Survey on the State of Dioxin Accumulation in Wildlife: Findings of the Fiscal 1999 Survey

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The Environment Agency of Japan has carried out studies since fiscal 1998 to grasp the state of dioxin accumulation in wildlife by conducting a dioxin survey in birds (kites, Japanese cormorants), marine mammals (North Pacific beaked whales, finless black porpoises), and land mammals (Japanese wood mice, raccoon dogs) (Japanese cormorants were added starting in fiscal 1999). In this document we report the findings of the fiscal 1999 survey, based on the discussion of the Research Team to Survey the State of Pollution by Dioxins in Wildlife (chaired by Gen Ohi, Director General, National Institute for Environmental Studies).

(1) Findings

(a) Birds (kites, Japanese cormorants) had a higher accumulation of dioxins (e.g., per gram of fat) than the other species covered in the present survey. Among the marine cetaceans co-planar PCBs made up about 90% of the dioxins present, a similar level to the previous year.

(b) Accumulations in kites, North Pacific beaked whales, finless black porpoises, and Japanese wood mice were lower than those of the previous year, but it is important to remember that these findings resulted from just two surveys.

(2) Summary

The findings of the 1999 survey indicate a declining trend in dioxin accumulations in comparison with the previous year, but it is essential to continue monitoring. For that purpose, the Environment Agency plans to continue studying the state of dioxin accumulation in birds, mammals, and other wildlife, and will initiate studies on birds regarding “biomarkers” that can serve as indicators of the effects of dioxins and other substances.

Notes:

1 Here, the term "dioxins" refers collectively to polychlorinated dibenzo-*p*-dioxins (hereafter PCDDs), polychlorinated dibenzofurans (hereafter PCDFs), and co-planar polychlorinated biphenyls (hereafter co-planar PCBs).

2 The unit pg-TEQ/g is the toxicity equivalency quantity of one trillionth of a gram (10^{-12} g) of dioxins per gram of body mass.

3 Biomarkers are the factors in living organisms which change in reaction to chemical substances taken into the body, and thus serve as indicators of the effects of chemical substances. In these studies, the plans are to measure an inducible enzyme (CYP1A1) and other such substances that are considered to be markers of the effects of dioxins.

1. Background

Dioxins represent a serious environmental issue in the context of human health. The concentrations of dioxins in wildlife provide indicators of environmental pollution that are useful to help determine the problem of dioxins for ecosystems as a whole.

The Environment Agency of Japan established the Research Team to Survey the State of Pollution by Dioxins in Wildlife in the 1998 fiscal year. The team conducted extensive surveys of the state of dioxin accumulation in wildlife, using what are though to be indicator species for this purpose.

The fiscal 1999 survey has narrowed the focus of study compared to the previous year, classifying subjects by habitat, and selecting six species of which specimens could likely be obtained in relatively large numbers on a continual basis. The North Pacific beaked whale was selected as a species that mainly inhabits the high seas, the finless black porpoise as a species that mainly inhabits the coastal waters, the kite and Japanese cormorant as species that range mainly from the coast to inland areas, and the Japanese wood mouse and raccoon dog as species that mainly inhabit inland areas.

The findings of the fiscal 1998 survey have been compiled and are reported below.

2. Summary of Research

(1) Kite [Milvus migrans]

Habitat

Kites are seen from plains up into mountainous areas throughout Japan. Although their primary habitat is in the regions extending outward from cities into farmland, they also live near bodies of water in mountainous areas. They prefer to be near rivers, lakes, and bogs, or locations near open water in harbors and so on. They ordinarily live near where they feed, with an activity range of about 1 to 3 km, but may travel approximately 10 km when in passage or when dispersed.

Feeding Habits

Kites are carnivorous, feeding on small to medium-sized mammals, birds, reptiles, amphibians, fish, insects, arachnids, worms, etc.

(a) Number of Specimens: 22 specimens

(b) Method of Collection: wildlife control, etc.

(c) Items Measured

Dioxins: Concentrations and Toxicity Equivalents (TEQ)

(d) Calculation Method

The wet weight toxic equivalency factors (TEFs) used were from WHO-TEF, 1998 (mammals).

Isomers that were detected at levels below the lower limit of determination were assigned a zero value.

Concentrations below the lower limit of determination were converted to TEQ values equivalent to the lower limit of determination or half of that lower limit, and those TEQ values are shown in a separate table for reference.

(e) Analysis Method

The survey was conducted according to the Environment Agency's Manual for Surveys of Wildlife Pollution by Dioxins (hereafter the manual).

(f) Findings (See appended materials)

Evaluation of the TEQs (calculated using avian TEFs, figures in brackets calculated using mammal TEFs) of dioxins produced results shown below.

<Muscle tissue: 22 specimens>

The mean value was 40 (35) pg-TEQ/g wet weight, and the median value was 28 (24) pg-TEQ/g wet weight.

The range detected was from 3.8 (2.6) to 110 (88) pg-TEQ/g wet weight.

<Fat tissue: 16 specimens>

The mean value was 510 (470) pg-TEQ/g wet weight, and the median value was 410 (350) pg-TEQ/g wet weight.

The range detected was from 56 (37) to 1,400 (1,400) pg-TEQ/g wet weight.

Co-planar PCBs accounted for a mean 58% (59%) of total TEQ value, and a median 61% (65%) of total TEQ value.

(2) Japanese Cormorant [Phalacrocorax carbo]

Habitat

The Japanese cormorant is distributed mainly through coastal regions, rivers, lakes, and bogs. They have a tendency to change their feeding places with the seasons. When breeding, they usually build nests in groups near a body of water.

Feeding Habits

Japanese cormorants feed mainly on fish found at relatively shallow depths in sea water and fresh water.

(a) Number of Specimens: 50 specimens

(b) Method of Collection: wildlife control

(c) Items Measured

Dioxins: Concentrations and TEQ

(d) Calculation Method

The wet weight toxic equivalency factors (TEFs) used were from WHO-TEF, 1998 (mammals).

Isomers which were at levels below the lower limit of determination were assigned a zero value.

Concentrations below the lower limit of determination were converted to TEQ values equivalent to the lower limit of determination or half of that lower limit, and those TEQ values are shown in a separate table for reference.

(e) Analysis Method

Refer to the manual.

(f) Findings

See appended materials.

Evaluation of the TEQ (calculated using avian TEF, figures in brackets calculated using mammal TEF) of dioxins produced results shown below.

< Muscle tissue: 50 specimens >

The mean value was 140 (130) pg-TEQ/g wet weight, and the median value was 120 (100) pg-TEQ/g wet weight.

The range detected was from 7.3 (5.9) to 370 (420) pg-TEQ/g wet weight.

Co-planar PCBs accounted for a mean 66% (68%) of total TEQ value, and a median 67% (68%) of total TEQ value.

(3) North Pacific Beaked Whale [Mesoplodon stejnegeri]

Habitat

The North Pacific beaked whale is pelagic, and inhabits the regions above oceanic slopes.

Feeding Habits

North Pacific beaked whales are carnivorous, feeding on cephalopods (cuttlefish, etc.) at medium to great depths (200-600 m).

(a) Number of Specimens: 14 specimens

(b) Method of Collection: Stranded carcasses

(c) Items Measured

Dioxins: Concentrations and TEQ

(d) Calculation Method

The wet weight toxic equivalency factors (TEFs) used were from WHO-TEF, 1998 (mammals). Isomers which were at levels below the lower limit of determination were assigned a zero value. Concentrations below the lower limit of determination were converted to TEQ values equivalent to the lower limit of determination or half of that lower limit, and those TEQ values are shown in a separate table for reference.

(e) Analysis Method

Refer to the manual.

(f) Findings

See appended materials.

Evaluation of the TEQ produced results shown below.

<Muscle tissue: 14 specimens >

The mean value was 4.5 pg-TEQ/g wet weight, and the median value was 2.6 pg-TEQ/g wet weight. The range detected was from 0.68 to 16 pg-TEQ/g wet weight.

< Fat tissue: 14 specimens >

The mean value was 99 pg-TEQ/g wet weight, and the median value was 78 pg-TEQ/g wet weight. The range detected was from 9.6 to 260 pg-TEQ/g wet weight.

Co-planar PCBs accounted for a mean 92% of total TEQ value, and a median 97% of total TEQ value.

(4) Finless Black Porpoise [Neophocaena phocaenoides]

Habitat

The finless black porpoise is coastal.

Feeding Habits

Finless black porpoises feed on small schooling fish and shallow-water cephalopods.

(a) Number of Specimens: 14 specimens

(b) Method of Collection: Stranded carcasses

(c) Items Measured

Dioxins: Concentrations and TEQ

(d) Calculation Method

The wet weight toxic equivalency factors (TEFs) used were from WHO-TEF, 1998 (mammals). Isomers which were at levels below the lower limit of determination were assigned a zero value. Concentrations below the lower limit of determination were converted to TEQ values equivalent to the lower limit of determination or half of that lower limit, and those TEQ values are shown in a separate table for reference.

(e) Analysis Method

Refer to the manual.

(f) Findings

See appended materials.

Evaluation of the TEQ produced results shown below.

< Muscle tissue: 13 specimens >

The mean value was 6.6 pg-TEQ/g wet weight, and the median value was 1.6 pg-TEQ/g wet weight. The range detected was from 0.48 to 62 pg-TEQ/g wet weight.

< Fat tissue: 12 specimens >

The mean value was 65 pg-TEQ/g wet weight, and the median value was 65 pg-TEQ/g wet weight. The range detected was from 24 to 110 pg-TEQ/g wet weight.

Co-planar PCBs accounted for a mean 91% of total TEQ value, and a median 92% of total TEQ value.

(5) Japanese Wood Mouse [Apodemus speciosus]

Habitat

The Japanese wood mouse is lives in shrine and temple groves, wooded areas bordering farmland, river flood plains, and so on from lowland to alpine regions. It has an activity range of several hectares.

Feeding Habits

It is an omnivorous animal that feeds on plant roots and stems, seeds, nuts and berries, insects, etc.

(a) Number of Specimens: 37 specimens

(b) Method of Collection: Caught in traps

(c) Items Measured

Dioxins: Concentrations and TEQ

(d) Calculation Method

The wet weight toxic equivalency factors (TEFs) used were from WHO-TEF, 1998 (mammals). Isomers which were at levels below the lower limit of determination were assigned a zero value. Concentrations below the lower limit of determination were converted to TEQ values equivalent to the lower limit of determination or half of that lower limit, and those TEQ values are shown in a separate table for reference.

(e) Analysis Method

Refer to the manual.

(f) Findings

See appended materials.

Evaluation of the TEQ of dioxins produced results shown below.

< Whole body: 37 specimens >

The mean value was 0.68 pg-TEQ/g wet weight, and the median value was 0.36 pg-TEQ/g wet weight.
The range detected was from 0.22 to 7.9 pg-TEQ/g wet weight.
Co-planar PCBs accounted for a mean 69% of total TEQ value, and a median 73% of total TEQ value.

(6) Raccoon Dog [Nyctereutes procyonoides]

Habitat

Raccoon dogs inhabit wooded areas, forest fringes, and semi-cultivated hillsides near human habitation from plains to sub-alpine regions. They are also seen sometimes in suburban residential areas.

Feeding Habits

The raccoon dog is an omnivorous animal that feeds on fruit, nuts, grains, insects, worms, crustaceans, snakes, frogs, field mice, birds, etc. Beetle larvae, worms, and other creatures that burrow in the earth form a relatively large part of its diet.

Its activity range is small near urban areas, but in mountainous regions may extend from several dozen to several hundred hectares.

(a) Number of Specimens: 11 specimens

(b) Method of Collection: Individual specimens that died after being rescued.

(c) Items Measured

Dioxins: Concentrations and TEQ

(d) Calculation Method

The wet weight toxic equivalency factors (TEFs) used were from WHO-TEF, 1998 (mammals). Isomers which were at levels below the lower limit of determination were assigned a zero value. Concentrations below the lower limit of determination were converted to TEQ values equivalent to the lower limit of determination or half of that lower limit, and those TEQ values are shown in a separate table for reference.

(e) Analysis Method

Refer to the manual.

(f) Findings

See appended materials.

Evaluation of the TEQ produced results shown below.

< Muscle tissue: 10 specimens >

The mean value was 21 pg-TEQ/g wet weight, and the median value was 5.2 pg-TEQ/g wet weight.

The range detected was from 1.4 to 78 pg-TEQ/g wet weight.

< Fat tissue: 10 specimens >

The mean value was 140 pg-TEQ/g wet weight, and the median value was 110 pg-TEQ/g wet weight.

The range detected was from 8.0 to 310 pg-TEQ/g wet weight.

Co-planar PCBs accounted for a mean 51% of total TEQ value, and a median 46% of total TEQ value.

3. Research Team Evaluation of Findings

The results of this survey show that the birds (kites and Japanese cormorants) had a higher accumulation of dioxins (amount per gram of fat, etc.) than the other species. The cetaceans showed a particularly high accumulation of co-planar PCBs (accounting for about 90% of their dioxins).

According to the results from fiscal 1998 on land mammals, they had relatively higher accumulations of PCDDs and PCDFs. In this survey, however, the accumulation of co-planar PCBs accounted for more than half of the total dioxins. (In fiscal 1998, co-planar PCBs accounted for 29% of the total in Japanese wood mice, and 69% in fiscal 1999. Meanwhile, the figure for raccoon dogs was 31% in fiscal 1998, and 51% in fiscal 1999). The reasons for this difference need to be elucidated by collecting and value investigating by obtaining more specimens.

The concentration of dioxins in specimens at one point in time represent only the result of accumulation. Because of this, it takes time before the values measured reflect any changes of dioxin levels in the environment. Comparison of this year's specimens to those obtained at the same geographical locations in the fiscal 1998 survey shows that mean concentrations of dioxins have diminished in many cases. However, only two surveys are available, further surveys should be continued in the coming years.

4. Future Plans

In the future we plan to conduct more surveys, in order to determine the state of dioxin accumulation in birds, marine mammals, and other species that are likely to contain high concentrations of dioxins, and verify the impact of measures that are being implemented based on the Law Concerning Special Measures Against Dioxins and the Basic Guidelines of Japan for the Promotion of Measures against Dioxins.

Plans are also being made to implement new surveys on birds, regarding biomarkers that are thought to be indicators of the effects of dioxins and other substances.

(TEQ by wet weight)
(The values in () for birds are calculated using TEF for mammals).

Species		Fat content	PCDDs	PCDFs	PCDDs+PCDFs	Coplanar PCBs	PCDDs+PCDFs+Co-PCBs
	unit	%	pgTEQ/g	pgTEQ/g	pgTEQ/g	pgTEQ/g	pgTEQ/g
Kite	mean	6.4	10 (11)	6.7 (3.5)	17 (14)	24 (21)	40 (35)
(muscle)	median	6.1	6.3 (6.7)	4.9 (2.6)	12 (9.7)	10 (9.3)	28 (24)
N=22	maximum	12	49 (53)	23 (12)	72 (65)	75 (60)	110 (88)
	minimum	1.2	0.5 (0.5)	0.8 (0.31)	1.3 (0.84)	1.9 (1.6)	3.8 (2.6)
	mean	78	120 (130)	76 (41)	200 (170)	310 (300)	510 (470)
(Fat)	median	81	63 (66)	56 (29)	110 (87)	210 (190)	410 (350)
N=16	maximum	93	450 (470)	180 (100)	620 (560)	1,100 (1,200)	1,400 (1,400)
	minimum	53	7 (7.7)	12 (4.6)	19 (12)	37 (24)	56 (37)
Japanese cormorant	mean	4.2	22 (23)	18 (9.5)	40 (33)	95 (94)	140 (130)
(muscle)	median	4.1	20 (21)	16 (8.2)	36 (30)	73 (71)	120 (100)
N=50	maximum	7.6	69 (75)	49 (26)	93 (85)	280 (350)	370 (420)
	minimum	1.9	1.3 (1.4)	1.9 (1.0)	3.2 (2.4)	4.1 (3.6)	7.3 (5.9)
North Pacific	mean	2.9	0.017	0.085	0.10	4.3	4.5
beaked whale	median	1.5	0.000047	0.044	0.047	2.6	2.6
(muscle)	maximum	9.0	0.17	0.38	0.54	16	16
N=14	minimum	1.0	<0.13	<0.075	<0.21	0.68	0.68
	mean	82	2.1	4.4	6.5	93	99
(Fat)	median	82	2.2	4.6	6.8	72	78
N=14	maximum	94	2.9	5.8	8.5	250	260
	minimum	70	1.1	2.2	3.3	1.1	9.6
Finless black	mean	5.4	0.21	0.25	0.46	6.2	6.6
porpoise	median	2.2	0.019	0.079	0.12	1.3	1.6
(muscle)	maximum	25	1.8	1.9	3.8	58	62
N=13	minimum	1.2	0.0013	<0.075	0.0013	0.45	0.48
	mean	77	3.2	3.7	6.9	58	65
(Fat)	median	82	3.1	3.6	6.8	57	65
N=12	maximum	94	6.3	6.5	12	100	110
	minimum	46	1.1	1.6	2.7	20	24
Japanese wood mouse	mean	3.0	0.12	0.20	0.32	0.36	0.68
(whole body)	median	2.2	N.D.	N.D.	0.010	0.18	0.36
N=37	maximum	7.1	2.9	1.5	3.8	4.2	7.9
	minimum	1.6	<0.13	<0.075	<0.21	<0.011	<0.22
Raccoon dog	mean	7.4	7.5	5.1	13	8.3	21
(muscle)	median	8.0	2.1	0.93	3.1	2.2	5.2
N=10	maximum	12	32	23	55	25	78
	minimum	1.5	0.15	0.047	0.25	0.90	1.4
	mean	65	45	31	76	64	140
(Fat)	median	66	30	16	43	53	110
N=10	maximum	79	100	83	180	160	310
	minimum	36	0.0058	0.15	0.16	7.8	8.0

State of Dioxin Accumulation in Wildlife (FY 1999) (1)

(TEQ by wet weight)

(The values in () for birds are calculated using TEF for mammals).

Species	Compounds analyzed	unit	* Note	mean	median	maximum	minimum
Kite	Fat content	%		6.3	5.7	12	1.2
(Muscle)	PCDDs	pgTEQ/g	ND=0*QL	10 (11)	6.3 (6.7)	49 (53)	0.51 (0.5)
N=22			ND=1/2*QL	10 (11)	6.3 (6.7)	49 (53)	0.52 (0.5)
			ND=1*QL	10 (11)	6.3 (6.7)	49 (53)	0.53 (0.5)
	PCDFs	pgTEQ/g	ND=0*QL	6.7 (3.5)	4.9 (2.6)	23 (12)	0.77 (0.3)
			ND=1/2*QL	6.7 (3.5)	4.9 (2.6)	23 (12)	0.81 (0.3)
			ND=1*QL	6.8 (3.6)	4.9 (2.6)	23 (12)	0.84 (0.4)
	PCDDs+PCDFs	pgTEQ/g	ND=0*QL	17 (14)	12 (9.7)	72 (65)	1.3 (0.8)
			ND=1/2*QL	17 (14)	12 (9.7)	72 (65)	1.3 (0.9)
			ND=1*QL	17 (14)	12 (9.7)	72 (65)	1.4 (0.9)
	Coplanar PCBs	pgTEQ/g	ND=0*QL	24 (21)	10 (9.3 #	75 (60)	1.9 (1.6)
			ND=1/2*QL	24 (21)	10 (9.3)	75 (60)	1.9 (1.6)
			ND=1*QL	24 (21)	10 (9.3)	75 (60)	1.9 (1.6)
	PCDDs+PCDFs+Co-PCBs	pgTEQ/g	ND=0*QL	40 (35)	28 (24)	110 (88)	3.8 (2.6)
			ND=1/2*QL	40 (35)	28 (24)	110 (88)	3.8 (2.6)
			ND=1*QL	40 (35)	28 (24)	110 (88)	3.8 (2.6)
	Fat content	%		76	79	88	53
(Fat)	PCDDs	pgTEQ/g	ND=0*QL	120 (130)	63 (66)	450 (470)	7.3 (7.7)
N=16			ND=1/2*QL	120 (130)	63 (66)	450 (470)	7.3 (7.7)
			ND=1*QL	120 (130)	63 (66)	450 (470)	7.3 (7.7)
	PCDFs	pgTEQ/g	ND=0*QL	76 (41)	56 (29)	180 (100)	12 (4.6)
			ND=1/2*QL	76 (41)	56 (30)	180 (100)	12 (4.6)
			ND=1*QL	77 (41)	57 (30)	180 (100)	12 (4.7)
	PCDDs+PCDFs	pgTEQ/g	ND=0*QL	200 (170)	110 (87)	620 (560)	19 (12)
			ND=1/2*QL	200 (170)	110 (88)	620 (560)	19 (12)
			ND=1*QL	200 (170)	110 (88)	620 (560)	19 (12)
	Coplanar PCBs	pgTEQ/g	ND=0*QL	310 (310)	210 (190)	1100 (1200)	37 (24)
			ND=1/2*QL	310 (310)	210 (190)	1100 (1200)	37 (24)
			ND=1*QL	310 (310)	210 (190)	1100 (1200)	37 (24)
	PCDDs+PCDFs+Co-PCBs	pgTEQ/g	ND=0*QL	510 (470)	410 (350)	1400 (1400)	56 (37)
			ND=1/2*QL	510 (470)	410 (350)	1400 (1400)	56 (37)
			ND=1*QL	510 (470)	410 (350)	1400 (1400)	56 (37)
Japanese corr	Fat content	%		4.5	4.1	7.6	2.9
(Muscle)	PCDDs	pgTEQ/g	ND=0*QL	22 (23)	20 (21)	69 (75)	1.3 (1.4)
N=50			ND=1/2*QL	22 (23)	20 (21)	69 (75)	1.3 (1.4)
			ND=1*QL	22 (23)	20 (21)	69 (75)	1.3 (1.4)
	PCDFs	pgTEQ/g	ND=0*QL	18 (10)	16 (8.2)	49 (26)	1.9 (1.0)
			ND=1/2*QL	18 (10)	16 (8.2)	49 (26)	1.9 (1.0)
			ND=1*QL	18 (10)	16 (8.2)	49 (26)	2.0 (1.0)
	PCDDs+PCDFs	pgTEQ/g	ND=0*QL	40 (33)	36 (30)	93 (85)	3.2 (2.4)
			ND=1/2*QL	40 (33)	36 (30)	93 (85)	3.2 (2.4)
			ND=1*QL	40 (33)	36 (30)	93 (85)	3.3 (2.4)
	Coplanar PCBs	pgTEQ/g	ND=0*QL	95 (94)	73 (71)	280 (350)	4.1 (3.6)
			ND=1/2*QL	95 (94)	73 (71)	280 (350)	4.1 (3.6)
			ND=1*QL	95 (94)	73 (71)	280 (350)	4.1 (3.6)
	PCDDs+PCDFs+Co-PCBs	pgTEQ/g	ND=0*QL	140 (130)	120 (100)	370 (420)	7.3 (5.9)
			ND=1/2*QL	140 (130)	120 (100)	370 (420)	7.3 (6.0)
			ND=1*QL	140 (130)	120 (100)	370 (420)	7.4 (6.0)

* Notes:

ND=0*QL: Calculated applying 0 as the concentration for the isomers below the detection limit.

ND=1/2*QL: Calculated applying 1/2 value of the detection limit as the concentration for the isomers below the detection limit.

ND=1*QL: Calculated applying the value of the detection limit as the concentration for the isomers below the detection limit.

State of Dioxin Accumulation in Wildlife (FY 1999) (2)

(TEQ by wet weight)

(The values in () for birds are calculated using TEF for mammals).

Species	Compounds analyzed	unit	* Note	mean	median	maximum	minimum
North Pacific Beaked Whale	Fat content	%		2.9	1.5	9.0	1.0
	PCDDs	pgTEQ/g	ND=0*QL	0.017	0.000047	0.17	0
			ND=1/2*QL	0.080	0.066	0.20	0.066
(Mustle)			ND=1*QL	0.14	0.13	0.23	0.13
N=14	PCDFs	pgTEQ/g	ND=0*QL	0.085	0.044	0.38	0
			ND=1/2*QL	0.11	0.065	0.38	0.037
			ND=1*QL	0.14	0.086	0.39	0.075
	PCDDs+PCDFs	pgTEQ/g	ND=0*QL	0.10	0.047	0.54	0
			ND=1/2*QL	0.19	0.13	0.58	0.10
			ND=1*QL	0.28	0.22	0.61	0.21
	Coplanar PCBs	pgTEQ/g	ND=0*QL	4.3	2.6	16	0.68
			ND=1/2*QL	4.3	2.6	16	0.68
			ND=1*QL	4.3	2.6	16	0.68
	PCDDs+PCDFs+Co-PCBs	pgTEQ/g	ND=0*QL	4.5	2.6	16	0.68
			ND=1/2*QL	4.5	2.7	16	0.78
			ND=1*QL	4.6	2.8	16	0.89
	Fat content	%		82	82	94	70
(Fat)	PCDDs	pgTEQ/g	ND=0*QL	2.1	2.2	2.9	1.1
N=14			ND=1/2*QL	2.1	2.2	2.9	1.1
			ND=1*QL	2.1	2.2	2.9	1.1
			ND=0*QL	4.4	4.6	5.8	2.2
	PCDFs	pgTEQ/g	ND=1/2*QL	4.4	4.6	5.8	2.2
			ND=1*QL	4.4	4.6	5.8	2.2
			ND=0*QL	6.5	6.8	8.5	3.3
	PCDDs+PCDFs	pgTEQ/g	ND=1/2*QL	6.5	6.8	8.5	3.3
			ND=1*QL	6.5	6.8	8.5	3.3
			ND=0*QL	93	72	250	1.1
	Coplanar PCBs	pgTEQ/g	ND=1/2*QL	93	72	250	1.1
			ND=1*QL	93	72	250	1.1
			ND=0*QL	99	78	260	9.6
	PCDDs+PCDFs+Co-PCBs	pgTEQ/g	ND=1/2*QL	99	78	260	9.6
			ND=1*QL	99	78	260	9.6
Finless Black Porpoise	Fat content	%		5.4	2.2	25	1.2
	PCDDs	pgTEQ/g	ND=0*QL	0.21	0.019	1.8	0.0013
			ND=1/2*QL	0.26	0.10	1.8	0.066
(Mustle)			ND=1*QL	0.32	0.16	1.9	0.13
N=13			ND=0*QL	0.25	0.079	1.9	0
	PCDFs	pgTEQ/g	ND=1/2*QL	0.27	0.10	2.0	0.037
			ND=1*QL	0.29	0.13	2.0	0.075
			ND=0*QL	0.46	0.12	3.8	0.0013
	PCDDs+PCDFs	pgTEQ/g	ND=1/2*QL	0.54	0.21	3.8	0.10
			ND=1*QL	0.61	0.27	3.8	0.21
			ND=0*QL	6.2	1.3	58	0.45
	Coplanar PCBs	pgTEQ/g	ND=1/2*QL	6.2	1.3	58	0.45
			ND=1*QL	6.2	1.3	58	0.45
			ND=0*QL	6.6	1.6	62	0.48
	PCDDs+PCDFs+Co-PCBs	pgTEQ/g	ND=1/2*QL	6.7	1.6	62	0.57
			ND=1*QL	6.8	1.6	62	0.66
	Fat content	%		77	82	94	46
(Fat)	PCDDs	pgTEQ/g	ND=0*QL	3.2	3.1	6.3	1.1
N=12			ND=1/2*QL	3.2	3.1	6.3	1.2
			ND=1*QL	3.3	3.1	6.3	1.3
			ND=0*QL	3.7	3.6	6.5	1.6
	PCDFs	pgTEQ/g	ND=1/2*QL	3.7	3.6	6.5	1.7
			ND=1*QL	3.7	3.6	6.5	1.7
			ND=0*QL	6.9	6.8	12	2.7
	PCDDs+PCDFs	pgTEQ/g	ND=1/2*QL	6.9	6.8	12	2.8
			ND=1*QL	7.0	6.8	12	2.9
			ND=0*QL	58	57	100	20
	Coplanar PCBs	pgTEQ/g	ND=1/2*QL	58	57	100	20
			ND=1*QL	58	57	100	20
			ND=0*QL	65	65	110	24
	PCDDs+PCDFs+Co-PCBs	pgTEQ/g	ND=1/2*QL	65	65	110	24
			ND=1*QL	65	65	110	24

* Notes:

ND=0*QL: Calculated applying 0 as the concentration for the isomers below the detection limit.

ND=1/2*QL: Calculated applying 1/2 value of the detection limit as the concentration for the isomers below the detection limit.

ND=1*QL: Calculated applying the value of the detection limit as the concentration for the isomers below the detection limit.

State of Dioxin Accumulation in Wildlife (FY 1999) (3)

(TEQ by wet weight)
(The values in () for birds are calculated using TEF for mammals).

Species	Compounds analyzed	unit	* Note	mean	median	maximum	minimum
Japanese Wood	Fat content	%		3.0	2.2	7.1	1.6
Mouse	PCDDs	pgTEQ/g	ND=0*QL	0.12	N.D.	2.9	0
			ND=1/2*QL	0.72	0.60	3.2	0.066
(whole body)			ND=1*QL	1.3	1.2	3.5	0.13
N=37	PCDFs	pgTEQ/g	ND=0*QL	0.20	N.D.	1.5	0
			ND=1/2*QL	0.51	0.38	1.8	0.037
			ND=1*QL	0.82	0.72	2.2	0.075
	PCDDs+PCDFs	pgTEQ/g	ND=0*QL	0.32	0.010	3.8	0
			ND=1/2*QL	1.2	1.0	4.3	0.10
			ND=1*QL	2.1	1.9	4.9	0.21
	Coplanar PCBs	pgTEQ/g	ND=0*QL	0.36	0.18	4.2	0
			ND=1/2*QL	0.38	0.19	4.2	0.0056
			ND=1*QL	0.40	0.23	4.2	0.011
	PCDDs+PCDFs+Co-PCBs	pgTEQ/g	ND=0*QL	0.68	0.36	7.9	0.00
			ND=1/2*QL	1.6	1.3	8.5	0.11
			ND=1*QL	2.5	2.2	9.0	0.22
Raccoon Dog	Fat content	%		7.4	8.0	12	1.5
(Mustle)	PCDDs	pgTEQ/g	ND=0*QL	7.5	2.1	32	0.15
N=10			ND=1/2*QL	7.5	2.1	32	0.23
			ND=1*QL	7.6	2.1	32	0.31
	PCDFs	pgTEQ/g	ND=0*QL	5.1	0.93	23	0.047
			ND=1/2*QL	5.2	1.0	23	0.090
			ND=1*QL	5.2	1.1	23	0.13
	PCDDs+PCDFs	pgTEQ/g	ND=0*QL	13	3.1	55	0.25
			ND=1/2*QL	13	3.1	55	0.37
			ND=1*QL	13	3.1	55	0.50
	Coplanar PCBs	pgTEQ/g	ND=0*QL	8.3	2.2	25	0.90
			ND=1/2*QL	8.3	2.2	25	0.90
			ND=1*QL	8.3	2.2	25	0.90
	PCDDs+PCDFs+Co-PCBs	pgTEQ/g	ND=0*QL	21	5.2	78	1.4
			ND=1/2*QL	21	5.3	78	1.5
			ND=1*QL	21	5.3	78	1.5
	Fat content	%		65	66	79	36
(Fat)	PCDDs	pgTEQ/g	ND=0*QL	45	30	100	0.0058
N=10			ND=1/2*QL	45	30	100	0.20
			ND=1*QL	45	30	100	0.39
	PCDFs	pgTEQ/g	ND=0*QL	31	16	83	0.15
			ND=1/2*QL	31	16	83	0.22
			ND=1*QL	31	16	83	0.29
	PCDDs+PCDFs	pgTEQ/g	ND=0*QL	76	43	180	0.16
			ND=1/2*QL	76	43	180	0.42
			ND=1*QL	76	43	180	0.68
	Coplanar PCBs	pgTEQ/g	ND=0*QL	64	53	160	7.8
			ND=1/2*QL	64	53	160	7.8
			ND=1*QL	64	53	160	7.8
	PCDDs+PCDFs+Co-PCBs	pgTEQ/g	ND=0*QL	140	110	310	8.0
			ND=1/2*QL	140	110	310	8.3
			ND=1*QL	140	110	310	8.5

* Notes:

ND=0*QL: Calculated applying 0 as the concentration for the isomers below the detection limit.

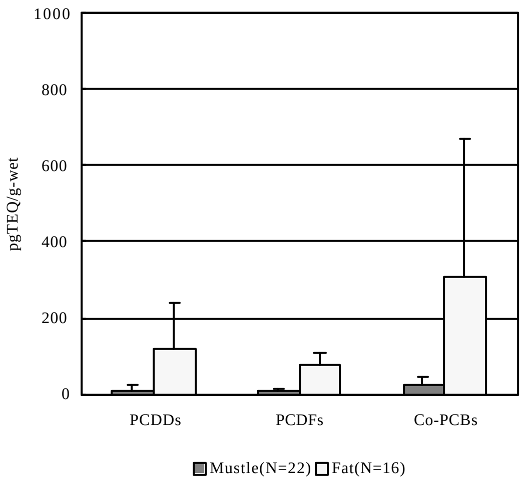
ND=1/2*QL: Calculated applying 1/2 value of the detection limit as the concentration for the isomers below the detection limit.

ND=1*QL: Calculated applying the value of the detection limit as the concentration for the isomers below the detection limit.

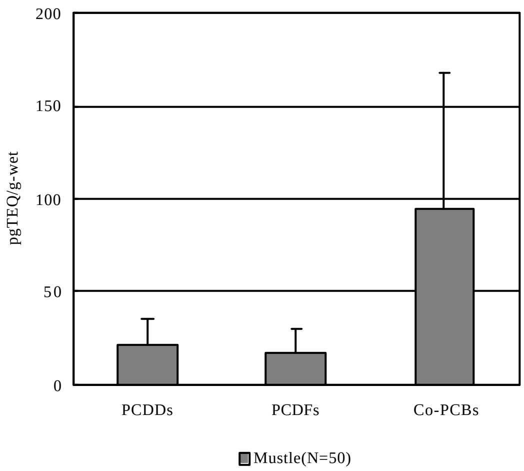
State of Dioxin Accumulation in Wildlife (FY 1999)

(TEQ by wet weight)
(The values in () for birds are calculated using TEF mammals).

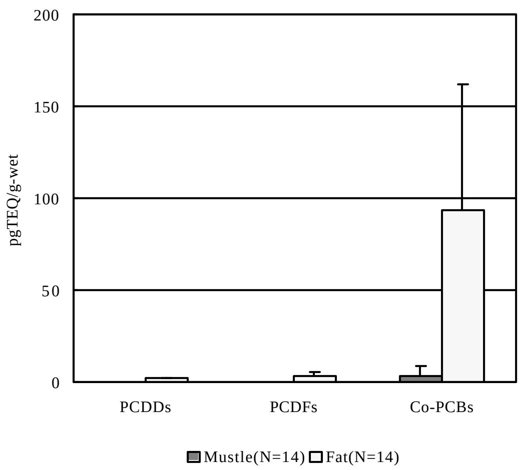
Kite



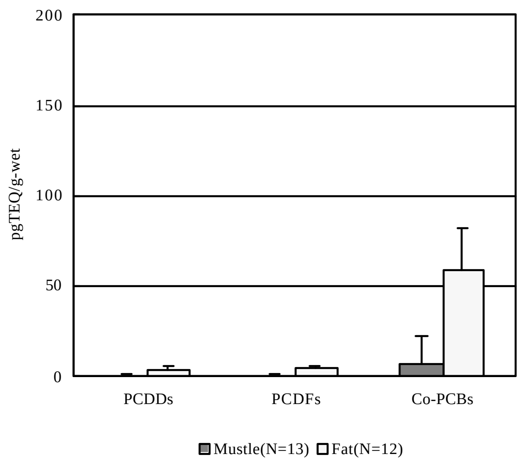
Japanese Cormorant



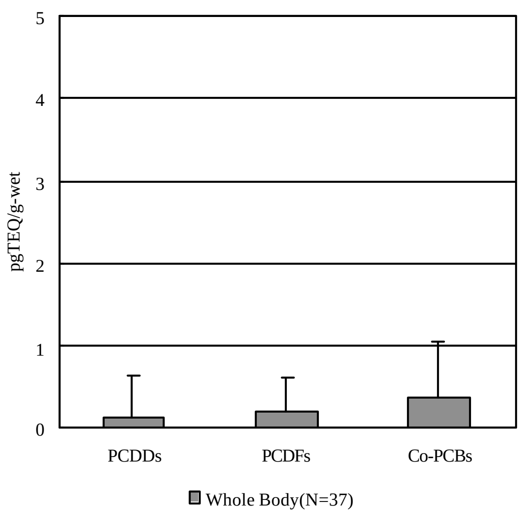
North Pacific Beaked Whale



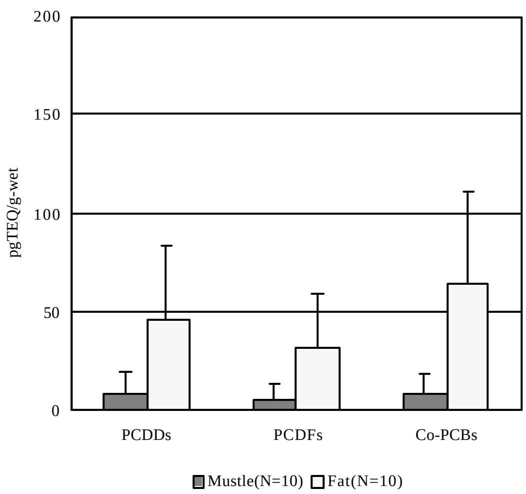
Finless Blank Porpoise



Japanese Wood Mouse



Raccoon Dog

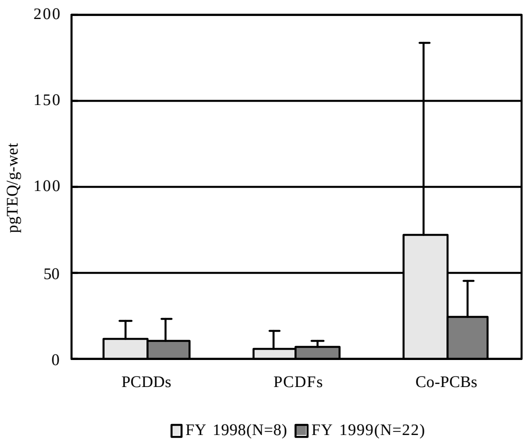


(Mean + s.d.)

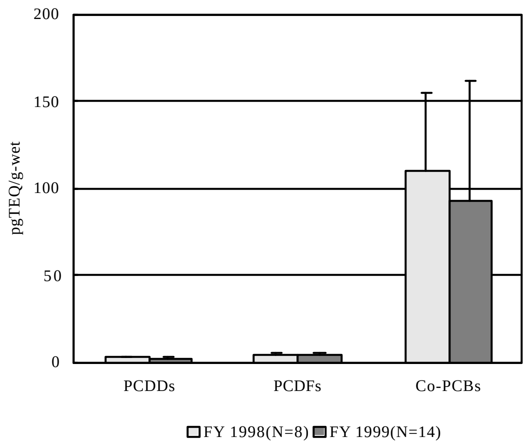
State of Dioxin Accumulation in Wildlife (FY 1999)

(Comparison with FY 1998 results)
(TEQ by wet weight)

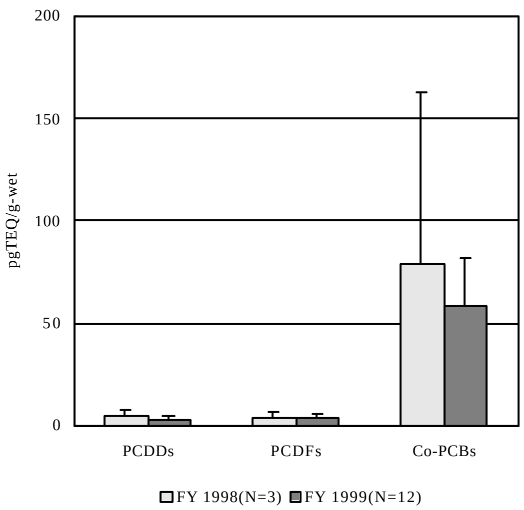
Kite (Mastle)



North Pacific Beaked Whale (Fat)



Fineless Black Porpoise (Fat)



Japanese Wood Mouse