

# Chapter 4 Summary of the FY2002 Monitoring Investigation

## 1. Purpose of the survey

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

## 2. Surveyed substances and areas

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

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

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

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

### 3. Analytical method

Suggested analytical methods are shown in Appendix D.

### 4. Method of assessment

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

#### 4.1 Study of the continuity of the Monitoring Investigation

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

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

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

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

#### (1) Change in target substances and media

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

## **(2) Change in survey areas**

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

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

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

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

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

## **(3) Change in quantitation (detection) limit**

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

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

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

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

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

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

† Quantitation limit is defined as 3 times the detection limit.

† Detection status (e.g. detected number/total sample number) is to be judged by the detection limit.

† In calculating “geometric mean”, measured values are to be used when the values are above the detection limit and one half of the observed values are to be used when the values are below the detection limit.

† In describing “geometric mean”, “median value”, etc., observed values are to be expressed as “trace” when the values are below the quantitation limit, and as “not detected (ND)” when the values are below the detection limit.

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

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

##### **a. PCBs**

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

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

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

##### **b. Organochlorinated compounds other than PCBs**

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

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

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

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

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

### **c. Organotin compounds**

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

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

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

## 4.2 Policy of assessment

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

## 5. Survey results

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

† Figure 4-1: PCBs

† Figure 4-2: HCB

† Figure 4-3: Dieldrin

† Figure 4-4: Endrin

† Figure 4-5: *p,p'*-DDT

† Figure 4-6: *p,p'*-DDE

† Figure 4-7: *p,p'*-DDD

† Figure 4-8: *trans*-Chlordane

† Figure 4-9: *cis*-Chlordane

† Figure 4-10: *trans*-Nonachlor

† Figure 4-11: *cis*-Nonachlor

† Figure 4-12: Oxychlordane

† Figure 4-13:  $\alpha$ -HCH

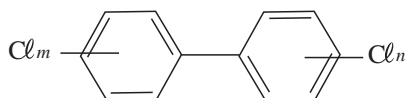
† Figure 4-14:  $\beta$ -HCH

† Figure 4-15: TBT

† Figure 4-16: TPT

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

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



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

Melting point: (mixture)

Boiling point: (mixture)

Water solubility ( $S_w$ ): (mixture)

Specific gravity: (mixture)

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

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

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

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

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

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

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

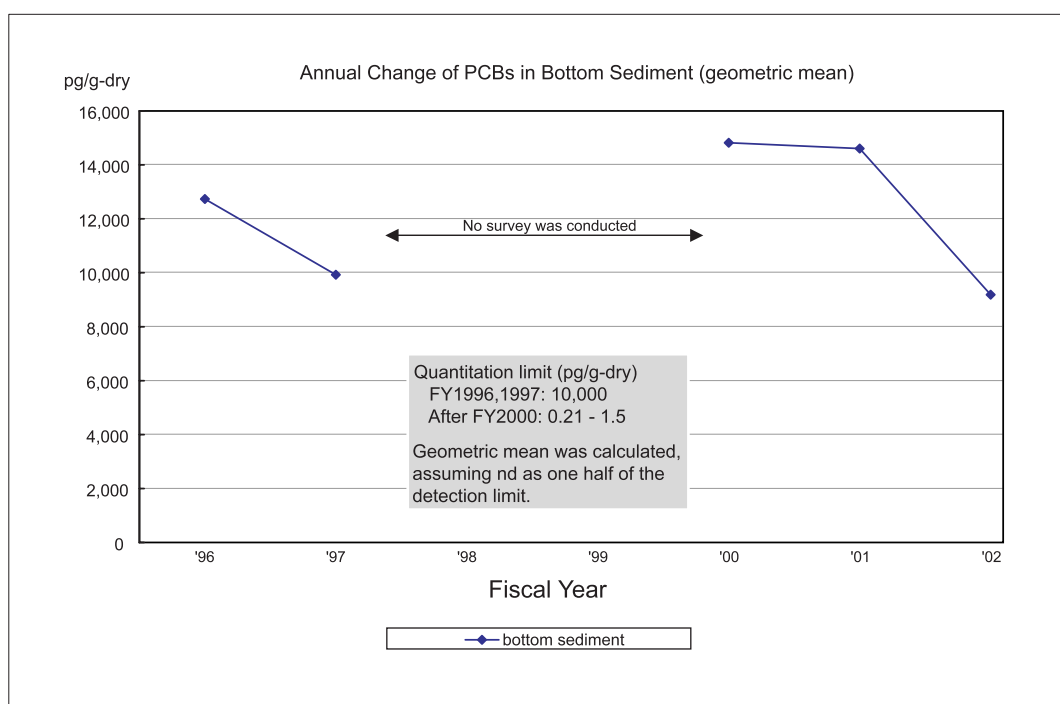
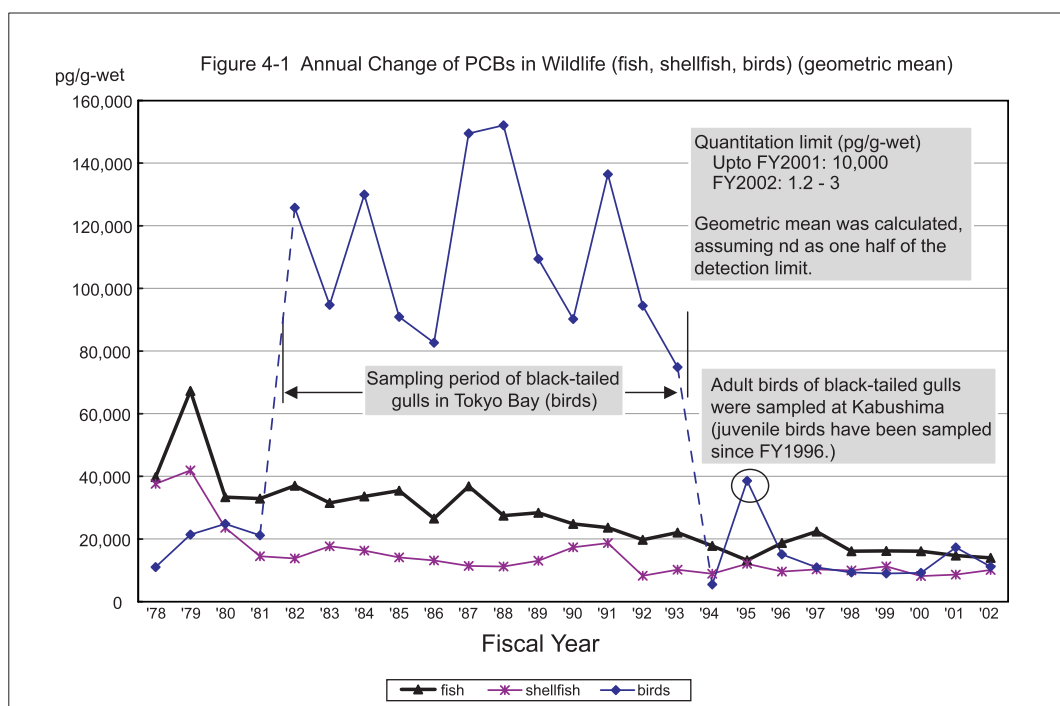
PCBs are substances included in the POPs Treaty, and also from the standpoint of global pollution monitoring, it is necessary to continue the monitoring to trace their fate. As the disposal of PCBs by decomposition has been started, its effects and influences must be taken into account. Furthermore,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



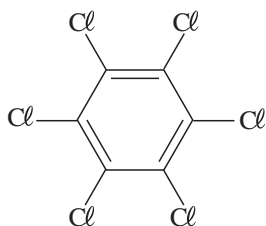
○ Survey Results of PCBs

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

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



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



Chemical formula / molecular weight:  $C_6Cl_6$  / 284.78

Melting point:  $231^\circ C$ <sup>1)</sup>,  $230^\circ C$ <sup>2)</sup>

Boiling point:  $323-326^\circ C$ <sup>1)</sup>,  $332^\circ C$ <sup>2)</sup>

Water solubility (Sw):  $0.005-0.035\text{ mg/L}$ <sup>1)</sup>, insoluble  $0.0062\text{ mg/L}$ <sup>2)</sup>

Specific gravity:  $2.044-2.44$ <sup>1)</sup>

*n*-Octanol/water partition coefficient (LogPow):  $5.23-6.18$ <sup>1)</sup>

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

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

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

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

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

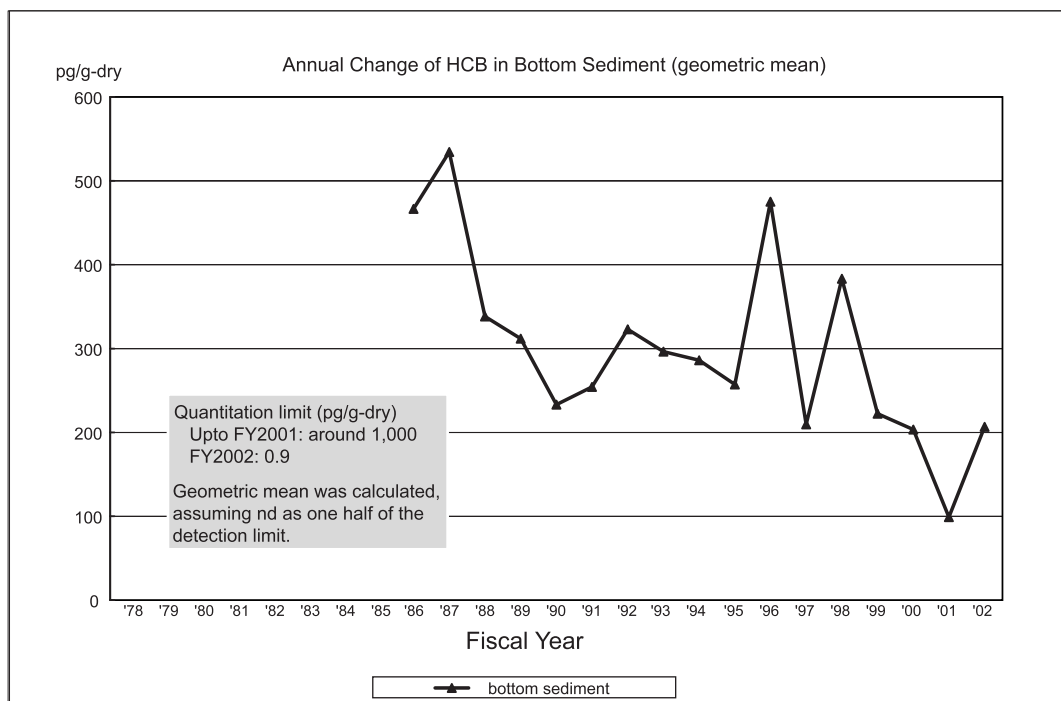
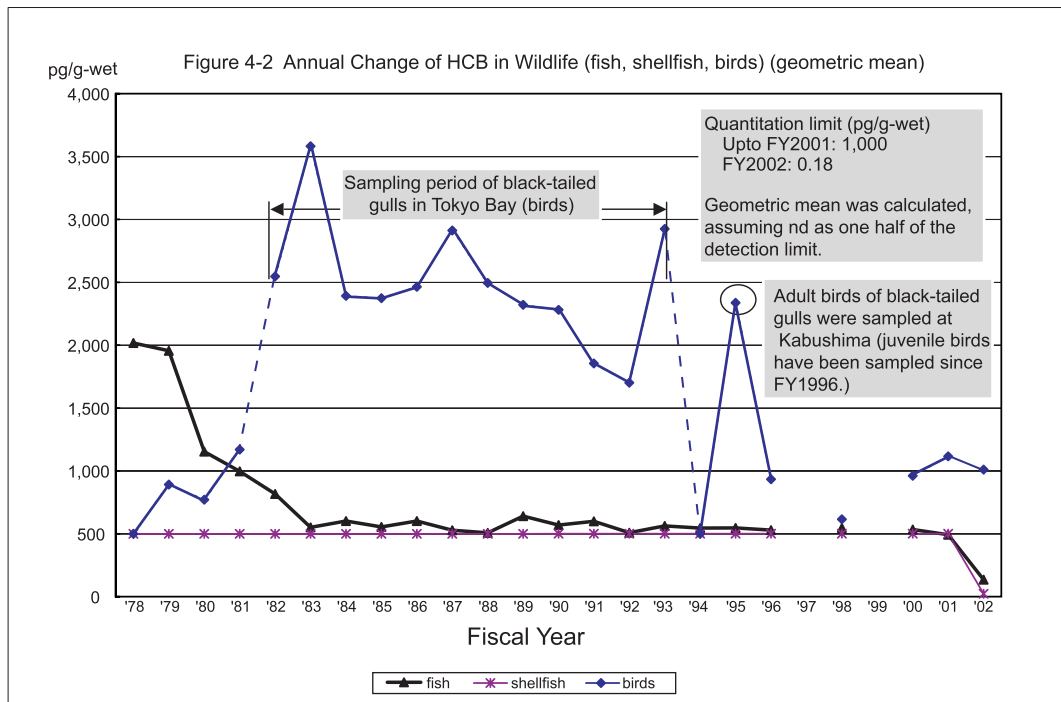
Although it is difficult to grasp the tendency of its persistence in air as the monitoring of HCB in air was only initiated in FY2002, persistence of HCB in widespread areas is recognized.

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

○Survey Results of HCB

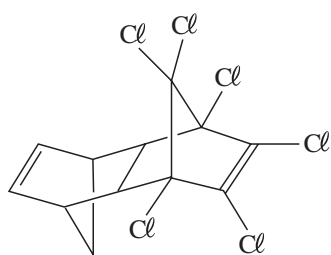
Substance	Unit	Geometric mean	Detected range	MQL	Detection frequency (area)	
Surface water	pg/L	36	9.8 - 1,400	0.6 0.06	38/38	
Bottom sediment	pg/g-dry	210	7.6 - 19,000	0.9	63/63	
Wildlife	Fish	pg/g-wet	140	19 - 910	0.18	14/14
	Shellfish	pg/g-wet	23	2.4 - 330	0.18	8/8
	Birds	pg/g-wet	1,000	560 - 16,000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

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



**[3] Drins (Aldrin, Dieldrin, Endrin)**

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



Chemical formula / molecular weight: C<sub>12</sub>H<sub>8</sub>Cl<sub>6</sub> / 364.91

Melting point: 101-105°C<sup>1)</sup>, 104°C<sup>2)</sup>

Boiling point: 145°C<sup>2)</sup>

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

Specific gravity: 1.65<sup>1)</sup>

*n*-Octanol/water partition coefficient (LogPow): 3.01-6.75<sup>1)</sup>

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

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

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

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

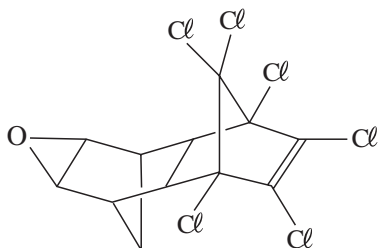
Concentration of aldrin in air was initiated in FY2002 and its persistence was detected in widespread areas.

○Survey Results of Aldrin

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

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

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



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

Melting point:  $150-175^{\circ}C$ <sup>1)</sup>,  $176^{\circ}C$ <sup>2)</sup>

Boiling point:  $385^{\circ}C$ <sup>2)</sup>

Water solubility (Sw): 0.022-0.25 mg/L ( $25^{\circ}C$ )<sup>1)</sup>, insoluble 0.2 mg/L<sup>2)</sup>

Specific gravity: 1.75<sup>1)</sup>

*n*-Octanol/water partition coefficient (LogPow): 4.7-5.61<sup>1)</sup>

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

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

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

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

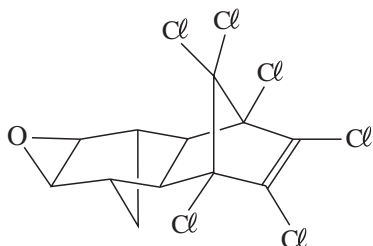
Monitoring of dieldrin in air was initiated in FY2002 and its persistence was detected in widespread areas.

#### ○Survey Results of Dieldrin

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

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

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



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

Melting point:  $200-230^{\circ}C$ <sup>1)</sup>,  $200^{\circ}C$ <sup>2)</sup>

Boiling point:  $245^{\circ}C$ <sup>2)</sup>

Water solubility ( $S_w$ ):  $0.024\text{ mg/L}$ <sup>1)</sup>,  $0.26\text{ mg/L}$ <sup>2)</sup>

Specific gravity: Unknown

*n*-Octanol/water partition coefficient (LogPow):  $5.22$ <sup>1)</sup>

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

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

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

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

#### ○Survey Results of Endrin

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

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

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

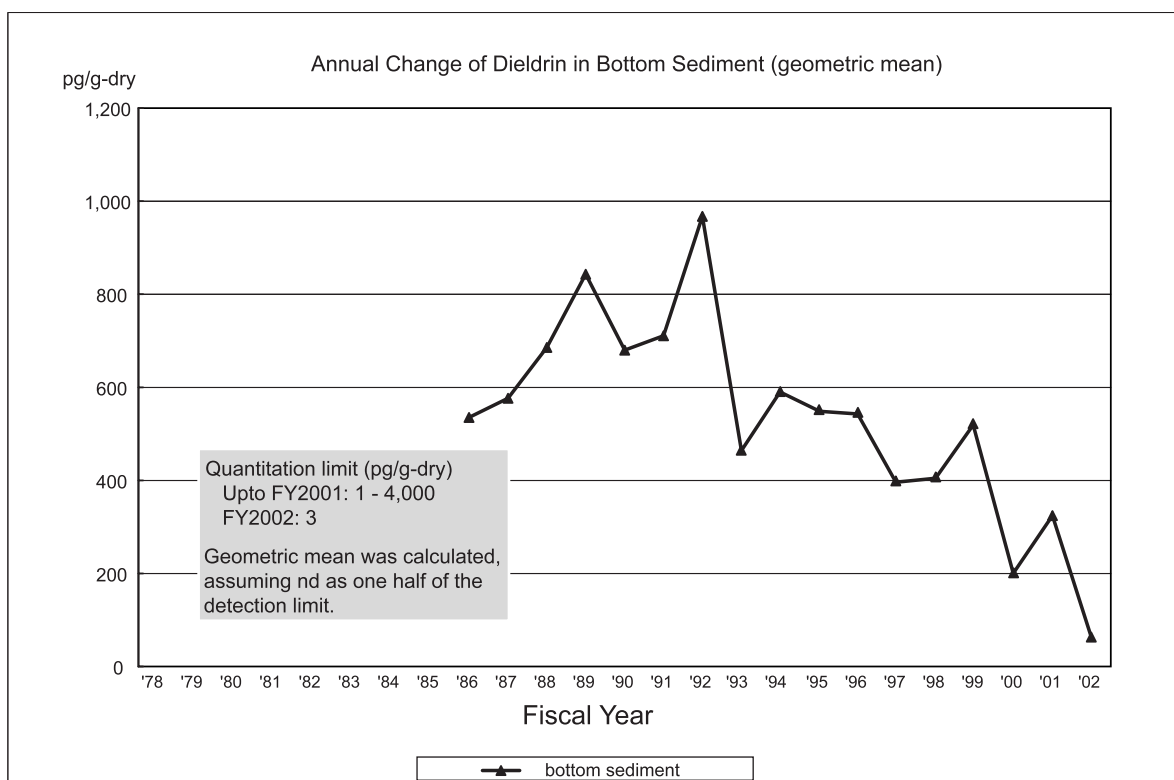
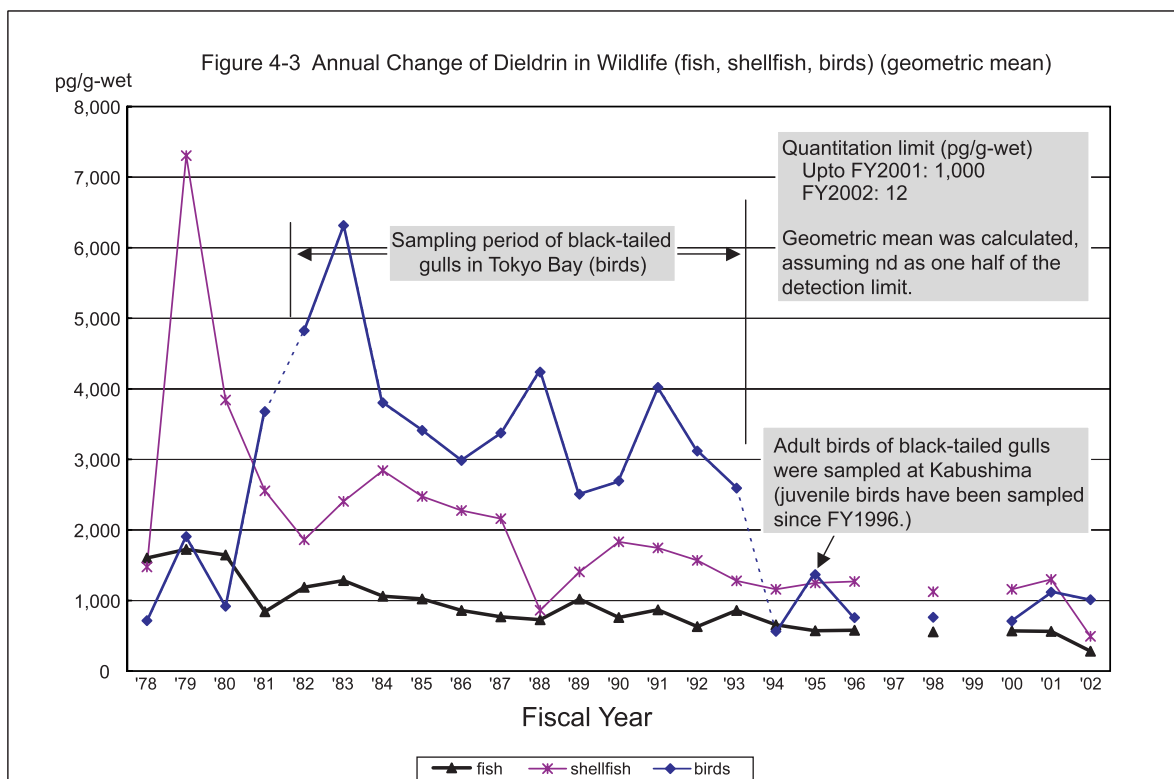
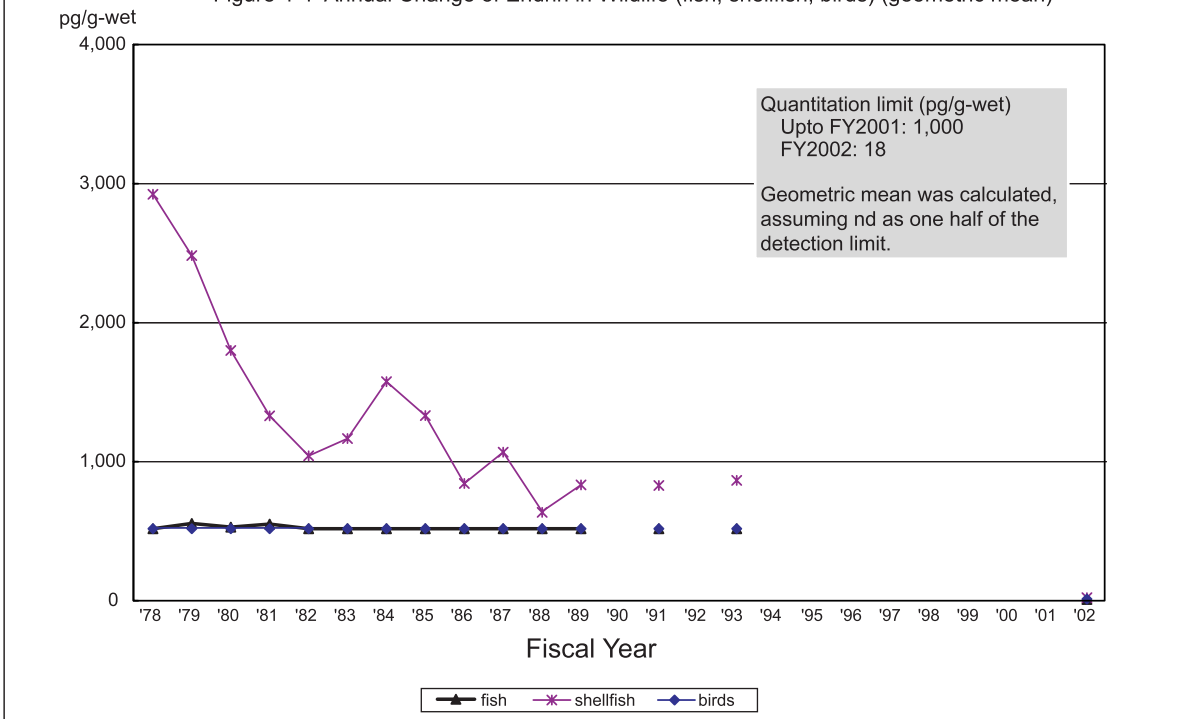


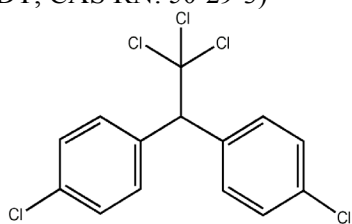
Figure 4-4 Annual Change of Endrin in Wildlife (fish, shellfish, birds) (geometric mean)





#### [4] DDTs

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



Chemical formula / molecular weight: C<sub>14</sub>H<sub>9</sub>Cl<sub>5</sub> / 354.49

Melting point: 108.5-109°C<sup>1)</sup>

Boiling point: Unknown

Water solubility (S<sub>w</sub>): 0.0012-0.0031 mg/L (25°C)<sup>1)</sup>

Specific gravity: Unknown

*n*-Octanol/water partition coefficient (LogPow): 6.19-6.38<sup>1)</sup>

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

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

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

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

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

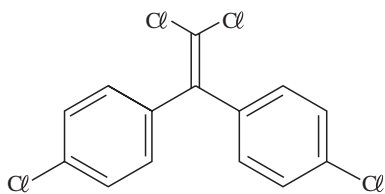
Monitoring of *p,p'*-DDT in air was initiated in FY2002 and its persistence was recognized in widespread areas.

#### ○ Survey Results of *p,p'*-DDT

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

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

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



Chemical formula / molecular weight: C<sub>14</sub>H<sub>8</sub>Cl<sub>4</sub> / 318.03

Melting point: Unknown

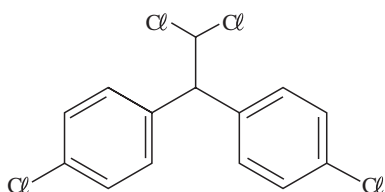
Boiling point: Unknown

Water solubility (Sw): Unknown

Specific gravity: Unknown

*n*-Octanol/water partition coefficient (LogPow): 6.51<sup>1)</sup>

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



Chemical formula / molecular weight: C<sub>14</sub>H<sub>10</sub>Cl<sub>4</sub> / 320.04

Melting point: 110°C<sup>1)</sup>, 109°C<sup>2)</sup>

Boiling point: 193°C<sup>2)</sup>

Water solubility (Sw): 0.16 mg/L<sup>2)</sup>

Specific gravity: 1.385<sup>2)</sup>

*n*-Octanol/water partition coefficient (LogPow): 6.02<sup>1)</sup>

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

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

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

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

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

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

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

○Survey Results of *p,p'*-DDE

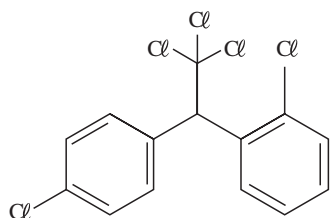
Substance	Unit	Geometric mean	Detected range	MQL	Detection frequency (area)	
Surface water	pg/L	24	1.3 - 760	0.6 0.06	38/38	
Bottom sediment	pg/g-dry	660	8.4 - 23,000	2.7	63/63	
Wildlife	Fish	pg/g-wet	2,500	510 - 98,000	2.4	14/14
	Shellfish	pg/g-wet	1,100	140 - 6,000	2.4	8/8
	Birds	pg/g-wet	36,000	8,100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

○Survey Results of *p,p'*-DDD

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

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

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



Chemical formula / molecular weight: C<sub>14</sub>H<sub>9</sub>Cl<sub>5</sub> / 354.49

Melting point: 74-74.5°C<sup>1)</sup>

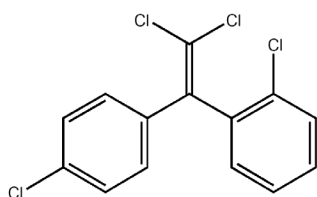
Boiling point: Unknown

Water solubility (Sw): 0.0012-0.0017 mg/L<sup>1)</sup>

Specific gravity: Unknown

*n*-Octanol/water partition coefficient (LogPow): 5.98<sup>1)</sup>

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



Chemical formula / molecular weight: C<sub>14</sub>H<sub>8</sub>Cl<sub>4</sub> / 318.03

Melting point: Unknown

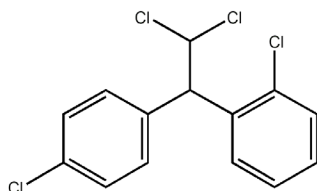
Boiling point: Unknown

Water solubility (Sw): Unknown

Specific gravity: Not known

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

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



Chemical formula / molecular weight: C<sub>14</sub>H<sub>10</sub>Cl<sub>4</sub> / 320.04

Melting point: 76°C<sup>2)</sup>

Boiling point: Unknown

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

Specific gravity: Unknown

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

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

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

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

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

○Survey Results of *o,p'*-DDT

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

○Survey Results of *o,p'*-DDE

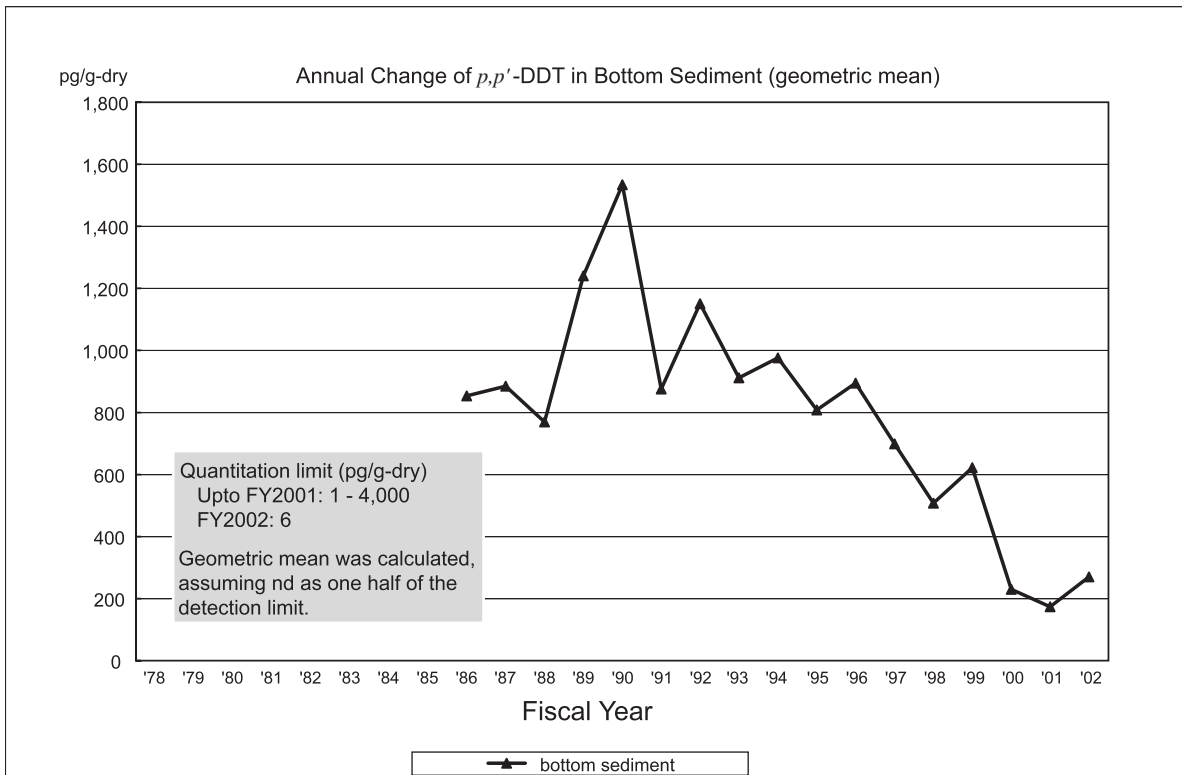
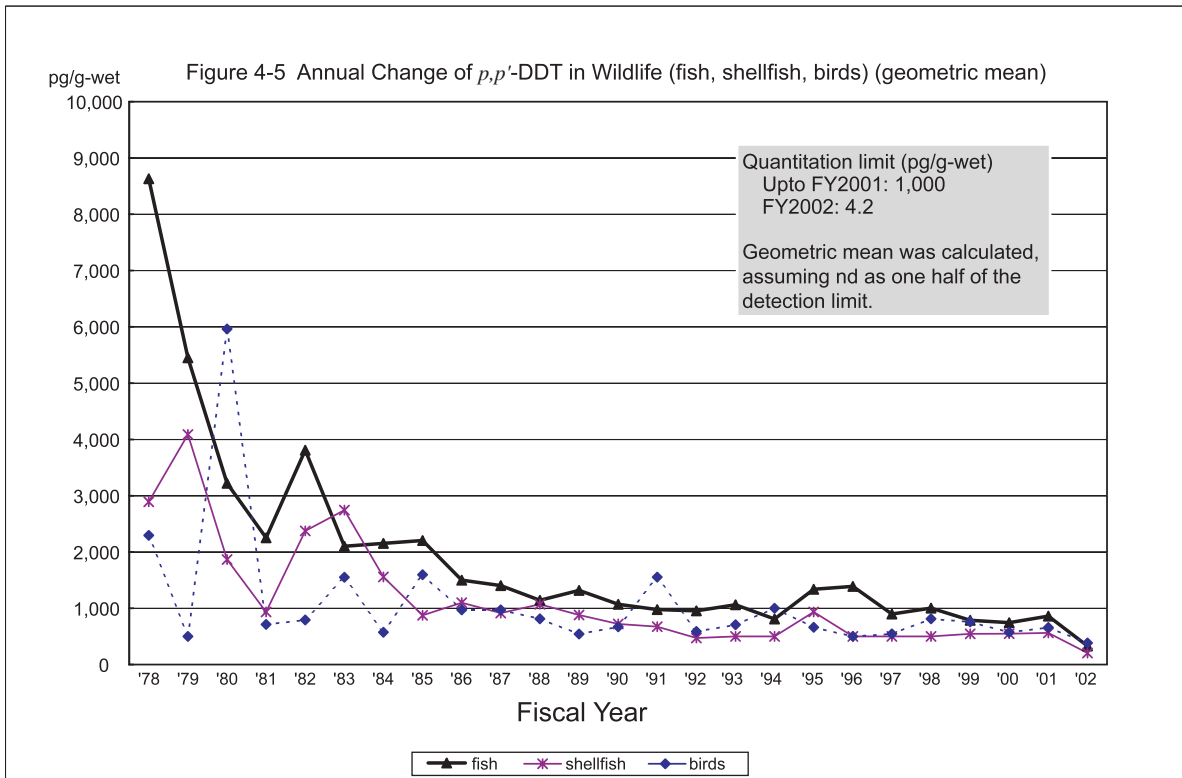
Substance	Unit	Geometric mean	Detected range	MQL	Detection frequency (area)	
Surface water	pg/L	2.3	0.25 - 680	0.9 0.09	38/38	
Bottom sediment	pg/g-dry	46	tr(1) - 16,000	3	63/63	
Wildlife	Fish	pg/g-wet	77	3.6 - 13,000	3.6	14/14
	Shellfish	pg/g-wet	88	13 - 1,100	3.6	8/8
	Birds	pg/g-wet	28	20 - 49	3.6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

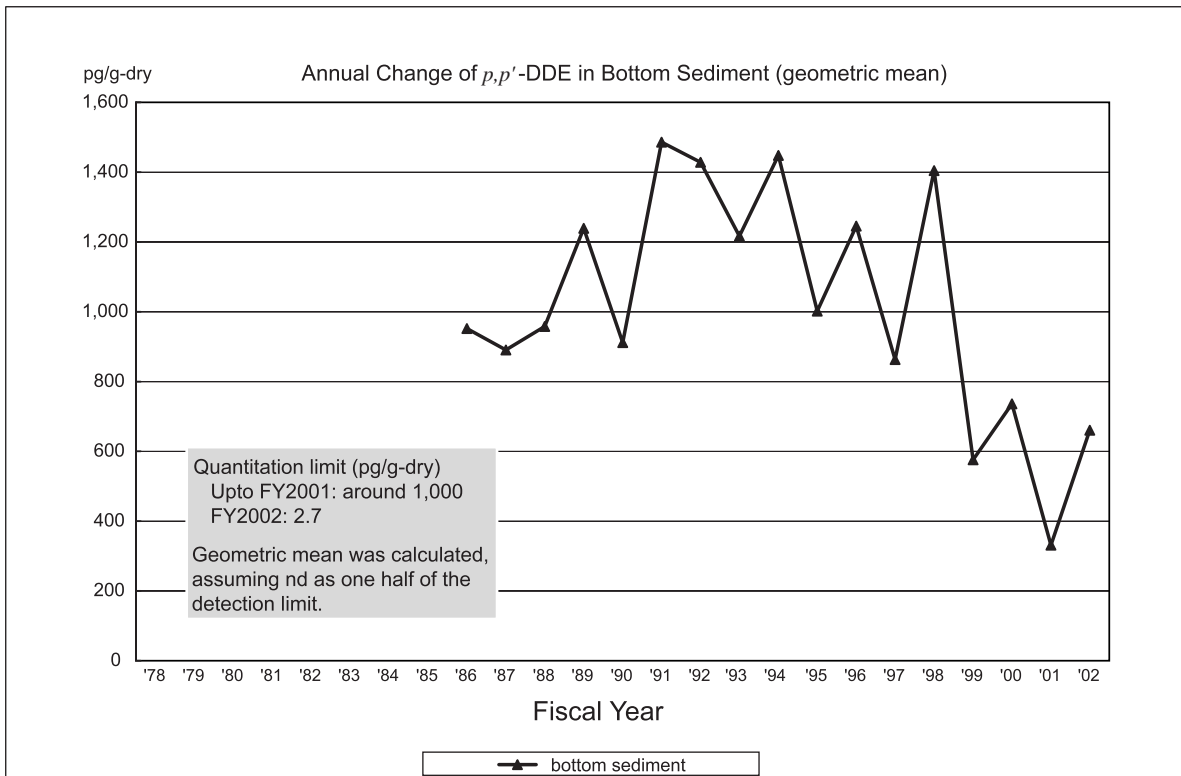
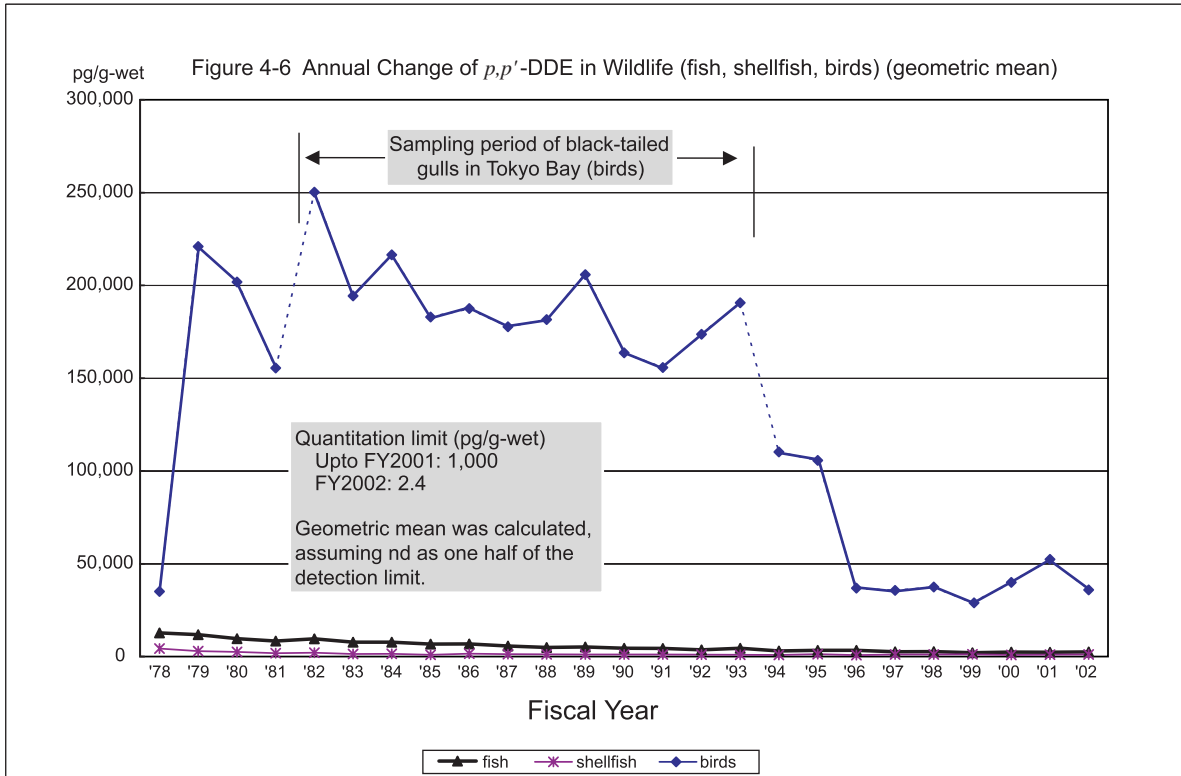
○Survey Results of *o,p'*-DDD

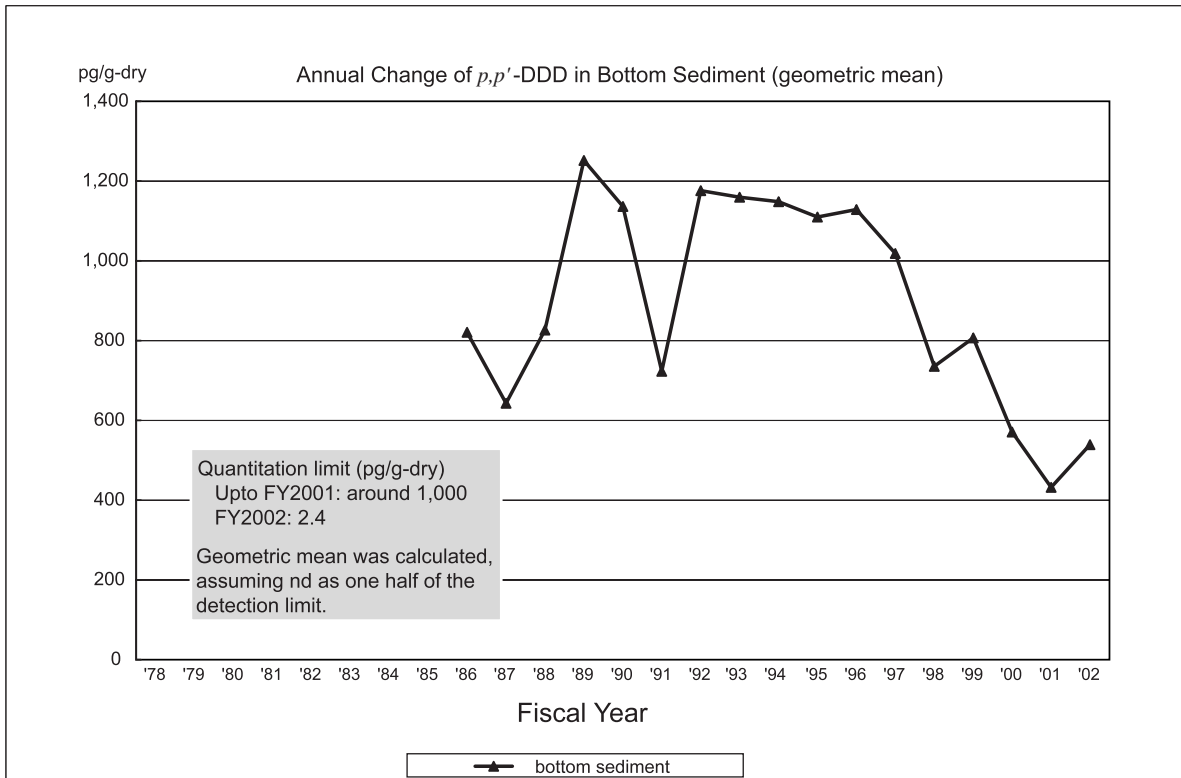
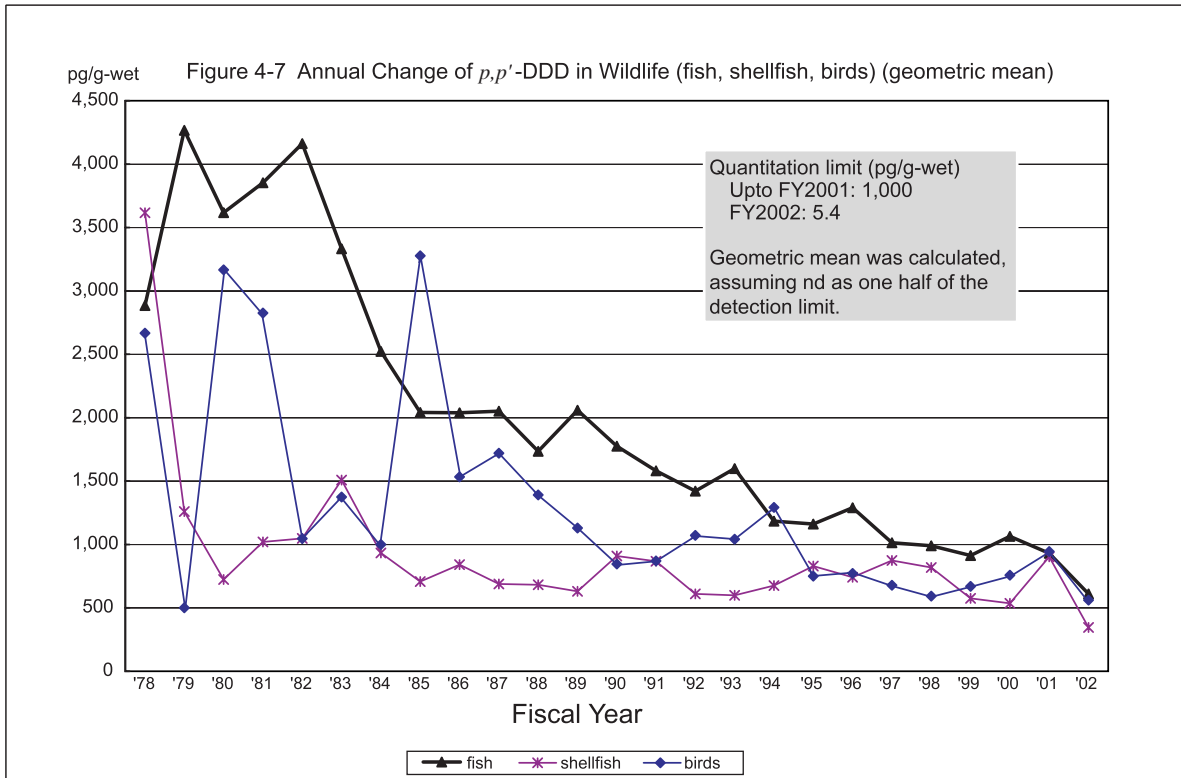
Substance	Unit	Geometric mean	Detected range	MQL	Detection frequency (area)	
Surface water	pg/L	5.5	0.21 - 110	0.6 0.06	38/38	
Bottom sediment	pg/g-dry	140	tr(2) - 14,000	6	62/63	
Wildlife	Fish	pg/g-wet	83	tr(5) - 1,100	12	14/14
	Shellfish	pg/g-wet	130	tr(9) - 2,900	12	8/8
	Birds	pg/g-wet	15	tr(8) -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

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

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



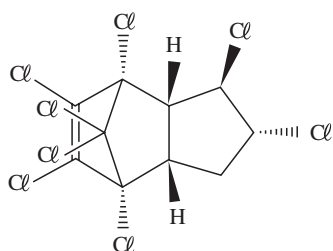






## [5] Chlordanes

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



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

Melting point: Unknown

Boiling point:  $175^{\circ}C$ <sup>3)</sup>

Water solubility (Sw): Insoluble (0.27 kPa)<sup>3)</sup>

Specific gravity: 1.59-1.63<sup>3)</sup>

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

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

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

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

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

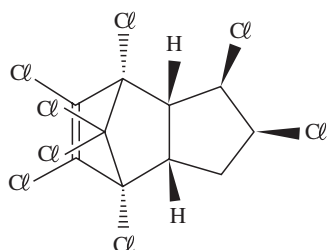
Monitoring in air was initiated in FY2002 and its persistence was recognized in widespread areas.

○ Survey Results of *trans*-Chlordane

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

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

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



Chemical formula / molecular weight: C<sub>10</sub>H<sub>6</sub>Cl<sub>8</sub> / 409.78

Melting point: Unknown

Boiling point: Unknown

Water solubility (S<sub>w</sub>): Unknown

Specific gravity: Unknown

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

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

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

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

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

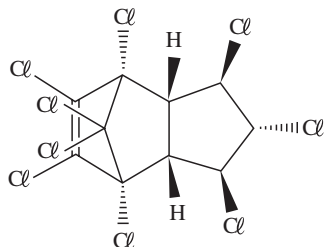
Monitoring in air was initiated in FY2002 and its persistence was recognized in widespread areas.

○Survey Results of *cis*-Chlordane

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

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

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



Chemical formula / molecular weight: C<sub>10</sub>H<sub>5</sub>Cl<sub>9</sub> / 444.23

Melting point: Unknown

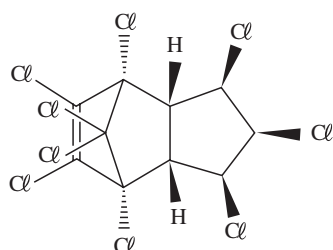
Boiling point: Unknown

Water solubility (Sw): Unknown

Specific gravity: Unknown

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

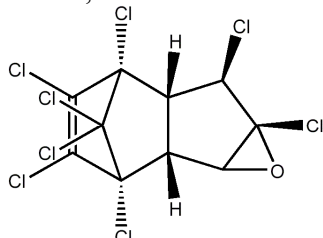
(*cis*-Nonachlor, CAS RN: 5103-73-1)



Chemical formula / molecular weight: C<sub>10</sub>H<sub>5</sub>Cl<sub>9</sub> / 444.23

Melting point: Unknown  
Boiling point: Unknown  
Water solubility (Sw): Unknown  
Specific gravity: Unknown  
*n*-Octanol/water partition coefficient (LogPow): Unknown

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



Chemical formula / molecular weight: C<sub>10</sub>H<sub>4</sub>Cl<sub>8</sub>O / 423.76

Melting point: Unknown  
Boiling point: Unknown  
Water solubility (Sw): Unknown  
Specific gravity: Unknown  
*n*-Octanol/water partition coefficient (LogPow): Unknown

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

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

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

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

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

○Survey Results of *trans*-Nonachlor

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

○Survey Results of *cis*-Nonachlor

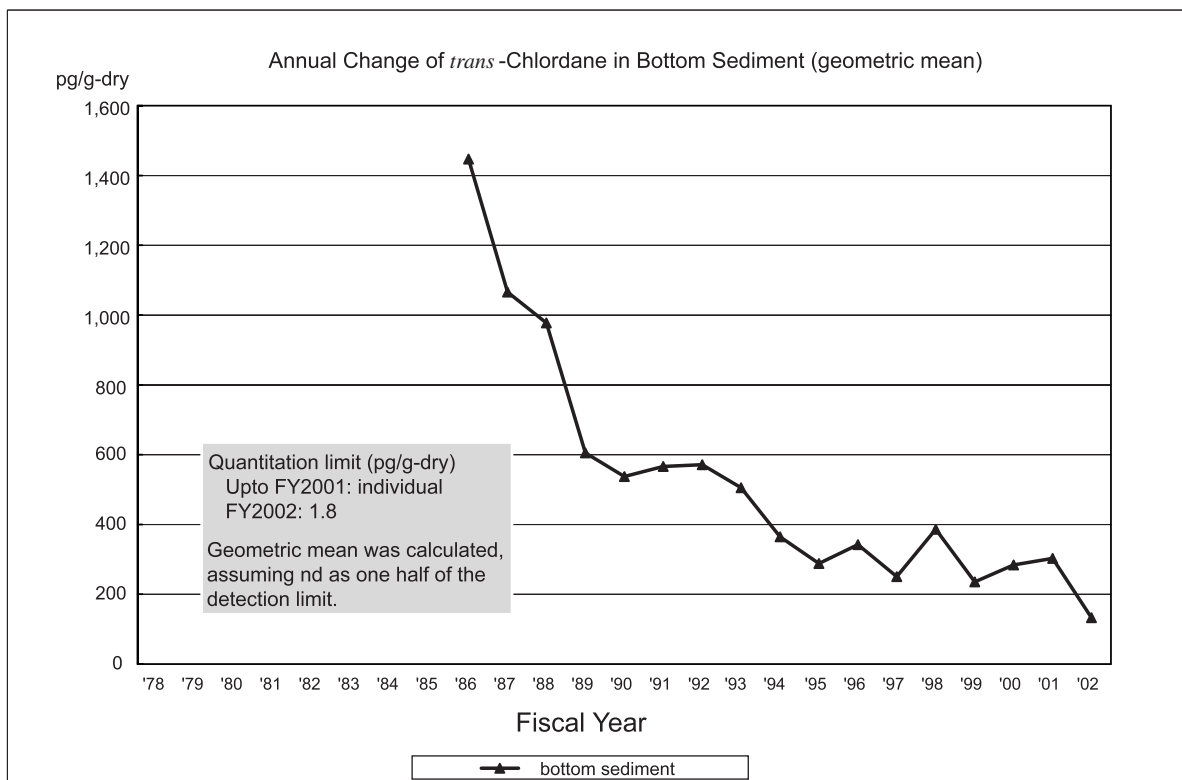
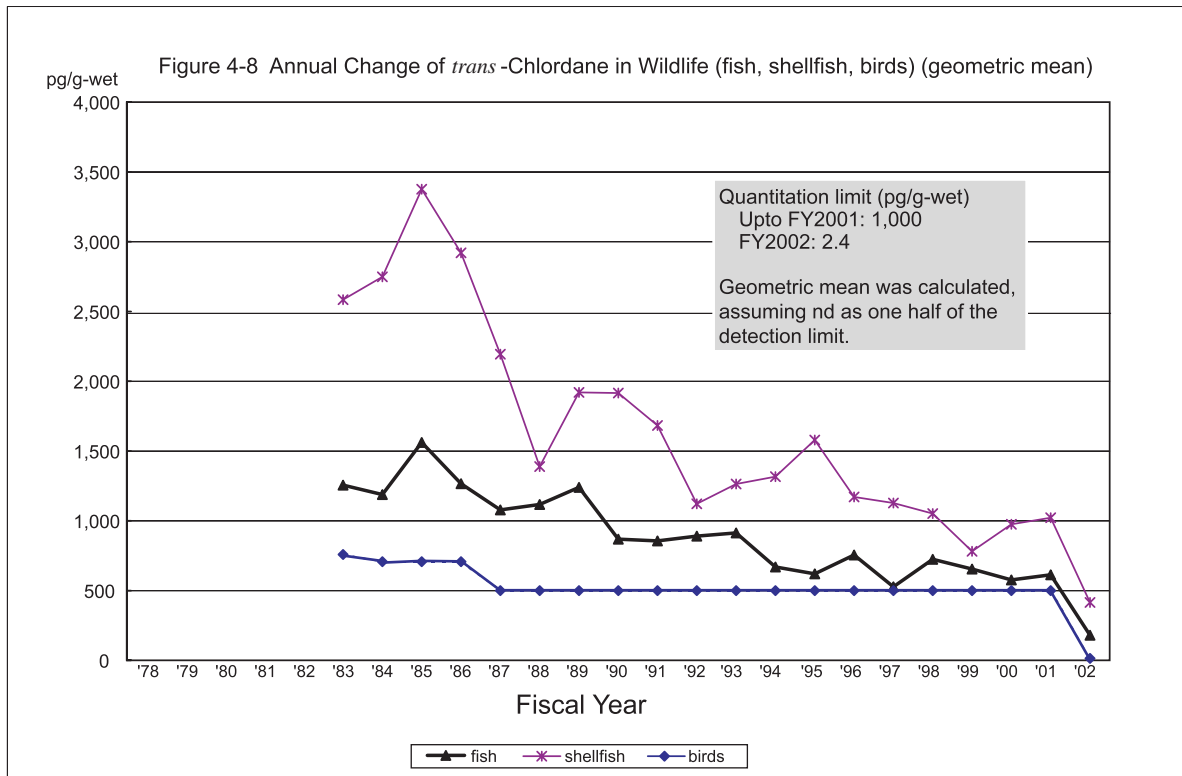
Substance	Unit	Geometric mean	Detected range	MQL	Detection frequency (area)
Surface water	pg/L	7.6	0.23 - 250	1.8 0.18	38/38
Bottom sediment	pg/g-dry	66	tr(1.0) - 7,800	2.1	63/63
Wildlife	Fish	pg/g-wet	420	1.2	14/14
	Shellfish	pg/g-wet	190	1.2	8/8
	Birds	pg/g-wet	200	1.2	2/2
Air	pg/m <sup>3</sup>	3.1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

○Survey Results of Oxychlordan

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

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

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



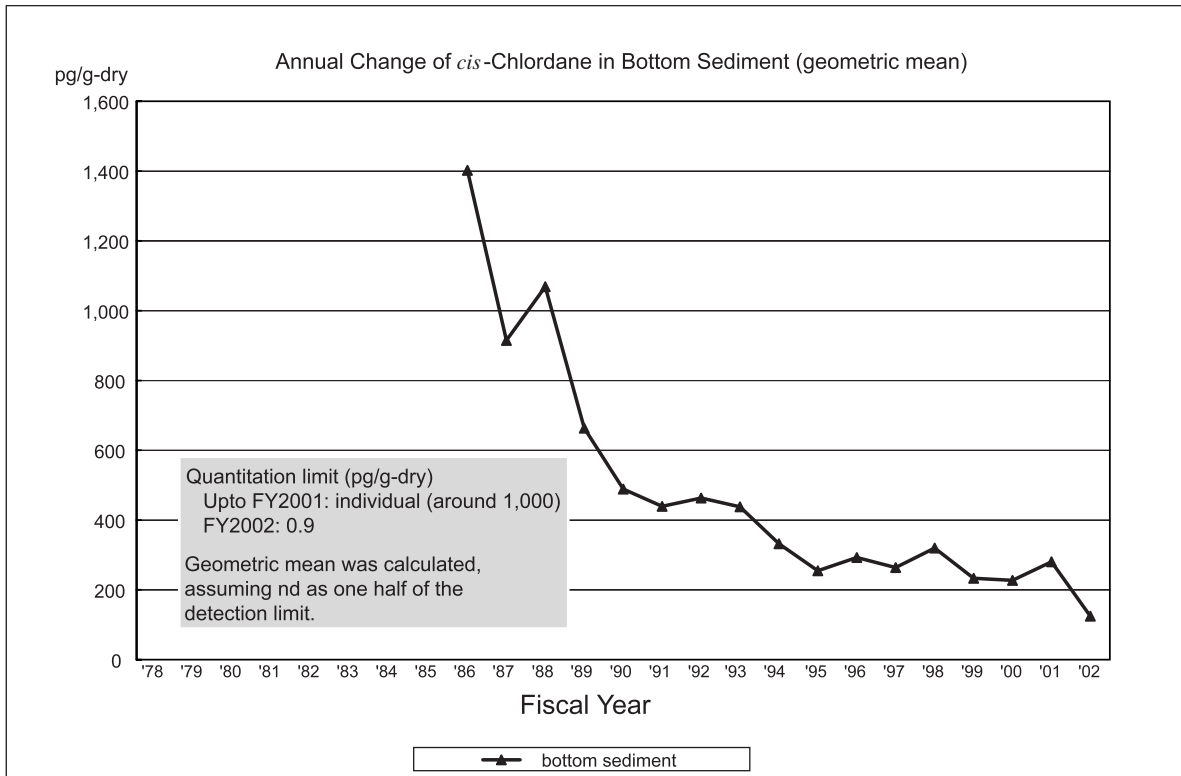
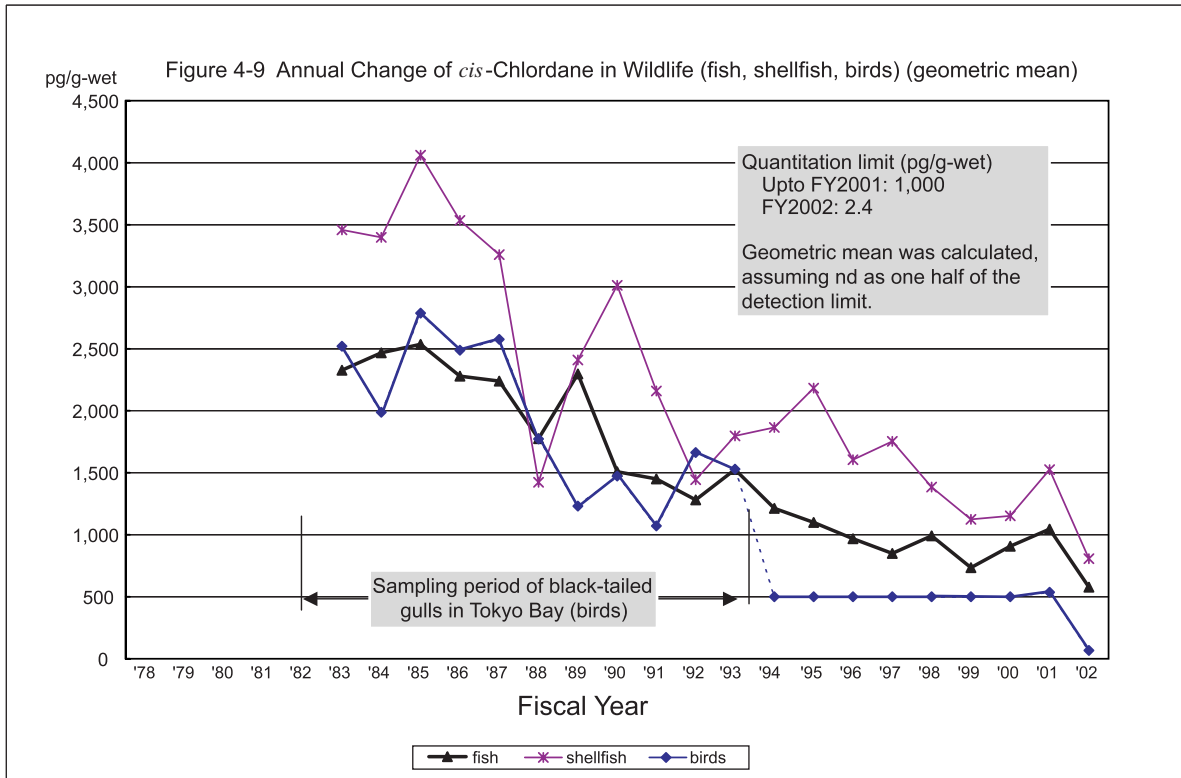
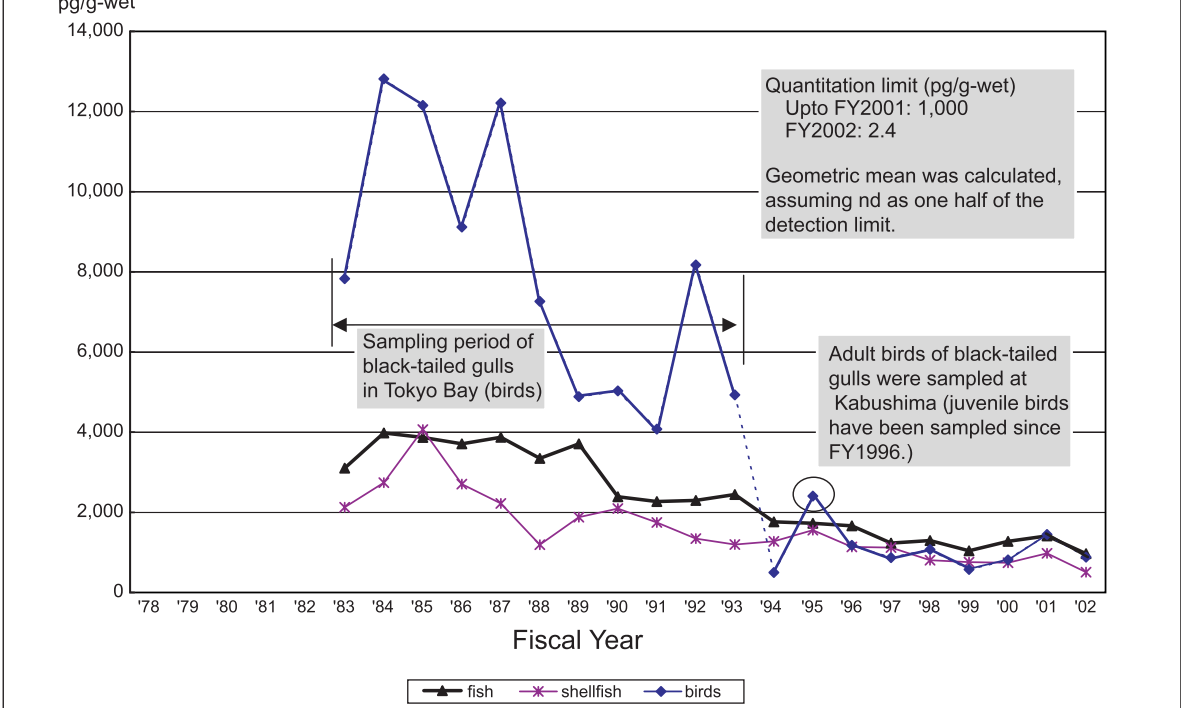
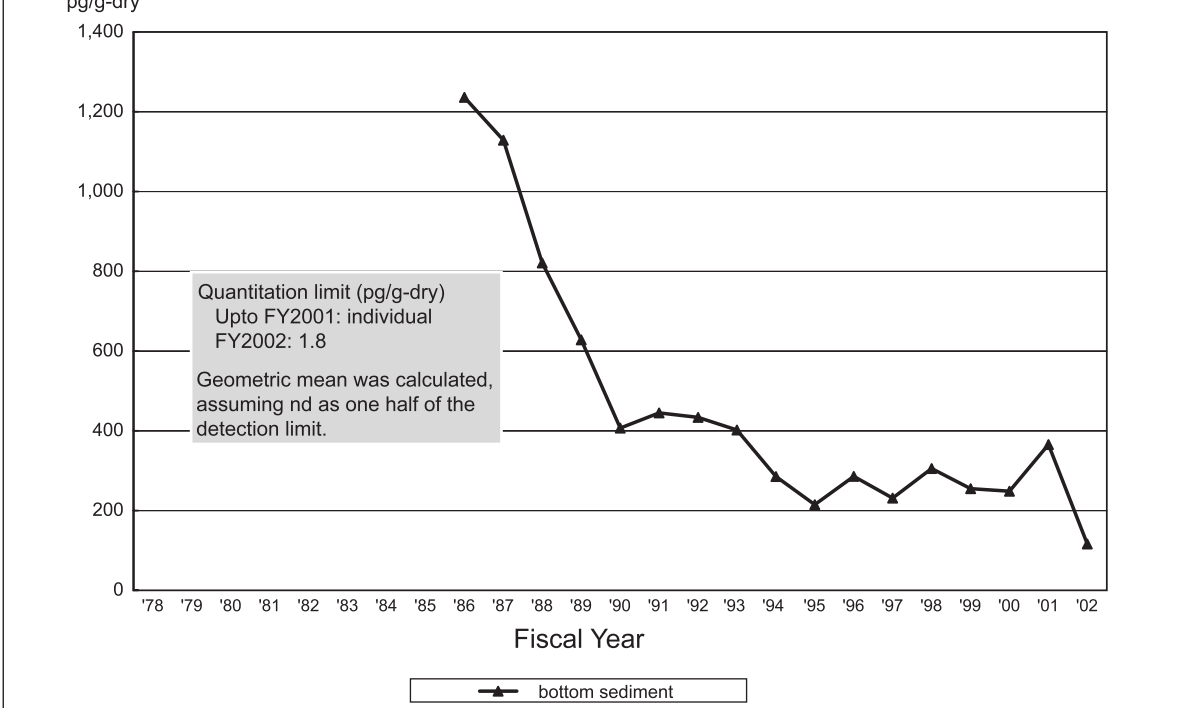


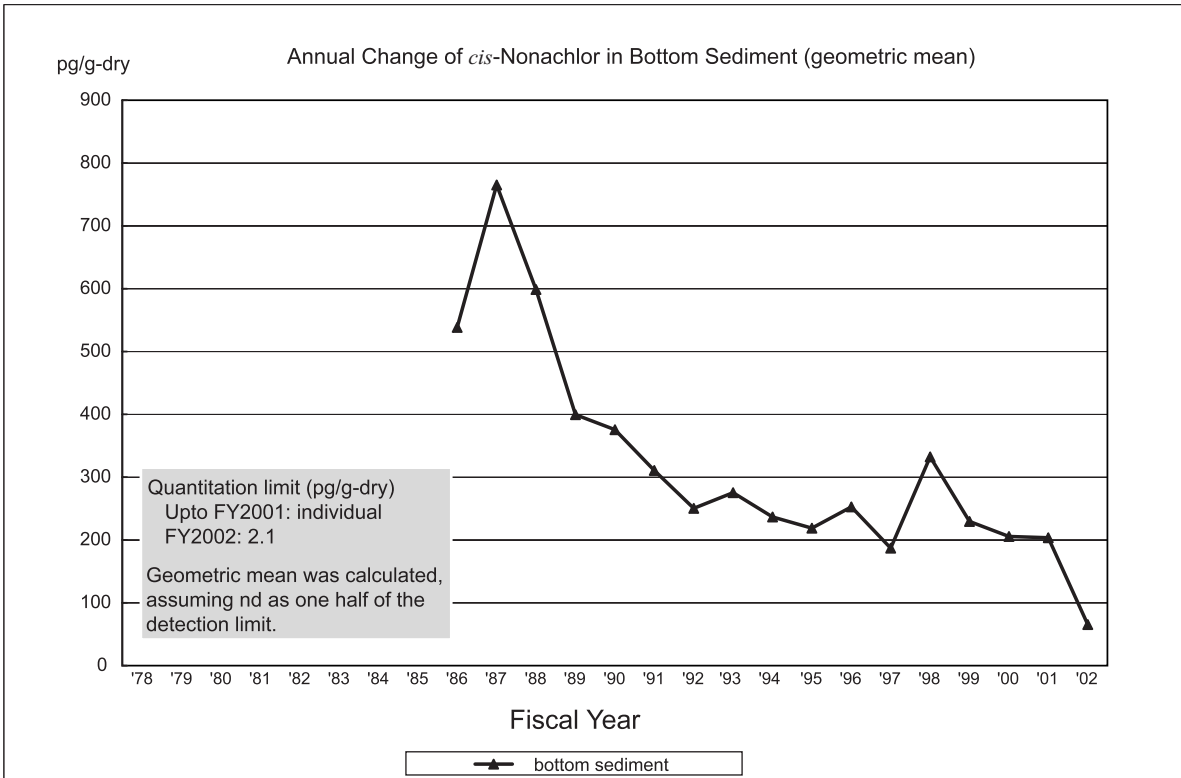
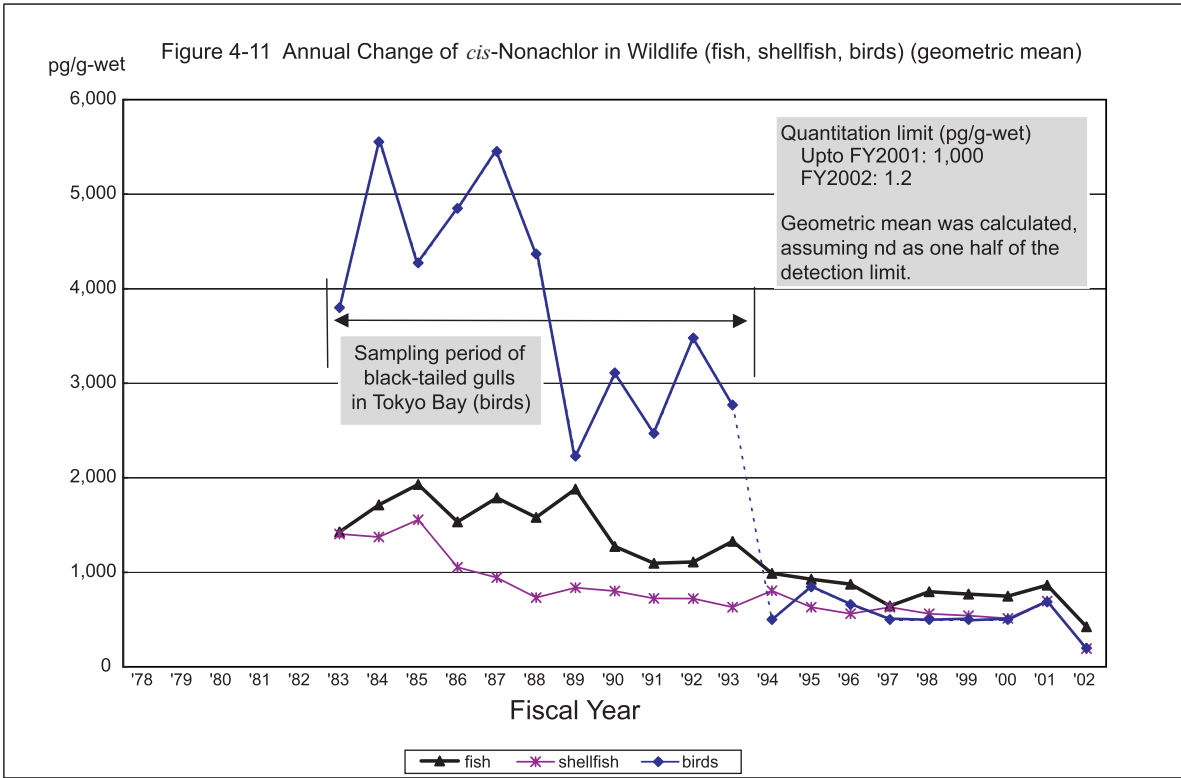
Figure 4-10 Annual Change of *trans*-Nonachlor in Wildlife (fish, shellfish, birds) (geometric mean)

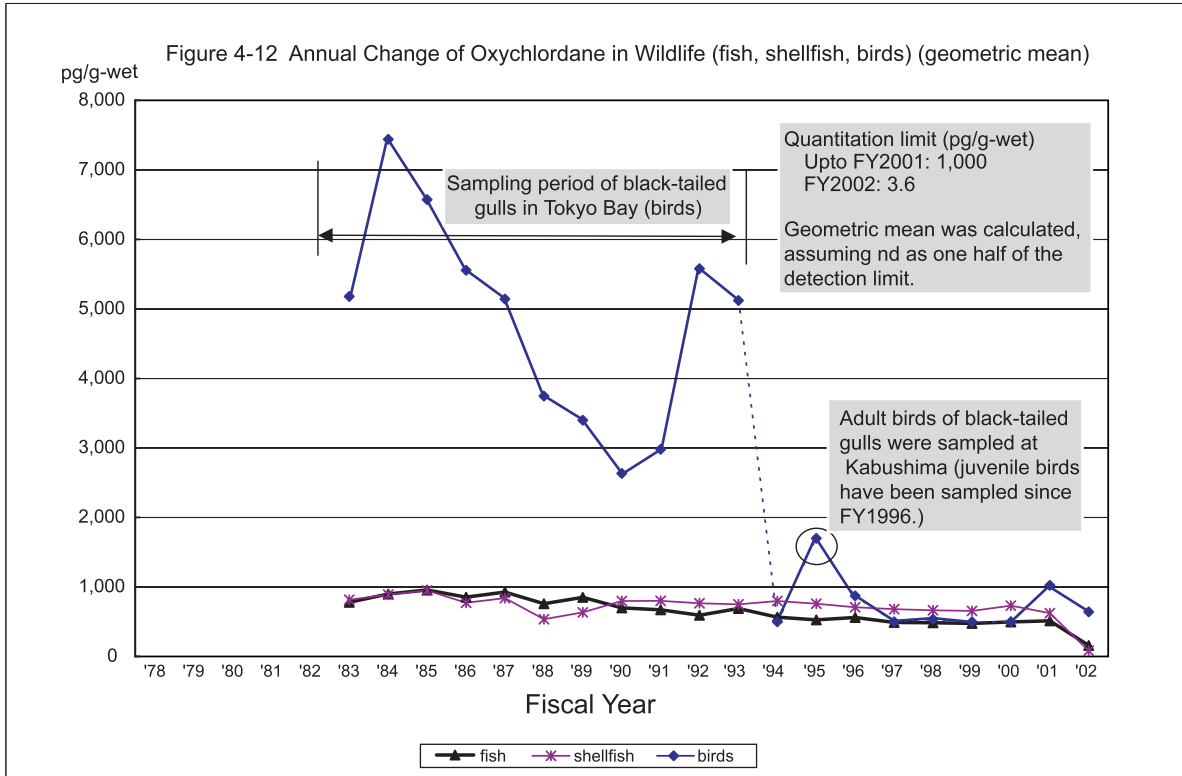


Annual Change of *trans*-Nonachlor in Bottom Sediment (geometric mean)

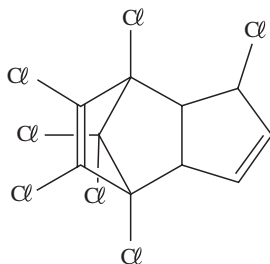








[6] Heptachlor (CAS RN: 76-44-8)



Chemical formula / molecular weight: C<sub>10</sub>H<sub>5</sub>Cl<sub>7</sub> / 373.32

Melting point: 95-96°C<sup>1)</sup>, 95°C<sup>2)</sup>

Boiling point: 145°C<sup>1)</sup>, 135°C<sup>2)</sup>

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

Specific gravity: 1.58<sup>1)2)</sup>

*n*-Octanol/water partition coefficient (LogPow): 3.87-6.13<sup>1)</sup>

Monitoring of heptachlor was started in FY2002 in all media.

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

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

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

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

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

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

○Survey Results of Heptachlor

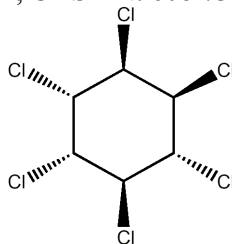
Substance	Unit	Geometric mean	Detected range	MQL	Detection frequency (area)	
Surface water	pg/L	tr(1.1)	tr(0.5) - 25	1.5 0.15	38/38	
Bottom sediment	pg/g-dry	3.5	tr(0.6) - 120	1.8	60/63	
Wildlife	Fish	pg/g-wet	4.0	tr(1.6) - 20	4.2	12/14
	Shellfish	pg/g-wet	3.6	tr(1.9) - 15	4.2	6/8
	Birds	pg/g-wet	tr(2.1)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

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

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

## [7] HCHs

( $\alpha$ -HCH, CAS RN: 608-73-1)



Chemical formula / molecular weight: C<sub>6</sub>H<sub>6</sub>Cl<sub>6</sub> / 290.83

Melting point: Unknown

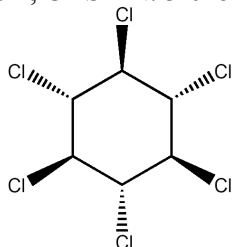
Boiling point: Unknown

Water solubility (S<sub>w</sub>): Unknown

Specific gravity: Unknown

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

( $\beta$ -HCH, CAS RN: 319-85-7)



Chemical formula / molecular weight: C<sub>6</sub>H<sub>6</sub>Cl<sub>6</sub> / 290.83

Melting point: 309-312°C<sup>1)</sup>, 312°C<sup>2)</sup>

Boiling point: 60°C<sup>2)</sup>

Water solubility (S<sub>w</sub>): 5 mg/L<sup>2)</sup>

Specific gravity: Unknown

*n*-Octanol/water partition coefficient (LogPow): 3.78<sup>1)</sup>

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

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

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

pg/g-wet for  $\beta$ -HCH.

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

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

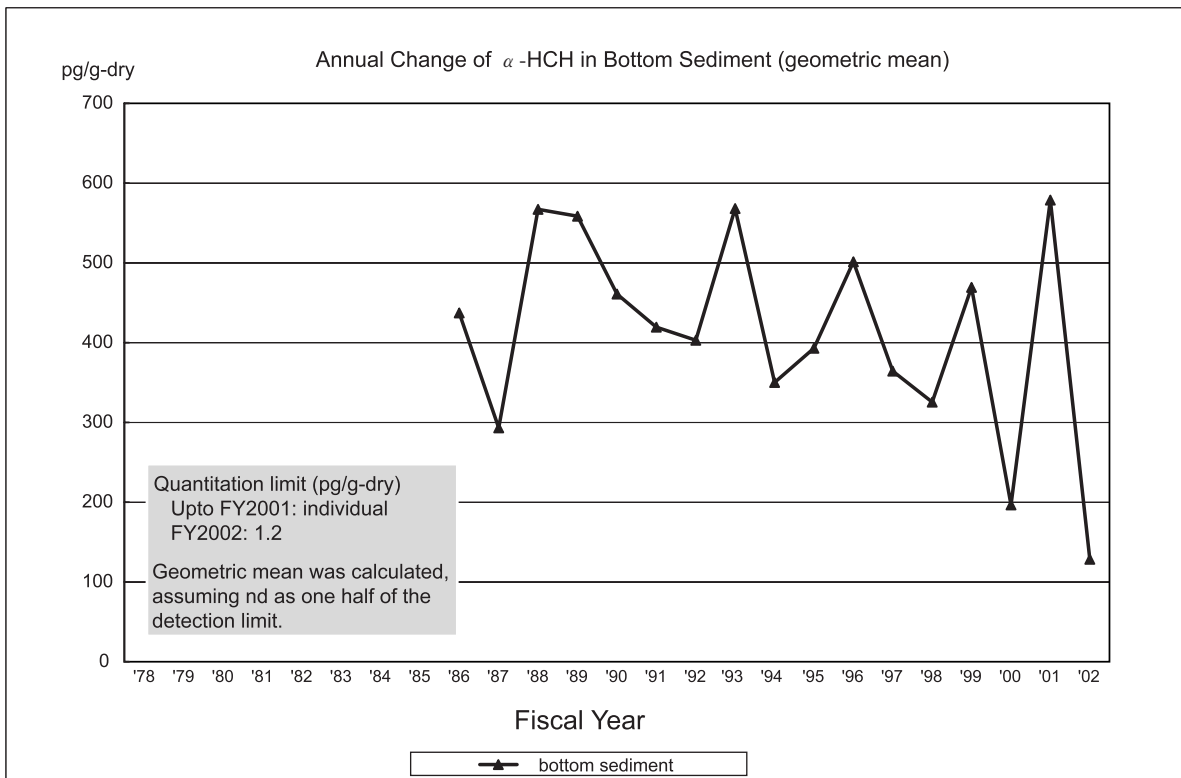
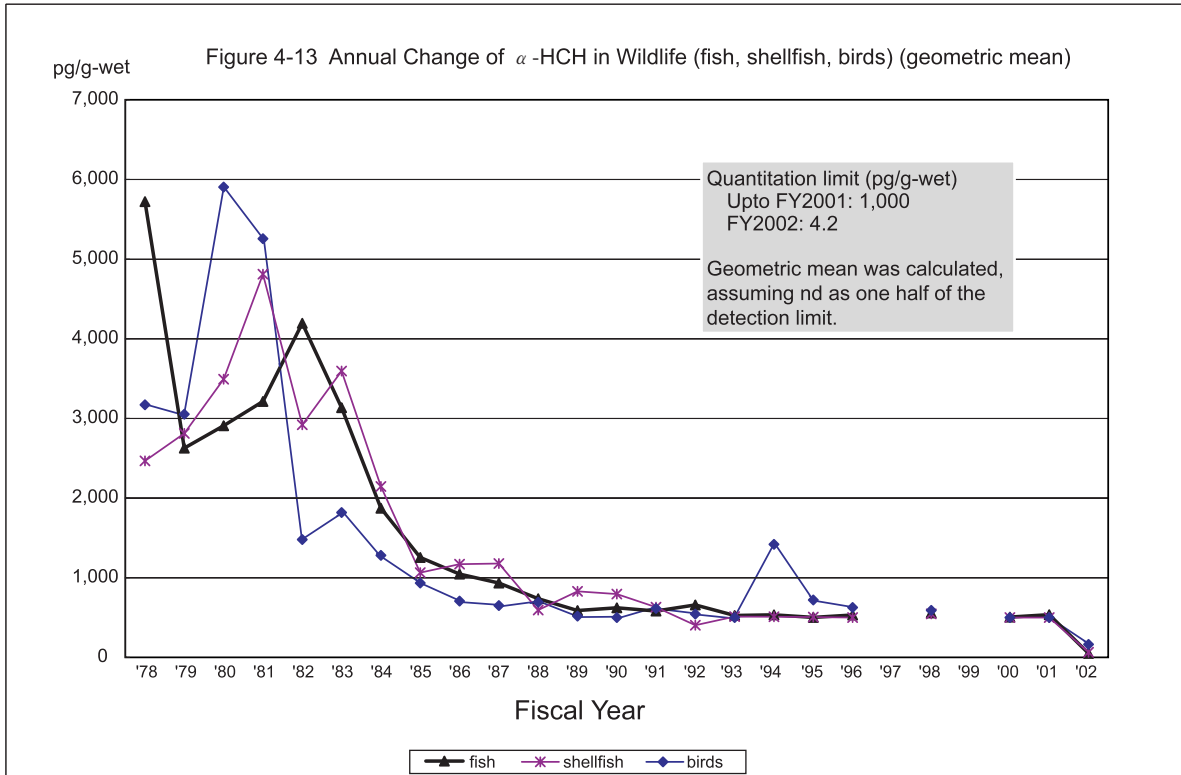
○ Survey Results of  $\alpha$ -HCH

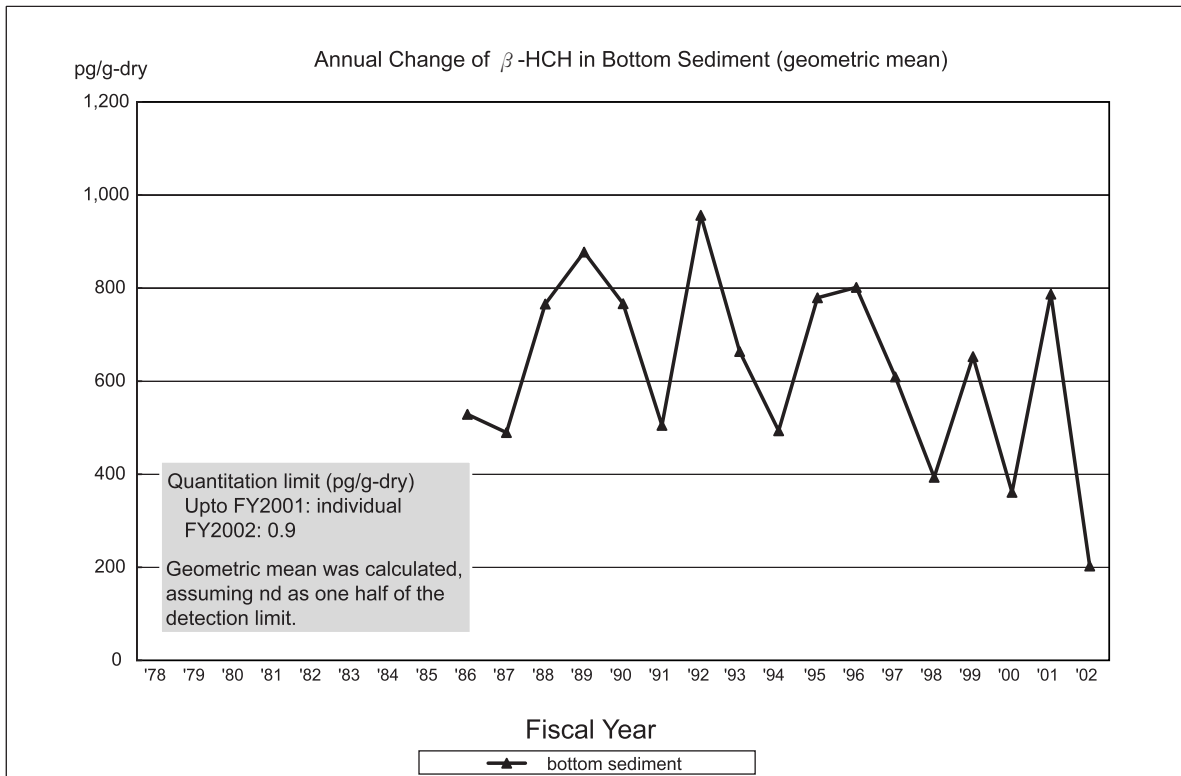
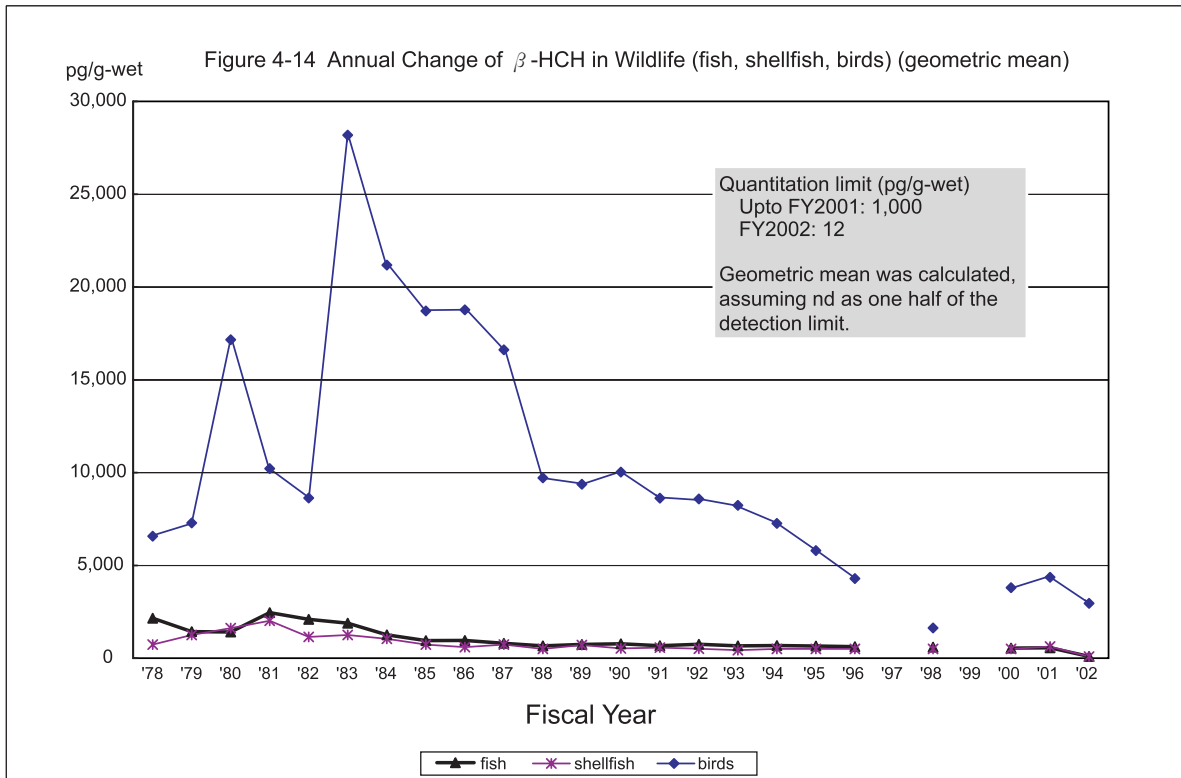
Substance	Unit	Geometric mean	Detected range	MQL	Detection frequency (area)
Surface water	pg/L	84	1.9 - 6,500	0.9 0.09	38/38
Bottom sediment	pg/g-dry	130	2.0 - 8,200	1.2	63/63
Wildlife	Fish	pg/g-wet	tr(1.9) - 590	4.2	14/14
	Shellfish	pg/g-wet	12 - 1,100	4.2	8/8
	Birds	pg/g-wet	93 - 360	4.2	2/2

○ Survey Results of  $\beta$ -HCH

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

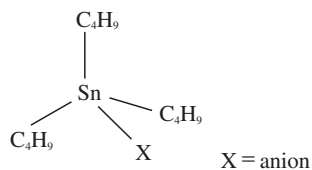
Note: Values of MQL for surface water in the upper row are obtained by standard sampling system (sample volume: 30L) and values in the lower row are by high-volume sampling system (sample volume: 100L).





### [8] Organotin compounds (TBT, TPT)

TBT (Tributyltin compounds, CAS RN: mixture)



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

Melting point: (mixture)

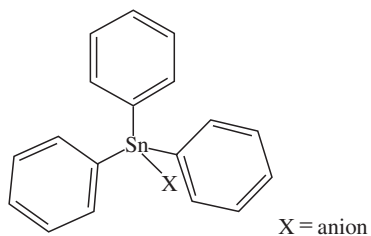
Boiling point: (mixture)

Water solubility (Sw): (mixture)

Specific gravity: (mixture)

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

TPT (Triphenyltin compounds, CAS RN: mixture)



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

Melting point: (mixture)

Boiling point: (mixture)

Water solubility (Sw): (mixture)

Specific gravity: (mixture)

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

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

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

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



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

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

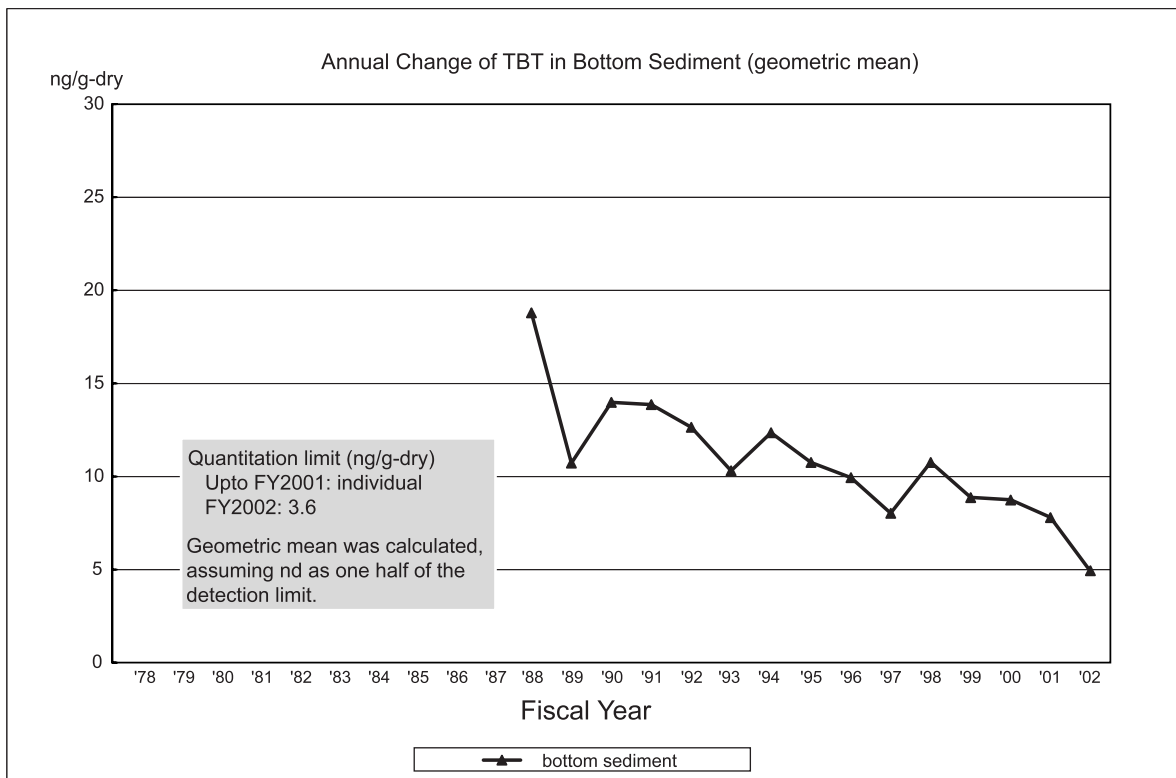
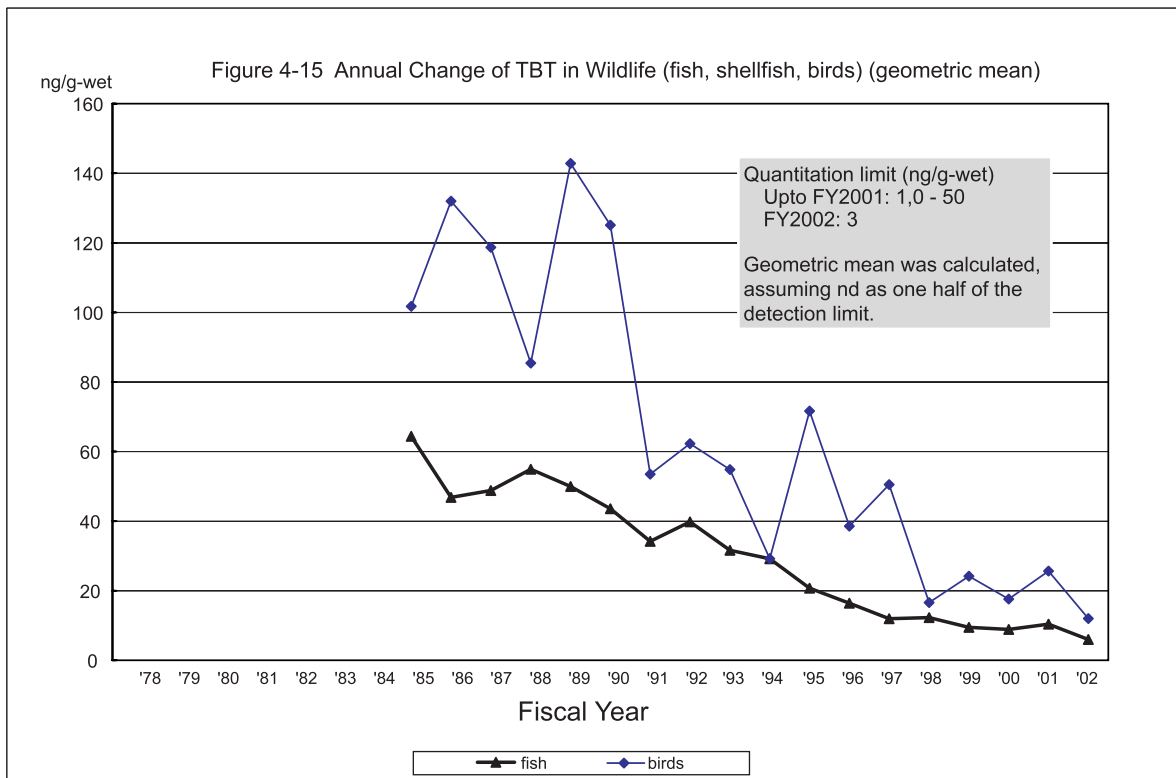
Considering the status of TBT and TPT production (seldom produced or used for the domestic open system), the status of pollution will improve further in the future. However, there remains a possibility of pollution related to the existence of unrestricted countries and areas, and it is necessary to successively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

○Survey Results of TBT

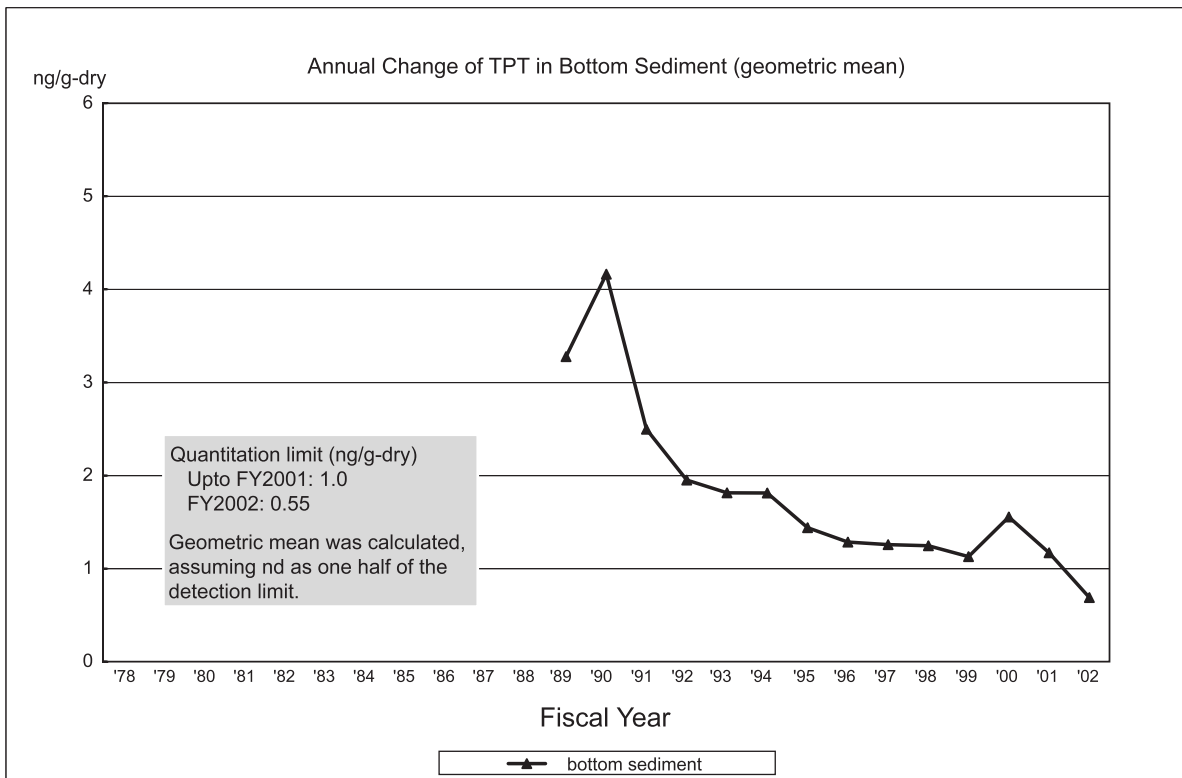
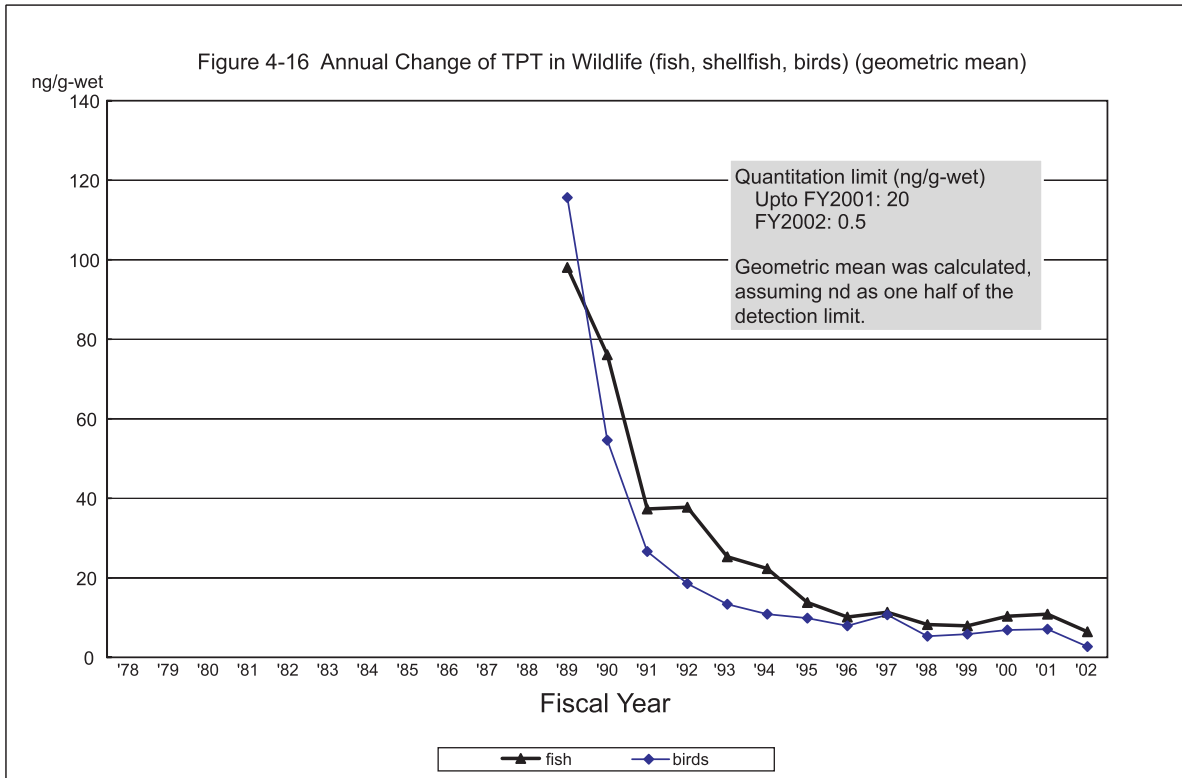
Substance	Unit	Geometric mean	Detected range	MQL	Detection frequency (area)	
Bottom sediment	pg/g-dry	4.9	tr(1.2) - 390	3.6	48/63	
Wildlife	Fish	pg/g-wet	6	tr(1) - 500	3	13/14
	Shellfish	pg/g-wet	12	tr(1) - 57	3	8/8
	Birds	pg/g-wet	ND	---	3	0/2

○Survey Results of TPT

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



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



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

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



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

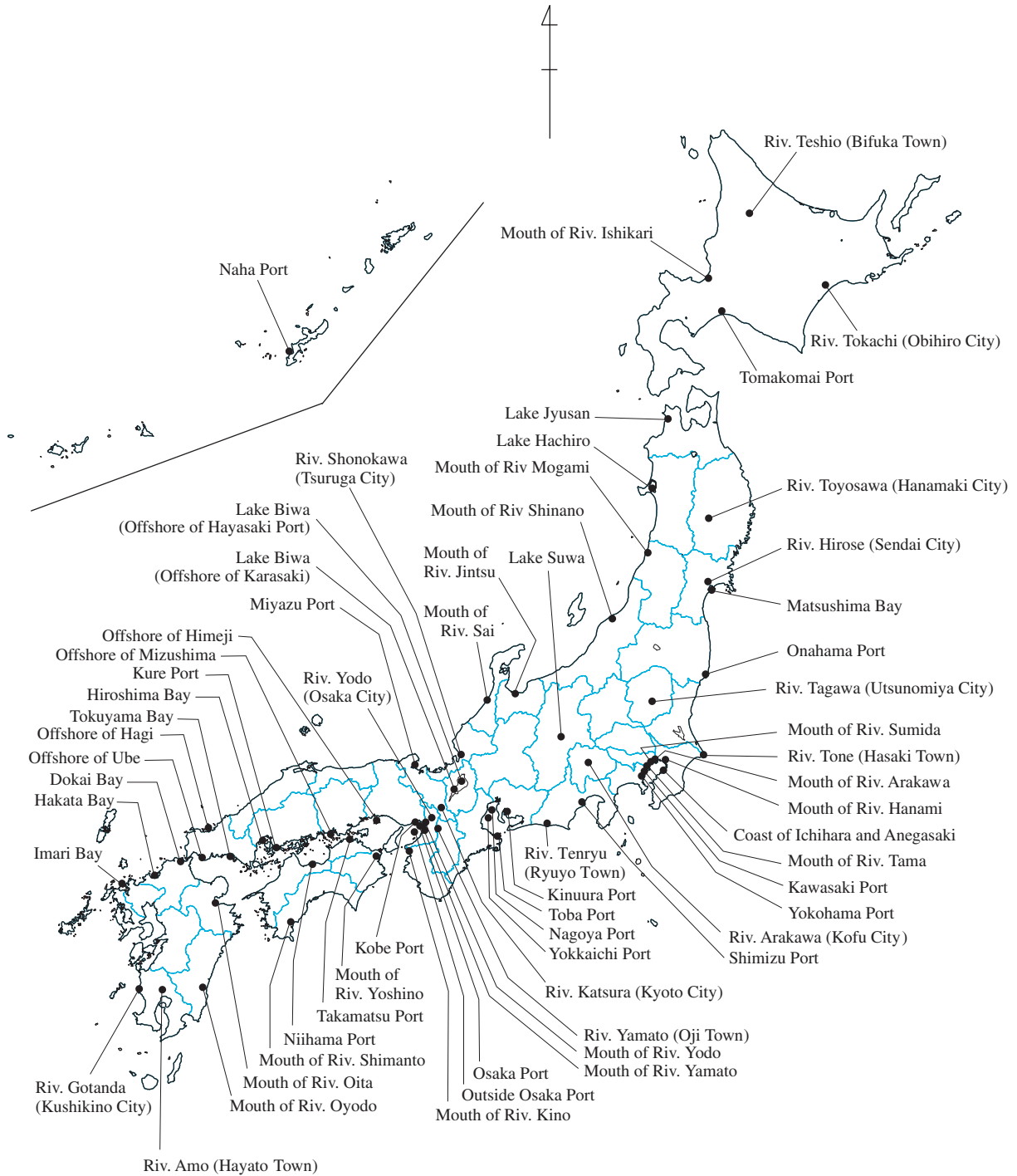


Figure 4-C Locations of the Monitoring Investigation for Wildlife (FY2002)

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



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



Table 4-2 Characteristics of Species Subject to Wildlife Monitoring

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



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

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

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

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

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

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

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

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

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

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

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

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

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

Detected areas / Surveyed areas

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

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

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

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

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

Table 4-5 Quantitation Limit in the FY2002 Monitoring Investigation

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

(Note 1): Quantitation Limit is defined as tree times the detection limit.

(Note 2): Quantitation limit of PCBs is shown as a range of homologs and isomers.

(Note 3): Two-sampling method was adopted for surface water: Upper and lower values are obtained by basic sampling system (30L) and by high-volume sampling system (100L), respectively.

High-volume sampling system was adopted at 3 areas (Miyazu Bay in Kyoto, Harima-Nada in Hyogo Prefecture and Imari Bay in Saga Prefecture).

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

Table 4-6 Survey Results of the FY2002 Monitoring Investigation

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

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

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

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

Survey No.	Substance	Surface Water		Bottom Sediment		Wildlife						Air	
		Range (pg/L) (frequency areas)	Mean (pg/L)	Range (pg/g-dry) (frequency areas)	Mean (pg/g-dry)	Fish		Shellfish		Birds		Range (pg/m <sup>3</sup> ) (frequency areas)	Mean (pg/m <sup>3</sup> )
						Range (pg/g-wet) (frequency areas)	Mean (pg/g-wet)	Range (pg/g-wet) (frequency areas)	Mean (pg/g-wet)	Range (pg/g-wet) (frequency areas)	Mean (pg/g-wet)		
6	Heptachlor	tr(0.5) -25 (38/38)	tr(1.1)	tr(0.6) -120 (60/63)	3.5	ND -20 (12/14)	4.0	ND -15 (6/8)	3.6	ND -5.2 (2/2)	tr(2.1)	0.20 -220 (34/34)	11
7	HCHs												
7-1	$\alpha$ -HCH	1.9 -6,500 (38/38)	84	2 -8,200 (63/63)	130	Tr(1.9) -590 (14/14)	51	12 -1,100 (8/8)	65	93 -360 (2/2)	160		
7-2	$\beta$ -HCH	0.21 -110 (38/38)	210	3.9 -11,000 (63/63)	200	tr(5) -1,800 (14/14)	99	32 -1,700 (8/8)	89	1,600 -7,300 (2/2)	3,000		
Survey No.	Substance	Bottom Sediment		Wildlife									
		Range (ng/g-dry) (frequency areas)	Mean (ng/g-dry)	Fish		Shellfish		Birds					
				Range (ng/g-wet) (frequency areas)	Mean (ng/g-wet)	Range (ng/g-wet) (frequency areas)	Mean (ng/g-wet)	Range (ng/g-wet) (frequency areas)	Mean (ng/g-wet)				
8	Organotin compounds												
8-1	TBT	ND -390 (48/63)	4.9	ND -500 (13/14)	6	tr(2) -57 (8/8)	12	---	---	(0/2)	ND		
8-2	TPT	ND -490 (30/63)	tr(0.69)	ND -520 (13/14)	6.4	ND -25 (7/8)	2.7	---	---	(0/2)	ND		

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

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

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