2 |
| | 2004 | 270 | 270 | 350 | 190 | 9.9 [3.3] | 10/10 | 2/2 |
| | 2005 | 370 | 340 | 690 | 250 | 3.5 [1.2] | 10/10 | 2/2 |
| | 2006 | 330 | 310 | 650 | 240 | 4 [1] | 10/10 | 2/2 |
| | 2007 | 280 | 270 | 350 | 250 | 4 [1] | 10/10 | 2/2 |
| | 2008 | 370 | 370 | 560 | 180 | 5 [2] | 10/10 | 2/2 |
| | 2009 | 220 | 210 | 390 | 160 | 3 [1] | 10/10 | 2/2 |
| | 2010 | 290 | --- | 360 | 240 | 2.4 [0.9] | 2/2 | 2/2 |
| | 2011 | --- | --- | 410 | 410 | 2.0 [0.8] | 1/1 | 1/1 |
| | 2012 | 160 | --- | 170 | 150 | 1.5 [0.6] | 2/2 | 2/2 |
| | 2013 | 300 | --- | 560 | 160 | 2.1 [0.8] | 2/2 | 2/2 |
| | 2015 | --- | --- | 20 | 20 | 2.1 [0.8] | 1/1 | 1/1 |
| | 2016 | 91 | --- | 270 | 31 | 1.9 [0.7] | 2/2 | 2/2 |
| | 2020 | --- | --- | 270 | 270 | 3 [1] | 1/1 | 1/1 |

| *trans*-Heptachlor epoxide | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2003 | nd | nd | 48 | nd | 13 [4.4] | 5/30 | 1/6 |
| | 2004 | nd | nd | 55 | nd | 12 [4.0] | 9/31 | 2/7 |
| | 2005 | nd | nd | 37 | nd | 23 [7.5] | 5/31 | 1/7 |
| | 2006 | nd | nd | 45 | nd | 13 [5] | 5/31 | 1/7 |
| | 2007 | nd | nd | 61 | nd | 13 [5] | 5/31 | 1/7 |
| | 2008 | nd | nd | 33 | nd | 10 [4] | 5/31 | 1/7 |
| | 2009 | tr(3) | nd | 24 | nd | 8 [3] | 13/31 | 3/7 |
| | 2010 | 3 | tr(2) | 24 | nd | 3 [1] | 3/6 | 3/6 |
| | 2011 | nd | nd | tr(6) | nd | 7 [3] | 1/4 | 1/4 |
| | 2012 | nd | nd | tr(4) | nd | 8 [3] | 1/5 | 1/5 |
| | 2013 | nd | nd | nd | nd | 7 [3] | 0/5 | 0/5 |
| | 2015 | nd | nd | nd | nd | 7 [3] | 0/3 | 0/3 |
| | 2016 | nd | nd | nd | nd | 9 [3] | 0/3 | 0/3 |
| | 2020 | nd | nd | nd | nd | 9 [4] | 0/3 | 0/3 |

| *trans*-Heptachlor epoxide | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Fish (pg/g-wet) | 2003 | nd | nd | nd | nd | 13 [4.4] | 0/70 | 0/14 |
| | 2004 | nd | nd | tr(10) | nd | 12 [4.0] | 2/70 | 2/14 |
| | 2005 | nd | nd | nd | nd | 23 [7.5] | 0/80 | 0/16 |
| | 2006 | nd | nd | nd | nd | 13 [5] | 0/80 | 0/16 |
| | 2007 | nd | nd | nd | nd | 13 [5] | 0/80 | 0/16 |
| | 2008 | nd | nd | nd | nd | 10 [4] | 0/85 | 0/17 |
| | 2009 | nd | nd | nd | nd | 8 [3] | 0/90 | 0/18 |
| | 2010 | nd | nd | nd | nd | 3 [1] | 0/18 | 0/18 |
| | 2011 | nd | nd | nd | nd | 7 [3] | 0/18 | 0/18 |
| | 2012 | nd | nd | nd | nd | 8 [3] | 0/19 | 0/19 |
| | 2013 | nd | nd | nd | nd | 7 [3] | 0/19 | 0/19 |
| | 2015 | nd | nd | 10 | nd | 7 [3] | 5/19 | 5/19 |
| | 2016 | nd | nd | nd | nd | 9 [3] | 0/19 | 0/19 |
| | 2020 | nd | nd | nd | nd | 9 [4] | 0/18 | 0/18 |
| Birds** (pg/g-wet) | 2003 | nd | nd | nd | nd | 13 [4.4] | 0/10 | 0/2 |
| | 2004 | nd | nd | nd | nd | 12 [4.0] | 0/10 | 0/2 |
| | 2005 | nd | nd | nd | nd | 23 [7.5] | 0/10 | 0/2 |
| | 2006 | nd | nd | nd | nd | 13 [5] | 0/10 | 0/2 |
| | 2007 | nd | nd | nd | nd | 13 [5] | 0/10 | 0/2 |
| | 2008 | nd | nd | nd | nd | 10 [4] | 0/10 | 0/2 |
| | 2009 | nd | nd | nd | nd | 8 [3] | 0/10 | 0/2 |
| | 2010 | nd | --- | nd | nd | 3 [1] | 0/2 | 0/2 |
| | 2011 | --- | --- | nd | nd | 7 [3] | 0/1 | 0/1 |
| | 2012 | nd | --- | nd | nd | 8 [3] | 0/2 | 0/2 |
| | 2013 | nd | --- | tr(5) | nd | 7 [3] | 1/2 | 1/2 |
| | 2015 | --- | --- | nd | nd | 7 [3] | 0/1 | 0/1 |
| | 2016 | nd | --- | nd | nd | 9 [3] | 0/2 | 0/2 |
| | 2020 | --- | --- | nd | nd | 9 [4] | 0/1 | 0/1 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived during FY2002~2009.
(Note 2) “ ** ” : There is no consistency between the results of the ornithological survey after FY2013 and those in previous years because of the changes in the survey sites and target species.
(Note 3) No monitoring was conducted in FY2014 and FY2017~2019.

<Air>

Heptachlor: The presence of the substance in air was monitored at 37 sites, and it was detected at all 37 valid sites adopting the detection limit of 0.04pg/m$^3$, and the detection range was 0.69 ~ 35pg/m$^3$.

As results of the inter-annual trend analysis from FY2003 to FY2020, a reduction tendency in specimens from warm season was identified as statistically significant.

*cis*-Heptachlor epoxide: The presence of the substance in air was monitored at 37 sites, and it was detected at all 37 valid sites adopting the detection limit of 0.04pg/m$^3$, and the detection range was 0.23 ~ 2.9pg/m$^3$.

As results of the inter-annual trend analysis from FY2003 to FY2020, a reduction tendency in specimens from warm season was identified as statistically significant.

*trans*-Heptachlor epoxide: The presence of the substance in air was monitored at 37 sites, and it was not detected at all 37 valid sites adopting the detection limit of 0.05pg/m$^3$.

Although the number of detections was small, the detection rate of specimens from warm season was decreased, it suggested a reduction tendency of the concentrations.

Stocktaking of the detection of Heptachlor, *cis*-Heptachlor epoxide and *trans*-Heptachlor epoxide in air during FY2002~2020

| Heptachlor | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air ($pg/m^3$) | 2002 | 11 | 14 | 220 | 0.20 | 0.12 [0.04] | 102/102 | 34/34 |
| | 2003 Warm season | 27 | 41 | 240 | 1.1 | 0.25 [0.085] | 35/35 | 35/35 |
| | 2003 Cold season | 10 | 16 | 65 | 0.39 | | 34/34 | 34/34 |
| | 2004 Warm season | 23 | 36 | 200 | 0.46 | 0.23 [0.078] | 37/37 | 37/37 |
| | 2004 Cold season | 11 | 18 | 100 | 0.53 | | 37/37 | 37/37 |
| | 2005 Warm season | 25 | 29 | 190 | 1.1 | 0.16 [0.054] | 37/37 | 37/37 |
| | 2005 Cold season | 6.5 | 7.9 | 61 | 0.52 | | 37/37 | 37/37 |
| | 2006 Warm season | 20 | 27 | 160 | 0.88 | 0.11 [0.04] | 37/37 | 37/37 |
| | 2006 Cold season | 6.8 | 7.2 | 56 | 0.32 | | 37/37 | 37/37 |
| | 2007 Warm season | 22 | 27 | 320 | 1.1 | 0.07 [0.03] | 36/36 | 36/36 |
| | 2007 Cold season | 6.3 | 8.0 | 74 | 0.42 | | 36/36 | 36/36 |
| | 2008 Warm season | 20 | 31 | 190 | 0.92 | 0.06 [0.02] | 37/37 | 37/37 |
| | 2008 Cold season | 7.5 | 12 | 60 | 0.51 | | 37/37 | 37/37 |
| | 2009 Warm season | 18 | 30 | 110 | 0.48 | 0.04 [0.01] | 37/37 | 37/37 |
| | 2009 Cold season | 6.3 | 7.8 | 48 | 0.15 | | 37/37 | 37/37 |
| | 2010 Warm season | 17 | 26 | 160 | 0.69 | 0.11 [0.04] | 37/37 | 37/37 |
| | 2010 Cold season | 7.2 | 9.5 | 53 | 0.22 | | 37/37 | 37/37 |
| | 2011 Warm season | 16 | 25 | 110 | 0.73 | 0.30 [0.099] | 35/35 | 35/35 |
| | 2011 Cold season | 6.1 | 10 | 56 | tr(0.13) | | 37/37 | 37/37 |
| | 2012 Warm season | 13 | 21 | 58 | 0.46 | 0.41 [0.14] | 36/36 | 36/36 |
| | 2012 Cold season | 3.2 | 4.9 | 20 | nd | | 35/36 | 35/36 |
| | 2013 Warm season | 11 | 21 | 43 | 0.46 | 0.16 [0.05] | 36/36 | 36/36 |
| | 2013 Cold season | 3.1 | 4.6 | 22 | tr(0.10) | | 36/36 | 36/36 |
| | 2015 Warm season | 8.7 | 11 | 49 | 0.43 | 0.19 [0.06] | 35/35 | 35/35 |
| | 2016 Warm season | 12 | 14 | 120 | tr(0.18) | 0.22 [0.08] | 37/37 | 37/37 |
| | 2020 Warm season | 7.6 | 9.2 | 35 | 0.69 | 0.10 [0.04] | 37/37 | 37/37 |

| *cis*-Heptachlor epoxide | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air ($pg/m^3$) | 2003 Warm season | 3.5 | 3.5 | 28 | 0.45 | 0.015 [0.0048] | 35/35 | 35/35 |
| | 2003 Cold season | 1.3 | 1.3 | 6.6 | 0.49 | | 34/34 | 34/34 |
| | 2004 Warm season | 2.8 | 2.9 | 9.7 | 0.65 | 0.052 [0.017] | 37/37 | 37/37 |
| | 2004 Cold season | 1.1 | 1.1 | 7.0 | 0.44 | | 37/37 | 37/37 |
| | 2005 Warm season | 1.5 | 1.7 | 11 | tr(0.10) | 0.12 [0.044] | 37/37 | 37/37 |
| | 2005 Cold season | 0.91 | 0.81 | 2.9 | 0.43 | | 37/37 | 37/37 |
| | 2006 Warm season | 1.7 | 2.0 | 6.7 | 0.13 | 0.11 [0.04] | 37/37 | 37/37 |
| | 2006 Cold season | 0.74 | 0.88 | 3.2 | nd | | 36/37 | 36/37 |
| | 2007 Warm season | 2.9 | 2.8 | 13 | 0.54 | 0.03 [0.01] | 36/36 | 36/36 |
| | 2007 Cold season | 0.93 | 0.82 | 3.0 | 0.41 | | 36/36 | 36/36 |
| | 2008 Warm season | 2.4 | 2.2 | 9.9 | 0.53 | 0.022 [0.008] | 37/37 | 37/37 |
| | 2008 Cold season | 0.91 | 0.84 | 3.0 | 0.37 | | 37/37 | 37/37 |
| | 2009 Warm season | 2.5 | 2.6 | 16 | 0.37 | 0.03 [0.01] | 37/37 | 37/37 |
| | 2009 Cold season | 1.0 | 0.91 | 3.8 | 0.42 | | 37/37 | 37/37 |
| | 2010 Warm season | 2.3 | 2.3 | 10 | 0.38 | 0.02 [0.01] | 37/37 | 37/37 |
| | 2010 Cold season | 0.93 | 0.85 | 4.3 | 0.33 | | 37/37 | 37/37 |
| | 2011 Warm season | 2.0 | 2.3 | 6.0 | 0.29 | 0.04 [0.01] | 35/35 | 35/35 |
| | 2011 Cold season | 0.90 | 0.90 | 2.8 | 0.35 | | 37/37 | 37/37 |
| | 2012 Warm season | 2.0 | 2.1 | 6.3 | 0.37 | 0.05 [0.02] | 36/36 | 36/36 |
| | 2012 Cold season | 0.62 | 0.57 | 1.9 | 0.30 | | 36/36 | 36/36 |
| | 2013 Warm season | 2.0 | 2.1 | 7.7 | 0.43 | 0.03 [0.01] | 36/36 | 36/36 |
| | 2013 Cold season | 0.66 | 0.63 | 1.4 | 0.32 | | 36/36 | 36/36 |
| | 2015 Warm season | 1.4 | 1.4 | 4.7 | tr(0.4) | 0.5 [0.2] | 35/35 | 35/35 |
| | 2016 Warm season | 1.9 | 1.9 | 9.1 | 0.30 | 0.12 [0.05] | 37/37 | 37/37 |
| | 2020 Warm season | 1.1 | 1.2 | 2.9 | 0.23 | 0.11 [0.04] | 37/37 | 37/37 |

| *trans*-Heptachl or epoxide | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air (pg/m$^3$) | 2003 Warm season | tr(0.036) | tr(0.038) | 0.30 | nd | 0.099 [0.033] | 18/35 | 18/35 |
| | 2003 Cold season | nd | nd | tr(0.094) | nd | | 3/34 | 3/34 |
| | 2004 Warm season | nd | nd | tr(0.38) | nd | 0.6 [0.2] | 4/37 | 4/37 |
| | 2004 Cold season | nd | nd | nd | nd | | 0/37 | 0/37 |
| | 2005 Warm season | tr(0.10) | tr(0.12) | 1.2 | nd | 0.16 [0.05] | 27/37 | 27/37 |
| | 2005 Cold season | nd | nd | 0.32 | nd | | 3/37 | 3/37 |
| | 2006 Warm season | nd | nd | 0.7 | nd | 0.3 [0.1] | 2/37 | 2/37 |
| | 2006 Cold season | nd | nd | tr(0.1) | nd | | 1/37 | 1/37 |
| | 2007 Warm season | nd | nd | 0.16 | nd | 0.14 [0.06] | 8/36 | 8/36 |
| | 2007 Cold season | nd | nd | tr(0.06) | nd | | 1/36 | 1/36 |
| | 2008 Warm season | nd | nd | 0.17 | nd | 0.16 [0.06] | 6/37 | 6/37 |
| | 2008 Cold season | nd | nd | nd | nd | | 0/37 | 0/37 |
| | 2009 Warm season | nd | nd | 0.18 | nd | 0.14 [0.05] | 10/37 | 10/37 |
| | 2009 Cold season | nd | nd | tr(0.06) | nd | | 1/37 | 1/37 |
| | 2010 Warm season | nd | nd | 0.16 | nd | 0.16 [0.06] | 6/37 | 6/37 |
| | 2010 Cold season | nd | nd | nd | nd | | 0/37 | 0/37 |
| | 2011 Warm season | nd | nd | 0.14 | nd | 0.13 [0.05] | 5/35 | 5/35 |
| | 2011 Cold season | nd | nd | nd | nd | | 0/37 | 0/37 |
| | 2012 Warm season | nd | nd | tr(0.08) | nd | 0.12 [0.05] | 8/36 | 8/36 |
| | 2012 Cold season | nd | nd | nd | nd | | 0/36 | 0/36 |
| | 2013 Warm season | nd | nd | tr(0.11) | nd | 0.12 [0.05] | 7/36 | 7/36 |
| | 2013 Cold season | nd | nd | nd | nd | | 0/36 | 0/36 |
| | 2015 Warm season | nd | nd | nd | nd | 0.03 [0.01] | 0/35 | 0/35 |
| | 2016 Warm season | nd | nd | tr(0.2) | nd | 0.3 [0.1] | 1/37 | 1/37 |
| | 2020 Warm season | nd | nd | nd | nd | 0.13 [0.05] | 0/37 | 0/37 |

(Note) No monitoring was conducted in FY2014 and FY2017~2019.

## [9] Toxaphenes (references)

・ History and state of monitoring

Toxaphenes are a group of organochlorine insecticides used on cotton, cereal grains, fruits, nuts, and vegetables and also it has also been used to control ticks and mites in livestock. No domestic record of manufacture/import of the substances was reported since those were historically never registrated under the Agricultural Chemicals Regulation Law. The substances were designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in September 2002. Also Toxaphenes are one of the original twelve POPs covered by the Stockholm Convention.

In previous monitoring series before FY2001, total amount of Toxaphenes was measured in FY1983 (in surface water and sediment) under the framework of "the Environmental Survey and Monitoring of Chemicals."

Under the framework of the Environmental Monitoring, Parlar-26, Parlar-50 and Parlar-62 have been monitored in surface water, sediment, wildlife (bivalves, fish and birds) and air from FY2003 to FY2009 and in wildlife (bivalves, fish and birds) in FY2015, in surface water, sediment, wildlife (bivalves, fish and birds) and air from FY2018.

No monitoring was conducted after FY2019. For reference, the monitoring results up to FY2018 are given below.

・ Monitoring results until FY2018

<Surface Water>

Stocktaking of the detection of Parlar-26, Parlar-50 and Parlar-62 in surface water during FY2003~2018

| Parlar-26 | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2003 | nd | nd | nd | nd | 40 [20] | 0/36 | 0/36 |
| | 2004 | nd | nd | nd | nd | 9 [3] | 0/38 | 0/38 |
| | 2005 | nd | nd | nd | nd | 10 [4] | 0/47 | 0/47 |
| | 2006 | nd | nd | nd | nd | 16 [5] | 0/48 | 0/48 |
| | 2007 | nd | nd | nd | nd | 20 [5] | 0/48 | 0/48 |
| | 2008 | nd | nd | nd | nd | 8 [3] | 0/48 | 0/48 |
| | 2009 | nd | nd | nd | nd | 5 [2] | 0/49 | 0/49 |
| | 2018 | nd | nd | 5 | nd | 4 [2] | 7/47 | 7/47 |
| Parlar-50 | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2003 | nd | nd | nd | nd | 70 [30] | 0/36 | 0/36 |
| | 2004 | nd | nd | nd | nd | 20 [7] | 0/38 | 0/38 |
| | 2005 | nd | nd | nd | nd | 20 [5] | 0/47 | 0/47 |
| | 2006 | nd | nd | nd | nd | 16 [5] | 0/48 | 0/48 |
| | 2007 | nd | nd | nd | nd | 9 [3] | 0/48 | 0/48 |
| | 2008 | nd | nd | nd | nd | 7 [3] | 0/48 | 0/48 |
| | 2009 | nd | nd | nd | nd | 7 [3] | 0/49 | 0/49 |
| | 2018 | nd | nd | tr(2) | nd | 6 [2] | 1/47 | 1/47 |
| Parlar-62 | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2003 | nd | nd | nd | nd | 300 [90] | 0/36 | 0/36 |
| | 2004 | nd | nd | nd | nd | 90 [30] | 0/38 | 0/38 |
| | 2005 | nd | nd | nd | nd | 70 [30] | 0/47 | 0/47 |
| | 2006 | nd | nd | nd | nd | 60 [20] | 0/48 | 0/48 |
| | 2007 | nd | nd | nd | nd | 70 [30] | 0/48 | 0/48 |
| | 2008 | nd | nd | nd | nd | 40 [20] | 0/48 | 0/48 |
| | 2009 | nd | nd | nd | nd | 40 [20] | 0/49 | 0/49 |
| | 2018 | nd | nd | nd | nd | 40 [20] | 0/47 | 0/47 |

(Note) No monitoring was conducted in FY2010~2017.

<Sediment>

Stocktaking of the detection of Parlar-26, Parlar-50 and Parlar-62 in sediment during FY2003~2018

| Parlar-26 | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2003 | nd | nd | nd | nd | 90 [30] | 0/186 | 0/62 |
| | 2004 | nd | nd | nd | nd | 60 [20] | 0/189 | 0/63 |
| | 2005 | nd | nd | nd | nd | 60 [30] | 0/189 | 0/63 |
| | 2006 | nd | nd | nd | nd | 12 [4] | 0/192 | 0/64 |
| | 2007 | nd | nd | nd | nd | 7 [3] | 0/192 | 0/64 |
| | 2008 | nd | nd | nd | nd | 12 [5] | 0/192 | 0/64 |
| | 2009 | nd | nd | nd | nd | 10 [4] | 0/192 | 0/64 |
| | 2018 | nd | nd | nd | nd | 8 [3] | 0/61 | 0/61 |
| **Parlar-50** | **Monitored year** | **Geometric mean*** | **Median** | **Maximum** | **Minimum** | **Quantification [Detection] limit** | **Detection Frequency Sample** | **Site** |
| Sediment (pg/g-dry) | 2003 | nd | nd | nd | nd | 200 [50] | 0/186 | 0/62 |
| | 2004 | nd | nd | nd | nd | 60 [20] | 0/189 | 0/63 |
| | 2005 | nd | nd | nd | nd | 90 [40] | 0/189 | 0/63 |
| | 2006 | nd | nd | nd | nd | 24 [7] | 0/192 | 0/64 |
| | 2007 | nd | nd | nd | nd | 30 [10] | 0/192 | 0/64 |
| | 2008 | nd | nd | nd | nd | 17 [6] | 0/192 | 0/64 |
| | 2009 | nd | nd | nd | nd | 12 [5] | 0/192 | 0/64 |
| | 2018 | nd | nd | tr(3) | nd | 8 [3] | 1/61 | 1/61 |
| **Parlar-62** | **Monitored year** | **Geometric mean*** | **Median** | **Maximum** | **Minimum** | **Quantification [Detection] limit** | **Detection Frequency Sample** | **Site** |
| Sediment (pg/g-dry) | 2003 | nd | nd | nd | nd | 4,000 [2,000] | 0/186 | 0/62 |
| | 2004 | nd | nd | nd | nd | 2,000 [400] | 0/189 | 0/63 |
| | 2005 | nd | nd | nd | nd | 2,000 [700] | 0/189 | 0/63 |
| | 2006 | nd | nd | nd | nd | 210 [60] | 0/192 | 0/64 |
| | 2007 | nd | nd | nd | nd | 300 [70] | 0/192 | 0/64 |
| | 2008 | nd | nd | nd | nd | 90 [40] | 0/192 | 0/64 |
| | 2009 | nd | nd | nd | nd | 80 [30] | 0/192 | 0/64 |
| | 2018 | nd | nd | tr(20) | nd | 50 [20] | 1/61 | 1/61 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived during FY2003~2009.

(Note 2) No monitoring was conducted in FY2010~2017.

<Wildlife>

Stocktaking of the detection of Parlar-26, Parlar-50 and Parlar-62 in wildlife (bivalves, fish and birds) during FY2003~2018

| Parlar-26 | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Bivalves (pg/g-wet) | 2003 | nd | nd | tr(39) | nd | 45 [15] | 11/30 | 3/6 |
| | 2004 | nd | nd | tr(32) | nd | 42 [14] | 15/31 | 3/7 |
| | 2005 | nd | nd | tr(28) | nd | 47 [16] | 7/31 | 4/7 |
| | 2006 | tr(9) | tr(12) | 25 | nd | 18 [7] | 21/31 | 5/7 |
| | 2007 | tr(7) | tr(8) | 20 | nd | 10 [4] | 26/31 | 6/7 |
| | 2008 | tr(7) | tr(8) | 22 | nd | 9 [3] | 27/31 | 7/7 |
| | 2009 | 9 | 9 | 23 | nd | 7 [3] | 27/31 | 7/7 |
| | 2015 | tr(10) | tr(15) | tr(17) | nd | 23 [9] | 2/3 | 2/3 |
| | 2018 | tr(10) | tr(15) | tr(15) | nd | 21 [8] | 2/3 | 2/3 |
| Fish (pg/g-wet) | 2003 | tr(28) | tr(24) | 810 | nd | 45 [15] | 44/70 | 11/14 |
| | 2004 | 43 | tr(41) | 1,000 | nd | 42 [14] | 54/70 | 13/14 |
| | 2005 | tr(42) | 53 | 900 | nd | 47 [16] | 50/75 | 13/16 |
| | 2006 | 41 | 44 | 880 | nd | 18 [7] | 70/80 | 15/16 |
| | 2007 | 24 | 32 | 690 | nd | 10 [4] | 64/80 | 14/16 |
| | 2008 | 35 | 33 | 730 | nd | 9 [3] | 79/85 | 17/17 |
| | 2009 | 25 | 20 | 690 | nd | 7 [3] | 82/90 | 18/18 |
| | 2015 | 26 | 28 | 400 | nd | 23 [9] | 13/19 | 13/19 |
| | 2018 | tr(17) | tr(17) | 280 | nd | 21 [8] | 12/18 | 12/18 |

| Parlar-26 | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Birds** (pg/g-wet) | 2003 | 120 | 650 | 2,500 | nd | 45 [15] | 5/10 | 1/2 |
| | 2004 | 70 | 340 | 810 | nd | 42 [14] | 5/10 | 1/2 |
| | 2005 | 86 | 380 | 1,200 | nd | 47 [16] | 5/10 | 1/2 |
| | 2006 | 48 | 290 | 750 | nd | 18 [7] | 5/10 | 1/2 |
| | 2007 | 34 | 280 | 650 | nd | 10 [4] | 5/10 | 1/2 |
| | 2008 | 38 | 320 | 1,200 | nd | 9 [3] | 6/10 | 2/2 |
| | 2009 | 26 | 200 | 500 | nd | 7 [3] | 6/10 | 2/2 |
| | 2015 | --- | --- | tr(10) | tr(10) | 23 [9] | 1/1 | 1/1 |
| | 2018 | 53 | --- | 54 | 53 | 21 [8] | 2/2 | 2/2 |

| Parlar-50 | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2003 | tr(12) | tr(12) | 58 | nd | 33 [11] | 17/30 | 4/6 |
| | 2004 | tr(15) | nd | tr(45) | nd | 46 [15] | 15/31 | 3/7 |
| | 2005 | nd | nd | tr(38) | nd | 54 [18] | 9/31 | 4/7 |
| | 2006 | tr(10) | 14 | 32 | nd | 14 [5] | 24/31 | 6/7 |
| | 2007 | 9 | 10 | 37 | nd | 9 [3] | 27/31 | 7/7 |
| | 2008 | tr(7) | tr(6) | 23 | nd | 10 [4] | 23/31 | 6/7 |
| | 2009 | 9 | 9 | 31 | nd | 8 [3] | 27/31 | 7/7 |
| | 2015 | tr(11) | tr(15) | tr(16) | nd | 30 [10] | 2/3 | 2/3 |
| | 2018 | tr(9) | 16 | 17 | nd | 16 [6] | 2/3 | 2/3 |
| Fish (pg/g-wet) | 2003 | 35 | 34 | 1,100 | nd | 33 [11] | 55/70 | 14/14 |
| | 2004 | 60 | 61 | 1,300 | nd | 46 [15] | 59/70 | 14/14 |
| | 2005 | tr(52) | 66 | 1,400 | nd | 54 [18] | 55/80 | 13/16 |
| | 2006 | 56 | 52 | 1,300 | nd | 14 [5] | 79/80 | 16/16 |
| | 2007 | 35 | 41 | 1,100 | nd | 9 [3] | 77/80 | 16/16 |
| | 2008 | 44 | 45 | 1,000 | nd | 10 [4] | 77/85 | 17/17 |
| | 2009 | 30 | 23 | 910 | nd | 8 [3] | 85/90 | 18/18 |
| | 2015 | tr(25) | tr(13) | 640 | nd | 30 [10] | 13/19 | 13/19 |
| | 2018 | 22 | 20 | 300 | nd | 16 [6] | 16/18 | 16/18 |
| Birds** (pg/g-wet) | 2003 | 110 | 850 | 3,000 | nd | 33 [11] | 5/10 | 1/2 |
| | 2004 | 83 | 440 | 1,000 | nd | 46 [15] | 5/10 | 1/2 |
| | 2005 | 100 | 480 | 1,500 | nd | 54 [18] | 5/10 | 1/2 |
| | 2006 | 46 | 380 | 1,000 | nd | 14 [5] | 5/10 | 1/2 |
| | 2007 | 34 | 360 | 930 | nd | 9 [3] | 5/10 | 1/2 |
| | 2008 | 49 | 410 | 1,600 | nd | 10 [4] | 5/10 | 1/2 |
| | 2009 | 29 | 250 | 620 | nd | 8 [3] | 5/10 | 1/2 |
| | 2015 | --- | --- | nd | nd | 30 [10] | 0/1 | 0/1 |
| | 2018 | tr(12) | --- | tr(13) | tr(11) | 16 [6] | 2/2 | 2/2 |

| Parlar-62 | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2003 | nd | nd | nd | nd | 120 [40] | 0/30 | 0/6 |
| | 2004 | nd | nd | nd | nd | 98 [33] | 0/31 | 0/7 |
| | 2005 | nd | nd | nd | nd | 100 [34] | 0/31 | 0/7 |
| | 2006 | nd | nd | nd | nd | 70 [30] | 0/31 | 0/7 |
| | 2007 | nd | nd | nd | nd | 70 [30] | 0/31 | 0/7 |
| | 2008 | nd | nd | nd | nd | 80 [30] | 0/31 | 0/7 |
| | 2009 | nd | nd | nd | nd | 70 [20] | 0/31 | 0/7 |
| | 2015 | nd | nd | nd | nd | 150 [60] | 0/3 | 0/3 |
| | 2018 | nd | nd | nd | nd | 100 [40] | 0/3 | 0/3 |
| Fish (pg/g-wet) | 2003 | nd | nd | 580 | nd | 120 [40] | 9/70 | 3/14 |
| | 2004 | nd | nd | 870 | nd | 98 [33] | 24/70 | 7/14 |
| | 2005 | nd | nd | 830 | nd | 100 [34] | 23/80 | 8/16 |
| | 2006 | tr(30) | nd | 870 | nd | 70 [30] | 28/80 | 10/16 |
| | 2007 | tr(30) | nd | 530 | nd | 70 [30] | 22/80 | 7/16 |
| | 2008 | tr(30) | nd | 590 | nd | 80 [30] | 31/85 | 8/17 |
| | 2009 | tr(20) | nd | 660 | nd | 70 [20] | 24/90 | 8/18 |
| | 2015 | nd | nd | 320 | nd | 150 [60] | 2/19 | 2/19 |
| | 2018 | nd | nd | 150 | nd | 100 [40] | 3/18 | 3/18 |

| Parlar-62 | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Birds** (pg/g-wet) | 2003 | tr(96) | 200 | 530 | nd | 120 [40] | 5/10 | 1/2 |
| | 2004 | tr(64) | 110 | 280 | nd | 98 [33] | 5/10 | 1/2 |
| | 2005 | tr(78) | 130 | 460 | nd | 100 [34] | 5/10 | 1/2 |
| | 2006 | 70 | 120 | 430 | nd | 70 [30] | 5/10 | 1/2 |
| | 2007 | tr(60) | 100 | 300 | nd | 70 [30] | 5/10 | 1/2 |
| | 2008 | tr(70) | 130 | 360 | nd | 80 [30] | 5/10 | 1/2 |
| | 2009 | tr(40) | 80 | 210 | nd | 70 [20] | 5/10 | 1/2 |
| | 2015 | --- | --- | nd | nd | 150 [60] | 0/1 | 0/1 |
| | 2018 | nd | --- | nd | nd | 100 [40] | 0/2 | 0/2 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived during FY2003~2009.
(Note 2) " ** " : There is no consistency between the results of the ornithological survey in FY2015 and those in previous years because of the changes in the survey sites and target species.
(Note 3) No monitoring was conducted in FY2010~2014, FY2016 and FY2017.

<Air>

Stocktaking of the detection of Parlar-26, Parlar-50 and Parlar-62 in air during FY2003~2018

| Parlar-26 | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Air (pg/m$^3$) | 2003 Warm season | 0.31 | 0.31 | 0.77 | tr(0.17) | 0.20 [0.066] | 35/35 | 35/35 |
| | 2003 Cold season | tr(0.17) | tr(0.17) | 0.27 | tr(0.091) | | 34/34 | 34/34 |
| | 2004 Warm season | 0.27 | 0.26 | 0.46 | tr(0.17) | 0.20 [0.066] | 37/37 | 37/37 |
| | 2004 Cold season | tr(0.15) | tr(0.15) | 0.50 | tr(0.094) | | 37/37 | 37/37 |
| | 2005 Warm season | nd | nd | nd | nd | 0.3 [0.1] | 0/37 | 0/37 |
| | 2005 Cold season | nd | nd | nd | nd | | 0/37 | 0/37 |
| | 2006 Warm season | nd | nd | nd | nd | 1.8 [0.6] | 0/37 | 0/37 |
| | 2006 Cold season | nd | nd | nd | nd | | 0/37 | 0/37 |
| | 2007 Warm season | nd | nd | tr(0.3) | nd | 0.6 [0.2] | 18/36 | 18/36 |
| | 2007 Cold season | nd | nd | nd | nd | | 0/36 | 0/36 |
| | 2008 Warm season | tr(0.21) | 0.22 | 0.58 | tr(0.12) | 0.22 [0.08] | 37/37 | 37/37 |
| | 2008 Cold season | tr(0.11) | tr(0.12) | tr(0.20) | nd | | 36/37 | 36/37 |
| | 2009 Warm season | tr(0.18) | tr(0.19) | 0.26 | tr(0.11) | 0.23 [0.09] | 37/37 | 37/37 |
| | 2009 Cold season | tr(0.12) | tr(0.13) | 0.27 | nd | | 33/37 | 33/37 |
| | 2018 Warm season | nd | nd | tr(0.3) | nd | 0.4 [0.2] | 12/37 | 12/37 |

| Parlar-50 | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Air (pg/m$^3$) | 2003 Warm season | nd | nd | tr(0.37) | nd | 0.81 [0.27] | 2/35 | 2/35 |
| | 2003 Cold season | nd | nd | nd | nd | | 0/34 | 0/34 |
| | 2004 Warm season | nd | nd | nd | nd | 1.2 [0.4] | 0/37 | 0/37 |
| | 2004 Cold season | nd | nd | nd | nd | | 0/37 | 0/37 |
| | 2005 Warm season | nd | nd | nd | nd | 0.6 [0.2] | 0/37 | 0/37 |
| | 2005 Cold season | nd | nd | nd | nd | | 0/37 | 0/37 |
| | 2006 Warm season | nd | nd | nd | nd | 1.6 [0.5] | 0/37 | 0/37 |
| | 2006 Cold season | nd | nd | nd | nd | | 0/37 | 0/37 |
| | 2007 Warm season | nd | tr(0.1) | tr(0.2) | nd | 0.3 [0.1] | 29/36 | 29/36 |
| | 2007 Cold season | nd | nd | nd | nd | | 0/36 | 0/36 |
| | 2008 Warm season | nd | nd | tr(0.19) | nd | 0.25 [0.09] | 15/37 | 15/37 |
| | 2008 Cold season | nd | nd | nd | nd | | 0/37 | 0/37 |
| | 2009 Warm season | nd | nd | tr(0.1) | nd | 0.3 [0.1] | 11/37 | 11/37 |
| | 2009 Cold season | nd | nd | tr(0.1) | nd | | 1/37 | 1/37 |
| | 2018 Warm season | nd | nd | tr(0.2) | nd | 0.5 [0.2] | 2/37 | 2/37 |

| Parlar-62 | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air (pg/m$^3$) | 2003 Warm season | nd | nd | nd | nd | 1.6 [0.52] | 0/35 | 0/35 |
| | 2003 Cold season | nd | nd | nd | nd | | 0/34 | 0/34 |
| | 2004 Warm season | nd | nd | nd | nd | 2.4 [0.81] | 0/37 | 0/37 |
| | 2004 Cold season | nd | nd | nd | nd | | 0/37 | 0/37 |
| | 2005 Warm season | nd | nd | nd | nd | 1.2 [0.4] | 0/37 | 0/37 |
| | 2005 Cold season | nd | nd | nd | nd | | 0/37 | 0/37 |
| | 2006 Warm season | nd | nd | nd | nd | 8 [3] | 0/37 | 0/37 |
| | 2006 Cold season | nd | nd | nd | nd | | 0/37 | 0/37 |
| | 2007 Warm season | nd | nd | nd | nd | 1.5 [0.6] | 0/36 | 0/36 |
| | 2007 Cold season | nd | nd | nd | nd | | 0/36 | 0/36 |
| | 2008 Warm season | nd | nd | nd | nd | 1.6 [0.6] | 0/37 | 0/37 |
| | 2008 Cold season | nd | nd | nd | nd | | 0/37 | 0/37 |
| | 2009 Warm season | nd | nd | nd | nd | 1.6 [0.6] | 0/37 | 0/37 |
| | 2009 Cold season | nd | nd | nd | nd | | 0/37 | 0/37 |
| | 2018 Warm season | nd | nd | nd | nd | 0.4 [0.2] | 0/37 | 0/37 |

(Note) No monitoring was conducted in FY2010~2017.

## [10] Mirex (references)

・ History and state of monitoring

Mirex was developed as an organochlorine insecticide chemical in the United States, and it was also used as a fire retardant in plastics, rubber, and electrical goods. No domestic record of manufacture/import of the substance was reported since it was historically never registrated under the Agricultural Chemicals Regulation Law. The substance was designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in September 2002. Also the substance is one of the original twelve POPs covered by the Stockholm Convention.

Before FY2001, the substance was measured in FY1983 (in surface water and sediment) under the framework of "the Environmental Survey and Monitoring of Chemicals."

Under the framework of the Environmental Monitoring, Mirex has been monitored in surface water, sediment, wildlife (bivalves, fish and birds) and air in FY2003~2009, FY2011 and FY2018.

No monitoring was conducted after FY2019. For reference, the monitoring results up to FY2018 are given below.

・ Monitoring results until FY2018

<Surface Water>

Stocktaking of the detection of Mirex in surface water during FY2003~2018

| Mirex | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Surface Water (pg/L) | 2003 | tr(0.13) | tr(0.12) | 0.8 | nd | 0.3 [0.09] | 25/36 | 25/36 |
| | 2004 | nd | nd | 1.1 | nd | 0.4 [0.2] | 18/38 | 18/38 |
| | 2005 | nd | nd | 1.0 | nd | 0.4 [0.1] | 14/47 | 14/47 |
| | 2006 | nd | nd | 0.07 | nd | 1.6 [0.5] | 1/48 | 1/48 |
| | 2007 | nd | nd | tr(0.5) | nd | 1.1 [0.4] | 2/48 | 2/48 |
| | 2008 | nd | nd | 0.7 | nd | 0.6 [0.2] | 4/48 | 4/48 |
| | 2009 | nd | nd | 0.5 | nd | 0.4 [0.2] | 8/49 | 8/49 |
| | 2011 | nd | nd | 0.8 | nd | 0.5 [0.2] | 3/49 | 3/49 |
| | 2018 | nd | nd | 1.0 | nd | 0.7 [0.3] | 3/47 | 3/47 |

(Note ) No monitoring was conducted in FY2010 and FY2012 ~ 2017.

<Sediment>

Stocktaking of the detection of Mirex in sediment during FY2003~2018

| Mirex | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Sediment (pg/g-dry) | 2003 | 2 | tr(1.6) | 1,500 | nd | 2 [0.4] | 137/186 | 51/62 |
| | 2004 | 2 | tr(1.6) | 220 | nd | 2 [0.5] | 153/189 | 55/63 |
| | 2005 | 1.8 | 1.2 | 5,300 | nd | 0.9 [0.3] | 134/189 | 48/63 |
| | 2006 | 1.7 | 1.2 | 640 | nd | 0.6 [0.2] | 156/192 | 57/64 |
| | 2007 | 1.5 | 0.9 | 200 | nd | 0.9 [0.3] | 147/192 | 55/64 |
| | 2008 | 1.4 | 1.1 | 820 | nd | 0.7 [0.3] | 117/192 | 48/64 |
| | 2009 | 1.4 | 1.3 | 620 | nd | 1.0 [0.4] | 126/192 | 49/64 |
| | 2011 | 1.2 | 0.9 | 1,900 | nd | 0.9 [0.4] | 42/64 | 42/64 |
| | 2018 | 1.1 | 0.9 | 240 | nd | 0.8 [0.3] | 44/61 | 44/61 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived during FY2003~2009.

(Note 2) No monitoring was conducted in FY2010 and FY2012 ~ 2017.

<Wildlife>

Stocktaking of the detection of Mirex in wildlife (bivalves, fish and birds) during FY2003~2018

| Mirex | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Bivalves (pg/g-wet) | 2003 | 4.9 | 4.2 | 19 | tr(1.6) | 2.4 [0.81] | 30/30 | 6/6 |
| | 2004 | 4.4 | 4.3 | 12 | tr(1.1) | 2.5 [0.82] | 31/31 | 7/7 |
| | 2005 | 5.4 | 5.2 | 20 | tr(1.9) | 3.0 [0.99] | 31/31 | 7/7 |
| | 2006 | 5 | 4 | 19 | tr(2) | 3 [1] | 31/31 | 7/7 |
| | 2007 | 5 | 4 | 18 | tr(2) | 3 [1] | 31/31 | 7/7 |
| | 2008 | 4 | tr(3) | 18 | tr(2) | 4 [1] | 31/31 | 7/7 |
| | 2009 | 5.9 | 5.2 | 21 | tr(1.7) | 2.1 [0.8] | 31/31 | 7/7 |
| | 2011 | 10 | 7.1 | 44 | 5.2 | 1.9 [0.8] | 4/4 | 4/4 |
| | 2018 | 4.9 | 3.2 | 20 | 1.8 | 1.4 [0.5] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2003 | 8.3 | 9.0 | 25 | tr(1.7) | 2.4 [0.81] | 70/70 | 14/14 |
| | 2004 | 13 | 11 | 180 | 3.8 | 2.5 [0.82] | 70/70 | 14/14 |
| | 2005 | 13 | 13 | 78 | tr(1.0) | 3.0 [0.99] | 80/80 | 16/16 |
| | 2006 | 11 | 10 | 53 | tr(2) | 3 [1] | 80/80 | 16/16 |
| | 2007 | 9 | 11 | 36 | tr(1) | 3 [1] | 80/80 | 16/16 |
| | 2008 | 11 | 13 | 48 | tr(1) | 4 [1] | 85/85 | 17/17 |
| | 2009 | 8.6 | 9.6 | 37 | tr(0.9) | 2.1 [0.8] | 90/90 | 18/18 |
| | 2011 | 12 | 15 | 41 | tr(1.3) | 1.9 [0.8] | 18/18 | 18/18 |
| | 2018 | 8.2 | 8.4 | 70 | 1.9 | 1.4 [0.5] | 18/18 | 18/18 |
| Birds (pg/g-wet) | 2003 | 120 | 150 | 450 | 31 | 2.4 [0.81] | 10/10 | 2/2 |
| | 2004 | 61 | 64 | 110 | 33 | 2.5 [0.82] | 10/10 | 2/2 |
| | 2005 | 77 | 66 | 180 | 41 | 3.0 [0.99] | 10/10 | 2/2 |
| | 2006 | 77 | 70 | 280 | 39 | 3 [1] | 10/10 | 2/2 |
| | 2007 | 57 | 59 | 100 | 32 | 3 [1] | 10/10 | 2/2 |
| | 2008 | 74 | 68 | 260 | 27 | 4 [1] | 10/10 | 2/2 |
| | 2009 | 49 | 50 | 79 | 32 | 2.1 [0.8] | 10/10 | 2/2 |
| | 2011 | --- | --- | 58 | 58 | 1.9 [0.8] | 1/1 | 1/1 |
| | 2018 | 110 | --- | 260 | 47 | 1.4 [0.5] | 2/2 | 2/2 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived during FY2003~2009.

(Note 2) No monitoring was conducted in FY2010 and FY2012~2017.

<Air>

Stocktaking of the detection of Mirex in air during FY2003~2018

| Mirex | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Air (pg/m$^3$) | 2003 Warm season | 0.11 | 0.12 | 0.19 | 0.047 | 0.0084 | 35/35 | 35/35 |
| | 2003 Cold season | 0.044 | 0.043 | 0.099 | 0.024 | [0.0028] | 34/34 | 34/34 |
| | 2004 Warm season | 0.099 | 0.11 | 0.16 | tr(0.042) | 0.05 [0.017] | 37/37 | 37/37 |
| | 2004 Cold season | tr(0.046) | tr(0.047) | 0.23 | tr(0.019) | | 37/37 | 37/37 |
| | 2005 Warm season | tr(0.09) | tr(0.09) | 0.24 | tr(0.05) | 0.10 [0.03] | 37/37 | 37/37 |
| | 2005 Cold season | tr(0.04) | tr(0.04) | tr(0.08) | nd | | 29/37 | 29/37 |
| | 2006 Warm season | tr(0.07) | tr(0.10) | 0.22 | nd | 0.13 [0.04] | 29/37 | 29/37 |
| | 2006 Cold season | tr(0.07) | tr(0.07) | 2.1 | nd | | 27/37 | 27/37 |
| | 2007 Warm season | 0.11 | 0.11 | 0.28 | 0.04 | 0.03 [0.01] | 36/36 | 36/36 |
| | 2007 Cold season | 0.04 | 0.04 | 0.09 | tr(0.02) | | 36/36 | 36/36 |
| | 2008 Warm season | 0.09 | 0.09 | 0.25 | 0.03 | 0.03 [0.01] | 37/37 | 37/37 |
| | 2008 Cold season | 0.05 | 0.04 | 0.08 | 0.03 | | 37/37 | 37/37 |
| | 2009 Warm season | 0.12 | 0.13 | 0.48 | 0.049 | 0.015 [0.006] | 37/37 | 37/37 |
| | 2009 Cold season | 0.058 | 0.054 | 0.18 | 0.030 | | 37/37 | 37/37 |
| | 2011 Warm season | 0.14 | 0.13 | 0.25 | 0.08 | 0.04 [0.01] | 35/35 | 35/35 |
| | 2011 Cold season | 0.07 | 0.07 | 0.11 | tr(0.03) | | 37/37 | 37/37 |
| | 2018 Warm season | 0.09 | 0.09 | 0.20 | 0.05 | 0.03 [0.01] | 37/37 | 37/37 |

(Note) No monitoring was conducted in FY2010 and FY2012~2017.

## [11] HCHs (references)

・ History and state of monitoring

HCHs were used as pesticides, household insecticides, and termiticides, etc. Even after their registration under the Agricultural Chemicals Regulation Law was expired in FY1971, they continue to be used as termiticides and wood preservatives. *α*-HCH, *β*-HCH, and *γ*-HCH (synonym: Lindane) were adopted as target chemicals at the COP4 of the Stockholm convention on Persistent Organic Pollutants in May 2009. The substances were designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in April 2010.

Among many HCH isomers, *α*-HCH, *β*-HCH, *γ*-HCH (synonym: Lindane) and *δ*-HCH have been monitored in surface water, sediment, wildlife (bivalves, fish and birds) and air.

Before FY2001, the substances were measured in FY1974 (in surface water, sediment and fish) under the framework of "the Environmental Survey and Monitoring of Chemicals." *α*-HCH and *β*-HCH had been the target chemicals, and surface water and sediment had been the monitored media during the period of FY1986~1998 and FY1986~2001, respectively. Under the framework of the Wildlife Monitoring, the substances were monitored in wildlife (bivalves, fish and birds) during the period of FY1978~1996 and in FY1998, FY2000 and FY2001 (*γ*-HCH (synonym: Lindane) and *δ*-HCH had not been monitored since FY1997 and FY1993, respectively.)

Under the framework of the Environmental Monitoring, *α*-HCH and *β*-HCH in surface water, sediment, and wildlife (bivalves, fish and birds) have been monitored since FY2002, except FY2018. *α*-HCH and *β*-HCH in air and *γ*-HCH (synonym: Lindane) and *δ*-HCH in surface water, sediment, wildlife (bivalves, fish and birds) and air have also been monitored since FY2003, except FY2018.

No monitoring was conducted in FY2020. For reference, the monitoring results up to FY2019 are given below.

・ Monitoring results until FY2018

<Surface Water>

Stocktaking of the detection of Total*α*-HCH, *β*-HCH, *γ*-HCH(synonym: Lindane) and *δ*-HCH in surface water during FY2002~2019

| *α*-HCH | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2002 | 86 | 76 | 6,500 | 1.9 | 0.9 [0.3] | 114/114 | 38/38 |
| | 2003 | 120 | 120 | 970 | 13 | 3 [0.9] | 36/36 | 36/36 |
| | 2004 | 150 | 145 | 5,700 | 13 | 6 [2] | 38/38 | 38/38 |
| | 2005 | 90 | 81 | 660 | 16 | 4 [1] | 47/47 | 47/47 |
| | 2006 | 110 | 90 | 2,100 | 25 | 3 [1] | 48/48 | 48/48 |
| | 2007 | 76 | 73 | 720 | 13 | 1.9 [0.6] | 48/48 | 48/48 |
| | 2008 | 78 | 75 | 1,100 | 9 | 4 [2] | 48/48 | 48/48 |
| | 2009 | 74 | 73 | 560 | 14 | 1.2 [0.4] | 49/49 | 49/49 |
| | 2010 | 94 | 75 | 1,400 | 14 | 4 [1] | 49/49 | 49/49 |
| | 2011 | 67 | 60 | 1,000 | 11 | 7 [3] | 49/49 | 49/49 |
| | 2012 | 65 | 56 | 2,200 | 9.5 | 1.4 [0.5] | 48/48 | 48/48 |
| | 2013 | 57 | 55 | 1,900 | 9 | 7 [2] | 48/48 | 48/48 |
| | 2014 | 47 | 41 | 700 | 7.3 | 4.5 [1.5] | 48/48 | 48/48 |
| | 2015 | 48 | 40 | 610 | 8.7 | 1.2 [0.4] | 48/48 | 48/48 |
| | 2016 | 38 | 36 | 640 | 5.1 | 1.1 [0.4] | 48/48 | 48/48 |
| | 2017 | 47 | 45 | 680 | 3.7 | 0.9 [0.4] | 47/47 | 47/47 |
| | 2019 | 35 | 37 | 640 | tr(2) | 4 [2] | 48/48 | 48/48 |

| β-HCH | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2002 | 210 | 180 | 1,600 | 24 | 0.9 [0.3] | 114/114 | 38/38 |
| | 2003 | 250 | 240 | 1,700 | 14 | 3 [0.7] | 36/36 | 36/36 |
| | 2004 | 260 | 250 | 3,400 | 31 | 4 [2] | 38/38 | 38/38 |
| | 2005 | 200 | 170 | 2,300 | 25 | 2.6 [0.9] | 47/47 | 47/47 |
| | 2006 | 200 | 160 | 2,000 | 42 | 1.7 [0.6] | 48/48 | 48/48 |
| | 2007 | 170 | 150 | 1,300 | 18 | 2.7[0.9] | 48/48 | 48/48 |
| | 2008 | 150 | 150 | 1,800 | 15 | 1.0 [0.4] | 48/48 | 48/48 |
| | 2009 | 150 | 150 | 1,100 | 18 | 0.6 [0.2] | 49/49 | 49/49 |
| | 2010 | 180 | 160 | 2,500 | 33 | 2.0 [0.7] | 49/49 | 49/49 |
| | 2011 | 130 | 120 | 840 | 28 | 2.0 [0.8] | 49/49 | 49/49 |
| | 2012 | 150 | 130 | 820 | 17 | 1.4 [0.5] | 48/48 | 48/48 |
| | 2013 | 130 | 130 | 1,100 | 20 | 7 [2] | 48/48 | 48/48 |
| | 2014 | 100 | 110 | 1,100 | 11 | 1.0 [0.4] | 48/48 | 48/48 |
| | 2015 | 130 | 120 | 1,100 | 21 | 1.2 [0.4] | 48/48 | 48/48 |
| | 2016 | 100 | 96 | 1,100 | 12 | 1.2 [0.4] | 48/48 | 48/48 |
| | 2017 | 100 | 110 | 830 | 12 | 1.8 [0.7] | 47/47 | 47/47 |
| | 2019 | 100 | 92 | 570 | 17 | 3 [1] | 48/48 | 48/48 |

| γ-HCH (synonym: Lindane) | Monitored year | Geometric mean* | Median | Maximu m | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2003 | 92 | 90 | 370 | 32 | 7 [2] | 36/36 | 36/36 |
| | 2004 | 91 | 76 | 8,200 | 21 | 20 [7] | 38/38 | 38/38 |
| | 2005 | 48 | 40 | 250 | tr(8) | 14 [5] | 47/47 | 47/47 |
| | 2006 | 44 | 43 | 460 | tr(9) | 18 [6] | 48/48 | 48/48 |
| | 2007 | 34 | 32 | 290 | 5.2 | 2.1 [0.7] | 48/48 | 48/48 |
| | 2008 | 34 | 32 | 340 | 4 | 3 [1] | 48/48 | 48/48 |
| | 2009 | 32 | 26 | 280 | 5.1 | 0.6 [0.2] | 49/49 | 49/49 |
| | 2010 | 26 | 22 | 190 | tr(5) | 6 [2] | 49/49 | 49/49 |
| | 2011 | 23 | 20 | 170 | 3 | 3 [1] | 49/49 | 49/49 |
| | 2012 | 22 | 21 | 440 | 3.0 | 1.3 [0.4] | 48/48 | 48/48 |
| | 2013 | 21 | 17 | 560 | 3.2 | 2.7 [0.8] | 48/48 | 48/48 |
| | 2014 | 18 | 18 | 350 | 3.5 | 1.2 [0.4] | 48/48 | 48/48 |
| | 2015 | 17 | 15 | 110 | 2.6 | 0.9 [0.3] | 48/48 | 48/48 |
| | 2016 | 14 | 13 | 130 | 1.8 | 0.8 [0.3] | 48/48 | 48/48 |
| | 2017 | 17 | 16 | 190 | 2.1 | 1.4 [0.5] | 47/47 | 47/47 |
| | 2019 | 14 | 12 | 480 | nd | 4 [2] | 47/48 | 47/48 |

| δ-HCH | Monitored year | Geometric mean* | Median | Maximu m | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2003 | 14 | 14 | 200 | tr(1.1) | 2 [0.5] | 36/36 | 36/36 |
| | 2004 | 24 | 29 | 670 | tr(1.4) | 2 [0.7] | 38/38 | 38/38 |
| | 2005 | 1.8 | nd | 62 | nd | 1.5 [0.5] | 23/47 | 23/47 |
| | 2006 | 24 | 18 | 1,000 | 2.2 | 2.0 [0.8] | 48/48 | 48/48 |
| | 2007 | 11 | 9.7 | 720 | tr(0.7) | 1.2 [0.4] | 48/48 | 48/48 |
| | 2008 | 11 | 10 | 1,900 | tr(1.1) | 2.3 [0.9] | 48/48 | 48/48 |
| | 2009 | 10 | 11 | 450 | tr(0.7) | 0.9 [0.4] | 49/49 | 49/49 |
| | 2010 | 16 | 17 | 780 | 0.9 | 0.8 [0.3] | 49/49 | 49/49 |
| | 2011 | 8.6 | 8.9 | 300 | 0.7 | 0.4 [0.2] | 49/49 | 49/49 |
| | 2012 | 7.9 | 6.7 | 220 | tr(0.5) | 1.1 [0.4] | 48/48 | 48/48 |
| | 2013 | 8.2 | 8.9 | 320 | tr(0.6) | 1.1 [0.4] | 48/48 | 48/48 |
| | 2014 | 7.1 | 6.5 | 590 | 0.7 | 0.4 [0.2] | 48/48 | 48/48 |
| | 2015 | 7.2 | 7.4 | 310 | 0.8 | 0.3 [0.1] | 48/48 | 48/48 |
| | 2016 | 5.5 | 6.0 | 920 | tr(0.5) | 0.8 [0.3] | 48/48 | 48/48 |
| | 2017 | 8.2 | 8.2 | 690 | tr(0.4) | 1.0 [0.4] | 47/47 | 47/47 |
| | 2019 | 5.1 | 5.3 | 85 | nd | 1.0 [0.4] | 46/48 | 46/48 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2002.

(Note 2) No monitoring was conducted in FY2018.

<Sediment>

Stocktaking of the detection of $\alpha$-HCH, $\beta$-HCH, $\gamma$-HCH(synonym: Lindane) and $\delta$-HCH in sediment during FY2002~2019

| $\alpha$-HCH | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2002 | 150 | 170 | 8,200 | 2.0 | 1.2 [0.4] | 189/189 | 63/63 |
| | 2003 | 160 | 170 | 9,500 | 2 | 2 [0.5] | 186/186 | 62/62 |
| | 2004 | 160 | 180 | 5,700 | tr(1.5) | 2 [0.6] | 189/189 | 63/63 |
| | 2005 | 140 | 160 | 7,000 | 3.4 | 1.7 [0.6] | 189/189 | 63/63 |
| | 2006 | 140 | 160 | 4,300 | tr(2) | 5 [2] | 192/192 | 64/64 |
| | 2007 | 140 | 150 | 12,000 | tr(1.3) | 1.8 [0.6] | 192/192 | 64/64 |
| | 2008 | 140 | 190 | 5,200 | nd | 1.6 [0.6] | 191/192 | 64/64 |
| | 2009 | 120 | 120 | 6,300 | nd | 1.1 [0.4] | 191/192 | 64/64 |
| | 2010 | 140 | 140 | 3,700 | 3.1 | 2.0 [0.8] | 64/64 | 64/64 |
| | 2011 | 120 | 140 | 5,100 | 1.6 | 1.5 [0.6] | 64/64 | 64/64 |
| | 2012 | 100 | 100 | 3,900 | tr(1.1) | 1.6 [0.5] | 63/63 | 63/63 |
| | 2013 | 94 | 98 | 3,200 | tr(0.6) | 1.5 [0.5] | 63/63 | 63/63 |
| | 2014 | 84 | 93 | 4,300 | nd | 2.4 [0.8] | 62/63 | 62/63 |
| | 2015 | 97 | 120 | 9,600 | 1.1 | 0.7 [0.3] | 62/62 | 62/62 |
| | 2016 | 64 | 77 | 5,000 | 1.1 | 0.9 [0.3] | 62/62 | 62/62 |
| | 2017 | 77 | 86 | 1,900 | 1.0 | 0.5 [0.2] | 62/62 | 62/62 |
| | 2019 | 67 | 83 | 2,600 | 1.3 | 1.1 [0.4] | 61/61 | 61/61 |

| $\beta$-HCH | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2002 | 230 | 230 | 11,000 | 3.9 | 0.9 [0.3] | 189/189 | 63/63 |
| | 2003 | 250 | 220 | 39,000 | 5 | 2 [0.7] | 186/186 | 62/62 |
| | 2004 | 240 | 230 | 53,000 | 4 | 3 [0.8] | 189/189 | 63/63 |
| | 2005 | 200 | 220 | 13,000 | 3.9 | 2.6 [0.9] | 189/189 | 63/63 |
| | 2006 | 190 | 210 | 21,000 | 2.3 | 1.3 [0.4] | 192/192 | 64/64 |
| | 2007 | 200 | 190 | 59,000 | 1.6 | 0.9 [0.3] | 192/192 | 64/64 |
| | 2008 | 190 | 200 | 8,900 | 2.8 | 0.8 [0.3] | 192/192 | 64/64 |
| | 2009 | 180 | 170 | 10,000 | 2.4 | 1.3 [0.5] | 192/192 | 64/64 |
| | 2010 | 230 | 210 | 8,200 | 11 | 2.4 [0.8] | 64/64 | 64/64 |
| | 2011 | 180 | 210 | 14,000 | 3 | 3 [1] | 64/64 | 64/64 |
| | 2012 | 160 | 170 | 8,300 | 3.7 | 1.5 [0.6] | 63/63 | 63/63 |
| | 2013 | 160 | 170 | 6,900 | 4.5 | 0.4 [0.1] | 63/63 | 63/63 |
| | 2014 | 140 | 140 | 7,200 | 2.9 | 0.9 [0.3] | 63/63 | 63/63 |
| | 2015 | 160 | 170 | 5,900 | 2.5 | 0.8 [0.3] | 62/62 | 62/62 |
| | 2016 | 130 | 160 | 6,000 | 3.7 | 0.9 [0.3] | 62/62 | 62/62 |
| | 2017 | 140 | 110 | 3,400 | 5.7 | 1.5 [0.6] | 62/62 | 62/62 |
| | 2019 | 130 | 110 | 4,100 | 4.0 | 1.2 [0.5] | 61/61 | 61/61 |

| $\gamma$-HCH (synonym: Lindane) | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2003 | 51 | 47 | 4,000 | tr(1.4) | 2 [0.4] | 186/186 | 62/62 |
| | 2004 | 53 | 48 | 4,100 | tr(0.8) | 2 [0.5] | 189/189 | 63/63 |
| | 2005 | 49 | 46 | 6,400 | tr(1.8) | 2.0 [0.7] | 189/189 | 63/63 |
| | 2006 | 48 | 49 | 3,500 | tr(1.4) | 2.1 [0.7] | 192/192 | 64/64 |
| | 2007 | 42 | 41 | 5,200 | tr(0.6) | 1.2 [0.4] | 192/192 | 64/64 |
| | 2008 | 40 | 43 | 2,200 | tr(0.7) | 0.9 [0.4] | 192/192 | 64/64 |
| | 2009 | 38 | 43 | 3,800 | nd | 0.6 [0.2] | 191/192 | 64/64 |
| | 2010 | 35 | 30 | 2,300 | tr(1.5) | 2.0 [0.7] | 64/64 | 64/64 |
| | 2011 | 35 | 42 | 3,500 | nd | 3 [1] | 62/64 | 62/64 |
| | 2012 | 30 | 29 | 3,500 | nd | 1.3 [0.4] | 61/63 | 61/63 |
| | 2013 | 33 | 35 | 2,100 | 0.9 | 0.6 [0.2] | 63/63 | 63/63 |
| | 2014 | 27 | 30 | 2,600 | nd | 2.7 [0.9] | 61/63 | 61/63 |
| | 2015 | 29 | 35 | 2,800 | tr(0.3) | 0.5 [0.2] | 62/62 | 62/62 |
| | 2016 | 20 | 25 | 3,100 | tr(0.7) | 0.8 [0.3] | 62/62 | 62/62 |
| | 2017 | 23 | 25 | 1,900 | tr(0.4) | 1.0 [0.4] | 62/62 | 62/62 |
| | 2019 | 23 | 27 | 2,100 | tr(0.6) | 1.0 [0.4] | 61/61 | 61/61 |

| δ-HCH | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Sediment (pg/g-dry) | 2003 | 42 | 46 | 5,400 | nd | 2 [0.7] | 180/186 | 61/62 |
| | 2004 | 55 | 55 | 5,500 | tr(0.5) | 2 [0.5] | 189/189 | 63/63 |
| | 2005 | 52 | 63 | 6,200 | nd | 1.0 [0.3] | 188/189 | 63/63 |
| | 2006 | 45 | 47 | 6,000 | nd | 1.7 [0.6] | 189/192 | 64/64 |
| | 2007 | 26 | 28 | 5,400 | nd | 5 [2] | 165/192 | 60/64 |
| | 2008 | 41 | 53 | 3,300 | nd | 2 [1] | 186/192 | 64/64 |
| | 2009 | 36 | 37 | 5,000 | nd | 1.2 [0.5] | 190/192 | 64/64 |
| | 2010 | 39 | 40 | 3,800 | 1.3 | 1.2 [0.5] | 64/64 | 64/64 |
| | 2011 | 37 | 47 | 5,000 | nd | 1.4 [0.5] | 63/64 | 63/64 |
| | 2012 | 28 | 28 | 3,100 | nd | 0.8 [0.3] | 62/63 | 62/63 |
| | 2013 | 31 | 29 | 2,500 | 0.4 | 0.3 [0.1] | 63/63 | 63/63 |
| | 2014 | 27 | 26 | 3,900 | 0.4 | 0.4 [0.1] | 63/63 | 63/63 |
| | 2015 | 27 | 28 | 2,900 | tr(0.4) | 0.5 [0.2] | 62/62 | 62/62 |
| | 2016 | 20 | 24 | 6,100 | nd | 0.5 [0.2] | 60/62 | 60/62 |
| | 2017 | 25 | 22 | 1,700 | tr(0.2) | 0.6 [0.2] | 62/62 | 62/62 |
| | 2019 | 22 | 23 | 2,500 | tr(0.2) | 0.5 [0.2] | 61/61 | 61/61 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2002~2009.
(Note 2) No monitoring was conducted in FY2018.

<Wildlife>

Stocktaking of the detection ofα-HCH, β-HCH, γ-HCH(synonym: Lindane) and δ-HCH in wildlife (bivalves, fish and birds) during FY2002~2019

| α-HCH | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2002 | 67 | 64 | 1,100 | 12 | 4.2 [1.4] | 38/38 | 8/8 |
| | 2003 | 45 | 30 | 610 | 9.9 | 1.8 [0.61] | 30/30 | 6/6 |
| | 2004 | 56 | 25 | 1,800 | tr(12) | 13 [4.3] | 31/31 | 7/7 |
| | 2005 | 38 | 25 | 1,100 | tr(7.1) | 11 [3.6] | 31/31 | 7/7 |
| | 2006 | 30 | 21 | 390 | 6 | 3 [1] | 31/31 | 7/7 |
| | 2007 | 31 | 17 | 1,400 | 8 | 7 [2] | 31/31 | 7/7 |
| | 2008 | 26 | 16 | 380 | 7 | 6 [2] | 31/31 | 7/7 |
| | 2009 | 45 | 21 | 2,200 | 9 | 5 [2] | 31/31 | 7/7 |
| | 2010 | 35 | 20 | 730 | 13 | 3 [1] | 6/6 | 6/6 |
| | 2011 | 64 | 33 | 1,200 | 13 | 3 [1] | 4/4 | 4/4 |
| | 2012 | 23 | 12 | 340 | 4.0 | 3.7 [1.2] | 5/5 | 5/5 |
| | 2013 | 30 | 25 | 690 | 6 | 3 [1] | 5/5 | 5/5 |
| | 2014 | 16 | 16 | 39 | 7 | 3 [1] | 3/3 | 3/3 |
| | 2015 | 11 | 15 | 25 | 3.5 | 3.0 [1.0] | 3/3 | 3/3 |
| | 2016 | 13 | 20 | 22 | 5 | 3 [1] | 3/3 | 3/3 |
| | 2017 | 15 | 16 | 32 | 6 | 3 [1] | 3/3 | 3/3 |
| | 2019 | 9 | 12 | 14 | 4 | 4 [2] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2002 | 57 | 56 | 590 | tr(1.9) | 4.2 [1.4] | 70/70 | 14/14 |
| | 2003 | 43 | 58 | 590 | 2.6 | 1.8 [0.61] | 70/70 | 14/14 |
| | 2004 | 57 | 55 | 2,900 | nd | 13 [4.3] | 63/70 | 14/14 |
| | 2005 | 42 | 43 | 1,000 | nd | 11 [3.6] | 75/80 | 16/16 |
| | 2006 | 44 | 53 | 360 | tr(2) | 3 [1] | 80/80 | 16/16 |
| | 2007 | 39 | 40 | 730 | tr(2) | 7 [2] | 80/80 | 16/16 |
| | 2008 | 36 | 47 | 410 | nd | 6 [2] | 84/85 | 17/17 |
| | 2009 | 39 | 32 | 830 | tr(2) | 5 [2] | 90/90 | 18/18 |
| | 2010 | 27 | 39 | 250 | tr(1) | 3 [1] | 18/18 | 18/18 |
| | 2011 | 37 | 54 | 690 | tr(2) | 3 [1] | 18/18 | 18/18 |
| | 2012 | 24 | 32 | 170 | nd | 3.7 [1.2] | 18/19 | 18/19 |
| | 2013 | 32 | 47 | 320 | tr(2) | 3 [1] | 19/19 | 19/19 |
| | 2014 | 26 | 40 | 210 | nd | 3 [1] | 18/19 | 18/19 |
| | 2015 | 18 | 26 | 180 | tr(1.3) | 3.0 [1.0] | 19/19 | 19/19 |
| | 2016 | 15 | 17 | 81 | nd | 3 [1] | 18/19 | 18/19 |
| | 2017 | 20 | 29 | 130 | nd | 3 [1] | 18/19 | 18/19 |
| | 2019 | 8 | 8 | 130 | nd | 4 [2] | 12/16 | 12/16 |

| α-HCH | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Birds** (pg/g-wet) | 2002 | 170 | 130 | 360 | 93 | 4.2 [1.4] | 10/10 | 2/2 |
| | 2003 | 73 | 74 | 230 | 30 | 1.8 [0.61] | 10/10 | 2/2 |
| | 2004 | 190 | 80 | 1,600 | 58 | 13 [4.3] | 10/10 | 2/2 |
| | 2005 | 76 | 77 | 85 | 67 | 11 [3.6] | 10/10 | 2/2 |
| | 2006 | 76 | 75 | 100 | 55 | 3 [1] | 10/10 | 2/2 |
| | 2007 | 75 | 59 | 210 | 43 | 7 [2] | 10/10 | 2/2 |
| | 2008 | 48 | 48 | 61 | 32 | 6 [2] | 10/10 | 2/2 |
| | 2009 | 43 | 42 | 56 | 34 | 5 [2] | 10/10 | 2/2 |
| | 2010 | 260 | --- | 430 | 160 | 3 [1] | 2/2 | 2/2 |
| | 2011 | --- | --- | 48 | 48 | 3 [1] | 1/1 | 1/1 |
| | 2012 | 35 | --- | 39 | 32 | 3.7 [1.2] | 2/2 | 2/2 |
| | 2013 | 46 | --- | 130 | 16 | 3 [1] | 2/2 | 2/2 |
| | 2014 | 61 | --- | 220 | 17 | 3 [1] | 2/2 | 2/2 |
| | 2015 | --- | --- | 13 | 13 | 3.0 [1.0] | 1/1 | 1/1 |
| | 2016 | 63 | --- | 170 | 23 | 3 [1] | 2/2 | 2/2 |
| | 2017 | 81 | --- | 930 | 7 | 3 [1] | 2/2 | 2/2 |
| | 2019 | --- | --- | 63 | 63 | 4 [2] | 1/1 | 1/1 |
| β-HCH | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
| Bivalves (pg/g-wet) | 2002 | 88 | 62 | 1,700 | 32 | 12 [4] | 38/38 | 8/8 |
| | 2003 | 78 | 50 | 1,100 | 23 | 9.9 [3.3] | 30/30 | 6/6 |
| | 2004 | 100 | 74 | 1,800 | 22 | 6.1 [2.0] | 31/31 | 7/7 |
| | 2005 | 85 | 56 | 2,000 | 20 | 2.2 [0.75] | 31/31 | 7/7 |
| | 2006 | 81 | 70 | 880 | 11 | 3 [1] | 31/31 | 7/7 |
| | 2007 | 79 | 56 | 1,800 | 21 | 7 [3] | 31/31 | 7/7 |
| | 2008 | 73 | 51 | 1,100 | 23 | 6 [2] | 31/31 | 7/7 |
| | 2009 | 83 | 55 | 1,600 | 27 | 6 [2] | 31/31 | 7/7 |
| | 2010 | 89 | 56 | 1,500 | 27 | 3 [1] | 6/6 | 6/6 |
| | 2011 | 130 | 68 | 2,000 | 39 | 3 [1] | 4/4 | 4/4 |
| | 2012 | 65 | 37 | 980 | 15 | 2.0 [0.8] | 5/5 | 5/5 |
| | 2013 | 61 | 47 | 710 | 17 | 2.2 [0.8] | 5/5 | 5/5 |
| | 2014 | 40 | 35 | 64 | 28 | 2.4 [0.9] | 3/3 | 3/3 |
| | 2015 | 34 | 45 | 69 | 13 | 3.0 [1.0] | 3/3 | 3/3 |
| | 2016 | 37 | 47 | 50 | 21 | 3 [1] | 3/3 | 3/3 |
| | 2017 | 39 | 47 | 60 | 21 | 3 [1] | 3/3 | 3/3 |
| | 2019 | 23 | 32 | 33 | 11 | 3 [1] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2002 | 110 | 120 | 1,800 | tr(5) | 12 [4] | 70/70 | 14/14 |
| | 2003 | 81 | 96 | 1,100 | tr(3.5) | 9.9 [3.3] | 70/70 | 14/14 |
| | 2004 | 110 | 140 | 1,100 | tr(3.9) | 6.1 [2.0] | 70/70 | 14/14 |
| | 2005 | 95 | 110 | 1,300 | 6.7 | 2.2 [0.75] | 80/80 | 16/16 |
| | 2006 | 89 | 110 | 1,100 | 4 | 3 [1] | 80/80 | 16/16 |
| | 2007 | 110 | 120 | 810 | 7 | 7 [3] | 80/80 | 16/16 |
| | 2008 | 94 | 150 | 750 | tr(4) | 6 [2] | 85/85 | 17/17 |
| | 2009 | 98 | 130 | 970 | tr(5) | 6 [2] | 90/90 | 18/18 |
| | 2010 | 81 | 110 | 760 | 5 | 3 [1] | 18/18 | 18/18 |
| | 2011 | 100 | 140 | 710 | 4 | 3 [1] | 18/18 | 18/18 |
| | 2012 | 72 | 100 | 510 | 6.5 | 2.0 [0.8] | 19/19 | 19/19 |
| | 2013 | 80 | 110 | 420 | 7.2 | 2.2 [0.8] | 19/19 | 19/19 |
| | 2014 | 75 | 140 | 460 | 4.4 | 2.4 [0.9] | 19/19 | 19/19 |
| | 2015 | 56 | 94 | 390 | 6.0 | 3.0 [1.0] | 19/19 | 19/19 |
| | 2016 | 41 | 65 | 200 | 5 | 3 [1] | 19/19 | 19/19 |
| | 2017 | 54 | 86 | 290 | 4 | 3 [1] | 19/19 | 19/19 |
| | 2019 | 27 | 35 | 400 | 3 | 3 [1] | 16/16 | 16/16 |

| β-HCH | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Birds** (pg/g-wet) | 2002 | 3,000 | 3,000 | 7,300 | 1,600 | 12 [4] | 10/10 | 2/2 |
| | 2003 | 3,400 | 3,900 | 5,900 | 1,800 | 9.9 [3.3] | 10/10 | 2/2 |
| | 2004 | 2,300 | 2,100 | 4,800 | 1,100 | 6.1 [2.0] | 10/10 | 2/2 |
| | 2005 | 2,500 | 2,800 | 6,000 | 930 | 2.2 [0.75] | 10/10 | 2/2 |
| | 2006 | 2,100 | 2,400 | 4,200 | 1,100 | 3 [1] | 10/10 | 2/2 |
| | 2007 | 2,000 | 1,900 | 3,200 | 1,400 | 7 [3] | 10/10 | 2/2 |
| | 2008 | 2,400 | 2,000 | 5,600 | 1,300 | 6 [2] | 10/10 | 2/2 |
| | 2009 | 1,600 | 1,400 | 4,200 | 870 | 6 [2] | 10/10 | 2/2 |
| | 2010 | 1,600 | --- | 2,800 | 910 | 3 [1] | 2/2 | 2/2 |
| | 2011 | --- | --- | 4,500 | 4,500 | 3 [1] | 1/1 | 1/1 |
| | 2012 | 1,400 | --- | 2,600 | 730 | 2.0 [0.8] | 2/2 | 2/2 |
| | 2013 | 1,400 | --- | 3,000 | 610 | 2.2 [0.8] | 2/2 | 2/2 |
| | 2014 | 290 | --- | 3,600 | 24 | 2.4 [0.9] | 2/2 | 2/2 |
| | 2015 | --- | --- | 57 | 57 | 3.0 [1.0] | 1/1 | 1/1 |
| | 2016 | 1,400 | --- | 2,600 | 790 | 3 [1] | 2/2 | 2/2 |
| | 2017 | 1,000 | --- | 3,500 | 300 | 3 [1] | 2/2 | 2/2 |
| | 2019 | --- | --- | 950 | 950 | 3 [1] | 1/1 | 1/1 |

| γ-HCH (synonym: Lindane) | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2003 | 19 | 18 | 130 | 5.2 | 3.3 [1.1] | 30/30 | 6/6 |
| | 2004 | tr(24) | tr(16) | 230 | nd | 31 [10] | 28/31 | 7/7 |
| | 2005 | 23 | 13 | 370 | tr(5.7) | 8.4 [2.8] | 31/31 | 7/7 |
| | 2006 | 18 | 12 | 140 | 7 | 4 [2] | 31/31 | 7/7 |
| | 2007 | 16 | 10 | 450 | tr(4) | 9 [3] | 31/31 | 7/7 |
| | 2008 | 12 | 10 | 98 | tr(3) | 9 [3] | 31/31 | 7/7 |
| | 2009 | 14 | 12 | 89 | tr(3) | 7 [3] | 31/31 | 7/7 |
| | 2010 | 14 | 9 | 150 | 5 | 3 [1] | 6/6 | 6/6 |
| | 2011 | 26 | 17 | 320 | 5 | 3 [1] | 4/4 | 4/4 |
| | 2012 | 8.1 | 3.5 | 68 | 3.0 | 2.3 [0.9] | 5/5 | 5/5 |
| | 2013 | 7.2 | 3.9 | 31 | tr(2.1) | 2.4 [0.9] | 5/5 | 5/5 |
| | 2014 | 7.4 | 4.8 | 18 | 4.6 | 2.2 [0.8] | 3/3 | 3/3 |
| | 2015 | 7.3 | 7.8 | 14 | tr(3.6) | 4.8 [1.6] | 3/3 | 3/3 |
| | 2016 | 6 | 5 | 11 | 4 | 3 [1] | 3/3 | 3/3 |
| | 2017 | 4 | 3 | 11 | tr(2) | 3 [1] | 3/3 | 3/3 |
| | 2019 | tr(2) | tr(2) | 7 | nd | 4 [1] | 2/3 | 2/3 |
| Fish (pg/g-wet) | 2003 | 16 | 22 | 130 | tr(1.7) | 3.3 [1.1] | 70/70 | 14/14 |
| | 2004 | tr(28) | tr(24) | 660 | nd | 31 [10] | 55/70 | 11/14 |
| | 2005 | 17 | 17 | 230 | nd | 8.4 [2.8] | 78/80 | 16/16 |
| | 2006 | 19 | 22 | 97 | tr(2) | 4 [2] | 80/80 | 16/16 |
| | 2007 | 15 | 15 | 190 | nd | 9 [3] | 71/80 | 15/16 |
| | 2008 | 13 | 16 | 96 | nd | 9 [3] | 70/85 | 15/17 |
| | 2009 | 14 | 12 | 180 | nd | 7 [3] | 81/90 | 17/18 |
| | 2010 | 9 | 13 | 56 | tr(1) | 3 [1] | 18/18 | 18/18 |
| | 2011 | 12 | 15 | 160 | tr(1) | 3 [1] | 18/18 | 18/18 |
| | 2012 | 7.8 | 12 | 43 | nd | 2.3 [0.9] | 18/19 | 18/19 |
| | 2013 | 8.6 | 12 | 81 | nd | 2.4 [0.9] | 17/19 | 17/19 |
| | 2014 | 8.4 | 14 | 45 | nd | 2.2 [0.8] | 16/19 | 16/19 |
| | 2015 | 6.1 | 7.9 | 42 | nd | 4.8 [1.6] | 14/19 | 14/19 |
| | 2016 | 5 | 5 | 43 | nd | 3 [1] | 18/19 | 18/19 |
| | 2017 | 6 | 9 | 30 | nd | 3 [1] | 16/19 | 16/19 |
| | 2019 | tr(3) | tr(3) | 34 | nd | 4 [1] | 13/16 | 13/16 |

| γ-HCH (synonym: Lindane) | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Birds** (pg/g-wet) | 2003 | 14 | 19 | 40 | 3.7 | 3.3 [1.1] | 10/10 | 2/2 |
| | 2004 | 64 | tr(21) | 1,200 | tr(11) | 31 [10] | 10/10 | 2/2 |
| | 2005 | 18 | 20 | 32 | 9.6 | 8.4 [2.8] | 10/10 | 2/2 |
| | 2006 | 16 | 17 | 29 | 8 | 4 [2] | 10/10 | 2/2 |
| | 2007 | 21 | 14 | 140 | tr(8) | 9 [3] | 10/10 | 2/2 |
| | 2008 | 12 | 14 | 19 | tr(5) | 9 [3] | 10/10 | 2/2 |
| | 2009 | 11 | 11 | 21 | tr(6) | 7 [3] | 10/10 | 2/2 |
| | 2010 | 10 | --- | 23 | 4 | 3 [1] | 2/2 | 2/2 |
| | 2011 | --- | --- | 26 | 26 | 3 [1] | 1/1 | 1/1 |
| | 2012 | 11 | --- | 19 | 6.3 | 2.3 [0.9] | 2/2 | 2/2 |
| | 2013 | 6.0 | --- | 24 | tr(1.5) | 2.4 [0.9] | 2/2 | 2/2 |
| | 2014 | 10 | --- | 24 | 4.4 | 2.2 [0.8] | 2/2 | 2/2 |
| | 2015 | --- | --- | nd | nd | 4.8 [1.6] | 0/1 | 0/1 |
| | 2016 | 5 | --- | 14 | tr(2) | 3 [1] | 2/2 | 2/2 |
| | 2017 | 4 | --- | 20 | tr(1) | 3 [1] | 2/2 | 2/2 |
| | 2019 | --- | --- | 7 | 7 | 4 [1] | 1/1 | 1/1 |

| δ-HCH | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2003 | 7.4 | tr(2.6) | 1,300 | nd | 3.9 [1.3] | 29/30 | 6/6 |
| | 2004 | 6.3 | tr(2.1) | 1,500 | nd | 4.6 [1.5] | 25/31 | 6/7 |
| | 2005 | 5.4 | tr(2.1) | 1,600 | nd | 5.1 [1.7] | 23/31 | 6/7 |
| | 2006 | 6 | tr(2) | 890 | tr(1) | 3 [1] | 31/31 | 7/7 |
| | 2007 | 4 | nd | 750 | nd | 4 [2] | 12/31 | 4/7 |
| | 2008 | tr(3) | nd | 610 | nd | 6 [2] | 7/31 | 3/7 |
| | 2009 | tr(4) | nd | 700 | nd | 5 [2] | 14/31 | 4/7 |
| | 2010 | 4 | tr(2) | 870 | nd | 3 [1] | 5/6 | 5/6 |
| | 2011 | 9 | tr(2) | 1,400 | tr(1) | 3 [1] | 4/4 | 4/4 |
| | 2012 | 3 | tr(1) | 580 | nd | 3 [1] | 3/5 | 3/5 |
| | 2013 | 3 | tr(1) | 230 | nd | 3 [1] | 3/5 | 3/5 |
| | 2014 | tr(1) | tr(2) | 3 | nd | 3 [1] | 2/3 | 2/3 |
| | 2015 | nd | nd | tr(1.5) | nd | 2.1 [0.8] | 1/3 | 1/3 |
| | 2016 | tr(1) | tr(1) | tr(2) | tr(1) | 3 [1] | 3/3 | 3/3 |
| | 2017 | tr(1.7) | tr(1.6) | 3.0 | tr(1.0) | 2.3 [0.9] | 3/3 | 3/3 |
| | 2019 | nd | nd | nd | nd | 4 [2] | 0/3 | 0/3 |
| Fish (pg/g-wet) | 2003 | tr(3.6) | 4.0 | 16 | nd | 3.9 [1.3] | 59/70 | 13/14 |
| | 2004 | tr(4.2) | tr(3.5) | 270 | nd | 4.6 [1.5] | 54/70 | 11/14 |
| | 2005 | tr(3.2) | tr(3.1) | 32 | nd | 5.1 [1.7] | 55/80 | 12/16 |
| | 2006 | 4 | 3 | 35 | nd | 3 [1] | 72/80 | 16/16 |
| | 2007 | tr(3) | tr(2) | 31 | nd | 4 [2] | 42/80 | 10/16 |
| | 2008 | tr(4) | tr(3) | 77 | nd | 6 [2] | 54/85 | 12/17 |
| | 2009 | tr(3) | tr(3) | 18 | nd | 5 [2] | 57/90 | 13/18 |
| | 2010 | tr(2) | tr(2) | 36 | nd | 3 [1] | 13/18 | 13/18 |
| | 2011 | 3 | 4 | 19 | nd | 3 [1] | 14/18 | 14/18 |
| | 2012 | tr(2) | tr(2) | 12 | nd | 3 [1] | 14/19 | 14/19 |
| | 2013 | 3 | tr(2) | 40 | nd | 3 [1] | 14/19 | 14/19 |
| | 2014 | tr(2) | tr(2) | 23 | nd | 3 [1] | 14/19 | 14/19 |
| | 2015 | tr(1.7) | tr(1.8) | 17 | nd | 2.1 [0.8] | 12/19 | 12/19 |
| | 2016 | tr(2) | tr(2) | 10 | nd | 3 [1] | 17/19 | 17/19 |
| | 2017 | 2.4 | 2.4 | 23 | nd | 2.3 [0.9] | 15/19 | 15/19 |
| | 2019 | nd | nd | 5 | nd | 4 [2] | 6/16 | 6/16 |

| δ-HCH | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Birds** (pg/g-wet) | 2003 | 19 | 18 | 31 | 12 | 3.9 [1.3] | 10/10 | 2/2 |
| | 2004 | 30 | 14 | 260 | 6.4 | 4.6 [1.5] | 10/10 | 2/2 |
| | 2005 | 16 | 15 | 30 | 10 | 5.1 [1.7] | 10/10 | 2/2 |
| | 2006 | 13 | 12 | 21 | 9 | 3 [1] | 10/10 | 2/2 |
| | 2007 | 12 | 10 | 22 | 4 | 4 [2] | 10/10 | 2/2 |
| | 2008 | 9 | 8 | 31 | tr(3) | 6 [2] | 10/10 | 2/2 |
| | 2009 | 5 | 6 | 9 | tr(3) | 5 [2] | 10/10 | 2/2 |
| | 2010 | 12 | --- | 13 | 11 | 3 [1] | 2/2 | 2/2 |
| | 2011 | --- | --- | 5 | 5 | 3 [1] | 1/1 | 1/1 |
| | 2012 | 4 | --- | 7 | tr(2) | 3 [1] | 2/2 | 2/2 |
| | 2013 | 3 | --- | 4 | tr(2) | 3 [1] | 2/2 | 2/2 |
| | 2014 | tr(2) | --- | 3 | tr(1) | 3 [1] | 2/2 | 2/2 |
| | 2015 | --- | --- | nd | nd | 2.1 [0.8] | 0/1 | 0/1 |
| | 2016 | tr(1) | --- | tr(2) | tr(1) | 3 [1] | 2/2 | 2/2 |
| | 2017 | nd | --- | tr(1.0) | nd | 2.3 [0.9] | 1/2 | 1/2 |
| | 2019 | --- | --- | 4 | 4 | 4 [2] | 1/1 | 1/1 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2002~2009.

(Note 2) “ ** ” indicates there is no consistency between the results of the ornithological survey after FY2013 and those in previous years because of the changes in the survey sites and target species.

(Note 3) No monitoring was conducted in FY2018.

<Air>

Stocktaking of the detection of*α*-HCH, *β*-HCH, *γ*-HCH (synonym: Lindane) and *δ*-HCH in air during FY2002~2019

| α-HCH | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air (pg/m$^3$) | 2009 Warm season | 58 | 58 | 340 | 19 | 0.12 [0.05] | 37/37 | 37/37 |
| | 2009 Cold season | 21 | 18 | 400 | 7.8 | | 37/37 | 37/37 |
| | 2010 Warm season | 46 | 51 | 280 | 14 | 1.4 [0.47] | 37/37 | 37/37 |
| | 2010 Cold season | 19 | 16 | 410 | 6.8 | | 37/37 | 37/37 |
| | 2011 Warm season | 43 | 44 | 410 | 9.5 | 2.5 [0.83] | 35/35 | 35/35 |
| | 2011 Cold season | 18 | 15 | 680 | 6.5 | | 37/37 | 37/37 |
| | 2012 Warm season | 37 | 37 | 250 | 15 | 2.1 [0.7] | 36/36 | 36/36 |
| | 2012 Cold season | 12 | 11 | 120 | 4.4 | | 36/36 | 36/36 |
| | 2013 Warm season | 36 | 39 | 220 | 13 | 5.2 [1.7] | 36/36 | 36/36 |
| | 2013 Cold season | 10 | 8.8 | 75 | tr(3.9) | | 36/36 | 36/36 |
| | 2014 Warm season | 44 | 40 | 650 | 14 | 0.19 [0.06] | 36/36 | 36/36 |
| | 2015 Warm season | 33 | 32 | 300 | 8.8 | 0.17 [0.06] | 35/35 | 35/35 |
| | 2016 Warm season | 39 | 35 | 520 | 5.4 | 0.17 [0.07] | 37/37 | 37/37 |
| | 2017 Warm season | 36 | 37 | 700 | 4.9 | 0.08 [0.03] | 37/37 | 37/37 |
| | 2019 Warm season | 21 | 21 | 230 | 6.3 | 0.12 [0.05] | 36/36 | 36/36 |

| β-HCH | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air (pg/m$^3$) | 2009 Warm season | 5.6 | 5.6 | 28 | 0.96 | 0.09 [0.03] | 37/37 | 37/37 |
| | 2009 Cold season | 1.8 | 1.8 | 24 | 0.31 | | 37/37 | 37/37 |
| | 2010 Warm season | 5.6 | 6.2 | 34 | 0.89 | 0.27 [0.09] | 37/37 | 37/37 |
| | 2010 Cold season | 1.7 | 1.7 | 29 | tr(0.26) | | 37/37 | 37/37 |
| | 2011 Warm season | 5.0 | 5.2 | 49 | 0.84 | 0.39 [0.13] | 35/35 | 35/35 |
| | 2011 Cold season | 1.7 | 1.7 | 91 | tr(0.31) | | 37/37 | 37/37 |
| | 2012 Warm season | 5.0 | 5.5 | 32 | 0.65 | 0.36 [0.12] | 36/36 | 36/36 |
| | 2012 Cold season | 0.93 | 1.1 | 8.5 | tr(0.26) | | 36/36 | 36/36 |
| | 2013 Warm season | 4.7 | 5.7 | 37 | 0.66 | 0.21 [0.07] | 36/36 | 36/36 |
| | 2013 Cold season | 0.97 | 0.95 | 6.7 | tr(0.17) | | 36/36 | 36/36 |
| | 2014 Warm season | 5.4 | 6.8 | 74 | 0.57 | 0.24 [0.08] | 36/36 | 36/36 |
| | 2015 Warm season | 3.0 | 3.0 | 34 | 0.36 | 0.25 [0.08] | 35/35 | 35/35 |
| | 2016 Warm season | 4.8 | 5.6 | 64 | 0.3 | 0.3 [0.1] | 37/37 | 37/37 |
| | 2017 Warm season | 4.1 | 5.1 | 59 | 0.67 | 0.11 [0.04] | 37/37 | 37/37 |
| | 2019 Warm season | 2.3 | 2.4 | 29 | 0.38 | 0.06 [0.02] | 36/36 | 36/36 |

| γ-HCH (synonym: Lindane) | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Air (pg/m$^3$) | 2009 Warm season | 17 | 19 | 65 | 2.9 | 0.06 [0.02] | 37/37 | 37/37 |
| | 2009 Cold season | 5.6 | 4.6 | 55 | 1.5 | | 37/37 | 37/37 |
| | 2010 Warm season | 14 | 16 | 66 | 2.3 | 0.35 [0.12] | 37/37 | 37/37 |
| | 2010 Cold season | 4.8 | 4.4 | 60 | 1.1 | | 37/37 | 37/37 |
| | 2011 Warm season | 14 | 17 | 98 | 2.7 | 1.6 [0.52] | 35/35 | 35/35 |
| | 2011 Cold season | 5.1 | 4.8 | 67 | tr(1.1) | | 37/37 | 37/37 |
| | 2012 Warm season | 13 | 15 | 55 | 2.3 | 0.95 [0.32] | 36/36 | 36/36 |
| | 2012 Cold season | 3.1 | 3.2 | 19 | tr(0.63) | | 36/36 | 36/36 |
| | 2013 Warm season | 12 | 14 | 58 | tr(2.0) | 2.2 [0.7] | 36/36 | 36/36 |
| | 2013 Cold season | 2.8 | 3.0 | 12 | nd | | 34/36 | 34/36 |
| | 2014 Warm season | 14 | 16 | 100 | 1.7 | 0.17 [0.06] | 36/36 | 36/36 |
| | 2015 Warm season | 8.3 | 10 | 51 | 1.4 | 0.19 [0.06] | 35/35 | 35/35 |
| | 2016 Warm season | 12 | 13 | 89 | 0.79 | 0.18 [0.07] | 37/37 | 37/37 |
| | 2017 Warm season | 10 | 11 | 93 | 0.84 | 0.10 [0.04] | 37/37 | 37/37 |
| | 2019 Warm season | 6.4 | 7.0 | 49 | 0.88 | 0.12 [0.05] | 36/36 | 36/36 |

| δ-HCH | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Air (pg/m$^3$) | 2009 Warm season | 1.3 | 1.3 | 21 | 0.09 | 0.04 [0.02] | 37/37 | 37/37 |
| | 2009 Cold season | 0.36 | 0.33 | 20 | 0.04 | | 37/37 | 37/37 |
| | 2010 Warm season | 1.4 | 1.3 | 25 | 0.11 | 0.05 [0.02] | 37/37 | 37/37 |
| | 2010 Cold season | 0.38 | 0.35 | 22 | 0.05 | | 37/37 | 37/37 |
| | 2011 Warm season | 1.1 | 1.1 | 33 | 0.11 | 0.063 [0.021] | 35/35 | 35/35 |
| | 2011 Cold season | 0.35 | 0.34 | 26 | tr(0.050) | | 37/37 | 37/37 |
| | 2012 Warm season | 1.0 | 1.3 | 20 | tr(0.06) | 0.07 [0.03] | 36/36 | 36/36 |
| | 2012 Cold season | 0.18 | 0.19 | 7.3 | nd | | 35/36 | 35/36 |
| | 2013 Warm season | 1.0 | 1.1 | 20 | tr(0.05) | 0.08 [0.03] | 36/36 | 36/36 |
| | 2013 Cold season | 0.17 | 0.17 | 5.3 | nd | | 34/36 | 34/36 |
| | 2014 Warm season | 1.2 | 1.3 | 50 | tr(0.07) | 0.19 [0.06] | 36/36 | 36/36 |
| | 2015 Warm season | 0.55 | 0.71 | 22 | nd | 0.15 [0.05] | 32/35 | 32/35 |
| | 2016 Warm season | 1.0 | 1.2 | 46 | nd | 0.20 [0.08] | 35/37 | 35/37 |
| | 2017 Warm season | 0.80 | 0.92 | 46 | nd | 0.08 [0.03] | 36/37 | 36/37 |
| | 2019 Warm season | 0.46 | 0.51 | 19 | tr(0.02) | 0.04 [0.02] | 36/36 | 36/36 |

(Note) No monitoring was conducted in FY2018.

## [12] Chlordecone (reference)

・ History and state of monitoring (reference)

Chlordecone is a synthetic chlorinated organic compound, which was mainly used as an agricultural pesticide. No domestic record of manufacture/import of the substance was reported since it was historically never registrated under the Agricultural Chemicals Regulation Law. Chlordecone was adopted as a target chemical at the Fourth Meeting of the Conference of Parties (COP4) on Stockholm convention on Persistent Organic Pollutants in May 2009 and designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in April 2010.

As a continuous survey, the first survey was in FY2008. In the Initial Environmental Survey and the Detailed Environmental Survey etc. under the framework of the Environmental Survey and Monitoring of Chemicals after FY2002, the substance was monitored in air in FY2003.

Under the framework of the Environmental Monitoring, the substance was monitored in surface water, sediment and wildlife (bivalves, fish and birds) in FY2008, and in surface water, sediment and wildlife (bivalves, fish and birds) air in FY2010 and FY2011.

No monitoring was conducted after FY2012. For reference, the monitoring results up to FY2011 are given below.

・ Monitoring results until FY2011

<Surface Water>

Stocktaking of the detection of Chlordecone in surface water during FY2008~2011

| Chlordecone | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2008 | nd | nd | 0.76 | nd | 0.14 [0.05] | 13/46 | 13/46 |
| | 2010 | tr(0.04) | nd | 1.6 | nd | 0.09 [0.04] | 13/49 | 13/49 |
| | 2011 | nd | nd | 0.70 | nd | 0.20 [0.05] | 15/49 | 15/49 |

(Note) No monitoring was conducted in FY2009.

<Sediment>

Stocktaking of the detection of Chlordecone sediment during FY2008~2011

| Chlordecone | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2008 | nd | nd | 5.8 | nd | 0.42 [0.16] | 23/129 | 10/49 |
| | 2010 | nd | nd | 2.8 | nd | 0.4 [0.2] | 9/64 | 9/64 |
| | 2011 | nd | nd | 1.5 | nd | 0.40 [0.20] | 9/64 | 9/64 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2008.

(Note 2) No monitoring was conducted in FY2009.

<Wildlife>

Stocktaking of the detection of Chlordecone in wildlife (bivalves, fish and birds) during FY2002~2014

| Chlordecone | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Bivalves (pg/g-wet) | 2008 | nd | nd | nd | nd | 5.6 [2.2] | 0/31 | 0/7 |
| | 2010 | nd | nd | nd | nd | 5.9 [2.3] | 0/6 | 0/6 |
| | 2011 | nd | nd | nd | nd | 0.5 [0.2] | 0/4 | 0/4 |
| Fish (pg/g-wet) | 2008 | nd | nd | nd | nd | 5.6 [2.2] | 0/85 | 0/17 |
| | 2010 | nd | nd | nd | nd | 5.9 [2.3] | 0/18 | 0/18 |
| | 2011 | nd | nd | nd | nd | 0.5 [0.2] | 0/18 | 0/18 |
| Birds (pg/g-wet) | 2008 | nd | nd | nd | nd | 5.6 [2.2] | 0/10 | 0/2 |
| | 2010 | nd | --- | nd | nd | 5.9 [2.3] | 0/2 | 0/2 |
| | 2011 | --- | --- | nd | nd | 0.5 [0.2] | 0/1 | 0/1 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2008.

(Note 2) No monitoring was conducted in FY209.

<Air>

Stocktaking of the detection of Chlordecone in air in FY2010 and 2011

| Chlordecone | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Air ($pg/m^3$) | 2010 Warm season | nd | nd | nd | nd | 0.04 [0.02] | 0/37 | 0/37 |
| | 2010 Cold season | nd | nd | nd | nd | | 0/37 | 0/37 |
| | 2011 Warm season | nd | nd | nd | nd | 0.04 [0.02] | 0/35 | 0/35 |
| | 2011 Cold season | nd | nd | nd | nd | | 0/37 | 0/37 |

## [13] Hexabromobiphenyls (reference)

・ History and state of monitoring

Hexabromobiphenyls are industrial chemicals that have been used as flame retardans. Hexabromobiphenyls were adopted as target chemicals at the COP4 of the Stockholm convention on Persistent Organic Pollutants in May 2009 and designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in April 2010.

As a continuous survey, the first survey was in FY2009. Under the framework of the Environmental Survey of Chemical Substances up to FY2001, the substance was monitored in surface water, sediment, wildlife (fish) and air in FY1989. Under the framework of the Initial Environmental Survey and the Detailed Environmental Survey etc. in the Environmental Survey and Monitoring of Chemicals after FY2002, the substance was monitored surface water and sediment in FY2003, in air in FY2004.

Under the framework of the Environmental Monitoring, the substances were monitored in surface water, sediment and wildlife (bivalves, fish and birds) in FY2009, in air in FY2010~2011 and in sediment, wildlife (bivalves, fish and birds) and air in FY2015.

No monitoring was conducted after FY2016. For reference, the monitoring results up to FY2015 are given below.

・ Monitoring results until FY2015

<Surface Water>

Stocktaking of the detection of Hexabromobiphenyls in surface water during FY2009~2011

| Hexabromobiphenyls | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit* | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2009 | nd | nd | nd | nd | 5.7 [2.2] | 0/49 | 0/49 |
| | 2010 | nd | nd | nd | nd | 3 [1] | 0/49 | 0/49 |
| | 2011 | nd | nd | nd | nd | 2.2 [0.9] | 0/49 | 0/49 |

(Note) “ ** “ indicates the sum value of the Quantification [Detection] limits of each congener in FY2009 and FY2011.

<Sediment>

Stocktaking of the detection of Hexabromobiphenyls in sediment during FY2002~2015

| Hexabromobiphenyls | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit** | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2009 | nd | nd | 12 | nd | 1.1 [0.40] | 45/190 | 21/64 |
| | 2010 | nd | nd | 18 | nd | 1.5 [0.6] | 10/64 | 10/64 |
| | 2011 | nd | nd | 6.3 | nd | 3.6 [1.4] | 8/64 | 8/64 |
| | 2015 | nd | nd | 15 | nd | 0.8 [0.3] | 9/62 | 9/62 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2009.

(Note 2) “ ** “ indicates the sum value of the Quantification [Detection] limits of each congener in FY2009 and FY2011.

(Note 3) No monitoring was conducted during FY2012~2014.

<Wildlife>

Stocktaking of the detection of Hexabromobiphenyls in wildlife (bivalves, fish and birds) during FY2009~2015

| Hexabromobiphenyls | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit** | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2009 | nd | nd | tr(0.53) | nd | 1.3 [0.43] | 1/31 | 1/7 |
| | 2010 | nd | nd | nd | nd | 24 [10] | 0/6 | 0/6 |
| | 2011 | nd | nd | nd | nd | 3 [1] | 0/4 | 0/4 |
| | 2015 | nd | nd | nd | nd | 14 [5] | 0/3 | 0/3 |
| Fish (pg/g-wet) | 2009 | tr(0.49) | tr(0.43) | 6.0 | nd | 1.3 [0.43] | 46/90 | 12/18 |
| | 2010 | nd | nd | nd | nd | 24 [10] | 0/18 | 0/18 |
| | 2011 | nd | nd | 3 | nd | 3 [1] | 5/18 | 5/18 |
| | 2015 | nd | nd | nd | nd | 14 [5] | 0/19 | 0/19 |
| Birds*** (pg/g-wet) | 2009 | 1.6 | 1.6 | 2.1 | tr(1.2) | 1.3 [0.43] | 10/10 | 2/2 |
| | 2010 | nd | --- | nd | nd | 24 [10] | 0/2 | 0/2 |
| | 2011 | --- | --- | 3 | 3 | 3 [1] | 1/1 | 1/1 |
| | 2015 | --- | --- | nd | nd | 14 [5] | 0/1 | 0/1 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2009.

(Note 2) “ ** “ indicates the sum value of the Quantification [Detection] limits of each congener in FY2009 and FY2010.

(Note 3) ”***” There is no consistency between the results of the ornithological survey in FY2015 and those in previous years because of the changes in the survey sites and target species.

(Note 4) No monitoring was conducted during FY2012~2014.

<Air>

Stocktaking of the detection of Hexabromobiphenyls in air during FY2010~2015

| Hexabromo biphenyls | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air ($pg/m^3$) | 2010 Warm season | nd | nd | nd | nd | 0.3 [0.1] | 0/37 | 0/37 |
| | 2010 Cold season | nd | nd | nd | nd | | 0/37 | 0/37 |
| | 2011 Warm season | nd | nd | nd | nd | 0.3 [0.1] | 0/35 | 0/35 |
| | 2011 Cold season | nd | nd | nd | nd | | 0/37 | 0/37 |
| | 2015 Warm season | nd | nd | 1.1 | nd | 0.06 [0.02] | 2/35 | 2/35 |

(Note) No monitoring was conducted during FY2012~2014.

## [14] Polybromodiphenyl ethers ($Br_4$~$Br_{10}$) (reference)

・ History and state of monitoring

Polybrominated diphenyl ethers have been used as flame retardants for plastics products. Tetrabromodiphenyl ethers, Pentabromodiphenyl ethers, Hexabromodiphenyl ethers, and Heptabromodiphenyl ethers were adopted as target chemicals at the COP4 of the Stockholm convention on Persistent Organic Pollutants in May 2009. The substances were designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in April 2010. Also, Decabromodiphenyl ether was adopted as target chemicals at the COP8 of the Stockholm convention on Persistent Organic Pollutants held from late April to early May 2017.The substance was designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in April 2018.

As a continuous survey, the first survey was in FY2008. Under the framework of the Environmental Survey of Chemical Substances up to FY2001, Decabromodiphenyl ether was monitored in surface water and sediment in FY1977 and FY1996, Polybromodiphenyl ethers ($Br_6$, $Br_8$ and $Br_{10}$) were monitored in surface water, sediment and wildlife (fish) in FY1987 and FY1988, Polybromodiphenyl ethers ($Br_1$~$Br_7$) were monitored in air in FY2001.In the Initial Environmental Survey and the Detailed Environmental Survey etc. under the framework of the Environmental Survey and Monitoring of Chemicals after FY2002, Decabromodiphenyl ether was monitored in surface water, sediment and wildlife (fish) in FY2002, Polybromodiphenyl ethers ($Br_6$, $Br_8$ and $Br_{10}$) were monitored in sediment and wildlife (fish) in FY2003, Pentabromodiphenyl ethers were monitored in sediment and Polybromodiphenyl ethers ($Br_1$~$Br_7$) in air in FY2004, Polybromodiphenyl ethers ($Br_1$~$Br_{7,}$ $Br_9$ and $Br_{10}$) were monitored in surface water in FY2005.

Under the framework of the Environmental Monitoring, Polybromodiphenyl ethers ($Br_4$~$Br_{10}$) were monitored in wildlife (bivalves, fish and birds) in FY2008, in surface water, sediment and air in FY2009 and in surface water, sediment and wildlife (bivalves, fish and birds) and air in FY2010~2012, 2014~2019.

No monitoring was conducted in FY2020. For reference, the monitoring results up to FY2019 are given below.

・ Monitoring results until FY2019

<Surface Water>

Stocktaking of the detection of Polybromodiphenyl ethers ($Br_4$~$Br_{10}$) in surface water during FY2009~2019

| Tetrabromodiphenyl ethers | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Surface Water (pg/L) | 2009 | 17 | 16 | 160 | nd | 8 [3] | 44/49 | 44/49 |
| | 2010 | nd | nd | 390 | nd | 9 [3] | 17/49 | 17/49 |
| | 2011 | 11 | 10 | 180 | nd | 4 [2] | 48/49 | 48/49 |
| | 2012 | tr(3) | tr(3) | 22 | nd | 4 [1] | 47/48 | 47/48 |
| | 2014 | tr(6) | tr(6) | 51 | tr(4) | 8 [3] | 48/48 | 48/48 |
| | 2015 | 4.3 | 4.1 | 40 | tr(1.2) | 3.6 [1.2] | 48/48 | 48/48 |
| | 2016 | 5 | tr(5) | 47 | tr(3) | 5 [2] | 48/48 | 48/48 |
| | 2017 | tr(4) | tr(4) | 12 | nd | 9 [3] | 44/47 | 44/47 |
| | 2018 | nd | nd | 72 | nd | 13 [5] | 22/47 | 22/47 |
| | 2019 | tr(6) | tr(6) | 320 | nd | 11 [4] | 39/48 | 39/48 |

| Pentabromodiphenyl ethers | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Surface Water (pg/L) | 2009 | 11 | 12 | 87 | nd | 11 [4] | 43/49 | 43/49 |
| | 2010 | tr(1) | tr(1) | 130 | nd | 3 [1] | 25/49 | 25/49 |
| | 2011 | 5 | 4 | 180 | nd | 3 [1] | 48/49 | 48/49 |
| | 2012 | tr(1) | tr(1) | 20 | nd | 2 [1] | 32/48 | 32/48 |
| | 2014 | nd | nd | 39 | nd | 4 [2] | 19/48 | 19/48 |
| | 2015 | tr(3.0) | tr(3.2) | 31 | nd | 6.3 [2.1] | 34/48 | 34/48 |
| | 2016 | tr(1.5) | tr(1.3) | 36 | nd | 2.4 [0.9] | 39/48 | 39/48 |
| | 2017 | nd | tr(1) | 8 | nd | 3 [1] | 24/47 | 24/47 |
| | 2018 | nd | nd | 110 | nd | 9 [3] | 13/47 | 13/47 |
| | 2019 | nd | nd | 69 | nd | 6 [2] | 19/48 | 19/48 |

| Hexabromodiphenyl ethers | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2009 | tr(0.9) | tr(0.7) | 18 | nd | 1.4 [0.6] | 26/49 | 26/49 |
| | 2010 | nd | nd | 51 | nd | 4 [2] | 16/49 | 16/49 |
| | 2011 | tr(1) | nd | 39 | nd | 3 [1] | 21/49 | 21/49 |
| | 2012 | nd | nd | 7 | nd | 3 [1] | 6/48 | 6/48 |
| | 2014 | nd | nd | 8 | nd | 4 [1] | 10/48 | 10/48 |
| | 2015 | nd | nd | 12 | nd | 1.5 [0.6] | 5/48 | 5/48 |
| | 2016 | nd | nd | 9.1 | nd | 2.1 [0.8] | 9/48 | 9/48 |
| | 2017 | nd | nd | tr(6) | nd | 7 [3] | 1/47 | 1/47 |
| | 2018 | nd | nd | 54 | nd | 3 [1] | 15/47 | 15/47 |
| | 2019 | nd | nd | 8 | nd | 2 [1] | 5/48 | 5/48 |

| Heptabromodiphenyl ethers | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2009 | nd | nd | 40 | nd | 4 [2] | 9/49 | 9/49 |
| | 2010 | nd | nd | 14 | nd | 3 [1] | 17/49 | 17/49 |
| | 2011 | nd | nd | 14 | nd | 6 [2] | 14/49 | 14/49 |
| | 2012 | nd | nd | 10 | nd | 4 [1] | 9/48 | 9/48 |
| | 2014 | nd | nd | 8 | nd | 8 [3] | 3/48 | 3/48 |
| | 2015 | nd | nd | 28 | nd | 2.0 [0.8] | 9/48 | 9/48 |
| | 2016 | nd | nd | 11 | nd | 7 [3] | 10/48 | 10/48 |
| | 2017 | nd | nd | 30 | nd | 14 [5] | 1/47 | 1/47 |
| | 2018 | nd | nd | 65 | nd | 8 [3] | 3/47 | 3/47 |
| | 2019 | nd | nd | 6 | nd | 4 [2] | 2/48 | 2/48 |

| Octabromodiphenyl ethers | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2009 | 3.0 | 3.9 | 56 | nd | 1.4 [0.6] | 37/49 | 37/49 |
| | 2010 | tr(2) | tr(2) | 69 | nd | 3 [1] | 40/49 | 40/49 |
| | 2011 | 4 | 3 | 98 | nd | 2 [1] | 44/49 | 44/49 |
| | 2012 | tr(2) | nd | 35 | nd | 4 [2] | 16/48 | 16/48 |
| | 2014 | 2.5 | 3.7 | 38 | nd | 1.6 [0.6] | 33/48 | 33/48 |
| | 2015 | 2.3 | 3.1 | 36 | nd | 1.5 [0.6] | 31/48 | 31/48 |
| | 2016 | 5.8 | 7.5 | 230 | nd | 0.8 [0.3] | 44/48 | 44/48 |
| | 2017 | tr(2) | nd | 33 | nd | 2 [1] | 22/47 | 22/47 |
| | 2018 | tr(2) | tr(1) | 69 | nd | 3 [1] | 35/47 | 35/47 |
| | 2019 | nd | nd | 14 | nd | 3 [1] | 12/48 | 12/48 |

| Nonabromodiphenyl ethers | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2009 | tr(46) | tr(38) | 500 | nd | 91 [30] | 32/49 | 32/49 |
| | 2010 | tr(17) | tr(13) | 620 | nd | 21 [7] | 39/49 | 39/49 |
| | 2011 | 33 | 24 | 920 | nd | 10 [4] | 47/49 | 47/49 |
| | 2012 | tr(21) | tr(19) | 320 | nd | 40 [13] | 30/48 | 30/48 |
| | 2014 | 37 | 38 | 590 | nd | 6 [2] | 47/48 | 47/48 |
| | 2015 | 36 | 33 | 330 | nd | 6 [2] | 47/48 | 47/48 |
| | 2016 | 43 | 45 | 3,900 | tr(2) | 4 [1] | 48/48 | 48/48 |
| | 2017 | 17 | 26 | 460 | nd | 7 [3] | 37/47 | 37/47 |
| | 2018 | 12 | 12 | 170 | nd | 6 [2] | 46/47 | 46/47 |
| | 2019 | tr(7) | 8 | 150 | nd | 8 [3] | 27/48 | 27/48 |

| Decabromodiphenyl ether | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2009 | tr(310) | tr(220) | 3,400 | nd | 600 [200] | 26/49 | 26/49 |
| | 2010 | tr(250) | tr(200) | 13,000 | nd | 300 [100] | 31/49 | 31/49 |
| | 2011 | 200 | 140 | 58,000 | nd | 60 [20] | 45/49 | 45/49 |
| | 2012 | tr(400) | tr(320) | 12,000 | nd | 660 [220] | 31/48 | 31/48 |
| | 2014 | 200 | 230 | 5,600 | tr(14) | 22 [9] | 48/48 | 48/48 |
| | 2015 | 720 | 570 | 13,000 | 140 | 18 [7] | 48/48 | 48/48 |
| | 2016 | 210 | 160 | 34,000 | tr(12) | 14 [6] | 48/48 | 48/48 |
| | 2017 | 150 | 210 | 4,100 | nd | 24 [8] | 46/47 | 46/47 |
| | 2018 | 120 | 110 | 2,700 | 12 | 11 [4] | 47/47 | 47/47 |
| | 2019 | 110 | 99 | 2,200 | tr(10) | 14 [6] | 48/48 | 48/48 |

(Note) No monitoring was conducted in FY2013.

<Sediment>

Stocktaking of the detection of Polybromodiphenyl ethers ($Br_4$~$Br_{10}$) in sediment during FY2009~2019

| Tetrabromodiphenyl ethers | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2009 | tr(60) | tr(44) | 1,400 | nd | 69 [23] | 131/192 | 51/64 |
| | 2010 | 35 | 38 | 910 | nd | 6 [2] | 57/64 | 57/64 |
| | 2011 | 32 | 30 | 2,600 | nd | 30 [10] | 47/64 | 47/64 |
| | 2012 | 27 | 37 | 4,500 | nd | 2 [1] | 60/63 | 60/63 |
| | 2014 | tr(24) | tr(19) | 550 | nd | 27 [9] | 44/63 | 44/63 |
| | 2015 | 30 | 28 | 1,400 | nd | 21 [7] | 44/62 | 44/62 |
| | 2016 | tr(21) | tr(16) | 390 | nd | 33 [11] | 35/62 | 35/62 |
| | 2017 | 13 | 10 | 570 | nd | 9 [4] | 44/62 | 44/62 |
| | 2018 | 21 | tr(16) | 3,100 | nd | 18 [6] | 43/61 | 43/61 |
| | 2019 | 15 | 14 | 710 | nd | 5 [2] | 58/61 | 58/61 |

| Pentabromodiphenyl ethers | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2009 | 36 | 24 | 1,700 | nd | 24 [8] | 146/192 | 57/64 |
| | 2010 | 26 | 23 | 740 | nd | 5 [2] | 58/64 | 58/64 |
| | 2011 | 24 | 18 | 4,700 | nd | 5 [2] | 62/64 | 62/64 |
| | 2012 | 21 | 21 | 2,900 | nd | 2.4 [0.9] | 62/63 | 62/63 |
| | 2014 | 16 | 14 | 570 | nd | 6 [2] | 53/63 | 53/63 |
| | 2015 | 23 | 20 | 1,300 | nd | 18 [6] | 44/62 | 44/62 |
| | 2016 | 13 | tr(10) | 400 | nd | 12 [4] | 46/62 | 46/62 |
| | 2017 | 10 | tr(5.5) | 560 | nd | 9 [4] | 37/62 | 37/62 |
| | 2018 | 19 | 24 | 2,800 | nd | 4 [2] | 53/61 | 53/61 |
| | 2019 | 9 | 9 | 740 | nd | 3 [1] | 52/61 | 52/61 |

| Hexabromodiphenyl ethers | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2009 | 21 | 21 | 2,600 | nd | 5 [2] | 139/192 | 53/64 |
| | 2010 | 23 | 23 | 770 | nd | 4 [2] | 57/64 | 57/64 |
| | 2011 | 31 | 42 | 2,000 | nd | 9 [3] | 52/64 | 52/64 |
| | 2012 | 15 | 19 | 1,700 | nd | 3 [1] | 48/63 | 48/63 |
| | 2014 | 21 | 27 | 730 | nd | 5 [2] | 50/63 | 50/63 |
| | 2015 | 11 | 15 | 820 | nd | 3 [1] | 42/62 | 42/62 |
| | 2016 | 17 | 19 | 600 | nd | 8 [3] | 40/62 | 40/62 |
| | 2017 | 16 | 24 | 570 | nd | 6 [2] | 44/62 | 44/62 |
| | 2018 | 29 | 37 | 1,300 | nd | 3 [1] | 52/61 | 52/61 |
| | 2019 | 14 | 17 | 690 | nd | 4 [2] | 41/61 | 41/61 |

| Heptabromodiphenyl ethers | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2009 | 30 | 25 | 16,000 | nd | 9 [4] | 125/192 | 51/64 |
| | 2010 | 28 | 18 | 930 | nd | 4 [2] | 58/64 | 58/64 |
| | 2011 | 29 | 32 | 2,400 | nd | 7 [3] | 55/64 | 55/64 |
| | 2012 | 34 | 32 | 4,400 | nd | 4 [2] | 48/63 | 48/63 |
| | 2014 | 19 | tr(14) | 680 | nd | 16 [6] | 41/63 | 41/63 |
| | 2015 | 16 | 21 | 1,800 | nd | 3 [1] | 44/62 | 44/62 |
| | 2016 | 16 | 17 | 1,100 | nd | 6 [2] | 44/62 | 44/62 |
| | 2017 | 18 | 16 | 580 | nd | 15 [6] | 36/62 | 36/62 |
| | 2018 | 44 | 48 | 1,900 | nd | 14 [5] | 46/61 | 46/61 |
| | 2019 | 15 | 11 | 1,400 | nd | 6 [3] | 39/61 | 39/61 |

| Octabromodiphenyl ethers | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2009 | 210 | 96 | 110,000 | nd | 1.2 [0.5] | 182/192 | 63/64 |
| | 2010 | 71 | 76 | 1,800 | nd | 10 [4] | 60/64 | 60/64 |
| | 2011 | 57 | 64 | 36,000 | nd | 10 [4] | 55/64 | 55/64 |
| | 2012 | 78 | 74 | 15,000 | nd | 19 [6] | 47/63 | 47/63 |
| | 2014 | 52 | 58 | 2,000 | nd | 12 [4] | 55/63 | 55/63 |
| | 2015 | 58 | tr(44) | 1,400 | nd | 48 [16] | 41/62 | 41/62 |
| | 2016 | 51 | 49 | 1,400 | nd | 6 [2] | 55/62 | 55/62 |
| | 2017 | 38 | 58 | 1,900 | nd | 5 [2] | 48/62 | 48/62 |
| | 2018 | 100 | 140 | 5,500 | nd | 1.2 [0.5] | 57/61 | 57/61 |
| | 2019 | 33 | 47 | 2,000 | nd | 3 [1] | 50/61 | 50/61 |

| Nonabromodiphenyl ethers | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Site |
|---|---|---|---|---|---|---|---|---|
| Sediment (pg/g-dry) | 2009 | 1,100 | 710 | 230,000 | nd | 9 [4] | 181/192 | 64/64 |
| | 2010 | 360 | 430 | 26,000 | nd | 24 [9] | 60/64 | 60/64 |
| | 2011 | 710 | 630 | 70,000 | nd | 23 [9] | 62/64 | 62/64 |
| | 2012 | 360 | 380 | 84,000 | nd | 34 [11] | 52/63 | 52/63 |
| | 2014 | 470 | 470 | 42,000 | nd | 60 [20] | 60/63 | 60/63 |
| | 2015 | 300 | 420 | 11,000 | nd | 24 [8] | 55/62 | 55/62 |
| | 2016 | 430 | 390 | 26,000 | nd | 27 [9] | 60/62 | 60/62 |
| | 2017 | 400 | 490 | 29,000 | nd | 15 [5] | 61/62 | 61/62 |
| | 2018 | 690 | 770 | 56,000 | nd | 5 [2] | 60/61 | 60/61 |
| | 2019 | 310 | 420 | 40,000 | nd | 5 [2] | 59/61 | 59/61 |

| Decabromodiphenyl ether | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Site |
|---|---|---|---|---|---|---|---|---|
| Sediment (pg/g-dry) | 2009 | 6,000 | 4,800 | 880,000 | tr(30) | 60 [20] | 192/192 | 64/64 |
| | 2010 | 5,100 | 4,200 | 700,000 | nd | 220 [80] | 60/64 | 60/64 |
| | 2011 | 4,200 | 4,700 | 700,000 | nd | 40 [20] | 62/64 | 62/64 |
| | 2012 | 5,700 | 6,300 | 760,000 | nd | 270 [89] | 60/63 | 60/63 |
| | 2014 | 5,600 | 5,000 | 980,000 | nd | 240 [80] | 61/63 | 61/63 |
| | 2015 | 6,600 | 7,200 | 490,000 | 40 | 40 [20] | 62/62 | 62/62 |
| | 2016 | 4,700 | 5,100 | 940,000 | nd | 120 [41] | 61/62 | 61/62 |
| | 2017 | 4,600 | 5,700 | 580,000 | tr(27) | 30 [10] | 62/62 | 62/62 |
| | 2018 | 5,100 | 6,300 | 520,000 | tr(14) | 42 [14] | 61/61 | 61/61 |
| | 2019 | 4,400 | 6,300 | 560,000 | 14 | 4 [2] | 61/61 | 61/61 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2009.

(Note 2) No monitoring was conducted in FY2013.

<Wildlife>

Stocktaking of the detection of Polybromodiphenyl ethers ($Br_4$~$Br_{10}$) in wildlife (bivalves, fish and birds) during FY2008~2019

| Tetrabromodiphenyl ethers | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2008 | 73 | 61 | 380 | 20 | 5.9 [2.2] | 31/31 | 7/7 |
| | 2010 | 59 | 73 | 310 | nd | 43 [16] | 5/6 | 5/6 |
| | 2011 | 96 | 120 | 490 | 26 | 16 [6] | 4/4 | 4/4 |
| | 2012 | 59 | 44 | 190 | 24 | 19 [7] | 5/5 | 5/5 |
| | 2014 | 56 | 38 | 140 | 33 | 15 [6] | 3/3 | 3/3 |
| | 2015 | 48 | 38 | 89 | 32 | 15 [6] | 3/3 | 3/3 |
| | 2016 | 42 | 32 | 98 | 23 | 13 [5] | 3/3 | 3/3 |
| | 2017 | 47 | 23 | 200 | 23 | 16 [6] | 3/3 | 3/3 |
| | 2018 | 36 | 26 | 68 | 26 | 14 [5] | 3/3 | 3/3 |
| | 2019 | 26 | tr(17) | 68 | tr(15) | 18 [7] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2008 | 120 | 110 | 1,300 | 9.8 | 5.9 [2.2] | 85/85 | 17/17 |
| | 2010 | 160 | 170 | 740 | tr(16) | 43 [16] | 18/18 | 18/18 |
| | 2011 | 110 | 110 | 860 | tr(9) | 16 [6] | 18/18 | 18/18 |
| | 2012 | 120 | 140 | 650 | tr(10) | 19 [7] | 19/19 | 19/19 |
| | 2014 | 150 | 160 | 1,300 | 18 | 15 [6] | 19/19 | 19/19 |
| | 2015 | 90 | 82 | 580 | tr(14) | 15 [6] | 19/19 | 19/19 |
| | 2016 | 76 | 53 | 390 | tr(10) | 13 [5] | 19/19 | 19/19 |
| | 2017 | 80 | 73 | 360 | tr(7) | 16 [6] | 19/19 | 19/19 |
| | 2018 | 79 | 61 | 440 | tr(13) | 14 [5] | 18/18 | 18/18 |
| | 2019 | 57 | 62 | 210 | tr(10) | 18 [7] | 16/16 | 16/16 |
| Birds** (pg/g-wet) | 2008 | 170 | 190 | 1,200 | 32 | 5.9 [2.2] | 10/10 | 2/2 |
| | 2010 | 140 | --- | 270 | 72 | 43 [16] | 2/2 | 2/2 |
| | 2011 | --- | --- | 67 | 67 | 16 [6] | 1/1 | 1/1 |
| | 2012 | 73 | --- | 110 | 49 | 19 [7] | 2/2 | 2/2 |
| | 2014 | 190 | --- | 480 | 78 | 15 [6] | 2/2 | 2/2 |
| | 2015 | --- | --- | 36 | 36 | 15 [6] | 1/1 | 1/1 |
| | 2016 | 170 | --- | 470 | 62 | 13 [5] | 2/2 | 2/2 |
| | 2017 | 130 | --- | 660 | 26 | 16 [6] | 2/2 | 2/2 |
| | 2018 | 290 | --- | 310 | 280 | 14 [5] | 2/2 | 2/2 |
| | 2019 | --- | --- | 210 | 210 | 18 [7] | 1/1 | 1/1 |

| Pentabromodiphenyl ethers | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Bivalves (pg/g-wet) | 2008 | 32 | 27 | 94 | tr(11) | 16 [5.9] | 31/31 | 7/7 |
| | 2010 | 32 | 37 | 98 | tr(9) | 14 [6] | 6/6 | 6/6 |
| | 2011 | 51 | 60 | 160 | tr(12) | 15 [6] | 4/4 | 4/4 |
| | 2012 | 28 | 24 | 67 | tr(8) | 18 [6] | 5/5 | 5/5 |
| | 2014 | 30 | 37 | 41 | 18 | 12 [5] | 3/3 | 3/3 |
| | 2015 | 18 | 19 | 20 | 16 | 13 [5] | 3/3 | 3/3 |
| | 2016 | 11 | 9 | 20 | tr(8) | 9 [4] | 3/3 | 3/3 |
| | 2017 | 18 | 16 | 62 | tr(6) | 12 [5] | 3/3 | 3/3 |
| | 2018 | 13 | 21 | 23 | tr(5) | 11 [4] | 3/3 | 3/3 |
| | 2019 | 12 | 12 | 28 | tr(5) | 10 [4] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2008 | 30 | 37 | 280 | nd | 16 [5.9] | 72/85 | 16/17 |
| | 2010 | 51 | 54 | 200 | nd | 14 [6] | 16/18 | 16/18 |
| | 2011 | 39 | 39 | 300 | nd | 15 [6] | 17/18 | 17/18 |
| | 2012 | 37 | 54 | 180 | nd | 18 [6] | 17/19 | 17/19 |
| | 2014 | 41 | 47 | 570 | nd | 12 [5] | 18/19 | 18/19 |
| | 2015 | 22 | 17 | 140 | nd | 13 [5] | 18/19 | 18/19 |
| | 2016 | 18 | 14 | 87 | tr(4) | 9 [4] | 19/19 | 19/19 |
| | 2017 | 23 | 28 | 87 | nd | 12 [5] | 18/19 | 18/19 |
| | 2018 | 21 | 21 | 100 | nd | 11 [4] | 17/18 | 17/18 |
| | 2019 | 17 | 18 | 58 | tr(4) | 10 [4] | 16/16 | 16/16 |
| Birds** (pg/g-wet) | 2008 | 150 | 130 | 440 | 52 | 16 [5.9] | 10/10 | 2/2 |
| | 2010 | 150 | --- | 200 | 120 | 14 [6] | 2/2 | 2/2 |
| | 2011 | --- | --- | 110 | 110 | 15 [6] | 1/1 | 1/1 |
| | 2012 | 85 | --- | 110 | 66 | 18 [6] | 2/2 | 2/2 |
| | 2014 | 100 | --- | 320 | 31 | 12 [5] | 2/2 | 2/2 |
| | 2015 | --- | --- | 22 | 22 | 13 [5] | 1/1 | 1/1 |
| | 2016 | 88 | --- | 300 | 26 | 9 [4] | 2/2 | 2/2 |
| | 2017 | 77 | --- | 500 | 12 | 12 [5] | 2/2 | 2/2 |
| | 2018 | 180 | --- | 240 | 140 | 11 [4] | 2/2 | 2/2 |
| | 2019 | --- | --- | 150 | 150 | 10 [4] | 1/1 | 1/1 |

| Hexabromodiphenyl ethers | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Bivalves (pg/g-wet) | 2008 | 19 | 16 | 82 | tr(5.3) | 14 [5.0] | 31/31 | 7/7 |
| | 2010 | 8 | 16 | 26 | nd | 8 [3] | 4/6 | 4/6 |
| | 2011 | 38 | 41 | 81 | 20 | 10 [4] | 4/4 | 4/4 |
| | 2012 | 21 | 23 | 130 | tr(6) | 10 [4] | 5/5 | 5/5 |
| | 2014 | 23 | 21 | 52 | 11 | 10 [4] | 3/3 | 3/3 |
| | 2015 | tr(9) | tr(6) | 41 | nd | 12 [5] | 2/3 | 2/3 |
| | 2016 | tr(13) | tr(13) | 40 | nd | 21 [8] | 2/3 | 2/3 |
| | 2017 | tr(14) | 20 | 36 | nd | 17 [7] | 2/3 | 2/3 |
| | 2018 | tr(12) | tr(12) | 34 | nd | 21 [8] | 2/3 | 2/3 |
| | 2019 | nd | nd | 24 | nd | 21 [8] | 1/3 | 1/3 |
| Fish (pg/g-wet) | 2008 | 46 | 51 | 310 | nd | 14 [5.0] | 83/85 | 17/17 |
| | 2010 | 39 | 47 | 400 | nd | 8 [3] | 16/18 | 16/18 |
| | 2011 | 53 | 50 | 430 | nd | 10 [4] | 17/18 | 17/18 |
| | 2012 | 55 | 71 | 320 | nd | 10 [4] | 18/19 | 18/19 |
| | 2014 | 60 | 61 | 1,100 | nd | 10 [4] | 18/19 | 18/19 |
| | 2015 | 44 | 45 | 250 | nd | 12 [5] | 18/19 | 18/19 |
| | 2016 | 42 | 36 | 190 | nd | 21 [8] | 18/19 | 18/19 |
| | 2017 | 49 | 49 | 210 | nd | 17 [7] | 18/19 | 18/19 |
| | 2018 | 44 | 48 | 190 | nd | 21 [8] | 17/18 | 17/18 |
| | 2019 | 42 | 40 | 290 | tr(12) | 21 [8] | 16/16 | 16/16 |
| Birds** (pg/g-wet) | 2008 | 140 | 120 | 380 | 62 | 14 [5.0] | 10/10 | 2/2 |
| | 2010 | 110 | --- | 140 | 86 | 8 [3] | 2/2 | 2/2 |
| | 2011 | --- | --- | 96 | 96 | 10 [4] | 1/1 | 1/1 |
| | 2012 | 150 | --- | 320 | 72 | 10 [4] | 2/2 | 2/2 |
| | 2014 | 170 | --- | 680 | 42 | 10 [4] | 2/2 | 2/2 |
| | 2015 | --- | --- | 30 | 30 | 12 [5] | 1/1 | 1/1 |
| | 2016 | 220 | --- | 740 | 68 | 21 [8] | 2/2 | 2/2 |
| | 2017 | 230 | --- | 1,000 | 51 | 17 [7] | 2/2 | 2/2 |
| | 2018 | 650 | --- | 1,300 | 330 | 21 [8] | 2/2 | 2/2 |
| | 2019 | --- | --- | 480 | 480 | 21 [8] | 1/1 | 1/1 |

| Heptabromodiphenyl ethers | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Bivalves (pg/g-wet) | 2008 | tr(8.5) | tr(7.6) | 35 | nd | 18 [6.7] | 20/31 | 7/7 |
| | 2010 | nd | nd | tr(10) | nd | 30 [10] | 1/6 | 1/6 |
| | 2011 | 14 | 26 | 44 | nd | 11 [4] | 3/4 | 3/4 |
| | 2012 | tr(8) | tr(6) | 59 | nd | 12 [5] | 3/5 | 3/5 |
| | 2014 | nd | nd | 13 | nd | 12 [5] | 1/3 | 1/3 |
| | 2015 | nd | nd | tr(11) | nd | 12 [5] | 1/3 | 1/3 |
| | 2016 | nd | nd | tr(8) | nd | 13 [5] | 1/3 | 1/3 |
| | 2017 | nd | nd | tr(9) | nd | 22 [8] | 1/3 | 1/3 |
| | 2018 | nd | nd | tr(10) | nd | 15 [6] | 1/3 | 1/3 |
| | 2019 | nd | nd | tr(18) | nd | 24 [9] | 1/3 | 1/3 |
| Fish (pg/g-wet) | 2008 | tr(11) | tr(8.1) | 77 | nd | 18 [6.7] | 44/85 | 10/17 |
| | 2010 | nd | nd | 40 | nd | 30 [10] | 4/18 | 4/18 |
| | 2011 | 13 | 21 | 130 | nd | 11 [4] | 13/18 | 13/18 |
| | 2012 | tr(11) | 18 | 120 | nd | 12 [5] | 11/19 | 11/19 |
| | 2014 | tr(10) | 13 | 280 | nd | 12 [5] | 10/19 | 10/19 |
| | 2015 | nd | nd | 44 | nd | 12 [5] | 4/19 | 4/19 |
| | 2016 | tr(9) | tr(7) | 85 | nd | 13 [5] | 11/19 | 11/19 |
| | 2017 | tr(11) | tr(12) | 55 | nd | 22 [8] | 10/19 | 10/19 |
| | 2018 | tr(9) | tr(8) | 58 | nd | 15 [6] | 11/18 | 11/18 |
| | 2019 | tr(10) | tr(10) | 82 | nd | 24 [9] | 9/16 | 9/16 |
| Birds** (pg/g-wet) | 2008 | 35 | 35 | 53 | 19 | 18 [6.7] | 10/10 | 2/2 |
| | 2010 | tr(19) | --- | 70 | nd | 30 [10] | 1/2 | 1/2 |
| | 2011 | --- | --- | 44 | 44 | 11 [4] | 1/1 | 1/1 |
| | 2012 | 63 | --- | 280 | 14 | 12 [5] | 2/2 | 2/2 |
| | 2014 | 19 | --- | 150 | nd | 12 [5] | 1/2 | 1/2 |
| | 2015 | --- | --- | tr(11) | tr(11) | 12 [5] | 1/1 | 1/1 |
| | 2016 | 65 | --- | 220 | 19 | 13 [5] | 2/2 | 2/2 |
| | 2017 | 89 | --- | 440 | tr(18) | 22 [8] | 2/2 | 2/2 |
| | 2018 | 230 | --- | 480 | 110 | 15 [6] | 2/2 | 2/2 |
| | 2019 | --- | --- | 260 | 260 | 24 [9] | 1/1 | 1/1 |

| Octabromodiphenyl ethers | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Bivalves (pg/g-wet) | 2008 | nd | nd | 10 | nd | 9.6 [3.6] | 15/31 | 6/7 |
| | 2010 | nd | nd | tr(10) | nd | 11 [4] | 2/6 | 2/6 |
| | 2011 | 7 | 9 | 29 | nd | 7 [3] | 3/4 | 3/4 |
| | 2012 | 8 | tr(7) | 25 | nd | 8 [3] | 4/5 | 4/5 |
| | 2014 | tr(9.2) | 11 | 14 | tr(5) | 11 [4] | 3/3 | 3/3 |
| | 2015 | nd | nd | nd | nd | 14 [5] | 0/3 | 0/3 |
| | 2016 | nd | nd | nd | nd | 16 [6] | 0/3 | 0/3 |
| | 2017 | nd | nd | tr(9) | nd | 20 [8] | 1/3 | 1/3 |
| | 2018 | nd | nd | nd | nd | 16 [6] | 0/3 | 0/3 |
| | 2019 | tr(8) | nd | 39 | nd | 17 [7] | 1/3 | 1/3 |
| Fish (pg/g-wet) | 2008 | tr(5.7) | nd | 73 | nd | 9.6 [3.6] | 35/85 | 7/17 |
| | 2010 | tr(6) | nd | 100 | nd | 11 [4] | 8/18 | 8/18 |
| | 2011 | tr(6) | tr(7) | 150 | nd | 7 [3] | 10/18 | 10/18 |
| | 2012 | tr(7) | 8 | 160 | nd | 8 [3] | 12/19 | 12/19 |
| | 2014 | 14 | 13 | 540 | nd | 11 [4] | 15/19 | 15/19 |
| | 2015 | tr(7) | nd | 60 | nd | 14 [5] | 9/19 | 9/19 |
| | 2016 | tr(8) | nd | 86 | nd | 16 [6] | 9/19 | 9/19 |
| | 2017 | tr(9.7) | nd | 88 | nd | 20 [8] | 9/19 | 9/19 |
| | 2018 | tr(7) | nd | 74 | nd | 16 [6] | 8/18 | 8/18 |
| | 2019 | tr(8) | nd | 120 | nd | 17 [7] | 8/16 | 8/16 |
| Birds** (pg/g-wet) | 2008 | 42 | 41 | 64 | 30 | 9.6 [3.6] | 10/10 | 2/2 |
| | 2010 | 41 | --- | 65 | 26 | 11 [4] | 2/2 | 2/2 |
| | 2011 | --- | --- | 66 | 66 | 7 [3] | 1/1 | 1/1 |
| | 2012 | 130 | --- | 420 | 40 | 8 [3] | 2/2 | 2/2 |
| | 2014 | 17 | --- | 140 | nd | 11 [4] | 1/2 | 1/2 |
| | 2015 | --- | --- | tr(5) | tr(5) | 14 [5] | 1/1 | 1/1 |
| | 2016 | 65 | --- | 220 | 19 | 16 [6] | 2/2 | 2/2 |
| | 2017 | 130 | --- | 720 | 25 | 20 [8] | 2/2 | 2/2 |
| | 2018 | 190 | --- | 580 | 61 | 16 [6] | 2/2 | 2/2 |
| | 2019 | --- | --- | 330 | 330 | 17 [7] | 1/1 | 1/1 |

| Nonabromodiphenyl ethers | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Bivalves (pg/g-wet) | 2008 | nd | nd | tr(23) | nd | 35 [13] | 5/31 | 1/7 |
| | 2010 | tr(16) | tr(15) | 60 | nd | 30 [10] | 5/6 | 5/6 |
| | 2011 | tr(12) | tr(11) | 40 | nd | 22 [9] | 3/4 | 3/4 |
| | 2012 | tr(15) | 25 | 45 | nd | 24 [9] | 3/5 | 3/5 |
| | 2014 | 40 | tr(20) | 110 | tr(20) | 30 [10] | 3/3 | 3/3 |
| | 2015 | nd | nd | tr(11) | nd | 23 [9] | 1/3 | 1/3 |
| | 2016 | nd | nd | nd | nd | 36 [14] | 0/3 | 0/3 |
| | 2017 | nd | nd | nd | nd | 50 [20] | 0/3 | 0/3 |
| | 2018 | nd | nd | nd | nd | 40 [20] | 0/3 | 0/3 |
| | 2019 | tr(20) | nd | 81 | nd | 50 [20] | 1/3 | 1/3 |
| Fish (pg/g-wet) | 2008 | nd | nd | tr(15) | nd | 35 [13] | 2/85 | 2/17 |
| | 2010 | nd | nd | 40 | nd | 30 [10] | 3/18 | 3/18 |
| | 2011 | nd | nd | tr(15) | nd | 22 [9] | 5/18 | 5/18 |
| | 2012 | nd | nd | 54 | nd | 24 [9] | 9/19 | 9/19 |
| | 2014 | tr(10) | tr(20) | 40 | nd | 30 [10] | 16/19 | 16/19 |
| | 2015 | nd | nd | 35 | nd | 23 [9] | 6/19 | 6/19 |
| | 2016 | nd | nd | tr(22) | nd | 36 [14] | 3/19 | 3/19 |
| | 2017 | nd | nd | 68 | nd | 50 [20] | 1/19 | 1/19 |
| | 2018 | nd | nd | nd | nd | 40 [20] | 0/18 | 0/18 |
| | 2019 | nd | nd | nd | nd | 50 [20] | 0/16 | 0/16 |
| Birds** (pg/g-wet) | 2008 | tr(21) | tr(20) | tr(33) | nd | 35 [13] | 9/10 | 2/2 |
| | 2010 | 32 | --- | 50 | tr(20) | 30 [10] | 2/2 | 2/2 |
| | 2011 | --- | --- | 62 | 62 | 22 [9] | 1/1 | 1/1 |
| | 2012 | 100 | --- | 150 | 67 | 24 [9] | 2/2 | 2/2 |
| | 2014 | tr(10) | --- | tr(20) | tr(10) | 30 [10] | 2/2 | 2/2 |
| | 2015 | --- | --- | tr(12) | tr(12) | 23 [9] | 1/1 | 1/1 |
| | 2016 | nd | --- | tr(21) | nd | 36 [14] | 1/2 | 1/2 |
| | 2017 | nd | --- | nd | nd | 50 [20] | 0/2 | 0/2 |
| | 2018 | 49 | --- | 53 | 46 | 40 [20] | 2/2 | 2/2 |
| | 2019 | --- | --- | nd | nd | 50 [20] | 0/1 | 0/1 |

| Decabromodiphenyl ether | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Bivalves (pg/g-wet) | 2008 | nd | nd | tr(170) | nd | 220 [74] | 8/31 | 3/7 |
| | 2010 | nd | nd | tr(190) | nd | 270 [97] | 2/6 | 2/6 |
| | 2011 | nd | nd | 240 | nd | 230 [80] | 1/4 | 1/4 |
| | 2012 | 120 | 170 | 480 | nd | 120 [50] | 4/5 | 4/5 |
| | 2014 | 220 | tr(150) | 570 | tr(120) | 170 [60] | 3/3 | 3/3 |
| | 2015 | nd | nd | tr(70) | nd | 170 [70] | 1/3 | 1/3 |
| | 2016 | nd | nd | tr(110) | nd | 300 [100] | 1/3 | 1/3 |
| | 2017 | nd | nd | tr(180) | nd | 210 [80] | 1/3 | 1/3 |
| | 2018 | nd | nd | nd | nd | 240 [80] | 0/3 | 0/3 |
| | 2019 | nd | nd | tr(180) | nd | 190 [70] | 1/3 | 1/3 |
| Fish (pg/g-wet) | 2008 | nd | nd | 230 | nd | 220 [74] | 5/76 | 4/16 |
| | 2010 | nd | nd | tr(150) | nd | 270 [97] | 2/18 | 2/18 |
| | 2011 | nd | nd | tr(90) | nd | 230 [80] | 2/18 | 2/18 |
| | 2012 | tr(59) | tr(60) | 380 | nd | 120 [50] | 11/19 | 11/19 |
| | 2014 | tr(75) | tr(70) | 300 | nd | 170 [60] | 13/19 | 13/19 |
| | 2015 | nd | nd | 380 | nd | 170 [70] | 5/19 | 5/19 |
| | 2016 | nd | nd | tr(190) | nd | 300 [100] | 7/19 | 7/19 |
| | 2017 | nd | nd | 2,100 | nd | 210 [80] | 1/19 | 1/19 |
| | 2018 | nd | nd | tr(110) | nd | 240 [80] | 2/18 | 2/18 |
| | 2019 | nd | nd | nd | nd | 190 [70] | 0/16 | 0/16 |
| Birds** (pg/g-wet) | 2008 | nd | nd | tr(110) | nd | 220 [74] | 4/10 | 1/2 |
| | 2010 | nd | --- | nd | nd | 270 [97] | 0/2 | 0/2 |
| | 2011 | --- | --- | tr(170) | tr(170) | 230 [80] | 1/1 | 1/1 |
| | 2012 | 250 | --- | 260 | 240 | 120 [50] | 2/2 | 2/2 |
| | 2014 | tr(65) | --- | tr(140) | nd | 170 [60] | 1/2 | 1/2 |
| | 2015 | --- | --- | tr(90) | tr(90) | 170 [70] | 1/1 | 1/1 |
| | 2016 | nd | --- | nd | nd | 300 [100] | 0/2 | 0/2 |
| | 2017 | nd | --- | nd | nd | 210 [80] | 0/2 | 0/2 |
| | 2018 | tr(210) | --- | 500 | tr(90) | 240 [80] | 2/2 | 2/2 |
| | 2019 | --- | --- | nd | nd | 190 [70] | 0/1 | 0/1 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2008.
(Note 2) "**" There is no consistency between the results of the ornithological survey after FY2014 and those in previous years because of the changes in the survey sites and target species.
(Note 3) No monitoring was conducted in FY2009 and FY2013.

<Air>

Stocktaking of the detection of Polybromodiphenyl ethers ($Br_4$~$Br_{10}$) in air during FY2008~2019

| Tetrabromo diphenyl ethers | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air (pg/m$^3$) | 2009 Warm season | 0.89 | 0.80 | 18 | 0.11 | 0.11 [0.04] | 37/37 | 37/37 |
| | 2009 Cold season | 0.40 | 0.37 | 7.1 | tr(0.04) | | 37/37 | 37/37 |
| | 2010 Warm season | 0.79 | 0.57 | 50 | 0.15 | 0.12 [0.05] | 37/37 | 37/37 |
| | 2010 Cold season | 0.40 | 0.35 | 25 | tr(0.09) | | 37/37 | 37/37 |
| | 2011 Warm season | 0.80 | 0.72 | 9.3 | tr(0.11) | 0.18 [0.07] | 35/35 | 35/35 |
| | 2011 Cold season | 0.36 | 0.34 | 7.0 | nd | | 35/37 | 35/37 |
| | 2012 Warm season | 0.7 | 0.7 | 5.7 | nd | 0.3 [0.1] | 35/36 | 35/36 |
| | 2012 Cold season | tr(0.2) | tr(0.2) | 1.7 | nd | | 25/36 | 25/36 |
| | 2014 Warm season | 0.53 | 0.47 | 2.3 | tr(0.09) | 0.28 [0.09] | 36/36 | 36/36 |
| | 2015 Warm season | tr(0.3) | tr(0.3) | 2.7 | nd | 0.4 [0.1] | 30/35 | 30/35 |
| | 2016 Warm season | 0.5 | 0.4 | 28 | nd | 0.4 [0.2] | 30/37 | 30/37 |
| | 2017 Warm season | 0.39 | 0.34 | 4.1 | tr(0.06) | 0.15 [0.05] | 37/37 | 37/37 |
| | 2018 Warm season | 0.28 | 0.26 | 3.9 | 0.05 | 0.05 [0.02] | 37/37 | 37/37 |
| | 2019 Warm season | 0.25 | 0.23 | 5.5 | tr(0.03) | 0.04 [0.01] | 36/36 | 36/36 |

| Pentabromo diphenyl ethers | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air (pg/m$^3$) | 2009 Warm season | 0.20 | 0.19 | 18 | nd | 0.16 [0.06] | 33/37 | 33/37 |
| | 2009 Cold season | 0.19 | 0.16 | 10 | nd | | 29/37 | 29/37 |
| | 2010 Warm season | 0.20 | 0.17 | 45 | nd | 0.12 [0.05] | 35/37 | 35/37 |
| | 2010 Cold season | 0.20 | 0.22 | 28 | nd | | 34/37 | 34/37 |
| | 2011 Warm season | 0.19 | 0.17 | 8.8 | nd | 0.16 [0.06] | 31/35 | 31/35 |
| | 2011 Cold season | 0.16 | tr(0.14) | 2.6 | nd | | 31/37 | 31/37 |
| | 2012 Warm season | tr(0.13) | tr(0.12) | 2.4 | nd | 0.14 [0.06] | 30/36 | 30/36 |
| | 2012 Cold season | tr(0.09) | tr(0.09) | 0.77 | nd | | 26/36 | 26/36 |
| | 2014 Warm season | tr(0.13) | tr(0.14) | 0.80 | nd | 0.28 [0.09] | 25/36 | 25/36 |
| | 2015 Warm season | nd | nd | 0.9 | nd | 0.6 [0.2] | 6/35 | 6/35 |
| | 2016 Warm season | nd | nd | 28 | nd | 0.4 [0.2] | 6/37 | 6/37 |
| | 2017 Warm season | 0.11 | 0.10 | 3.4 | nd | 0.10 [0.04] | 33/37 | 33/37 |
| | 2018 Warm season | tr(0.08) | nd | 4.1 | nd | 0.20 [0.08] | 18/37 | 18/37 |
| | 2019 Warm season | tr(0.10) | tr(0.06) | 6.1 | nd | 0.12 [0.05] | 27/36 | 27/36 |

| Hexabromo diphenyl ethers | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air (pg/m$^3$) | 2009 Warm season | tr(0.11) | tr(0.11) | 2.0 | nd | 0.22 [0.09] | 19/37 | 19/37 |
| | 2009 Cold season | tr(0.20) | 0.22 | 27 | nd | | 24/37 | 24/37 |
| | 2010 Warm season | tr(0.14) | tr(0.13) | 4.9 | nd | 0.16 [0.06] | 29/37 | 29/37 |
| | 2010 Cold season | 0.24 | 0.27 | 5.4 | nd | | 31/37 | 31/37 |
| | 2011 Warm season | tr(0.11) | tr(0.10) | 1.2 | nd | 0.14 [0.05] | 28/35 | 28/35 |
| | 2011 Cold season | 0.16 | 0.18 | 1.7 | nd | | 30/37 | 30/37 |
| | 2012 Warm season | nd | nd | 3.1 | nd | 0.3 [0.1] | 9/36 | 9/36 |
| | 2012 Cold season | tr(0.1) | tr(0.1) | 0.5 | nd | | 22/36 | 22/36 |
| | 2014 Warm season | nd | nd | 0.4 | nd | 0.4 [0.1] | 5/36 | 5/36 |
| | 2015 Warm season | nd | nd | 2.0 | nd | 1.1 [0.4] | 3/35 | 3/35 |
| | 2016 Warm season | nd | nd | 2.7 | nd | 0.6 [0.2] | 3/37 | 3/37 |
| | 2017 Warm season | nd | nd | 2.1 | nd | 0.3 [0.1] | 11/37 | 11/37 |
| | 2018 Warm season | nd | nd | 1.5 | nd | 0.17 [0.06] | 9/37 | 9/37 |
| | 2019 Warm season | tr(0.05) | nd | 0.79 | nd | 0.13 [0.05] | 15/36 | 15/36 |

| Heptabromo diphenyl ethers | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air (pg/m$^3$) | 2009 Warm season | tr(0.1) | nd | 1.7 | nd | 0.3 [0.1] | 17/37 | 17/37 |
| | 2009 Cold season | tr(0.2) | 0.3 | 20 | nd | | 25/37 | 25/37 |
| | 2010 Warm season | tr(0.2) | tr(0.1) | 1.4 | nd | 0.3 [0.1] | 24/37 | 24/37 |
| | 2010 Cold season | 0.3 | 0.4 | 11 | nd | | 28/37 | 28/37 |
| | 2011 Warm season | tr(0.1) | tr(0.1) | 1.1 | nd | 0.3 [0.1] | 20/35 | 20/35 |
| | 2011 Cold season | tr(0.2) | tr(0.2) | 2.3 | nd | | 25/37 | 25/37 |
| | 2012 Warm season | nd | nd | 1.8 | nd | 0.5 [0.2] | 6/36 | 6/36 |
| | 2012 Cold season | nd | nd | 0.7 | nd | | 8/36 | 8/36 |
| | 2014 Warm season | nd | nd | tr(0.4) | nd | 0.7 [0.2] | 2/36 | 2/36 |
| | 2015 Warm season | nd | nd | tr(0.6) | nd | 1.3 [0.4] | 2/35 | 2/35 |
| | 2016 Warm season | nd | nd | 1.3 | nd | 1.1 [0.4] | 1/37 | 1/37 |
| | 2017 Warm season | nd | nd | 3.2 | nd | 0.4 [0.2] | 10/37 | 10/37 |
| | 2018 Warm season | tr(0.09) | nd | 1.3 | nd | 0.20 [0.08] | 16/37 | 16/37 |
| | 2019 Warm season | tr(0.1) | tr(0.1) | 2.7 | nd | 0.3 [0.1] | 24/36 | 24/36 |

| Octabromo diphenyl ethers | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air (pg/m$^3$) | 2009 Warm season | tr(0.2) | 0.3 | 1.6 | nd | 0.3 [0.1] | 23/37 | 23/37 |
| | 2009 Cold season | 0.3 | 0.4 | 7.1 | nd | | 26/37 | 26/37 |
| | 2010 Warm season | 0.25 | 0.30 | 2.3 | nd | 0.15 [0.06] | 30/37 | 30/37 |
| | 2010 Cold season | 0.40 | 0.52 | 6.9 | nd | | 32/37 | 32/37 |
| | 2011 Warm season | 0.24 | 0.31 | 1.9 | nd | 0.20 [0.08] | 27/35 | 27/35 |
| | 2011 Cold season | 0.35 | 0.44 | 7.0 | nd | | 30/37 | 30/37 |
| | 2012 Warm season | tr(0.2) | tr(0.2) | 1.2 | nd | 0.3 [0.1] | 29/36 | 29/36 |
| | 2012 Cold season | 0.3 | 0.4 | 1.2 | nd | | 30/36 | 30/36 |
| | 2014 Warm season | tr(0.1) | tr(0.1) | 0.7 | nd | 0.4 [0.1] | 22/36 | 22/36 |
| | 2015 Warm season | nd | nd | 3.8 | nd | 1.1 [0.4] | 9/35 | 9/35 |
| | 2016 Warm season | nd | nd | 1.6 | nd | 0.6 [0.2] | 18/37 | 18/37 |
| | 2017 Warm season | tr(0.19) | 0.23 | 5.7 | nd | 0.21 [0.07] | 28/37 | 28/37 |
| | 2018 Warm season | 0.15 | 0.14 | 1.3 | nd | 0.11 [0.04] | 34/37 | 34/37 |
| | 2019 Warm season | tr(0.2) | tr(0.2) | 2.6 | nd | 0.3 [0.1] | 32/36 | 32/36 |

| Nonabromo diphenyl ethers | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air (pg/m$^3$) | 2009 Warm season | tr(0.7) | tr(0.7) | 3.0 | nd | 1.8 [0.6] | 22/37 | 22/37 |
| | 2009 Cold season | tr(1.0) | tr(0.8) | 3.9 | nd | | 27/37 | 27/37 |
| | 2010 Warm season | nd | nd | 24 | nd | 3.7 [1.2] | 12/37 | 12/37 |
| | 2010 Cold season | tr(1.2) | tr(1.3) | 7.1 | nd | | 22/37 | 22/37 |
| | 2011 Warm season | tr(0.8) | 0.9 | 3.9 | nd | 0.9 [0.4] | 29/35 | 29/35 |
| | 2011 Cold season | 1.1 | 1.1 | 14 | nd | | 30/37 | 30/37 |
| | 2012 Warm season | tr(0.5) | tr(0.5) | 5.1 | nd | 1.2 [0.4] | 24/36 | 24/36 |
| | 2012 Cold season | tr(0.9) | tr(1.1) | 4.7 | nd | | 30/36 | 30/36 |
| | 2014 Warm season | nd | nd | tr(3) | nd | 4 [1] | 7/36 | 7/36 |
| | 2015 Warm season | nd | nd | 12 | nd | 3.2 [1.1] | 14/35 | 14/35 |
| | 2016 Warm season | tr(0.9) | tr(0.9) | 11 | nd | 1.4 [0.5] | 28/37 | 28/37 |
| | 2017 Warm season | 0.8 | 0.8 | 40 | nd | 0.6 [0.2] | 31/37 | 31/37 |
| | 2018 Warm season | 0.5 | 0.7 | 3 | nd | 0.4 [0.2] | 31/37 | 31/37 |
| | 2019 Warm season | 0.5 | 0.7 | 3.1 | nd | 0.3 [0.1] | 34/36 | 34/36 |

| Decabromo diphenyl ether | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air (pg/m$^3$) | 2009 Warm season | tr(7) | tr(9) | 31 | nd | 16 [5] | 28/37 | 28/37 |
| | 2009 Cold season | tr(10) | tr(11) | 45 | nd | | 29/37 | 29/37 |
| | 2010 Warm season | nd | nd | 290 | nd | 27 [9.1] | 10/37 | 10/37 |
| | 2010 Cold season | tr(11) | tr(12) | 88 | nd | | 21/37 | 21/37 |
| | 2011 Warm season | tr(8.2) | tr(9.0) | 30 | nd | 12 [4.0] | 31/35 | 31/35 |
| | 2011 Cold season | tr(8.4) | tr(9.0) | 44 | nd | | 29/37 | 29/37 |
| | 2012 Warm season | nd | nd | 31 | nd | 16 [5] | 17/36 | 17/36 |
| | 2012 Cold season | tr(10) | tr(12) | 73 | nd | | 28/36 | 28/36 |
| | 2014 Warm season | tr(4.7) | tr(5.0) | 64 | nd | 9 [3] | 24/36 | 24/36 |
| | 2015 Warm season | 4.2 | 4.3 | 61 | nd | 2.2 [0.7] | 30/35 | 30/35 |
| | 2016 Warm season | 5 | 5 | 86 | nd | 3 [1] | 35/37 | 35/37 |
| | 2017 Warm season | 4.2 | 4.4 | 140 | nd | 2.4 [0.8] | 34/37 | 34/37 |
| | 2018 Warm season | 2.6 | 3.4 | 19 | nd | 2.0 [0.8] | 31/37 | 31/37 |
| | 2019 Warm season | 1.8 | 2.6 | 14 | nd | 0.3 [0.1] | 32/36 | 32/36 |

(Note) No monitoring was conducted in FY2013.

## [15] Perfluorooctane sulfonic acid (PFOS)

・ History and state of monitoring

Perfluorooctane sulfonic acid (PFOS) has been used as electric and electronic parts, fire fighting foam, photo imaging, hydraulic fluids and textiles. Perfluorooctane sulfonic acid, its salts and perfluorooctane sulfonyl fluoride were adopted as target chemicals at the COP4 of the Stockholm convention on Persistent Organic Pollutants in May 2009, and designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in April 2010.

As a continuous survey, the first survey was in FY2008. Under the framework the Initial Environmental Survey and the Detailed Environmental Survey etc. in the Environmental Survey and Monitoring of Chemicals after FY2002, the substance was monitored in surface water in FY2002, sediment and wildlife (fish) in FY2003, air in FY2004, surface water, sediment and wildlife (bivalves and fish) in FY2005.

Under the framework of the Environmental Monitoring, the substance was monitored in surface water and sediment in FY2009~2012, FY2014~2016, and FY2018~2020, in wildlife (bivalves, fish and birds) in FY2009~2012, FY2014~2017, FY2019 and FY2020, in air in FY2010~2012, FY2014~2017 and FY2019surface water, sediment, wildlife (bivalves, fish and birds) and air in FY2010~2017, FY2019 and FY2020.

・ Monitoring results

<Surface Water>

The presence of the substance in surface water was monitored at 46 sites, and it was detected at all 46 valid sites adopting the detection limit of 30pg/L, and the detection range was tr(52) ~ 3,700pg/L.

As results of the inter-annual trend analysis from FY2009 to FY2020, a reduction tendency in specimens from lake areas was identified as statistically significant.

Stocktaking of the detection of Perfluorooctane sulfonic acid (PFOS) in surface water during FY2009~2020

| Perfluorooctane sulfonic acid (PFOS) | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2009 | 730 | 580 | 14,000 | tr(26) | 37 [14] | 49/49 | 49/49 |
| | 2010 | 490 | 380 | 230,000 | tr(37) | 50 [20] | 49/49 | 49/49 |
| | 2011 | 480 | 360 | 10,000 | tr(20) | 50 [20] | 49/49 | 49/49 |
| | 2012 | 550 | 510 | 14,000 | 39 | 31 [12] | 48/48 | 48/48 |
| | 2014 | 460 | 410 | 7,500 | nd | 50 [20] | 47/48 | 47/48 |
| | 2015 | 630 | 490 | 4,700 | 120 | 29 [11] | 48/48 | 48/48 |
| | 2016 | 330 | 300 | 14,000 | tr(23) | 50 [20] | 48/48 | 48/48 |
| | 2018 | 310 | 300 | 4,100 | nd | 70 [30] | 42/47 | 42/47 |
| | 2019 | 290 | 260 | 2,500 | nd | 80 [30] | 47/48 | 47/48 |
| | 2020 | 330 | 260 | 3,700 | tr(52) | 80 [30] | 46/46 | 46/46 |

(Note) No monitoring was conducted in FY2013 and FY2017.

<Sediment>

The presence of the substance in sediment was monitored at 58 sites, and it was detected at all 58 valid sites adopting the detection limit of 2pg/g-dry, and the detection range was tr(3) ~ 450pg/g-dry.

As results of the inter-annual trend analysis from FY2009 to FY2020, reduction tendencies in specimens from river mouth areas and sea areas were identified as statistically significant and a reduction tendency in specimens from the overall areas in sediment was also identified as statistically significant.

Stocktaking of the detection of Perfluorooctane sulfonic acid (PFOS) in sediment during FY2009~2020

| Perfluorooctane sulfonic acid (PFOS) | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2009 | 78 | 97 | 1,900 | nd | 9.6 [3.7] | 180/190 | 64/64 |
| | 2010 | 82 | 100 | 1,700 | tr(3) | 5 [2] | 64/64 | 64/64 |
| | 2011 | 92 | 110 | 1,100 | nd | 5 [2] | 63/64 | 63/64 |
| | 2012 | 68 | 84 | 1,200 | tr(7) | 9 [4] | 63/63 | 63/63 |
| | 2014 | 59 | 79 | 980 | nd | 5 [2] | 62/63 | 62/63 |
| | 2015 | 91 | 88 | 2,200 | 7 | 3 [1] | 62/62 | 62/62 |
| | 2016 | 54 | 61 | 690 | 5 | 5 [2] | 62/62 | 62/62 |
| | 2018 | 43 | 57 | 700 | nd | 7 [3] | 55/61 | 55/61 |
| | 2019 | 44 | 46 | 460 | nd | 9 [4] | 60/61 | 60/61 |
| | 2020 | 40 | 48 | 450 | tr(3) | 5 [2] | 58/58 | 58/58 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2009.

(Note 2) No monitoring was conducted in FY2013.

<Wildlife>

The presence of the substance in bivalves was monitored in 3 areas, and it was detected at all 3 valid areas adopting the detection limit of 2pg/g-wet, and the detection range was tr(4) ~ 130pg/g-wet. For fish, the presence of the substance was monitored in 18 areas, and it was detected at all 18 valid areas adopting the detection limit of 2pg/g-wet, and the detection range was 5 ~ 3,000pg/g-wet. For birds, the presence of the substance was monitored in 1 area, and detected in the area adopting the detection limit of 2pg/g-wet, and the detected concentration was 8,500pg/g-wet.

Although the number of detections was small, the detection rate of specimens from the bivalves was decreased, it suggested a reduction tendency of the concentrations.

Stocktaking of the detection of Perfluorooctane sulfonic acid (PFOS) in wildlife (bivalves, fish and birds) during FY2009~2020

| Perfluorooctane sulfonic acid (PFOS) | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Bivalves (pg/g-wet) | 2009 | 24 | 28 | 640 | nd | 19 [7.4] | 17/31 | 5/7 |
| | 2010 | 72 | 85 | 680 | nd | 25 [9.6] | 5/6 | 5/6 |
| | 2011 | 38 | 44 | 100 | 16 | 10 [4] | 4/4 | 4/4 |
| | 2012 | 27 | 21 | 160 | tr(4) | 7 [3] | 5/5 | 5/5 |
| | 2014 | 8 | 6 | 93 | nd | 5 [2] | 2/3 | 2/3 |
| | 2015 | 7 | tr(2) | 210 | nd | 4 [2] | 2/3 | 2/3 |
| | 2016 | 11 | tr(6) | 160 | nd | 9 [3] | 2/3 | 2/3 |
| | 2017 | 22 | 34 | 160 | nd | 12 [4] | 2/3 | 2/3 |
| | 2019 | 10 | tr(4) | 140 | tr(2) | 6 [2] | 3/3 | 3/3 |
| | 2020 | 16 | 8 | 130 | tr(4) | 5 [2] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2009 | 220 | 230 | 15,000 | nd | 19 [7.4] | 83/90 | 17/18 |
| | 2010 | 390 | 480 | 15,000 | nd | 25 [9.6] | 17/18 | 17/18 |
| | 2011 | 82 | 95 | 3,200 | nd | 10 [4] | 16/18 | 16/18 |
| | 2012 | 110 | 130 | 7,300 | tr(5) | 7 [3] | 19/19 | 19/19 |
| | 2014 | 82 | 83 | 4,600 | nd | 5 [2] | 18/19 | 18/19 |
| | 2015 | 91 | 90 | 2,500 | nd | 4 [2] | 18/19 | 18/19 |
| | 2016 | 79 | 80 | 5,200 | nd | 9 [3] | 18/19 | 18/19 |
| | 2017 | 150 | 150 | 11,000 | tr(4) | 12 [4] | 19/19 | 19/19 |
| | 2019 | 67 | 80 | 3,600 | tr(3) | 6 [2] | 16/16 | 16/16 |
| | 2020 | 76 | 100 | 3,000 | 5 | 5 [2] | 18/18 | 18/18 |

| Perfluorooctane sulfonic acid (PFOS) | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Birds** (pg/g-wet) | 2009 | 300 | 360 | 890 | 37 | 19 [7.4] | 10/10 | 2/2 |
| | 2010 | 1,300 | --- | 3,000 | 580 | 25 [9.6] | 2/2 | 2/2 |
| | 2011 | --- | --- | 110 | 110 | 10 [4] | 1/1 | 1/1 |
| | 2012 | 160 | --- | 410 | 63 | 7 [3] | 2/2 | 2/2 |
| | 2014 | 4,600 | --- | 110,000 | 190 | 5 [2] | 2/2 | 2/2 |
| | 2015 | --- | --- | 790 | 790 | 4 [2] | 1/1 | 1/1 |
| | 2016 | 3,600 | --- | 9,100 | 1,400 | 9 [3] | 2/2 | 2/2 |
| | 2017 | 9,800 | --- | 32,000 | 3,000 | 12 [4] | 2/2 | 2/2 |
| | 2019 | --- | --- | 360 | 360 | 6 [2] | 1/1 | 1/1 |
| | 2020 | --- | --- | 8,500 | 8,500 | 5 [2] | 1/1 | 1/1 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2009.

(Note 2) “ ** ” indicates there is no consistency between the results of the ornithological survey after FY2014 and those in previous years because of the changes in the survey sites and target species.

(Note 3) No monitoring was conducted in FY2013 and FY2018.

<Air>

The presence of the substance in air was monitored at 37 sites, and it was detected at all 37 valid sites adopting the detection limit of 0.1pg/m$^3$, and the detection range was 1.1 ~ 7.2pg/m$^3$.

As results of the inter-annual trend analysis from FY2010 to FY2020, a reduction tendency in specimens from warm season was identified as statistically significant.

Stocktaking of the detection of Perfluorooctane sulfonic acid (PFOS) in air during FY2010~2020

| Perfluorooctane sulfonic acid (PFOS) | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air (pg/m$^3$) | 2010 Warm season | 5.2 | 5.9 | 14 | 1.6 | 0.4 [0.1] | 37/37 | 37/37 |
| | 2010 Cold season | 4.7 | 4.4 | 15 | 1.4 | | 37/37 | 37/37 |
| | 2011 Warm season | 4.4 | 4.2 | 10 | 0.9 | 0.5 [0.2] | 35/35 | 35/35 |
| | 2011 Cold season | 3.7 | 3.8 | 9.5 | 1.3 | | 37/37 | 37/37 |
| | 2012 Warm season | 3.6 | 3.8 | 8.9 | 1.3 | 0.5 [0.2] | 36/36 | 36/36 |
| | 2012 Cold season | 2.7 | 3.0 | 5.9 | 1.0 | | 36/36 | 36/36 |
| | 2013 Warm season | 4.6 | 5.2 | 9.6 | 1.2 | 0.3 [0.1] | 36/36 | 36/36 |
| | 2013 Cold season | 3.7 | 3.9 | 7.4 | 1.6 | | 36/36 | 36/36 |
| | 2014 Warm season | 3.1 | 3.2 | 8.6 | 0.52 | 0.17 [0.06] | 36/36 | 36/36 |
| | 2015 Warm season | 2.8 | 2.6 | 8.8 | 0.59 | 0.19 [0.06] | 35/35 | 35/35 |
| | 2016 Warm season | 3.1 | 2.4 | 9.3 | 0.7 | 0.6 [0.2] | 37/37 | 37/37 |
| | 2017 Warm season | 2.9 | 2.7 | 8.9 | 1.1 | 0.3 [0.1] | 37/37 | 37/37 |
| | 2019 Warm season | 3.8 | 4.1 | 7.8 | 1.3 | 0.8 [0.3] | 36/36 | 36/36 |
| | 2020 Warm season | 3.4 | 4.2 | 7.2 | 1.1 | 0.3 [0.1] | 37/37 | 37/37 |

(Note) No monitoring was conducted in FY2018.

### [16] Perfluorooctanoic acid (PFOA)

・ History and state of monitoring

Perfluorooctanoic acids (PFOA) have been used as water repellent agent, oil repellent agent and surface acting agent. PFOA, its salts and PFOA-related compounds were adopted as target chemicals at the COP9 of the Stockholm convention on Persistent Organic Pollutants held from late April to early May 2019. The substances were designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in April 2021.

As a continuous survey, the first survey was in FY2009. Under the framework of the Environmental Survey and Monitoring of Chemicals after FY2002, the Initial Environmental Survey and the Detailed Environmental Survey etc., the substance was monitored in surface water in FY2002, sediment and wildlife (fish) in FY2003, air in FY2004, surface water, sediment and wildlife (bivalves and fish) in FY2005.

Under the framework of the Environmental Monitoring, the substance was monitored in surface water and sediment in FY2009~2012, FY2014~2016, and FY2018~2020, in wildlife (bivalves, fish and birds) in FY2009~2012, FY2014~2017, FY2019 and FY2020, in air in FY2010~2012, FY2014~2017 and FY2019surface water, sediment, wildlife (bivalves, fish and birds) and air in FY2010~2017, FY2019 and FY2020.

・ Monitoring results

<Surface Water>

The presence of the substance in surface water was monitored at 46 sites, and it was detected at all 46 valid sites adopting the detection limit of 30pg/L, and the detection range was 220 ~ 16,000pg/L.

As results of the inter-annual trend analysis from FY2009 to FY2020, a reduction tendency in specimens from river mouth areas was identified as statistically significant and a reduction tendency in specimens from the overall areas in surface water was also identified as statistically significant.

Stocktaking of the detection of Perfluorooctanoic acid (PFOA) in surface water during FY2009~2020

| Perfluorooctanoic acid (PFOA) | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2009 | 1,600 | 1,300 | 31,000 | 250 | 59 [23] | 49/49 | 49/49 |
| | 2010 | 2,700 | 2,400 | 23,000 | 190 | 60 [20] | 49/49 | 49/49 |
| | 2011 | 2,000 | 1,700 | 50,000 | 380 | 50 [20] | 49/49 | 49/49 |
| | 2012 | 1,400 | 1,100 | 26,000 | 240 | 170 [55] | 48/48 | 48/48 |
| | 2014 | 1,400 | 1,400 | 26,000 | 140 | 50 [20] | 48/48 | 48/48 |
| | 2015 | 1,400 | 1,200 | 17,000 | 310 | 56 [22] | 48/48 | 48/48 |
| | 2016 | 1,300 | 1,200 | 21,000 | 260 | 50 [20] | 48/48 | 48/48 |
| | 2018 | 1,100 | 1,100 | 28,000 | 160 | 70 [30] | 47/47 | 47/47 |
| | 2019 | 1,000 | 900 | 11,000 | 160 | 90 [40] | 48/48 | 48/48 |
| | 2020 | 1,100 | 920 | 16,000 | 220 | 90 [30] | 46/46 | 46/46 |

(Note) No monitoring was conducted in FY2013 and FY2017.

<Sediment>

The presence of the substance in sediment was monitored at 58 sites, and it was detected at 57 of the 58 valid sites adopting the detection limit of 3pg/g-dry, and the detection range was up to 190pg/g-dry.

As results of the inter-annual trend analysis from FY2009 to FY2020, a reduction tendencies in specimens from river areas and river mouth areas were identified as statistically significant.

Stocktaking of the detection of Perfluorooctanoic acid (PFOA) in sediment during FY2009~2020

| Perfluorooctanoic acid (PFOA) | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2009 | 27 | 24 | 500 | nd | 8.3 [3.3] | 182/190 | 64/64 |
| | 2010 | 28 | 33 | 180 | nd | 12 [5] | 62/64 | 62/64 |
| | 2011 | 100 | 93 | 1,100 | 22 | 5 [2] | 64/64 | 64/64 |
| | 2012 | 51 | 48 | 280 | 12 | 4 [2] | 63/63 | 63/63 |
| | 2014 | 44 | 50 | 190 | tr(6) | 11 [5] | 63/63 | 63/63 |
| | 2015 | 48 | 48 | 270 | 8 | 3 [1] | 62/62 | 62/62 |
| | 2016 | 27 | 27 | 190 | nd | 9 [4] | 61/62 | 61/62 |
| | 2018 | 23 | 25 | 190 | nd | 9 [4] | 58/61 | 58/61 |
| | 2019 | 21 | 22 | 190 | tr(3) | 5 [2] | 61/61 | 61/61 |
| | 2020 | 21 | 22 | 190 | nd | 8 [3] | 57/58 | 57/58 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2009.
(Note 2) No monitoring was conducted in FY2013 and FY2017.

<Wildlife>

The presence of the substance in bivalves was monitored in 3 areas, and it was detected at all 3 valid areas adopting the detection limit of 2pg/g-wet, and the detection range was tr(3) ~ 14pg/g-wet. For fish, the presence of the substance was monitored in 18 areas, and it was detected at 12 of the 18 valid areas adopting the detection limit of 2pg/g-wet, and the detection range was up to 49pg/g-wet. For birds, the presence of the substance was monitored in 1 area, and detected in the area adopting the detection limit of 2pg/g-wet, and the detected concentration was 280pg/g-wet.

Although the number of detections was small, the detection rates of specimens from bivalves and fish were decreased, it suggested a reduction tendency of the concentrations.

Stocktaking of the detection of Perfluorooctanoic acid (PFOA) in wildlife (bivalves, fish and birds) during FY2009~2017

| Perfluorooctanoic acid (PFOA) | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Bivalves (pg/g-wet) | 2009 | tr(20) | tr(21) | 94 | nd | 25 [9.9] | 27/31 | 7/7 |
| | 2010 | 28 | 33 | 76 | nd | 26 [9.9] | 5/6 | 5/6 |
| | 2011 | tr(19) | tr(22) | tr(40) | nd | 41 [14] | 3/4 | 3/4 |
| | 2012 | tr(21) | tr(23) | 46 | nd | 38 [13] | 4/5 | 4/5 |
| | 2014 | tr(4) | tr(6) | 10 | nd | 10 [3] | 2/3 | 2/3 |
| | 2015 | tr(6.5) | tr(6.3) | 26 | nd | 10 [3.4] | 2/3 | 2/3 |
| | 2016 | 4 | 7 | 9 | nd | 4 [2] | 2/3 | 2/3 |
| | 2017 | tr(6) | tr(7) | 18 | nd | 12 [4] | 2/3 | 2/3 |
| | 2019 | tr(3) | tr(4) | tr(5) | tr(2) | 6 [2] | 3/3 | 3/3 |
| | 2020 | 6 | tr(5) | 14 | tr(3) | 6 [2] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2009 | tr(23) | tr(19) | 490 | nd | 25 [9.9] | 74/90 | 17/18 |
| | 2010 | tr(13) | tr(11) | 95 | nd | 26 [9.9] | 13/18 | 13/18 |
| | 2011 | nd | nd | 51 | nd | 41 [14] | 7/18 | 7/18 |
| | 2012 | tr(35) | tr(32) | 86 | nd | 38 [13] | 18/19 | 18/19 |
| | 2014 | tr(6) | tr(4) | 85 | nd | 10 [3] | 11/19 | 11/19 |
| | 2015 | tr(5.7) | tr(5.3) | 99 | nd | 10 [3.4] | 11/19 | 11/19 |
| | 2016 | 4 | tr(3) | 20 | tr(2) | 4 [2] | 19/19 | 19/19 |
| | 2017 | tr(6) | tr(4) | 79 | nd | 12 [4] | 12/19 | 12/19 |
| | 2019 | tr(3) | tr(3) | 18 | nd | 6 [2] | 12/16 | 12/16 |
| | 2020 | tr(4) | tr(2) | 49 | nd | 6 [2] | 12/18 | 12/18 |

| Perfluorooctanoic acid (PFOA) | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Birds** (pg/g-wet) | 2009 | 32 | 29 | 58 | tr(16) | 25 [9.9] | 10/10 | 2/2 |
| | 2010 | 38 | --- | 48 | 30 | 26 [9.9] | 2/2 | 2/2 |
| | 2011 | --- | --- | nd | nd | 41 [14] | 0/1 | 0/1 |
| | 2012 | tr(27) | --- | tr(28) | tr(26) | 38 [13] | 2/2 | 2/2 |
| | 2014 | 62 | --- | 2,600 | nd | 10 [3] | 1/2 | 1/2 |
| | 2015 | --- | --- | 31 | 31 | 10 [3.4] | 1/1 | 1/1 |
| | 2016 | 130 | --- | 320 | 52 | 4 [2] | 2/2 | 2/2 |
| | 2017 | 240 | --- | 680 | 85 | 12 [4] | 2/2 | 2/2 |
| | 2019 | --- | --- | 27 | 27 | 6 [2] | 1/1 | 1/1 |
| | 2020 | --- | --- | 280 | 280 | 6 [2] | 1/1 | 1/1 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2009.

(Note 2) " ** " indicates there is no consistency between the results of the ornithological survey after FY2014 and those in previous years because of the changes in the survey sites and target species.

(Note 3) No monitoring was conducted in FY2013 and FY2018.

<Air>

The presence of the substance in air was monitored at 37 sites, and it was detected at all 37 valid sites adopting the detection limit of 0.3pg/m$^3$, and the detection range was 4.9 ~ 55pg/m$^3$.

Stocktaking of the detection of Perfluorooctanoic acid (PFOA) in air during FY2010~2020

| Perfluorooctanoic acid (PFOA) | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Air (pg/m$^3$) | 2010 Warm season | 25 | 26 | 210 | 4.0 | 0.5 [0.2] | 37/37 | 37/37 |
| | 2010 Cold season | 14 | 14 | 130 | 2.4 | | 37/37 | 37/37 |
| | 2011 Warm season | 20 | 18 | 240 | tr(3.5) | 5.4 [1.8] | 35/35 | 35/35 |
| | 2011 Cold season | 12 | 11 | 97 | nd | | 36/37 | 36/37 |
| | 2012 Warm season | 11 | 12 | 120 | 1.9 | 0.7 [0.2] | 36/36 | 36/36 |
| | 2012 Cold season | 6.9 | 6.0 | 48 | 1.6 | | 36/36 | 36/36 |
| | 2013 Warm season | 23 | 23 | 190 | 3.2 | 1.8 [0.6] | 36/36 | 36/36 |
| | 2013 Cold season | 14 | 14 | 53 | 3.0 | | 36/36 | 36/36 |
| | 2014 Warm season | 28 | 29 | 210 | 5.4 | 0.4 [0.1] | 36/36 | 36/36 |
| | 2015 Warm season | 19 | 17 | 260 | tr(3.7) | 4.2 [1.4] | 35/35 | 35/35 |
| | 2016 Warm season | 17 | 15 | 140 | 3.2 | 1.3 [0.4] | 37/37 | 37/37 |
| | 2017 Warm season | 14 | 13 | 150 | tr(2.0) | 3.3 [1.1] | 37/37 | 37/37 |
| | 2019 Warm season | 14 | 14 | 46 | 5.5 | 0.8 [0.3] | 36/36 | 36/36 |
| | 2020 Warm season | 13 | 12 | 55 | 4.9 | 0.8 [0.3] | 37/37 | 37/37 |

(Note) No monitoring was conducted in FY2018.

### [17] Pentachlorobenzene

・ History and state of monitoring

Pentachlorobenzene have been used as used in PCB products, in dyestuff carriers, as a fungicide, a flame retardant and as a chemical intermediate e.g. previously for the production of quintozene. PeCB might still be used as an intermediate. PeCB is also produced unintentionally during combustion, thermal and industrial processes. It also present as impurities in products such as solvents or pesticides.It was historically never registered under the Agricultural Chemicals Regulation Law. The substance is produced as a by-product when agricultural chemicals are produced. In addition, it is generated unintentionally at the time of combustion. The substance was adopted as target chemicals at the COP4 of the Stockholm convention on Persistent Organic Pollutants in May 2009 and designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in April 2010.

As a continuous survey to FY2001, undert the framework “the Wildlife Monitoring of Chemicals,” the substance was monitored in wildlife (bivalves and fish) in FY1980, wildlife (bivalves, fish and birds) from FY1979 to FY1986, in FY1988, FY1990, FY1992, FY1996 and FY1999.

Under the framework of the Environmental Monitoring, the substance was monitored in surface water in FY2007, FY2010~2015 and FY2017~2020, in sediment and wildlife (bivalves, fish and birds) in FY2007 and FY2010~2020, in air in FY2007, FY2009~2020.

・ Monitoring results

<Surface Water>

The presence of the substance in surface water was monitored at 46 sites, and it was detected at all 46 valid sites adopting the detection limit of 1pg/L, and the detection range was tr(2) ~ 500pg/L.

Stocktaking of the detection of Pentachlorobenzene in surface water during FY2007~2020

| Pentachlorobenzene | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2007 | nd | nd | nd | nd | 3,300 [1,300] | 0/48 | 0/48 |
| | 2010 | 8 | 5 | 100 | tr(1) | 4 [1] | 49/49 | 49/49 |
| | 2011 | 11 | 11 | 170 | 2.6 | 2.4 [0.9] | 49/49 | 49/49 |
| | 2012 | 14 | 11 | 170 | 3 | 3 [1] | 48/48 | 48/48 |
| | 2013 | 12 | 10 | 170 | tr(3) | 4 [1] | 48/48 | 48/48 |
| | 2014 | 10 | 7.0 | 180 | 2.8 | 0.8 [0.3] | 48/48 | 48/48 |
| | 2015 | 13 | 11 | 180 | 3.0 | 1.5 [0.5] | 48/48 | 48/48 |
| | 2017 | 8.8 | 5.9 | 140 | 2.0 | 1.4 [0.6] | 47/47 | 47/47 |
| | 2018 | 12 | 9.7 | 320 | 2.7 | 1.3 [0.5] | 47/47 | 47/47 |
| | 2019 | 9 | 7 | 360 | tr(2) | 6 [2] | 48/48 | 48/48 |
| | 2020 | 7 | 5 | 500 | tr(2) | 3 [1] | 46/46 | 46/46 |

(Note) No monitoring was conducted in FY2008, FY2009 and FY2016.

<Sediment>

The presence of the substance in sediment was monitored at 58 sites, and it was detected at all 58 valid sites adopting the detection limit of 0.2pg/g-dry, and the detection range was 1.8 ~ 2,900pg/g-dry.

As results of the inter-annual trend analysis from FY2002 to FY2020, reduction tendency in specimens from sea areas was identified as statistically significant.

Stocktaking of the detection of Pentachlorobenzene in sediment during FY2007~2020

| Pentachlorobenzene | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Sediment (pg/g-dry) | 2007 | tr(46) | nd | 2,400 | nd | 86 [33] | 79/192 | 35/64 |
| | 2010 | 90 | 95 | 4,200 | 1.0 | 0.9 [0.3] | 64/64 | 64/64 |
| | 2011 | 95 | 76 | 4,500 | 3 | 5 [2] | 64/64 | 64/64 |
| | 2012 | 33 | 33 | 1,100 | nd | 2.5 [0.8] | 62/63 | 62/63 |
| | 2013 | 84 | 98 | 3,800 | 2.2 | 2.1 [0.7] | 63/63 | 63/63 |
| | 2014 | 70 | 78 | 3,600 | tr(1.2) | 2.4 [0.8] | 63/63 | 63/63 |
| | 2015 | 65 | 69 | 2,600 | 2.4 | 1.5 [0.5] | 62/62 | 62/62 |
| | 2016 | 62 | 71 | 3,700 | tr(1.1) | 1.8 [0.6] | 62/62 | 62/62 |
| | 2017 | 61 | 61 | 2,800 | 1.3 | 1.2 [0.5] | 62/62 | 62/62 |
| | 2018 | 72 | 77 | 3,400 | 1.2 | 0.9 [0.3] | 61/61 | 61/61 |
| | 2019 | 29 | 27 | 3,300 | 1.2 | 0.9 [0.4] | 61/61 | 61/61 |
| | 2020 | 63 | 65 | 2,900 | 1.8 | 0.4 [0.2] | 58/58 | 58/58 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2007.

(Note 2) No monitoring was conducted in FY2008 and FY2009.

<Wildlife>

The presence of the substance in bivalves was monitored in 3 areas, and it was detected at all 3 valid areas adopting the detection limit of 1pg/g-wet, and the detection range was 8 ~ 9pg/g-wet. For fish, the presence of the substance was monitored in 18 areas, and it was detected at 14 of the 18 valid areas adopting the detection limit of 1pg/g-wet, and the detection range was up to 120pg/g-wet. For birds, the presence of the substance was monitored in 1 area, and detected in the area adopting the detection limit of 1pg/g-wet, and the detected concentration was 390pg/g-wet.

Although the number of detections was small, the detection rate of specimens from the bivalves was decreased, it suggested a reduction tendency of the concentrations.

Stocktaking of the detection of Pentachlorobenzene in wildlife (bivalves, fish and birds) during FY2007~2020

| Pentachlorobenzene | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2007 | nd | nd | tr(150) | nd | 180 [61] | 1/31 | 1/7 |
| | 2010 | 18 | 16 | 110 | 5.9 | 1.9 [0.7] | 6/6 | 6/6 |
| | 2011 | 28 | 16 | 260 | 10 | 4 [1] | 4/4 | 4/4 |
| | 2012 | 16 | 9.7 | 110 | tr(5.8) | 8.1 [2.7] | 5/5 | 5/5 |
| | 2013 | nd | nd | 87 | nd | 78 [26] | 1/5 | 1/5 |
| | 2014 | 14 | 11 | 23 | 10 | 9.3 [3.1] | 3/3 | 3/3 |
| | 2015 | tr(11) | tr(9.7) | 18 | tr(7.4) | 12 [4.0] | 3/3 | 3/3 |
| | 2016 | tr(13) | tr(12) | 15 | tr(11) | 15 [5.1] | 3/3 | 3/3 |
| | 2017 | 18 | 19 | 22 | 14 | 4 [1] | 3/3 | 3/3 |
| | 2018 | tr(8) | tr(7) | tr(13) | tr(5) | 15 [5] | 3/3 | 3/3 |
| | 2019 | 10 | 11 | 14 | 7 | 3 [1] | 3/3 | 3/3 |
| | 2020 | 9 | 9 | 9 | 8 | 3 [1] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2007 | nd | nd | 480 | nd | 180 [61] | 36/80 | 10/16 |
| | 2010 | 42 | 37 | 230 | 5.6 | 1.9 [0.7] | 18/18 | 18/18 |
| | 2011 | 36 | 37 | 220 | 5 | 4 [1] | 18/18 | 18/18 |
| | 2012 | 29 | 37 | 190 | tr(5.0) | 8.1 [2.7] | 19/19 | 19/19 |
| | 2013 | tr(35) | tr(40) | 160 | nd | 78 [26] | 11/19 | 11/19 |
| | 2014 | 38 | 51 | 280 | nd | 9.3 [3.1] | 18/19 | 18/19 |
| | 2015 | 26 | 40 | 230 | nd | 12 [4.0] | 18/19 | 18/19 |
| | 2016 | 19 | 22 | 150 | nd | 15 [5.1] | 16/19 | 16/19 |
| | 2017 | 29 | 32 | 170 | 4 | 4 [1] | 19/19 | 19/19 |
| | 2018 | 19 | 29 | 70 | nd | 15 [5] | 15/18 | 15/18 |
| | 2019 | 20 | 19 | 280 | 3 | 3 [1] | 16/16 | 16/16 |
| | 2020 | 11 | 19 | 120 | nd | 3 [1] | 14/18 | 14/18 |

| Pentachlorobenzene | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Birds** (pg/g-wet) | 2007 | tr(140) | tr(140) | 210 | tr(89) | 180 [61] | 10/10 | 2/2 |
| | 2010 | 91 | --- | 170 | 49 | 1.9 [0.7] | 2/2 | 2/2 |
| | 2011 | --- | --- | 52 | 52 | 4 [1] | 1/1 | 1/1 |
| | 2012 | 77 | --- | 130 | 46 | 8.1 [2.7] | 2/2 | 2/2 |
| | 2013 | 300 | --- | 390 | 230 | 78 [26] | 2/2 | 2/2 |
| | 2014 | 56 | --- | 560 | tr(5.6) | 9.3 [3.1] | 2/2 | 2/2 |
| | 2015 | --- | --- | 53 | 53 | 12 [4.0] | 1/1 | 1/1 |
| | 2016 | 240 | --- | 570 | 100 | 15 [5.1] | 2/2 | 2/2 |
| | 2017 | 130 | --- | 470 | 35 | 4 [1] | 2/2 | 2/2 |
| | 2018 | 370 | --- | 480 | 280 | 15 [5] | 2/2 | 2/2 |
| | 2019 | --- | --- | 470 | 470 | 3 [1] | 1/1 | 1/1 |
| | 2020 | --- | --- | 390 | 390 | 3 [1] | 1/1 | 1/1 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2007.

(Note 2) “ ** ” indicates there is no consistency between the results of the ornithological survey after FY2013 and those in previous years because of the changes in the survey sites and target species.

(Note 3) No monitoring was conducted in FY2008 and FY2009.

<Air>

The presence of the substance in air was monitored at 37 sites, and it was detected at all 37 valid sites adopting the detection limit of 0.07pg/m$^3$, and the detection range was 35 ~ 180pg/m$^3$.

Stocktaking of the detection of Pentachlorobenzene in air during FY2007~2020

| Pentachloro benzene | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Air (pg/m$^3$) | 2007 Warm season | 85 | 83 | 310 | 18 | 12 [4.8] | 78/78 | 26/26 |
| | 2007 Cold season | 60 | 55 | 220 | 27 | | 75/75 | 25/25 |
| | 2009 Warm season | 63 | 64 | 210 | 20 | 6.4 [2.5] | 111/111 | 37/37 |
| | 2009 Cold season | 25 | 22 | 120 | tr(5.0) | | 111/111 | 37/37 |
| | 2010 Warm season | 68 | 73 | 140 | 36 | 1.2 [0.5] | 37/37 | 37/37 |
| | 2010 Cold season | 70 | 69 | 180 | 37 | | 37/37 | 37/37 |
| | 2011 Warm season | 61 | 60 | 140 | 30 | 2.1 [0.70] | 35/35 | 35/35 |
| | 2011 Cold season | 59 | 57 | 180 | 26 | | 37/37 | 37/37 |
| | 2012 Warm season | 58 | 57 | 150 | 31 | 1.8 [0.6] | 36/36 | 36/36 |
| | 2012 Cold season | 55 | 55 | 120 | 27 | | 36/36 | 36/36 |
| | 2013 Warm season | 55 | 58 | 160 | 27 | 1.7 [0.6] | 36/36 | 36/36 |
| | 2013 Cold season | 55 | 52 | 110 | 34 | | 36/36 | 36/36 |
| | 2014 Warm season | 83 | 86 | 210 | 39 | 0.9 [0.3] | 36/36 | 36/36 |
| | 2015 Warm season | 67 | 68 | 170 | 34 | 0.6 [0.2] | 35/35 | 35/35 |
| | 2016 Warm season | 75 | 75 | 220 | 33 | 0.5 [0.2] | 37/37 | 37/37 |
| | 2017 Warm season | 71 | 69 | 200 | 32 | 0.3 [0.1] | 37/37 | 37/37 |
| | 2018 Warm season | 59 | 61 | 100 | 30 | 0.22 [0.08] | 37/37 | 37/37 |
| | 2019 Warm season | 64 | 64 | 110 | 36 | 0.09 [0.04] | 36/36 | 36/36 |
| | 2020 Warm season | 69 | 63 | 180 | 35 | 0.17 [0.07] | 37/37 | 37/37 |

(Note) No monitoring was conducted in FY2008.

## [18] Endosulfans (reference)

・ History and state of monitoring

Endosulfans had been used an insecticide that has been used since the 1950s to control crop pests, tsetse flies and ectoparasites of cattle and as a wood preservative. Endosulfans were adopted as target chemicals at the COP5 of the Stockholm convention on Persistent Organic Pollutants in Apri 2011. The substances were designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in May 2014.

As a continuous survey, the first survey was in FY2011, under the framework of the Environmental Survey of Chemical Substances up to FY2001, the substance was monitored in surface water and sediment in FY1982 and air in FY1996.

Under the framework of the Environmental Monitoring, the substances were monitored in surface water, sediment, wildlife (bivalves, fish and birds) and air in FY2011 and FY2012, in wildlife (bivalves, fish and birds) and air in FY2014 and FY2015 and in air in FY2016 and in surface water, sediment in FY2018.

No monitoring was conducted after FY2019. For reference, the monitoring results up to FY2018 are given below.

・ Monitoring results until FY2018

<Surface Water>

Stocktaking of the detection of $\alpha$-Endosulfan and $\beta$-Endosulfan in surface water during FY2011~2018

| $\alpha$-Endosulfan | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2011 | nd | nd | 180 | nd | 120 [50] | 2/49 | 2/49 |
| | 2012 | nd | nd | 30 | nd | 27 [10] | 3/48 | 3/48 |
| | 2018 | nd | nd | tr(50) | nd | 120 [40] | 1/47 | 1/47 |
| $\beta$-Endosulfan | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2011 | nd | nd | 270 | nd | 22 [9] | 8/49 | 8/49 |
| | 2012 | nd | nd | tr(12) | nd | 24 [9] | 1/48 | 1/48 |
| | 2018 | nd | nd | tr(20) | nd | 30 [10] | 3/47 | 3/47 |

(Note) No monitoring was conducted during FY2013~2017.

<Sediment>

Stocktaking of the detection of $\alpha$-Endosulfan and $\beta$-Endosulfan in sediment during FY2011~2018

| $\alpha$-Endosulfan | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2011 | tr(13) | tr(11) | 480 | nd | 30 [10] | 35/64 | 35/64 |
| | 2012 | nd | nd | 480 | nd | 13 [5] | 19/63 | 19/63 |
| | 2018 | nd | nd | 30 | nd | 5 [2] | 21/61 | 21/61 |
| $\beta$-Endosulfan | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2011 | tr(5) | tr(4) | 240 | nd | 9 [4] | 38/64 | 38/64 |
| | 2012 | nd | nd | 250 | nd | 13 [5] | 8/63 | 8/63 |
| | 2018 | nd | nd | 41 | nd | 5 [2] | 11/61 | 11/61 |

(Note) No monitoring was conducted during FY2013~2017.

<Wildlife>

Stocktaking of the detection of α-Endosulfan and β-Endosulfan in wildlife (bivalves, fish and birds) during FY2011~2015

| α-Endosulfan | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2011 | 62 | 120 | 330 | nd | 50 [20] | 3/4 | 3/4 |
| | 2012 | tr(54) | tr(61) | 200 | nd | 71 [24] | 4/5 | 4/5 |
| | 2014 | tr(20) | nd | 130 | nd | 60 [20] | 1/3 | 1/3 |
| | 2015 | nd | nd | 130 | nd | 120 [38] | 1/3 | 1/3 |
| Fish (pg/g-wet) | 2011 | tr(20) | tr(20) | 140 | nd | 50 [20] | 10/18 | 10/18 |
| | 2012 | nd | nd | tr(54) | nd | 71 [24] | 6/19 | 6/19 |
| | 2014 | nd | nd | tr(30) | nd | 60 [20] | 1/19 | 1/19 |
| | 2015 | nd | nd | tr(49) | nd | 120 [38] | 1/19 | 1/19 |
| Birds* (pg/g-wet) | 2011 | --- | --- | nd | nd | 50 [20] | 0/1 | 0/1 |
| | 2012 | nd | --- | nd | nd | 71 [24] | 0/2 | 0/2 |
| | 2014 | nd | --- | nd | nd | 60 [20] | 0/2 | 0/2 |
| | 2015 | --- | --- | nd | nd | 120 [38] | 0/1 | 0/1 |

| β-Endosulfan | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2011 | 16 | 26 | 52 | 4 | 11 [4] | 4/4 | 4/4 |
| | 2012 | 15 | 16 | 43 | nd | 14 [5] | 4/5 | 4/5 |
| | 2014 | nd | nd | 23 | nd | 19 [6] | 1/3 | 1/3 |
| | 2015 | nd | nd | tr(22) | nd | 32 [11] | 1/3 | 1/3 |
| Fish (pg/g-wet) | 2011 | nd | nd | 37 | nd | 11 [4] | 9/18 | 9/18 |
| | 2012 | nd | nd | 15 | nd | 14 [5] | 6/19 | 6/19 |
| | 2014 | nd | nd | tr(8) | nd | 19 [6] | 3/19 | 3/19 |
| | 2015 | nd | nd | tr(11) | nd | 32 [11] | 1/19 | 1/19 |
| Birds* (pg/g-wet) | 2011 | --- | --- | nd | nd | 11 [4] | 0/1 | 0/1 |
| | 2012 | nd | --- | tr(7) | nd | 14 [5] | 1/2 | 1/2 |
| | 2014 | nd | --- | tr(8) | nd | 19 [6] | 1/2 | 1/2 |
| | 2015 | --- | --- | nd | nd | 32 [11] | 0/1 | 0/1 |

(Note 1) " * " indicates there is no consistency between the results of the ornithological survey after FY2014 and those in previous years because of the changes in the survey sites and target species.
(Note 2) No monitoring was conducted in FY2013.

<Air>

Stocktaking of the detection of α-Endosulfan and β-Endosulfan in air during FY2011~2016

| α-Endosulfan | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| 大気 ($pg/m^3$) | 2011 Warm season | 26 | 24 | 190 | tr(7.8) | 12 [4.0] | 35/35 | 35/35 |
| | 2011 Cold season | tr(9.6) | tr(9.8) | 45 | nd | | 35/37 | 35/37 |
| | 2012 Warm season | 23 | 22 | 98 | tr(6.0) | 16 [5.3] | 36/36 | 36/36 |
| | 2012 Cold season | nd | nd | 19 | nd | | 15/36 | 15/36 |
| | 2014 Warm season | 20 | 23 | 90 | 2.6 | 0.8 [0.3] | 36/36 | 36/36 |
| | 2015 Warm season | 10 | 11 | 140 | 1.6 | 1.0 [0.3] | 35/35 | 35/35 |
| | 2016 Warm season | 8.9 | 9.3 | 46 | 1.0 | 0.8 [0.3] | 37/37 | 37/37 |

| β-Endosulfan | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| 大気 ($pg/m^3$) | 2011 Warm season | 2.1 | 1.8 | 11 | nd | 1.2 [0.39] | 34/35 | 34/35 |
| | 2011 Cold season | tr(0.80) | tr(0.90) | 8.3 | nd | | 31/37 | 31/37 |
| | 2012 Warm season | 1.3 | 1.3 | 18 | nd | 1.2 [0.4] | 33/36 | 33/36 |
| | 2012 Cold season | nd | nd | 1.7 | nd | | 17/36 | 17/36 |
| | 2014 Warm season | 1.3 | 1.4 | 6.1 | nd | 1.2 [0.4] | 33/36 | 33/36 |
| | 2015 Warm season | 0.7 | 0.6 | 38 | nd | 0.5 [0.2] | 33/35 | 33/35 |
| | 2016 Warm season | 0.8 | tr(0.7) | 3.3 | nd | 0.8 [0.3] | 34/37 | 34/37 |

(Note) No monitoring was conducted in FY2013.

### [19] 1,2,5,6,9,10-Hexabromocyclododecanes (reference)

・ History and state of monitoring

1,2,5,6,9,10-Hexabromocyclododecanes have been used a flame retardant additive, providing fire protection during the service life of vehicles, buildings or articles, as well as protection while stored. *α*-1,2,5,6,9,10-Hexabromocyclododecane, *β*-1,2,5,6,9,10-Hexabromocyclododecane and *γ*-1,2,5,6,9,10-Hexabromocyclododecane were adopted as target chemicals at the COP6 of the Stockholm convention on Persistent Organic Pollutants held from late April to early May 2013, and designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in May 2014.

As a continuous survey, the first survey was in FY2011, under the framework of the Environmental Survey of Chemical Substances up to FY2001, the substances were monitored in surface water, sediment and wildlife (fish) in FY1987. In the framework of the Environmental Survey and Monitoring of Chemicals after FY2002 under the Initial Environmental Survey and the Detailed Environmental Survey etc., the substance was monitored in surface water and sediment in FY2003, in wildlife (fish) in FY2004.

Under the framework of the Environmental Monitoring, *α*-1,2,5,6,9,10-Hexabromocyclododecane, *β*-1,2,5,6,9,10-Hexabromocyclododecane, *γ*-1,2,5,6,9,10-Hexabromocyclododecane, *δ*-1,2,5,6,9,10-Hexabromo cyclododecane and *ε*-1,2,5,6,9,10-Hexabromocyclododecan have been monitored in surface water, sediment and wildlife (bivalves, fish and birds) in FY2011, in sediment, wildlife (bivalves, fish and birds) and air in FY2012, surface water, wildlife (bivalves, fish and birds) and air in FY2014 and in sediment, wildlife (bivalves, fish and birds) and air in FY2015. And *α*-1,2,5,6,9,10-Hexabromocyclododecane, *β*-1,2,5,6,9,10-Hexabromocyclododecane and *γ*-1,2,5,6,9,10-Hexabromocyclododecane have been monitored in sediment, wildlife (bivalves, fish and birds) and air in FY2016 in wildlife (bivalves, fish and birds) and air in FY2017 in wildlife (bivalves, fish and birds) in FY2018 in wildlife (bivalves, fish and birds) and air in FY2019.

No monitoring was conducted in FY2020. For reference, the monitoring results up to FY2019 are given below.

・ Monitoring results until FY2019

<Surface Water>

Stocktaking of the detection of 1,2,5,6,9,10-Hexabromocyclododecanes in surface water in FY2011 and FY2014

| *α*-1,2,5,6,9,10-Hexabromocyclododecane | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2011 | nd | nd | 6,300 | nd | 1,500 [600] | 4/47 | 4/47 |
| | 2014 | nd | nd | 1,600 | nd | 1,500 [600] | 1/48 | 1/48 |

| *β*-1,2,5,6,9,10-Hexabromocyclododecane | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2011 | nd | nd | 1,300 | nd | 1,300 [500] | 4/47 | 4/47 |
| | 2014 | nd | nd | tr(300) | nd | 500 [200] | 1/48 | 1/48 |

| *γ*-1,2,5,6,9,10-Hexabromocyclododecane | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2011 | nd | nd | 65,000 | nd | 1,200 [500] | 5/47 | 5/47 |
| | 2014 | nd | nd | nd | nd | 700 [300] | 0/48 | 0/48 |

| *δ*-1,2,5,6,9,10-Hexabromocyclododecane | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2011 | nd | nd | nd | nd | 790 [300] | 0/47 | 0/47 |
| | 2014 | nd | nd | nd | nd | 600 [200] | 0/48 | 0/48 |

| *ε*-1,2,5,6,9,10-Hexabromocyclododecane | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2011 | nd | nd | nd | nd | 740 [300] | 0/47 | 0/47 |
| | 2014 | nd | nd | nd | nd | 400 [200] | 0/48 | 0/48 |

<Sediment>

Stocktaking of the detection of 1,2,5,6,9,10-Hexabromocyclododecanes in sediment during FY2011~2016

| $\alpha$-1,2,5,6,9,10-Hexa bromocyclododecane | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Sediment (pg/g-dry) | 2011 | 430 | nd | 24,000 | nd | 420 [280] | 78/186 | 35/62 |
| | 2012 | 310 | 280 | 22,000 | nd | 180 [70] | 47/63 | 47/63 |
| | 2015 | 390 | 410 | 27,000 | nd | 150 [60] | 47/62 | 47/62 |
| | 2016 | 260 | 210 | 27,000 | nd | 130 [60] | 43/62 | 43/62 |

| $\beta$-1,2,5,6,9,10-Hexa bromocyclododecane | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Sediment (pg/g-dry) | 2011 | nd | nd | 14,000 | nd | 250 [170] | 48/186 | 21/62 |
| | 2012 | tr(93) | nd | 8,900 | nd | 150 [60] | 29/63 | 29/63 |
| | 2015 | 120 | 92 | 7,600 | nd | 150 [60] | 33/62 | 33/62 |
| | 2016 | tr(87) | nd | 7,400 | nd | 130 [50] | 31/62 | 31/62 |

| $\gamma$-1,2,5,6,9,10-Hexa bromocyclododecane | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Sediment (pg/g-dry) | 2011 | 670 | nd | 570,000 | nd | 400 [260] | 89/186 | 36/62 |
| | 2012 | 420 | 330 | 55,000 | nd | 160 [60] | 52/63 | 52/63 |
| | 2015 | 330 | 450 | 60,000 | nd | 110 [42] | 48/62 | 48/62 |
| | 2016 | 250 | 190 | 50,000 | nd | 150 [60] | 42/62 | 42/62 |

| $\delta$-1,2,5,6,9,10-Hexa bromocyclododecane | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Sediment (pg/g-dry) | 2011 | nd | nd | 800 | nd | 350 [250] | 11/186 | 6/62 |
| | 2012 | nd | nd | 680 | nd | 300 [100] | 5/63 | 5/63 |
| | 2015 | nd | nd | nd | nd | 180 [70] | 0/62 | 0/62 |

| $\varepsilon$-1,2,5,6,9,10-Hexa bromocyclododecane | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Sediment (pg/g-dry) | 2011 | nd | nd | tr(260) | nd | 280 [210] | 2/186 | 1/62 |
| | 2012 | nd | nd | 310 | nd | 150 [60] | 7/63 | 7/63 |
| | 2015 | nd | nd | nd | nd | 130 [51] | 0/62 | 0/62 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2011.

(Note 2) No monitoring was conducted in FY2013 and FY2014. No monitoring of $\delta$-1,2,5,6,9,10-Hexabromocyclododecane and $\varepsilon$-1,2,5,6,9,10-Hexabromocyclododecane was conducted in FY2016.

<Wildlife>

Stocktaking of the detection of 1,2,5,6,9,10-Hexabromocyclododecanes in wildlife (bivalves, fish and birds) during FY2011~2019

| $\alpha$-1,2,5,6,9,10-Hexa bromocyclododecane | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2011 | 1,100 | 1,200 | 13,000 | tr(86) | 170 [70] | 10/10 | 4/4 |
| | 2012 | 530 | 480 | 2,500 | 190 | 50 [20] | 5/5 | 5/5 |
| | 2014 | 270 | 270 | 380 | 200 | 30 [10] | 3/3 | 3/3 |
| | 2015 | 260 | 200 | 560 | 150 | 30 [10] | 3/3 | 3/3 |
| | 2016 | 140 | 140 | 180 | 110 | 22 [9] | 3/3 | 3/3 |
| | 2017 | 190 | 200 | 430 | 86 | 24 [9] | 3/3 | 3/3 |
| | 2018 | 120 | 88 | 270 | 76 | 23 [9] | 3/3 | 3/3 |
| | 2019 | 140 | 150 | 260 | 68 | 24 [9] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2011 | 770 | 850 | 69,000 | nd | 170 [70] | 41/51 | 16/17 |
| | 2012 | 510 | 560 | 8,700 | nd | 50 [20] | 18/19 | 18/19 |
| | 2014 | 240 | 290 | 15,000 | nd | 30 [10] | 18/19 | 18/19 |
| | 2015 | 160 | 180 | 3,000 | nd | 30 [10] | 18/19 | 18/19 |
| | 2016 | 110 | 140 | 1,100 | tr(12) | 22 [9] | 19/19 | 19/19 |
| | 2017 | 140 | 140 | 7,800 | tr(9) | 24 [9] | 19/19 | 19/19 |
| | 2018 | 89 | 140 | 530 | nd | 23 [9] | 17/18 | 17/18 |
| | 2019 | 79 | 92 | 980 | nd | 24 [9] | 15/16 | 15/16 |

| α-1,2,5,6,9,10-Hexa bromocyclododecane | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Birds** (pg/g-wet) | 2011 | 200 | nd | 530 | nd | 170 [70] | 1/3 | 1/1 |
| | 2012 | 120 | --- | 1,400 | nd | 50 [20] | 1/2 | 1/2 |
| | 2014 | 480 | --- | 1,800 | 130 | 30 [10] | 2/2 | 2/2 |
| | 2015 | --- | --- | 80 | 80 | 30 [10] | 1/1 | 1/1 |
| | 2016 | 400 | --- | 1,600 | 100 | 22 [9] | 2/2 | 2/2 |
| | 2017 | 330 | --- | 2,200 | 50 | 24 [9] | 2/2 | 2/2 |
| | 2018 | 600 | --- | 610 | 590 | 23 [9] | 2/2 | 2/2 |
| | 2019 | --- | --- | 1,100 | 1,100 | 24 [9] | 1/1 | 1/1 |

| β-1,2,5,6,9,10-Hexa bromocyclododecane | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2011 | tr(70) | tr(85) | 240 | nd | 98 [40] | 7/10 | 3/4 |
| | 2012 | tr(25) | 40 | 90 | nd | 40 [10] | 4/5 | 4/5 |
| | 2014 | tr(10) | tr(10) | tr(20) | tr(10) | 30 [10] | 3/3 | 3/3 |
| | 2015 | tr(10) | tr(10) | 30 | nd | 30 [10] | 2/3 | 2/3 |
| | 2016 | nd | tr(8) | tr(9) | nd | 21 [8] | 2/3 | 2/3 |
| | 2017 | tr(9) | nd | 36 | nd | 23 [9] | 1/3 | 1/3 |
| | 2018 | nd | nd | nd | nd | 22 [8] | 0/3 | 0/3 |
| | 2019 | nd | nd | tr(22) | nd | 24 [9] | 1/3 | 1/3 |
| Fish (pg/g-wet) | 2011 | nd | nd | 760 | nd | 98 [40] | 11/51 | 5/17 |
| | 2012 | nd | nd | 40 | nd | 40 [10] | 8/19 | 8/19 |
| | 2014 | nd | nd | 30 | nd | 30 [10] | 5/19 | 5/19 |
| | 2015 | nd | nd | tr(20) | nd | 30 [10] | 2/19 | 2/19 |
| | 2016 | nd | nd | tr(12) | nd | 21 [8] | 3/19 | 3/19 |
| | 2017 | nd | nd | tr(12) | nd | 23 [9] | 2/19 | 2/19 |
| | 2018 | nd | nd | nd | nd | 22 [8] | 0/18 | 0/18 |
| | 2019 | nd | nd | nd | nd | 24 [9] | 0/16 | 0/16 |
| Birds** (pg/g-wet) | 2011 | nd | nd | nd | nd | 98 [40] | 0/3 | 0/1 |
| | 2012 | nd | --- | nd | nd | 40 [10] | 0/2 | 0/2 |
| | 2014 | nd | --- | nd | nd | 30 [10] | 0/2 | 0/2 |
| | 2015 | --- | --- | nd | nd | 30 [10] | 0/1 | 0/1 |
| | 2016 | nd | --- | nd | nd | 21 [8] | 0/2 | 0/2 |
| | 2017 | nd | --- | nd | nd | 23 [9] | 0/2 | 0/2 |
| | 2018 | nd | --- | nd | nd | 22 [8] | 0/2 | 0/2 |
| | 2019 | --- | --- | nd | nd | 24 [9] | 0/1 | 0/1 |

| γ-1,2,5,6,9,10-Hexa bromocyclododecane | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2011 | 440 | 470 | 3,300 | nd | 210 [80] | 8/10 | 4/4 |
| | 2012 | 170 | 180 | 910 | 30 | 30 [10] | 5/5 | 5/5 |
| | 2014 | 60 | 60 | 110 | 30 | 30 [10] | 3/3 | 3/3 |
| | 2015 | 70 | 90 | 200 | tr(20) | 30 [10] | 3/3 | 3/3 |
| | 2016 | 37 | 39 | 61 | tr(21) | 24 [9] | 3/3 | 3/3 |
| | 2017 | 49 | 30 | 200 | tr(20) | 24 [9] | 3/3 | 3/3 |
| | 2018 | tr(19) | 39 | 46 | nd | 21 [8] | 2/3 | 2/3 |
| | 2019 | 34 | 22 | 140 | tr(13) | 22 [9] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2011 | 210 | tr(90) | 50,000 | nd | 210 [80] | 26/51 | 10/17 |
| | 2012 | 75 | 80 | 1,600 | nd | 30 [10] | 16/19 | 16/19 |
| | 2014 | 30 | tr(20) | 2,800 | nd | 30 [10] | 12/19 | 12/19 |
| | 2015 | tr(20) | tr(10) | 230 | nd | 30 [10] | 10/19 | 10/19 |
| | 2016 | tr(16) | tr(13) | 160 | nd | 24 [9] | 11/19 | 11/19 |
| | 2017 | tr(16) | tr(18) | 120 | nd | 24 [9] | 12/19 | 12/19 |
| | 2018 | tr(11) | tr(11) | 130 | nd | 21 [8] | 10/18 | 10/18 |
| | 2019 | tr(12) | tr(13) | 62 | nd | 22 [9] | 9/16 | 9/16 |
| | | | | | | | Sample | Site |
| Birds** (pg/g-wet) | 2011 | tr(180) | nd | 460 | nd | 210 [80] | 1/3 | 1/1 |
| | 2012 | 31 | --- | 190 | nd | 30 [10] | 1/2 | 1/2 |
| | 2014 | tr(10) | --- | tr(10) | tr(10) | 30 [10] | 2/2 | 2/2 |
| | 2015 | --- | --- | tr(10) | tr(10) | 30 [10] | 1/1 | 1/1 |
| | 2016 | tr(10) | --- | tr(20) | nd | 24 [9] | 1/2 | 1/2 |
| | 2017 | tr(9) | --- | tr(18) | nd | 24 [9] | 1/2 | 1/2 |
| | 2018 | nd | --- | nd | nd | 21 [8] | 0/2 | 0/2 |
| | 2019 | --- | --- | nd | nd | 22 [9] | 0/1 | 0/1 |

| δ-1,2,5,6,9,10-Hexa bromocyclododecane | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2011 | nd | nd | nd | nd | 140 [60] | 0/10 | 0/4 |
| | 2012 | nd | nd | nd | nd | 50 [20] | 0/5 | 0/5 |
| | 2014 | nd | nd | nd | nd | 30 [10] | 0/3 | 0/3 |
| | 2015 | nd | nd | nd | nd | 30 [10] | 0/3 | 0/3 |
| Fish (pg/g-wet) | 2011 | nd | nd | nd | nd | 140 [60] | 0/51 | 0/17 |
| | 2012 | nd | nd | nd | nd | 50 [20] | 0/19 | 0/19 |
| | 2014 | nd | nd | nd | nd | 30 [10] | 0/19 | 0/19 |
| | 2015 | nd | nd | tr(20) | nd | 30 [10] | 1/19 | 1/19 |
| Birds** (pg/g-wet) | 2011 | nd | nd | nd | nd | 140 [60] | 0/3 | 0/1 |
| | 2012 | nd | --- | nd | nd | 50 [20] | 0/2 | 0/2 |
| | 2014 | nd | --- | nd | nd | 30 [10] | 0/2 | 0/2 |
| | 2015 | --- | --- | nd | nd | 30 [10] | 0/1 | 0/1 |

| ε-1,2,5,6,9,10-Hexa bromocyclododecane | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2011 | nd | nd | nd | nd | 140 [60] | 0/10 | 0/4 |
| | 2012 | nd | nd | tr(30) | nd | 40 [20] | 1/5 | 1/5 |
| | 2014 | nd | nd | tr(20) | nd | 30 [10] | 1/3 | 1/3 |
| | 2015 | nd | nd | tr(10) | nd | 30 [10] | 1/3 | 1/3 |
| Fish (pg/g-wet) | 2011 | nd | nd | nd | nd | 140 [60] | 0/51 | 0/17 |
| | 2012 | nd | nd | tr(30) | nd | 40 [20] | 3/19 | 3/19 |
| | 2014 | nd | nd | 80 | nd | 30 [10] | 3/19 | 3/19 |
| | 2015 | nd | nd | tr(10) | nd | 30 [10] | 1/19 | 1/19 |
| Birds** (pg/g-wet) | 2011 | nd | nd | nd | nd | 140 [60] | 0/3 | 0/1 |
| | 2012 | nd | --- | nd | nd | 40 [20] | 0/2 | 0/2 |
| | 2014 | nd | --- | nd | nd | 30 [10] | 0/2 | 0/2 |
| | 2015 | --- | --- | nd | nd | 30 [10] | 0/1 | 0/1 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2011.

(Note 2) " ** " : There is no consistency between the results of the ornithological survey after FY2014 and those in previous years because of the changes in the survey sites and target species.

(Note 3) No monitoring was conducted in FY2013. No monitoring of *δ*-1,2,5,6,9,10-Hexabromocyclododecane and *ε*-1,2,5,6,9,10-Hexabromocyclododecane was conducted after FY2016.

<Air

Stocktaking of the detection of 1,2,5,6,9,10-Hexabromocyclododecanes in air during FY2012~2019

| α-1,2,5,6,9,10-Hexabromo cyclododecane | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air (pg/m$^3$) | 2012 Warm season | 1.7 | 2.2 | 130 | nd | 0.6 [0.2] | 31/36 | 31/36 |
| | 2012 Cold season | 2.9 | 3.0 | 63 | nd | | 35/36 | 35/36 |
| | 2014 Warm season | tr(0.6) | tr(0.7) | 3.1 | nd | 1.2 [0.4] | 25/36 | 25/36 |
| | 2015 Warm season | tr(0.6) | tr(0.7) | 30 | nd | 0.9 [0.3] | 26/35 | 26/35 |
| | 2016 Warm season | 0.5 | 0.5 | 2.4 | tr(0.1) | 0.3 [0.1] | 37/37 | 37/37 |
| | 2017 Warm season | 0.5 | 0.5 | 3.3 | nd | 0.3 [0.1] | 36/37 | 36/37 |
| | 2019 Warm season | 0.5 | 0.5 | 4.1 | nd | 0.3 [0.1] | 35/36 | 35/36 |

| β-1,2,5,6,9,10-Hexabromo cyclododecane | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air (pg/m$^3$) | 2012 Warm season | 0.5 | 0.5 | 29 | nd | 0.3 [0.1] | 30/36 | 30/36 |
| | 2012 Cold season | 0.8 | 0.8 | 18 | nd | | 35/36 | 35/36 |
| | 2014 Warm season | nd | nd | tr(0.8) | nd | 1.0 [0.3] | 8/36 | 8/36 |
| | 2015 Warm season | nd | nd | 3.9 | nd | 0.8 [0.3] | 7/35 | 7/35 |
| | 2016 Warm season | tr(0.1) | tr(0.1) | 0.7 | nd | 0.3 [0.1] | 21/37 | 21/37 |
| | 2017 Warm season | tr(0.2) | tr(0.1) | 0.8 | nd | 0.3 [0.1] | 33/37 | 33/37 |
| | 2019 Warm season | tr(0.13) | tr(0.15) | 1.2 | nd | 0.21 [0.08] | 26/36 | 26/36 |

| γ-1,2,5,6,9,10-Hexabromo cyclododecane | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air ($pg/m^3$) | 2012 Warm season | 1.6 | 1.7 | 280 | nd | 0.3 [0.1] | 31/36 | 31/36 |
| | 2012 Cold season | 2.1 | 1.8 | 84 | nd | | 35/36 | 35/36 |
| | 2014 Warm season | nd | nd | tr(1.2) | nd | 1.3 [0.4] | 4/36 | 4/36 |
| | 2015 Warm season | nd | nd | 4.4 | nd | 0.8 [0.3] | 11/35 | 11/35 |
| | 2016 Warm season | tr(0.1) | nd | 1.4 | nd | 0.3 [0.1] | 16/37 | 16/37 |
| | 2017 Warm season | tr(0.1) | tr(0.1) | 0.8 | nd | 0.3 [0.1] | 20/37 | 20/37 |
| | 2019 Warm season | nd | nd | 1.5 | nd | 0.4 [0.2] | 15/36 | 15/36 |

| δ-1,2,5,6,9,10-Hexabromo cyclododecane | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air ($pg/m^3$) | 2012 Warm season | nd | nd | 0.8 | nd | 0.4 [0.2] | 1/36 | 1/36 |
| | 2012 Cold season | nd | nd | 1.1 | nd | | 1/36 | 1/36 |
| | 2014 Warm season | nd | nd | nd | nd | 1.8 [0.6] | 0/36 | 0/36 |
| | 2015 Warm season | nd | nd | 1.9 | nd | 1.9 [0.6] | 1/35 | 1/35 |

| ε-1,2,5,6,9,10-Hexabromo cyclododecane | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air ($pg/m^3$) | 2012 Warm season | nd | nd | nd | nd | 0.6 [0.2] | 0/36 | 0/36 |
| | 2012 Cold season | nd | nd | tr(0.5) | nd | | 1/36 | 1/36 |
| | 2014 Warm season | nd | nd | nd | nd | 0.9 [0.3] | 0/36 | 0/36 |
| | 2015 Warm season | nd | nd | nd | nd | 0.9 [0.3] | 0/35 | 0/35 |

(Note) No monitoring of α-1,2,5,6,9,10-Hexabromocyclododecane, β-1,2,5,6,9,10-Hexabromocyclododecane and γ-1,2,5,6,9,10-Hexabromocyclododecane was conducted in FY2013 and FY2018. No monitoring of δ-1,2,5,6,9,10-Hexabromocyclododecane and ε-1,2,5,6,9,10-Hexabromocyclododecane was conducted in FY2013 and FY2016~2019.

## [20] Total Polychlorinated Naphthalenes (Total PCNs) (reference)

・ History and results of the monitoring

Polychlorinated Naphthalenes (PCNs) make effective insulating coatings for electrical wires and have been used as wood preservatives, as rubber and plastic additives, for capacitor dielectrics and in lubricants. The substances with over 3 chloric ions were designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in August 1979. And PCNs ($Cl_2$~$Cl_8$) was adopted as target chemicals at the COP7 of the Stockholm convention on Persistent Organic Pollutants in May 2015 and Dichloronaphthalene designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in April 2016.

In previous monitoring series, Polychlorinated Naphthalenes were monitored in wildlife (bivalves, fish and birds) during the period of FY1980~1985 FY1987 FY 1989 FY 1991 and FY 1993 under the framework of "the Wildlife Monitoring."

Under the framework of "the Environmental Monitoring", Polychlorinated Naphthalenes with over a chloric ions have been monitored in wildlife (bivalves, fish and birds) in FY 2006, in surface water, sediment, wildlife (bivalves, fish and birds) and air in FY2008, in air in FY2014, in wildlife (bivalves, fish and birds) in FY2015 and in sediment, wildlife (bivalves, fish and birds) and air in FY2016~2017, in surface water, sediment, wildlife (bivalves, fish and birds) and air in FY2018 and FY2019.

No monitoring was conducted in FY2020. For reference, the monitoring results up to FY2019 are given below.

・ Monitoring results until FY2019

<Surface Water>

Stocktaking of the detection of Total Polychlorinated Naphthalenes in surface water during FY2008~2019

| Total Polychlorinated Naphthalenes | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit* | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2008 | nd | nd | 180 | nd | 85[30] | 9/48 | 9/48 |
| | 2018 | tr(32) | tr(34) | 260 | nd | 35 [12] | 39/47 | 39/47 |
| | 2019 | tr(14) | tr(12) | 260 | nd | 24 [7.5] | 32/48 | 32/48 |

(Note 1) " * " indicates the sum value of the Quantification [Detection] limits of each congener.
(Note 2) No monitoring was conducted during FY2009~2017.

<Sediment>

Stocktaking of the detection of Total Polychlorinated Naphthalenes in sediment during FY2008~2019

| Total Polychlorinated Naphthalenes | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit** | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2008 | 410 | 400 | 28,000 | nd | 84 [30] | 166/189 | 58/63 |
| | 2016 | 760 | 870 | 160,000 | nd | 59 [20] | 59/62 | 59/62 |
| | 2017 | 630 | 800 | 32,000 | tr(16) | 27 [9.1] | 62/62 | 62/62 |
| | 2018 | 680 | 810 | 34,000 | 9.9 | 8.5 [3.2] | 61/61 | 61/61 |
| | 2019 | 600 | 720 | 58,000 | 13 | 7.3 [2.7] | 61/61 | 61/61 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2008.
(Note 2) " ** " indicates the sum value of the Quantification [Detection] limits of each congener.
(Note 3) No monitoring was conducted during FY2009~2015.

<Wildlife>

Stocktaking of the detection of Total Polychlorinated Naphthalenes in wildlife (bivalves, fish and birds) during FY2006~2019

| Total Polychlorinated Naphthalenes | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit** | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Bivalves (pg/g-wet) | 2006 | 98 | 73 | 1.2 | tr(19) | 27 [11] | 31/31 | 7/7 |
| | 2008 | 94 | 73 | 1,300 | tr(11) | 26 [10] | 31/31 | 7/7 |
| | 2015 | 70 | 67 | 580 | nd | 54 [18] | 2/3 | 2/3 |
| | 2016 | 72 | tr(49) | 790 | nd | 57 [19] | 2/3 | 2/3 |
| | 2017 | 46 | 68 | 1,400 | nd | 33 [12] | 2/3 | 2/3 |
| | 2018 | 58 | tr(22) | 700 | tr(13) | 36 [12] | 3/3 | 3/3 |
| | 2019 | 84 | 96 | 820 | nd | 40 [15] | 2/3 | 2/3 |
| Fish (pg/g-wet) | 2006 | 72 | 49 | 2,700 | nd | 27 [11] | 78/80 | 16/16 |
| | 2008 | 59 | 40 | 2,200 | nd | 26 [10] | 79/85 | 17/17 |
| | 2015 | tr(50) | 85 | 390 | nd | 54 [18] | 13/19 | 13/19 |
| | 2016 | tr(44) | tr(48) | 340 | nd | 57 [19] | 13/19 | 13/19 |
| | 2017 | 32 | 51 | 360 | nd | 33 [12] | 17/19 | 17/19 |
| | 2018 | 41 | 36 | 520 | nd | 36 [12] | 16/18 | 16/18 |
| | 2019 | 46 | 78 | 270 | nd | 40 [15] | 12/16 | 12/16 |
| Birds*** (pg/g-wet) | 2006 | tr(17) | tr(18) | 27 | tr(11) | 27 [11] | 10/10 | 2/2 |
| | 2008 | tr(10) | nd | tr(22) | nd | 26 [10] | 5/10 | 1/2 |
| | 2015 | --- | --- | tr(20) | tr(20) | 54 [18] | 1/1 | 1/1 |
| | 2016 | 130 | --- | 320 | tr(49) | 57 [19] | 2/2 | 2/2 |
| | 2017 | 91 | --- | 460 | tr(18) | 33 [12] | 2/2 | 2/2 |
| | 2018 | 230 | --- | 250 | 220 | 36 [12] | 2/2 | 2/2 |
| | 2019 | --- | --- | 170 | 170 | 40 [15] | 1/1 | 1/1 |

(Note 1) “ * ” :Arithmetic mean values were calculated for each point, from which the geometric mean value for all points were derived in FY2006 and FY2008.

(Note 2) “ ** ” indicates the sum value of the Quantification [Detection] limits of each congener.

(Note 3) “ *** ” indicates there is no consistency between the results of the ornithological survey after FY2015 and those in previous years because of the changes in the survey sites and target species.

(Note 4) No monitoring was conducted in FY2007 and FY2009~2014.

<Air>

Stocktaking of the detection of Total Polychlorinated Naphthalenes in sediment during FY2008~2019

| Total Polychlorinated Naphthalenes | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit* | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Air ($pg/m^3$) | 2008 Warm season | 200 | 230 | 660 | 35 | 4.0 [1.3] | 22/22 | 22/22 |
| | 2008 Cold season | tr(9.6) | tr(9.8) | 45 | nd | | 36/36 | 36/36 |
| | 2014 Warm season | 110 | 130 | 1,600 | 5.4 | 2.8 [1.0] | 36/36 | 36/36 |
| | 2016 Warm season | 110 | 130 | 660 | 9.0 | 0.79 [0.28] | 37/37 | 37/37 |
| | 2017 Warm season | 110 | 120 | 920 | 7 | 0.67 [0.24] | 37/37 | 37/37 |
| | 2018 Warm season | 86 | 110 | 590 | 5.3 | 0.5 [0.2] | 37/37 | 37/37 |
| | 2019 Warm season | 100 | 130 | 1,100 | 6.5 | 0.6 [0.2] | 36/36 | 36/36 |

(Note 1) “ * ” indicates the sum value of the Quantification [Detection] limits of each congener.

(Note 2) No monitoring was conducted in FY2009~2013 and FY2015.

## [21] Hexachlorobuta-1,3-diene

・ History and results of the monitoring

Hexachlorobuta-1,3-diene had been used as a solvent for other chlorine-containing compounds. The substance was designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law on April 2005. The substance was adopted as target chemicals at the COP7 of the Stockholm convention on Persistent Organic Pollutants in May 2015.

As a continuous survey, the first survey was in FY2007, under the framework of the Environmental Survey of Chemical Substances up to FY2002, the substance was monitored in surface wate and sediment in FY1981, under the framework of the Environmental Survey and Monitoring of Chemicals after FY2002, in the Initial Environmental Survey and the Detailed Environmental Survey etc., the substance was monitored in surface water and sediment in FY2007.

Under the framework of the Environmental Monitoring, the substances have been monitored in surface water sediment and wildlife (bivalves, fish and birds) in FY2007, FY2013 and FY2020, and in air in FY2015~2020

・ Monitoring results

<Surface Water>

The presence of the substance in surface water was monitored at 46 sites, and it was detected at 1 of the 46 valid sites adopting the detection limit of 40pg/L, and the detected concentration was 490pg/L.

Stocktaking of the detection of Hexachlorobuta-1,3-diene in surface water during FY2007~2020

| Hexachlorobuta 1,3-diene | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2007 | nd | nd | nd | nd | 870 [340] | 0/48 | 0/48 |
| | 2013 | nd | nd | tr(43) | nd | 94 [37] | 1/48 | 1/48 |
| | 2020 | nd | nd | 490 | nd | 100 [40] | 1/46 | 1/46 |

(Note) No monitoring was conducted during FY2008~2012 and FY2013~2019.

<Sediment>

The presence of the substance in sediment was monitored at 58 sites, and it was detected at 2 of the 58 valid sites adopting the detection limit of 10pg/g-dry, and the detection range was up to 180pg/g-dry.

Stocktaking of the detection of Hexachlorobuta-1,3-diene in sediment during FY2007~2020

| Hexachlorobuta 1,3-diene | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2007 | nd | nd | 1,300 | nd | 22 [8.5] | 22/192 | 10/64 |
| | 2013 | nd | nd | 1,600 | nd | 9.9 [3.8] | 40/189 | 20/63 |
| | 2020 | nd | nd | 180 | nd | 30 [10] | 2/58 | 2/58 |

(Note 1) “ * ” :Arithmetic mean values were calculated for each point, from which the geometric mean value for all points were derived in FY2007 and FY2013.

(Note 2) No monitoring was conducted during FY2008~2012 and FY2013~2019.

<Wildlife>

The presence of the substance in bivalves was monitored in 3 areas, and it was detected at 1 of the 3 valid areas adopting the detection limit of 5pg/g-wet, and the detected concentration was tr(7)pg/g-wet. For fish, the presence of the substance was monitored in 18 areas, and it was detected at 8 of the 18 valid areas adopting the detection limit of 5pg/g-wet, and the detection range was up to 19pg/g-wet. For birds, the presence of the substance was monitored in 1 area, and not detected in the area adopting the detection limit of 5pg/g-wet.

Stocktaking of the detection of Hexachlorobuta-1,3-diene in wildlife (bivalves, fish and birds) during FY2007~2020

| Hexachlorobuta 1,3-diene | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Bivalves (pg/g-wet) | 2007 | nd | nd | nd | nd | 36 [12] | 0/31 | 0/7 |
| | 2013 | nd | nd | tr(7.1) | nd | 9.4 [3.7] | 3/13 | 1/5 |
| | 2020 | nd | nd | tr(7) | nd | 13 [5] | 1/3 | 1/3 |
| Fish (pg/g-wet) | 2007 | nd | nd | nd | nd | 36 [12] | 0/80 | 0/16 |
| | 2013 | nd | nd | 59 | nd | 9.4 [3.7] | 7/57 | 4/19 |
| | 2020 | nd | nd | 19 | nd | 13 [5] | 8/18 | 8/18 |
| Birds** (pg/g-wet) | 2007 | nd | nd | nd | nd | 36 [12] | 0/10 | 0/2 |
| | 2013 | nd | nd | nd | nd | 9.4 [3.7] | 0/6 | 0/2 |
| | 2020 | --- | --- | nd | nd | 13 [5] | 0/1 | 0/1 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2007.

(Note 2) " ** " indicates there is no consistency between the results of the ornithological survey after FY2013 and FY2007 because of the changes in the survey sites and target species.

<Air>

The presence of the substance in air was monitored at 37 sites, and it was detected at all 37 valid sites adopting the detection limit of 10pg/m$^3$, and the detection range was 1,500 ~ 9,800pg/m$^3$.

Stocktaking of the detection of Hexachlorobuta-1,3-diene in air during FY2015~2020

| Hexachloro buta 1,3-diene | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Air (pg/m$^3$) | 2015 Warm season | 1,100 | 1,200 | 3,500 | 45 | 29 [11] | 102/102 | 34/34 |
| | 2016 Warm season | 850 | 800 | 4,300 | 510 | 60 [20] | 111/111 | 37/37 |
| | 2017 Warm season | 4,200 | 4,000 | 23,000 | 1,100 | 60 [20] | 37/37 | 37/37 |
| | 2018 Warm season | 3,600 | 3,500 | 8,500 | 150 | 30 [10] | 110/110 | 37/37 |
| | 2019 Warm season | 1,500 | 2,600 | 5,800 | nd | 50 [20] | 104/108 | 35/36 |
| | 2020 Warm season | 2,500 | 2,500 | 9,800 | 1,500 | 30 [10] | 110/110 | 37/37 |

## [22] Pentachlorophenol and its salts and esters (reference)

・ History and state of monitoring

Pentachlorophenol was used as a herbicide, insecticide, fungicide, algaecide, disinfectant and as an ingredient in antifouling paint. Pentachlorophenol and its salts and esters were adopted as target chemicals at the COP7 of the Stockholm convention on Persistent Organic Pollutants in May 2015, and designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in Octorber 2016.

As a continuous survey, the first survey of Pentachlorophenol was in FY2015, under the framework of the Environmental Survey of Chemical Substances up to FY2007, the substance was monitored in surface water and sediment in FY1974 and FY1996, and under the framework of the Environmental Survey and Monitoring of Chemicals after FY2002, in the Initial Environmental Survey and the Detailed Environmental Survey etc., the substance was monitored in surface water in FY2005.

Under the framework of the Environmental Monitoring, Pentachlorophenol was monitored in surface water in FY2015. And Pentachlorophenol and Pentachloroanisole were monitored in wildlife (bivalves, fish and birds) and air in FY2016, in surfacewater, sediment, wildlife (bivalves, fish and birds) and air in FY2017~2019.

No monitoring was conducted in FY2020. For reference, the monitoring results up to FY2020 are given below.

・ Monitoring results until FY2019

<Surface Water>

Stocktaking of the detection of Pentachlorophenol and Pentachloroanisole in surface water during FY2015~2019

| Pentachlorophenol | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2015 | tr(130) | tr(90) | 26,000 | nd | 260 [85] | 25/48 | 25/48 |
| | 2017 | 86 | 110 | 3,500 | nd | 30 [10] | 43/47 | 43/47 |
| | 2018 | 50 | 47 | 4,400 | nd | 24 [9] | 44/47 | 44/47 |
| | 2019 | tr(60) | tr(50) | 3,500 | nd | 60 [20] | 32/48 | 32/48 |
| Pentachloroanisole | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2017 | tr(10) | tr(8) | 1,000 | nd | 14 [5] | 32/47 | 32/47 |
| | 2018 | tr(10) | tr(7) | 230 | nd | 16 [6] | 30/47 | 30/47 |
| | 2019 | tr(10) | nd | 210 | nd | 30 [10] | 20/48 | 20/48 |

(Note) No monitoring was conducted in FY2016. No monitoring of Pentachloroanisole was conducted in FY2015.

<Sediment>

Stocktaking of the detection of Pentachlorophenol and Pentachloroanisole in sediment during FY2017~2019

| Pentachlorophenol | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2017 | 350 | 390 | 7,400 | 8 | 4 [2] | 62/62 | 62/62 |
| | 2018 | 220 | 300 | 3,900 | nd | 18 [6] | 59/61 | 59/61 |
| | 2019 | 260 | 380 | 6,200 | 7 | 6 [2] | 61/61 | 61/61 |
| Pentachloroanisole | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2017 | 34 | 32 | 190 | nd | 5 [2] | 61/62 | 61/62 |
| | 2018 | tr(23) | tr(25) | 160 | nd | 27 [9] | 53/61 | 53/61 |
| | 2019 | 14 | 15 | 140 | nd | 2.1 [0.8] | 60/61 | 60/61 |

<Wildlife>

Stocktaking of the detection of Pentachlorophenol and Pentachloroanisole in wildlife (bivalves, fish and birds) during FY2016~2019

| Pentachlorophenol | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2016 | tr(45) | tr(46) | 65 | tr(30) | 63 [21] | 3/3 | 3/3 |
| | 2017 | nd | nd | tr(35) | nd | 36 [12] | 1/3 | 1/3 |
| | 2018 | tr(20) | tr(20) | 30 | tr(10) | 30 [10] | 3/3 | 3/3 |
| | 2019 | 26 | 26 | 54 | 13 | 10 [4] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2016 | 100 | 130 | 990 | nd | 63 [21] | 18/19 | 18/19 |
| | 2017 | tr(15) | tr(15) | 110 | nd | 36 [12] | 14/19 | 14/19 |
| | 2018 | tr(10) | tr(10) | 80 | nd | 30 [10] | 13/18 | 13/18 |
| | 2019 | 17 | 22 | 57 | nd | 10 [4] | 14/16 | 14/16 |
| Birds (pg/g-wet) | 2016 | 1,200 | --- | 3,100 | 440 | 63 [21] | 2/2 | 2/2 |
| | 2017 | 1,800 | --- | 11,000 | 300 | 36 [12] | 2/2 | 2/2 |
| | 2018 | 460 | --- | 1,200 | 180 | 30 [10] | 2/2 | 2/2 |
| | 2019 | --- | --- | 430 | 430 | 10 [4] | 1/1 | 1/1 |
| Pentachloroanisole | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
| Bivalves (pg/g-wet) | 2016 | 7 | 3 | 35 | 3 | 3 [1] | 3/3 | 3/3 |
| | 2017 | 6 | tr(3) | 36 | tr(2) | 4 [1] | 3/3 | 3/3 |
| | 2018 | 6 | tr(4) | 21 | tr(2) | 6 [2] | 3/3 | 3/3 |
| | 2019 | 4 | tr(2) | 15 | tr(2) | 3 [1] | 3/3 | 3/3 |
| Fish (pg/g-wet) | 2016 | 8 | 6 | 100 | tr(1) | 3 [1] | 19/19 | 19/19 |
| | 2017 | 7 | 5 | 120 | tr(1) | 4 [1] | 19/19 | 19/19 |
| | 2018 | 8 | 7 | 73 | nd | 6 [2] | 16/18 | 16/18 |
| | 2019 | 5 | 6 | 59 | tr(1) | 3 [1] | 16/16 | 16/16 |
| Birds (pg/g-wet) | 2016 | 12 | --- | 14 | 10 | 3 [1] | 2/2 | 2/2 |
| | 2017 | 23 | --- | 47 | 11 | 4 [1] | 2/2 | 2/2 |
| | 2018 | 15 | --- | 20 | 11 | 6 [2] | 2/2 | 2/2 |
| | 2019 | --- | --- | 91 | 91 | 3 [1] | 1/1 | 1/1 |

<Air>

Stocktaking of the detection of Pentachlorophenol and Pentachloroanisole in air during FY2016~2019

| Pentachloro phenol | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air (pg/m$^3$) | 2016 Warm season | 6.3 | 6.0 | 25 | 0.6 | 0.5 [0.2] | 37/37 | 37/37 |
| | 2017 Warm season | 4.6 | 4.8 | 33 | 0.7 | 0.6 [0.2] | 37/37 | 37/37 |
| | 2018 Warm season | 5.1 | 5.8 | 30 | 0.9 | 0.5 [0.2] | 37/37 | 37/37 |
| | 2019 Warm season | 4.1 | 4.2 | 22 | 0.6 | 0.6 [0.2] | 36/36 | 36/36 |
| Pentachloro phenol | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
| Air (pg/m$^3$) | 2016 Warm season | 39 | 42 | 220 | 3.4 | 1.0 [0.4] | 37/37 | 37/37 |
| | 2017 Warm season | 34 | 36 | 210 | 6.0 | 1.2 [0.5] | 37/37 | 37/37 |
| | 2018 Warm season | 34 | 40 | 110 | 4.6 | 1.1 [0.4] | 37/37 | 37/37 |
| | 2019 Warm season | 30 | 32 | 180 | 4.3 | 0.3 [0.1] | 36/36 | 36/36 |

## [23] Short-chain chlorinated paraffins

・ History and state of monitoring

Short-chain chlorinated paraffinsare are used primarily in metalworking applications and in polyvinyl chloride (PVC) plastics. Other uses are adhesives and sealants, leather fat liquors, plastics, and as flame retardants in rubber, textiles and polymeric materials. The substances were adopted as target chemicals at the COP8 of the Stockholm convention on Persistent Organic Pollutants in April-May 2017.

Under the framework of the Initial Environmental Survey and the Detailed Environmental Survey etc., the substances were surveied in surface water, sediment and wildlife (fish) in FY2004 and in surface water, sediment and wildlife (bivalves and fish) in FY2005.

Under the framework of the Environmental Monitoring, the substances have been monitored in wildlife (bivalves, fish and birds) and air in FY2016, and in surface water, sediment, wildlife (bivalves, fish and birds) and air in FY2017~2020.

The results of short-chain chlorinated paraffins are tentative values obtained in trials among various problems in the measurement method.

・ Monitoring results

<Surface water>

Chlorinated decanes: The presence of the substance in surface water was monitored at 46 sites, and it was detected at 16 of the 46 valid sites adopting the detection limit of 200pg/L, and the detection range was up to 1,800pg/L.

Chlorinated undecanes: The presence of the substance in surface water was monitored at 46 sites, and it was detected at 4 of the 46 valid sites adopting the detection limit of 300pg/L, and the detection range was up to 2,400pg/L.

Chlorinated dodecanes: The presence of the substance in surface water was monitored at 46 sites, and it was detected at 4 of the 46 valid sites adopting the detection limit of 300pg/L, and the detection range was up to 2,600pg/L.

Chlorinated tridecanes: The presence of the substance in surface water was monitored at 46 sites, and it was detected at 8 of the 46 valid sites adopting the detection limit of 200pg/L, and the detection range was up to 2,000pg/L.

Stocktaking of the detection of Chlorinated decanes, Chlorinated undecanes, Chlorinated dodecanes and Chlorinated tridecanes in surface water during FY2017~2019

| Chlorinated decanes | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2017 | nd | nd | tr(1,600) | nd | 3,300 [1,100] | 1/47 | 1/47 |
| | 2018 | nd | nd | 1,600 | nd | 1,000 [400] | 8/47 | 8/47 |
| | 2019 | nd | nd | 2,300 | nd | 600 [200] | 17/48 | 17/48 |
| | 2020 | nd | nd | 1,800 | nd | 400 [200] | 16/46 | 16/46 |
| Chlorinated undecanes | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2017 | nd | nd | 3,100 | nd | 1,500 [500] | 13/47 | 13/47 |
| | 2018 | nd | nd | 3,500 | nd | 2,000 [800] | 6/47 | 6/47 |
| | 2019 | nd | nd | 5,000 | nd | 1,400 [500] | 19/48 | 19/48 |
| | 2020 | nd | nd | 2,400 | nd | 900 [300] | 4/46 | 4/46 |
| Chlorinated dodecanes | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2017 | nd | nd | 10,000 | nd | 3,300 [1,100] | 4/47 | 4/47 |
| | 2018 | nd | nd | 3,000 | nd | 3,000 [1,000] | 16/47 | 16/47 |
| | 2019 | nd | nd | 34,000 | nd | 1,000 [400] | 20/48 | 20/48 |
| | 2020 | nd | nd | 2,600 | nd | 700 [300] | 4/46 | 4/46 |

| Chlorinated tridecanes | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Surface Water (pg/L) | 2017 | nd | nd | 10,000 | nd | 3,600 [1,200] | 7/47 | 7/47 |
| | 2018 | nd | nd | 11,000 | nd | 4,500 [1,500] | 18/47 | 18/47 |
| | 2019 | nd | nd | 38,000 | nd | 1,300 [500] | 17/48 | 17/48 |
| | 2020 | nd | nd | 2,000 | nd | 500 [200] | 8/46 | 8/46 |

(Note) Chlorinated paraffins with 5~9 chlorines are target chemicals.

<Sediment>

Chlorinated decanes: The presence of the substance in sediment was monitored at 58 sites, and it was detected at 21 of the 58 valid sites adopting the detection limit of 400pg/g-dry, and the detection range was up to 6,000pg/g-dry.

Chlorinated undecanes: The presence of the substance in sediment was monitored at 58 sites, and it was detected at 25 of the 58 valid sites adopting the detection limit of 500pg/g-dry, and the detection range was up to 6,900pg/g-dry.

Chlorinated dodecanes: The presence of the substance in sediment was monitored at 58 sites, and it was detected at 31 of the 58 valid sites adopting the detection limit of 800pg/g-dry, and the detection range was up to 18,000pg/g-dry.

Chlorinated tridecanes: The presence of the substance in sediment was monitored at 58 sites, and it was detected at 40 of the 58 valid sites adopting the detection limit of 500pg/g-dry, and the detection range was up to 26,000pg/g-dry.

Stocktaking of the detection of Chlorinated decanes, Chlorinated undecanes, Chlorinated dodecanes and Chlorinated tridecanes in sediment during FY2017~2019

| Chlorinated decanes | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Sediment (pg/g-dry) | 2017 | nd | nd | 17,000 | nd | 10,000 [4,000] | 12/62 | 12/62 |
| | 2018 | nd | nd | 7,000 | nd | 6,000 [2,000] | 7/61 | 7/61 |
| | 2019 | nd | nd | 2,600 | nd | 2,000 [1,000] | 8/61 | 8/61 |
| | 2020 | nd | nd | 6,000 | nd | 900 [400] | 21/58 | 21/58 |
| Chlorinated undecanes | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
| Sediment (pg/g-dry) | 2017 | nd | nd | 37,000 | nd | 10,000 [4,000] | 19/62 | 19/62 |
| | 2018 | nd | nd | tr(13,000) | nd | 15,000 [5,000] | 7/61 | 7/61 |
| | 2019 | nd | nd | 5,900 | nd | 2,000 [1,000] | 22/61 | 22/61 |
| | 2020 | tr(600) | nd | 6,900 | nd | 1,200 [500] | 25/58 | 25/58 |
| Chlorinated dodecanes | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
| Sediment (pg/g-dry) | 2017 | nd | nd | 44,000 | nd | 11,000 [4,000] | 19/62 | 19/62 |
| | 2018 | tr(2,000) | nd | 38,000 | nd | 6,000 [2,000] | 28/61 | 28/61 |
| | 2019 | tr(1,100) | nd | 83,000 | nd | 2,000 [1,000] | 27/61 | 27/61 |
| | 2020 | tr(1,300) | tr(1,200) | 18,000 | nd | 2,000 [800] | 31/58 | 31/58 |
| Chlorinated tridecanes | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
| Sediment (pg/g-dry) | 2017 | nd | nd | 94,000 | nd | 12,000 [5,000] | 18/62 | 18/62 |
| | 2018 | nd | nd | 36,000 | nd | 9,000 [3,000] | 24/61 | 24/61 |
| | 2019 | tr(1,700) | tr(1,700) | 60,000 | nd | 2,000 [1,000] | 39/61 | 39/61 |
| | 2020 | 1,400 | tr(1,100) | 26,000 | nd | 1,200 [500] | 40/58 | 40/58 |

(Note) Chlorinated paraffins with 5~9 chlorines are target chemicals.

<Wildlife>

Chlorinated decanes: The presence of the substance in bivalves was monitored in 3 areas, and it was detected at 2 of the 3 valid areas adopting the detection limit of 300pg/g-wet, and the detection range was up to tr(700)pg/g-wet. For fish, the presence of the substance was monitored in 18 areas, and it was detected at 3 of the 18 valid areas adopting the detection limit of 300pg/g-wet, and the detection range was up to tr(500)pg/g-wet. For birds, the presence of the substance was monitored in 1 area, and not detected in the area adopting the detection limit of 300pg/g-wet.

Chlorinated undecanes: The presence of the substance in bivalves was monitored in 3 areas, and it was detected at 2 of the 3 valid areas adopting the detection limit of 300pg/g-wet, and the detection range was up to 1,800pg/g-wet. For fish, the presence of the substance was monitored in 18 areas, and it was detected at 4 of the 18 valid areas adopting the detection limit of 300pg/g-wet, and the detection range was up to 1,400pg/g-wet. For birds, the presence of the substance was monitored in 1 area, and detected in the area adopting the detection limit of 300pg/g-wet, and the detected concentration was 1,100pg/g-wet.

Chlorinated dodecanes: The presence of the substance in bivalves was monitored in 3 areas, and it was detected at 2 of the 3 valid areas adopting the detection limit of 200pg/g-wet, and the detection range was up to 700pg/g-wet. For fish, the presence of the substance was monitored in 18 areas, and it was detected at 2 of the 18 valid areas adopting the detection limit of 200pg/g-wet, and the detection range was up to 1,400pg/g-wet. For birds, the presence of the substance was monitored in 1 area, and not detected in the area adopting the detection limit of 200pg/g-wet.

Chlorinated tridecanes: The presence of the substance in bivalves was monitored in 3 areas, and it was detected at 2 of the 3 valid areas adopting the detection limit of 200pg/g-wet, and the detection range was up to 1,700pg/g-wet. For fish, the presence of the substance was monitored in 18 areas, and it was detected at 2 of the 18 valid areas adopting the detection limit of 200pg/g-wet, and the detection range was up to 1,900pg/g-wet. For birds, the presence of the substance was monitored in 1 area, and detected in the area adopting the detection limit of 200pg/g-wet, and the detected concentration was tr(300)pg/g-wet.

Stocktaking of the detection of Chlorinated decanes, Chlorinated undecanes, Chlorinated dodecanes and Chlorinated tridecanes in wildlife (bivalves, fish and birds) during FY2016~2019

| Chlorinated decanes | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2016 | tr(700) | tr(700) | 2,200 | nd | 1,300 [500] | 2/3 | 2/3 |
| | 2017 | 670 | 1,700 | 1,800 | nd | 500 [200] | 2/3 | 2/3 |
| | 2018 | nd | tr(400) | tr(400) | nd | 1,200 [400] | 2/3 | 2/3 |
| | 2019 | nd | nd | nd | nd | 900 [300] | 0/3 | 0/3 |
| | 2020 | tr(400) | tr(700) | tr(700) | nd | 900 [300] | 2/3 | 2/3 |
| Fish (pg/g-wet) | 2016 | tr(600) | tr(700) | 2,800 | nd | 1,300 [500] | 13/19 | 13/19 |
| | 2017 | tr(410) | tr(400) | 2,100 | nd | 500 [200] | 16/19 | 16/19 |
| | 2018 | nd | nd | tr(800) | nd | 1,200 [400] | 1/18 | 1/18 |
| | 2019 | nd | nd | tr(700) | nd | 900 [300] | 5/16 | 5/16 |
| | 2020 | nd | nd | tr(500) | nd | 900 [300] | 3/18 | 3/18 |
| Birds (pg/g-wet) | 2016 | tr(1,000) | --- | 1,300 | tr(800) | 1,300 [500] | 2/2 | 2/2 |
| | 2017 | tr(400) | --- | 1,600 | nd | 500 [200] | 1/2 | 1/2 |
| | 2018 | nd | --- | tr(600) | nd | 1,200 [400] | 1/2 | 1/2 |
| | 2019 | --- | --- | tr(600) | tr(600) | 900 [300] | 1/1 | 1/1 |
| | 2020 | --- | --- | nd | nd | 900 [300] | 0/1 | 0/1 |
| **Chlorinated undecanes** | **Monitored year** | **Geometric mean*** | **Median** | **Maximum** | **Minimum** | **Quantification [Detection] limit** | **Detection Frequency Sample** | **Detection Frequency Site** |
| Bivalves (pg/g-wet) | 2016 | tr(2,900) | tr(2,000) | 6,000 | tr(2,000) | 3,000 [1,000] | 3/3 | 3/3 |
| | 2017 | 2,200 | 3,400 | 11,000 | tr(300) | 800 [300] | 3/3 | 3/3 |
| | 2018 | nd | nd | nd | nd | 1,800 [700] | 0/3 | 0/3 |
| | 2019 | nd | nd | 600 | nd | 500 [200] | 1/3 | 1/3 |
| | 2020 | tr(700) | 1,300 | 1,800 | nd | 800 [300] | 2/3 | 2/3 |
| Fish (pg/g-wet) | 2016 | tr(2,900) | tr(2,000) | 15,000 | nd | 3,000 [1,000] | 18/19 | 18/19 |
| | 2017 | 1,900 | 1,100 | 24,000 | nd | 800 [300] | 16/19 | 16/19 |
| | 2018 | nd | nd | tr(700) | nd | 1,800 [700] | 1/18 | 1/18 |
| | 2019 | tr(300) | tr(400) | 1,100 | nd | 500 [200] | 11/16 | 11/16 |
| | 2020 | nd | nd | 1,400 | nd | 800 [300] | 4/18 | 4/18 |
| Birds (pg/g-wet) | 2016 | 4,900 | --- | 8,000 | 3,000 | 3,000 [1,000] | 2/2 | 2/2 |
| | 2017 | 5,000 | --- | 31,000 | 800 | 800 [300] | 2/2 | 2/2 |
| | 2018 | nd | --- | nd | nd | 1,800 [700] | 0/2 | 0/2 |
| | 2019 | --- | --- | 1,400 | 1,400 | 500 [200] | 1/1 | 1/1 |
| | 2020 | --- | --- | 1,100 | 1,100 | 800 [300] | 1/1 | 1/1 |

| Chlorinated dodecanes | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2016 | tr(1,400) | tr(1,500) | tr(1,800) | tr(1,100) | 2,100 [700] | 3/3 | 3/3 |
| | 2017 | 2,000 | 1,400 | 4,700 | 1,300 | 900 [300] | 3/3 | 3/3 |
| | 2018 | nd | nd | nd | nd | 1,500 [600] | 0/3 | 0/3 |
| | 2019 | nd | nd | nd | nd | 1,200 [500] | 0/3 | 0/3 |
| | 2020 | tr(300) | tr(500) | 700 | nd | 600 [200] | 2/3 | 2/3 |
| Fish (pg/g-wet) | 2016 | tr(1,800) | tr(1,800) | 8,700 | nd | 2,100 [700] | 17/19 | 17/19 |
| | 2017 | 2,100 | 2,100 | 19,000 | nd | 900 [300] | 18/19 | 18/19 |
| | 2018 | nd | nd | nd | nd | 1,500 [600] | 0/18 | 0/18 |
| | 2019 | nd | nd | tr(900) | nd | 1,200 [500] | 2/16 | 2/16 |
| | 2020 | nd | nd | 1,400 | nd | 600 [200] | 2/18 | 2/18 |
| Birds (pg/g-wet) | 2016 | 3,800 | --- | 6,600 | 2,200 | 2,100 [700] | 2/2 | 2/2 |
| | 2017 | 5,500 | --- | 25,000 | 1,200 | 900 [300] | 2/2 | 2/2 |
| | 2018 | nd | --- | nd | nd | 1,500 [600] | 0/2 | 0/2 |
| | 2019 | --- | --- | tr(500) | tr(500) | 1,200 [500] | 1/1 | 1/1 |
| | 2020 | --- | --- | nd | nd | 600 [200] | 0/1 | 0/1 |

| Chlorinated tridecanes | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] Limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2016 | tr(700) | tr(700) | tr(900) | tr(500) | 1,100 [400] | 3/3 | 3/3 |
| | 2017 | 870 | 700 | 3,100 | tr(300) | 500 [200] | 3/3 | 3/3 |
| | 2018 | nd | nd | nd | nd | 1,400 [500] | 0/3 | 0/3 |
| | 2019 | 500 | 400 | 1,100 | tr(300) | 400 [200] | 3/3 | 3/3 |
| | 2020 | tr(400) | tr(300) | 1,700 | nd | 500 [200] | 2/3 | 2/3 |
| Fish (pg/g-wet) | 2016 | tr(800) | tr(800) | 4,900 | nd | 1,100 [400] | 17/19 | 17/19 |
| | 2017 | tr(290) | nd | 4,100 | nd | 500 [200] | 8/19 | 8/19 |
| | 2018 | nd | nd | nd | nd | 1,400 [500] | 0/18 | 0/18 |
| | 2019 | tr(200) | tr(200) | 1,300 | nd | 400 [200] | 11/16 | 11/16 |
| | 2020 | nd | nd | 1,900 | nd | 500 [200] | 2/18 | 2/18 |
| Birds (pg/g-wet) | 2016 | 1,400 | --- | 1,500 | 1,400 | 1,100 [400] | 2/2 | 2/2 |
| | 2017 | 900 | --- | 8,100 | nd | 500 [200] | 1/2 | 1/2 |
| | 2018 | nd | --- | nd | nd | 1,400 [500] | 0/2 | 0/2 |
| | 2019 | --- | --- | 1,300 | 1,300 | 400 [200] | 1/1 | 1/1 |
| | 2020 | --- | --- | tr(300) | tr(300) | 500 [200] | 1/1 | 1/1 |

(Note) Chlorinated paraffins with 5~9 chlorines are target chemicals.

<Air>

Chlorinated decanes: The presence of the substance in air was monitored at 37 sites, and it was detected at all 37 valid sites adopting the detection limit of 50pg/m$^3$, and the detection range was tr(60) ~ 560pg/m$^3$.

Chlorinated undecanes: The presence of the substance in air was monitored at 37 sites, and it was detected at all 37 valid sites adopting the detection limit of 50pg/m$^3$, and the detection range was tr(50) ~ 1,900pg/m$^3$.

Chlorinated dodecanes: The presence of the substance in air was monitored at 37 sites, and it was detected at 29 of the 37 valid sites adopting the detection limit of 50pg/m3, and the detection range was up to 640pg/m$^3$.

Chlorinated tridecanes: The presence of the substance in air was monitored at 37 sites, and it was detected at 23 of the 37 valid sites adopting the detection limit of 40pg/m$^3$, and the detection range was up to 360pg/m$^3$.

Stocktaking of the detection of Chlorinated decanes, Chlorinated undecanes, Chlorinated dodecanes and Chlorinated tridecanes in air during FY2016~2019

| Chlorinated decanes | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air (pg/m$^3$) | 2016 Warm season | tr(170) | tr(200) | 940 | nd | 290 [110] | 24/37 | 24/37 |
| | 2017 Warm season | 370 | 380 | 1,500 | tr(70) | 140 [50] | 37/37 | 37/37 |
| | 2018 Warm season | 370 | 390 | 1,700 | tr(130) | 150 [60] | 37/37 | 37/37 |
| | 2019 Warm season | 400 | 400 | 1,500 | tr(100) | 400 [100] | 36/36 | 36/36 |
| | 2020 Warm season | 170 | 170 | 560 | tr(60) | 120 [50] | 37/37 | 37/37 |

| Chlorinated undecanes | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Air (pg/m3) | 2016 Warm season | tr(350) | tr(320) | 3,200 | nd | 610 [240] | 20/37 | 20/37 |
| | 2017 Warm season | 500 | 510 | 2,300 | tr(90) | 190 [60] | 37/37 | 37/37 |
| | 2018 Warm season | 450 | 430 | 2,600 | tr(100) | 110 [40] | 37/37 | 37/37 |
| | 2019 Warm season | 400 | 400 | 2,300 | tr(100) | 300 [100] | 36/36 | 36/36 |
| | 2020 Warm season | 220 | 220 | 1,900 | tr(50) | 120 [50] | 37/37 | 37/37 |

| Chlorinated dodecanes | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Air (pg/m3) | 2016 Warm season | nd | nd | 740 | nd | 430 [170] | 7/37 | 7/37 |
| | 2017 Warm season | 190 | 190 | 730 | tr(30) | 100 [30] | 37/37 | 37/37 |
| | 2018 Warm season | 190 | 190 | 880 | tr(60) | 110 [40] | 37/37 | 37/37 |
| | 2019 Warm season | tr(140) | tr(170) | 1,600 | nd | 260 [90] | 23/36 | 23/36 |
| | 2020 Warm season | tr(80) | tr(70) | 640 | nd | 140 [50] | 29/37 | 29/37 |

| Chlorinated tridecanes | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Air (pg/m3) | 2016 Warm season | nd | nd | 510 | nd | 320 [120] | 13/37 | 13/37 |
| | 2017 Warm season | 150 | 160 | 1,600 | nd | 120 [40] | 35/37 | 35/37 |
| | 2018 Warm season | tr(100) | tr(110) | 470 | nd | 180 [70] | 26/37 | 26/37 |
| | 2019 Warm season | tr(90) | tr(90) | 1,600 | nd | 250 [80] | 19/36 | 19/36 |
| | 2020 Warm season | tr(40) | tr(40) | 360 | nd | 100 [40] | 23/37 | 23/37 |

(Note) In FY2016, Chlorinated decanes with 4~6 chlorines and Chlorinated undecanes, Chlorinated dodecanes and Chlorinated tridecanes with 4~7 chlorines are target chemicals. From FY2017 to FY2019, Chlorinated paraffins with 4~7 chlorines are target chemicals. In FY2020, Chlorinated paraffins with 4~8 chlorines are target chemicals.

## [24] Dicofol

・ History and state of monitoring

Dicofol was used as insecticides and mites etc., but the registration of Chlordanes under the Agricultural Chemicals Regulation Law was expired in FY2004. The substance was designated as a Class I Specified Chemical Substance under the Chemical Substances Control Law in April 2005. The substance was adopted as a target chemical at the COP9 of the Stockholm convention on Persistent Organic Pollutants held from late April to early May 2019.

Under the framework of the Initial Environmental Survey and the Detailed Environmental Survey etc., the substance was surveied in sediment in FY2004.

Under the framework of the Environmental Monitoring, the substance has been monitored in wildlife (bivalves, fish and birds) in FY2006, in surface water, sediment and wildlife (bivalves, fish and birds) in FY2008, in air in FY2016, in wildlife (bivalves, fish and birds) in FY2018, and in surface water, sediment, wildlife (bivalves, fish and birds) and air in FY2019 and FY2020.

・ Monitoring results

<Surface Water>

The presence of the substance in surface water was monitored at 46 sites, and it was detected at 1 of the 46 valid sites adopting the detection limit of 5pg/L, and the detected concentration was 30pg/L.

Stocktaking of the detection of Dicofol in surface water during FY2008~2020

| Dicofol | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface Water (pg/L) | 2008 | nd | nd | 76 | nd | 25 [10] | 13/48 | 13/48 |
| | 2019 | nd | nd | 40 | nd | 13 [8] | 3/48 | 3/48 |
| | 2020 | nd | nd | 30 | nd | 13 [5] | 1/46 | 1/46 |

(Note) No monitoring was conducted in FY2009~2018.

<Sediment>

The presence of the substance in sediment was monitored at 58 sites, and it was detected at 23 of the 58 valid sites adopting the detection limit of 5pg/g-dry, and the detection range was up to 77pg/g-dry.

Stocktaking of the detection of Dicofol in sediment during FY2008~2020

| Dicofol | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2008 | nd | nd | 460 | nd | 160 [63] | 13/63 | 30/186 |
| | 2019 | 4 | 4 | 84 | nd | 4 [2] | 40/61 | 40/61 |
| | 2020 | tr(5) | nd | 77 | nd | 13 [5] | 23/58 | 23/58 |

(Note 1) “ * ” :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2008.

(Note 2) No monitoring was conducted in FY2009~2018.

<Wildlife>

The presence of the substance in bivalves was monitored in 3 areas, and it was detected at 1 of the 3 valid areas adopting the detection limit of 10pg/g-wet, and the detected concentration was tr(20)pg/g-wet. For fish, the presence of the substance was monitored in 18 areas, and it was detected at 8 of the 18 valid areas adopting the detection limit of 10pg/g-wet, and the detection range was up to 330pg/g-wet. For birds, the presence of the substance was monitored in 1 area, and not detected in the area adopting the detection limit of 10pg/g-wet.

Stocktaking of the detection of Dicofol in wildlife (bivalves, fish and birds) during FY2006~2020

| Dicofol | Monitored year | Geometric mean* | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Bivalves (pg/g-wet) | 2006 | tr(58) | tr(70) | 240 | nd | 92 [36] | 22/31 | 5/7 |
| | 2008 | tr(110) | 120 | 210 | nd | 120 [48] | 28/31 | 7/7 |
| | 2018 | nd | nd | 30 | nd | 30 [10] | 1/3 | 1/3 |
| | 2019 | nd | nd | tr(10) | nd | 30 [10] | 1/3 | 1/3 |
| | 2020 | nd | nd | tr(20) | nd | 30 [10] | 1/3 | 1/3 |
| Fish (pg/g-wet) | 2006 | nd | nd | 290 | nd | 92 [36] | 5/80 | 1/16 |
| | 2008 | tr(62) | tr(77) | 270 | nd | 120 [48] | 55/85 | 14/17 |
| | 2018 | tr(10) | nd | 280 | nd | 30 [10] | 9/18 | 9/18 |
| | 2019 | tr(10) | tr(10) | 120 | nd | 30 [10] | 12/16 | 12/16 |
| | 2020 | tr(10) | nd | 330 | nd | 30 [10] | 8/18 | 8/18 |
| Birds (pg/g-wet) | 2006 | nd | nd | nd | nd | 92 [36] | 0/10 | 0/2 |
| | 2008 | nd | nd | 300 | nd | 120 [48] | 1/10 | 1/2 |
| | 2018 | nd | --- | nd | nd | 30 [10] | 0/2 | 0/2 |
| | 2019 | --- | --- | nd | nd | 30 [10] | 0/1 | 0/1 |
| | 2020 | --- | --- | nd | nd | 30 [10] | 0/1 | 0/1 |

(Note 1) " * " :Arithmetic mean value was calculated for each point, from which the geometric mean value for all points was derived in FY2006 and FY2008.

(Note 2) No monitoring was conducted in FY2007 and FY2009~2017.

<Air>

The presence of the substance in air was monitored at 37 sites, and it was detected at 3 of the 37 valid sites adopting the detection limit of 0.2pg/m$^3$, and the detection range was up to tr(0.3)pg/m$^3$.

Stocktaking of the detection of Dicofol in air during FY2016~2020

| Dicofol | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] limit | Detection Frequency Sample | Detection Frequency Site |
|---|---|---|---|---|---|---|---|---|
| Air (pg/m$^3$) | 2016 Warm season | nd | nd | 1.0 | nd | 0.5 [0.2] | 10/37 | 10/37 |
| | 2019 Warm season | nd | nd | 0.4 | nd | 0.4 [0.2] | 5/36 | 5/36 |
| | 2020 Warm season | nd | nd | tr(0.3) | nd | 0.5 [0.2] | 3/37 | 3/37 |

(Note 2) No monitoring was conducted in FY2017 and FY2018.

## [25] Perfluorohexane sulfonic acid (PFHxS)

・ History and state of monitoring

Perfluorohexane sulfonic acid (PFHxS) is used as Fluoropolymer processing aid and Surfactant etc. At the fifteenth meeting held from 1 to 4 October 2019, the Committee adopted the risk management evaluation on perfluorohexane sulfonic acid (PFHxS), its salts and PFHxS-related compounds and recommended to the Conference of the Parties that it consider listing the chemicals in Annex A to the Convention without specific exemptions.

Under the framework of the Environmental Monitoring, the substance has been monitored in surface water, and sediment in FY2018 and FY2019, in surface water, sediment, wildlife (bivalves, fish and birds) and air in FY2020.

・ Monitoring results

<Surface Water>

The presence of the substance in surface water was monitored at 46 sites, and it was detected at 44 of the 46 valid sites adopting the detection limit of 20pg/L, and the detection range was up to 1,500pg/L.

Stocktaking of the detection of Perfluorohexane sulfonic acid (PFHxS) in surface water during FY2018~2020

| Perfluorohexane sulfonic acid (PFHxS) | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] Limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Surface water (pg/L) | 2018 | 190 | 130 | 2,600 | nd | 120 [50] | 44/47 | 44/47 |
| | 2019 | 150 | 120 | 1,800 | nd | 60 [30] | 45/48 | 45/48 |
| | 2020 | 160 | 120 | 1,500 | nd | 60 [20] | 44/46 | 44/46 |

<Sediment>

The presence of the substance in sediment was monitored at 58 sites, and it was detected at 13 of the 58 valid sites adopting the detection limit of 3pg/g-dry, and the detection range was up to 10pg/g-dry.

Stocktaking of the detection of Perfluorohexane sulfonic acid (PFHxS) in sediment during FY2018~2020

| Perfluorohexane sulfonic acid (PFHxS) | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] Limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2018 | nd | nd | 27 | nd | 11 [5] | 15/61 | 15/61 |
| | 2019 | nd | nd | 15 | nd | 13 [5] | 10/61 | 10/61 |
| | 2020 | nd | nd | 10 | nd | 6 [3] | 13/58 | 13/58 |

<Wildlife>

The presence of the substance in bivalves was monitored in 3 areas, and it was detected at 2 of the 3 valid areas adopting the detection limit of 2pg/g-wet, and the detection range was up to tr(3)pg/g-wet. For fish, the presence of the substance was monitored in 18 areas, and it was detected at 10 of the 18 valid areas adopting the detection limit of 2pg/g-wet, and the detection range was up to 18pg/g-wet. For birds, the presence of the substance was monitored in 1 area, and detected in the area adopting the detection limit of 2pg/g-wet, and the detected concentration was 190pg/g-wet.

Stocktaking of the detection of Perfluorohexane sulfonic acid (PFHxS) in in wildlife (bivalves, fish and birds) in FY2020

| Perfluorohexane sulfonic acid (PFHxS) | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] Limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Bivalves (pg/g-wet) | 2020 | tr(2) | tr(3) | tr(3) | nd | 5 [2] | 2/3 | 2/3 |
| Fish (pg/g-wet) | 2020 | tr(3) | tr(2) | 18 | nd | 5 [2] | 10/18 | 10/18 |

| Perfluorohexane sulfonic acid (PFHxS) | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] Limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Birds (pg/g-wet) | 2020 | --- | --- | 190 | 190 | 5 [2] | 1/1 | 1/1 |

<Air>

The presence of the substance in air was monitored at 37 sites, and it was detected at all 37 valid sites adopting the detection limit of 0.1pg/m$^3$, and the detection range was 0.7 ~ 6.1pg/m$^3$.

Stocktaking of the detection of Perfluorohexane sulfonic acid (PFHxS) in air in FY2020

| Perfluorohexane sulfonic acid (PFHxS) | Monitored year | Geometric mean | Median | Maximum | Minimum | Quantification [Detection] Limit | Detection Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Sample | Site |
| Sediment (pg/g-dry) | 2020 | 2.5 | 2.4 | 6.1 | 0.7 | 0.3 [0.1] | 37/37 | 37/37 |

●References


i) Environmental Health and Safety Division, Environmental Health Department, Ministry of the Environment, “Chemicals in the Environment,” the Surface Water/Sediment Monitoring (http://www.env.go.jp/chemi/kurohon/)

ii) Environmental Health and Safety Division, Environmental Health Department, Ministry of the Environment, “Chemicals in the Environment,” the Wildlife Monitoring (http://www.env.go.jp/chemi/kurohon/)

iii) Environmental Health and Safety Division, Environmental Health Department, Ministry of the Environment, “Chemicals in the Environment,” the Follow-up Survey of the Status of Pollution by Unintentionally Formed Chemicals (http://www.env.go.jp/chemi/kurohon/)

iv) Environmental Health and Safety Division, Environmental Health Department, Ministry of the Environment, “Chemicals in the Environment,” the Environmental Survey of Chemical Substances (http://www.env.go.jp/chemi/kurohon/)

## Reference: Egg of Great Cormorants (egg yolk and white)

In the FY2020 monitoring survey, eggs of great cormorants were analyzed to check for the presence of 11 chemicals (groups): PCBs, Hexachlorobenzene, Chlordanes Heptachlors, Perfluorooctane sulfonic acid (PFOS), Perfluorooctanoic acids (PFOA), Pentachlorobenzene, Hexachlorobuta-1,3-diene, Short-chain chlorinated paraffins, Dicofol and Perfluorohexane sulfonic acid (PFHxS).

The eggs were taken around Koyaike pond*. The results of the analysis in Table 1.

(Note 1) " * " :The eggs were taken by Water and Air Quality Control Division, Environmental Management Bureau, Agricultural and Environmental Affairs Department, Hyogo Prefectural Government and Green Nature Division, Environmental Policy Office, Department of Citizen Autonomy, Itami City.

Table 1 List of the detection values of egg of Great Cormorant

| No. | Target chemicals | Quantification [Detection] Limits | Egg of Great Cormorant | | (Reposted) Adult of Great Cormorant** |
|---|---|---|---|---|---|
| | | | Koyaike pond (Itami City) | | Lake Biwa (offshore of Tikubu Island) |
| | | | Egg white | Egg yolk | |
| [1] | Total PCBs | 31 [11] | 43,000 | 18,000,000 | 74,000 |
| [2] | HCB | 3 [1] | 110 | 32,000 | 2,900 |
| [7] | Chlordanes | | | | |
| | [7-1] *cis*- Chlordanes | 3 [1] | nd | 1,100 | 83 |
| | [7-2] *trans*- Chlordanes | 6 [2] | nd | 740 | 34 |
| | [7-3] Oxychlordane | 3 [1] | 240 | 51,000 | 820 |
| | [7-4] *cis*- Nonachlor | 3 [1] | 48 | 25,000 | 480 |
| | [7-5] *trans*- Nonachlor | 4 [2] | nd | 1,300 | 81 |
| [8] | Heptachlors | | | | |
| | [8-1] Heptachlor | 3 [1] | nd | nd | nd |
| | [8-2] *cis*- Heptachlor epoxide | 3 [1] | 61 | 7,400 | 270 |
| | [8-3] *trans*- Heptachlor epoxide | 9 [4] | nd | 84 | nd |
| [15] | Perfluorooctane sulfonic acid (PFOS) | 5 [2] | 67 | 15,000 | 8,500 |
| [16] | Perfluorooctanoic acids (PFOA) | 6 [2] | 14 | 1,200 | 280 |
| [17] | Pentachlorobenzene | 3 [1] | 22 | 5,600 | 390 |
| [21] | Hexachlorobuta-1,3-diene | 13 [5] | nd | 29 | nd |
| [23] | Short-chain chlorinated paraffinsare | | | | |
| | [23-1] Chlorinated decanes | 900 [300] | nd | nd | nd |
| | [23-2] Chlorinated undecanes | 800 [300] | nd | nd | 1,100 |
| | [23-3] Chlorinated dodecanes | 600 [200] | nd | 900 | nd |
| | [23-4] Chlorinated tridecanes | 500 [200] | nd | 1,000 | tr(300) |
| [24] | Dicofol | 30 [10] | nd | 30 | nd |
| [25] | Perfluorohexane sulfonic acid (PFHxS) | 5 [2] | 9 | 1,400 | 190 |

(Note 1) "*" indicates the sum value of the Quantification [Detection] limits of each congener.
(Note 2) "**" indicates these values are previously mentioned in the main part but are mentioned here again to indicate the stage of life cycle of great cormorants from egg to adult.