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ANNEX to Report nr. 719101012

A model for environmental risk assessment and standard setting based on biomagnification. Top predators in terrestrial ecosystems.

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APPENDICES:

Appendix A

Food choice of birds and mammals

Appendix A1: The diet of eight selected bird of prey species.
Relative weights are converted to relative weights with the conversion factors reported by De Bruijn (1979), unless otherwise stated.

predator species	prey type (birds/mammals)	prey species	relative number (%)	relative weight (%)	location	reference	comment
Accipiter nisus (Sparrowhawk)	birds	Passer domesticus	26.3	25.1	Dutch–German border, forests and agricul–tural land and villages	Opdam (1978)	There are differences in prey composition in winter and breeding season. In May, June, July the proportion of juveniles among prey is considerable (about 40%).
		Passer montanus	10.4	9.9			
		Turdus merula	6.6	22.5			
		Fringilla coelebs	5.9	5.2			
		Parus major	4.8	3.1			
		Sturnus vulgaris	4.5	12.3			
		Parus caeruleus	3.9	1.6			
		Alauda arvensis	3.8	4.5			
		Turdus pilaris	2.6	8.9			
		Turdus philomelos	2.3	5.5			
		Erithacus rubecula	2.0	1.4			
Accipiter gentilis (Goshawk)	mammals	Oryctolagus cuniculus	3.2	9.1	forest area on the Dutch–German border	Opdam et al. (1977)	Proportion of not fully grown juveniles in 5 major prey species is also determined (only in April to July) and amounted to about 40%.
		Lepus europaeus	0.3	0.9			
	birds	Collumba palumbus	37.7	42.8			
		Collumba livia	21.8	19.2			
		Garrulus glandarius	8.8	4.0			
		Turdus merula	4.5	12.8			
		Phasianus colchicus	3.5	9.9			
		Sturnus vulgaris	3.5	0.8			
		Turdus pilaris	2.1	0.6			
Buteo buteo (Buzzard)	mammals	Microtidae	55.0	33.6	Europe, average	Glutz von Blotzheim et al. (1971)	Reported mean body weights: BWpasserines = 25 g. BWcorvidae = 170 g. BWphasianidae = 800 g.
		Talpa europea	9.0	16.5			
		Cricetus cricetus	4.0	7.2			
		Lepus lepus	4.0	24.5			
		Muridae	2.0	1.0			
		Soricidae	1.0	0.4			
	birds	small passerines	10.0	5.1			
		Corvidae	1.0	3.5			
		Phasianidae	0.5	8.2			

Appendix A1: The diet of eight selected bird of prey species. (continued)

predator species	prey type (birds/mammals)	prey species	relative number (%)	relative weight (%)	location	reference	comment
Falco tinnunculus (Kestrel)	mammals	Microtus arvalis	87.0	95.0	Netherlands (Oost-Flevoland)	Cave (1968)	
		Micromys minutus	9.0	3.0			
		Sorex araneus	2.0	0.9			
		Apodemus sylvaticus	1.0	0.9			
		Sorex minutus	1.0	0.2			
Asio otus (Long-eared Owl)	mammals	Microtus arvalis		66.9	Netherlands (Groningen)	Wijnandts (1984)	
		Apodemus sylvaticus		8.6			
		Clethrionomys glareolus		3.5			
		Microtus agrestis		3.8			
		rest		4.3			
	birds	Turdus spp.		3.3			
		Passer spp.		2.8			
		Sturnus vulgarus		2.7			
		Parus spp.		0.9			
		rest		3.2			
Strix aluco (Tawny Owl)	mammals	Clethrionomys glareolus		7.4	Netherlands (Twente)	Smeenk (1972)	
		Sorex araneus		7.3			
		Talpa europaea		7.3			
		Apodemus sylvaticus		6.8			
		Rattus norvegicus		6.2			
		Oryctolagus cuniculus		6.1			
		Microtus agrestis		5.5			
		Microtus arvalis		4.9			
		rest		4.7			
	birds	Turdus spp.		27.2			
		Passer spp.		5.0			
		Parus spp.		2.4			
		Rana spp.		9.2			

Appendix A1: The diet of eight selected bird of prey species. (continued)

predator species	prey type (birds/mammals)	prey species	relative number (%)	relative weight (%)	location	reference	comment
Tyto alba (Barn Owl)	mammals	Microtus arvalis		48.8	Netherlands (average)	De Bruijn (1979)	This is an average of a socalled maximum vole year and a minimum vole year.
		Sorex araneus		15.2			
		Crocidura russula		8.9			
		Apodemus sylvaticus		6.3			
		Mus musculus		3.0			
		Microtus agrestis		2.2			
		Arvicola terrestris		3.3			
		Rattus spp.		3.4			
		rest		1.8			
	birds	Passer domesticus		7.1			
Athene noctua (Little Owl)	mammals	Talpa europea		21.2	Netherlands (Betuwe)	Van Zoest and Fuchs (1988)	Prey brought to the nestbox in the period 21 April – 12 June.
		Microtus spp.		8.8			
		Muridae		6.5			One breeding pair is studied.
		Apodemus sylvaticus		6.2			
		Bat spp.		0.8			Rest mammals are unidentified.
		rest		8.9			
	birds	total		5.4			Rest invertebrates comprise leaches and Diptera larvae.
	Rana spp.			0.8			
	Lumbricidae			20.0			
	insect spp.			8.0			
	caterpillars			7.6			
	rest			5.6			

Appendix A2: Diet of two selected beast of prey species

species	diet components	relative number (%)	relative weight (%)	quantitative data available ?	average body weight prey species	reference	comment
Meles meles (Badger)	earthworms		27	yes		Ma and Broekhuizen (1989)	stomach analysis of animals found dead from 1985 – 1988 therefore the proportion of molluscs and amphibians may be underestimated
	insects (mainly Coleoptera)		18				
	grass		14				
	maize		14				
	mammals (mole, mice, rabbit, hedgehog)		12				
	amphibians (toad)		5				
	birds (crow, thrush, meadow – pipit)		2				
	acorns		5				
	fruits		2				
	slugs		1				
Mustela nivalis (Weasel)	shrews	12	3	yes	12	Brugge (1977)	determined from alimentary tract contents
	mice	14	7		24		
	voles	62	37		30		
	moles	1	2		90		
	mole rats	1	2		120		
	rat spp.	3	9		150		
	musk rats	1	5		250		
	hares/rabbits	1	6		300		
	birds (passerines, ducks, pigeon and unknown)	5	30		300		

Appendix A3: Diet of birds of lower trophic level. Only the important prey bird species of the selected raptorial birds are shown.

bird species	adult/juvenile, season	diet components	relative number (%)	relative weight (%)	data quantified?	reference	comment
Perdix perdix (Partridge)	adults:	green parts, root stocks seeds, harvest remainder			no	Ten Den (1989a)	
	juveniles:	mainly animal food (arthropods) in the first month					
Phasianus colchicus (Pheasant)	adults:	mainly (all kinds of) plant material		90–95	partly	Janda (1964)	
		also arthropods, molluscs and earthworms		5–10			
	juveniles:	mainly animal food (arthropods) in the first month:		60–80			
		Hymenoptera	21.0				
		Lepidoptera	11.6			Hill (1985a)	
		Heteroptera	17.5				
		Homoptera	22.6				
		Diptera	12.1				
		Coleoptera	11.9				
Columba livia (Domestic Pigeon)		very variable, all kinds of plant parts many seeds, also some animal food (like larvae and earthworms) also garbage			no	Glutz von Blotzheim and Bauer (1980)	
Columba palumbus (Wood Pigeon)		Nearly completely herbivorous: seeds, leaves, fruits, root stocks etc. Diet depends strongly on season and supply (harvest remains etc.).			no	Glutz von Blotzheim and Bauer (1980)	
Turdus merula (Blackbird)	adults:	Mainly animal food, most important are: earthworms, beetles and ants. Also often: snails, slugs, spiders, insects and their larvae, young birds and eggs, mushrooms, garbage, fruits			partly	Glutz von Blotzheim and Bauer (1988)	
	in breeding season:	only animal food					
	annually:	animal food:		48.7		Eble (1963)	calculated with the volumetric method of stomach contents
		vegetable food:		51.3			

Appendix A3: Diet of birds of lower trophic level. Only the important prey bird species of the selected raptorial birds are shown. (continued)

bird species	adult/juvenile, season	diet components	relative number (%)	relative weight (%)	data quantified?	reference	comment
Turdus pilaris	in summer:	mainly earthworms and beetles:			yes	Glutz von Blotzheim and Bauer (1988)	
(Fieldfare)		earthworms		57.4			
		Coleoptera larvae and images		8.8			
		Gastropoda (snails and slugs)		3.5			
		Lepidoptera larvae		2.2			
		Diptera		1.3			
		Hymenoptera		0.7			
		vegetation from earthworm guts		25.0			
		vegetation		1.0			
	in autumn and winter:	mainly berries and fruits					
Turdus philomelos	in spring and summer:	mainly animal food			yes	Glutz von Blotzheim and Bauer (1988)	
(Song Thrush)	in autumn and winter:	mainly vegetable food					
	annually:	Mollusca		30.1			
		Coleoptera		29.8			
		Annelida		8.4			
		Plant parts		25.6			
	annually:	animal food:		62.9			
		vegetable food:		37.1		Eble (1963)	calculated with the volumetric method of stomach contents
Hirundo rustica		only insects, mainly Diptera and			yes	Witherby et al. (1952)	
(Swallow)		also many Hemiptera, Hymenoptera (ants) and Coleoptera					
		predacious insects 20–35%		30			
		non–predacious insects 60–85%.		70		Beal (1918) in: Ram (1990)	
Alauda arvensis		mainly herbivorous especially cereal seeds			partly	Witherby et al. (1952)	
(Skylark)		also seeds of herbs and young leaves					
	in spring and summer:	many insects, spiders, earthworms etc.					
	over one year:	vegetable food		54.0			
		animal food		46.0			
Erithacus rubecula	in breeding season:	mainly animal food with a broad spectrum					
(Robin)		insects (larvae and adults), spiders,			no	Witherby et al. (1952)	
		Myriapoda, Isopoda, Gastropoda, Annelida					
	in late summer and autumn:	many fruits					

Appendix A3: Diet of birds of lower trophic level. Only the important prey bird species of the selected raptorial birds are shown. (continued)

bird species	adult/juvenile, season	diet components	relative number (%)	relative weight (%)	data quantified?	reference	comment
Passer domesticus (House Sparrow)	adults:	mainly vegetable food, especially seeds		90.0	no	Van der Plas (1980)	
		also animal food (insects)		10.0			
	juveniles:	mainly insects, especially Coleoptera, followed by Hemiptera etc.		95.0			
	summer:	grains 65−83%, seeds 10−25%, fruits 0−4%, non−predacious insects 0−5%.			yes	Kalmbach (1940) in Ram (1990)	
	winter:	grains 75−90%, seeds 15−20%, non−predacious insects 0−5%.					
Sturnus vulgaris (Starling)		vegetable portion varies from 23−51% and comprises fruits and seeds Diet depends strongly on season and supply (harvest remains etc.).		23−51	partly	Gallacher (1978)	
	in breeding season:	in decreasing order: Tipula paludosa larvae (Diptera), Lepidoptera larvae and Coleoptera				Tinbergen (1981)	
	annually:	animal food:		77.0		Eble (1963)	calculated with the volumetric method of stomach contents
		vegetable food:		23.0			
	summer:	non−predacious insects 30−47% predacious insects 0−6%, spiders and myriapods 14−20%, larval insects 2−8%, fruits 25−40%, grains 0−2%.				Linsey (1939) in Ram ??	
	winter:	non−predacious insects 16−25% spiders and myriapods 8−14%, larval insects 2−8%, fruits 30−44%, grains 0−10%. garbage 20−35%					
Fringilla coelebs (Chaffinch)	in spring and summer:	mainly animal food (insects)		85.0	partly	Kragenow (1986)	
		also some fruits and seeds		15.0			
	in autumn and winter:	mainly seeds and fruits		75−85			
		some animal food (insects)		15−25			

Appendix A3: Diet of birds of lower trophic level. Only the important prey bird species of the selected raptorial birds are shown. (continued)

bird species	adult/juvenile, season	diet components	relative number (%)	relative weight (%)	data quantified?	reference	comment
Phoenicurus spp. (Redstarts)	adults:	mainly insects			no	Witherby et al. (1952)	
	juveniles:	mainly caterpillars					
Parus spp. (Great and Blue Tit)	adults:	mainly insects and their larvae also buds (in spring) and berries and seeds (in late summer and autumn)			yes	Witherby et al. (1952)	
	juveniles:	mainly Lepidoptera larvae					
	over one year:	insects:		77.0			
		fruits and seeds:		23.0		Collinge (1927)	
Carduelis cannabina (Linnet)	adults:	mainly seeds of weeds and some insects like Lepidoptera adults and larvae			no	Witherby et al. (1952)	
	juveniles:	mainly larvae of Lepidoptera, Diptera also small Coleoptera and spiders					
Corvus monedula (Jackdaw)		mainly animal food		71.5	partly	Witherby et al. (1952)	
		also vegetable food		28.5			
		portion of insects is 42%		42.0			
		broad food spectrum: larvae of Lepidoptera, Diptera (Tipulidae) and also young birds eggs of birds, snails, slugs, earthworms, woodlice, fruits, cereals, berries etc.					
Garrulus glandarius (Jay)	adults:	mainly herbivorous: acorns, beech mast, grain, cherries and other fruits and buds also: young birds, eggs and mice			partly	Goodwin (1976)	
		animal food:		28			
		vegetable food:		72		Keve and Sterbetz (1968)	review of diet studies in many countries.

Appendix A4: Diet of mammals of "lower trophic level". Only the quantitatively important prey species of raptors are shown. (On WW basis, unless otherwise stated).

species	season, site, soil conditions, etc.	diet components	relative weight (%)	quantitative data available ?	reference	comment
Microtus agrestis (Field Vole)				yes		
		stems and leaves of grass spp.	90		Ma et al. (1991)	
		herbs (Dicotyledons)	10		Hunter et al. (1987c)	on DW basis
						stomach analysis method
		mosses (esp. taken in spring and summer)	5		Faber and Ma (1986)	
Microtus arvalis (Common Vole)		comparable with M. agrestis		yes	Niethammer and Krapp (1982)	
Micromys minutus (Harvest Mouse)	summer and autumn:	seeds of cereals, other crops and grass		no	Niethammer and Krapp (1982)	
	winter:	animal food especially insects, sometimes cannibalism				
Arvicola terrestris (Water Vole)		mainly vegetative parts of shore- and water plants (a broad species spectrum)		no	Niethammer and Krapp (1982)	
Lepus europaeus (Hare)		completely herbivorous: grass, cereal crops, and turnip bulbs in winter		no	Corbett and Southern (1977)	
Oryctolagus cuniculus (Rabbit)		completely herbivorous: leaves, stems, roots, root stocks of both wild plants and agricultural crops		no	Corbett and Southern (1977)	
Cricetus cricetus (Common Hamster)		mainly green plant parts	50	yes	Niethammer and Krapp (1982)	
		also grains and seeds	35			
		plant root (stocks)	5			
		animal food (mainly Coleoptera and snails)	10			

Appendix A4: Diet of mammals of "lower trophic level". Only the quantitatively important prey species of raptors are shown. (continued)

species	season, site, soil conditions, etc.	diet components	relative weight (%)	quantitative data available ?	reference	comment
Clethrionomys glareolus				yes	Niethammer and Krapp (1982)	
(Bank Vole)		mainly seeds and leaves of trees and shrubs				
		also larvae, insects, young birds and eggs				
	in winter:	seeds	25			average of seven European countries (own estimation)
		green plant (and tree) parts	30			
		moss, lichen	10			
		berries	4			
		animal food	6			
		bark	5			
		miscellaneous	20			
Apodemus sylvaticus				yes		
(Wood mouse)	Cd contaminated site	seeds of trees and shrubs	65		Hunter et al. (1987c)	
		fruits (bramble)	10			
		grass seed	10		on DW basis	
		green plants	10			
		invertebrates	0–5			
		miscellaneous	0–5			
Mus musculus (House Mouse)		mainly seeds of cereals, but also of wild plants; also insects (Lepidoptera larvae etc.)		no	Niethammer and Krapp (1982)	
Rattus norvegicus (Brown Rat)		major part: cereals, fruits, vegetables; also flesh, fish, eggs and young birds, amphibians, garbage, etc.		no	Niethammer and Krapp (1982)	
Sorex araneus				yes		
(Common Shrew)	Cd contaminated site	Arachnida	45.0		Hunter et al. (1987c)	earthworms are underestimated because faeces were used for analysis
		Coleoptera (adults)	25.0			
		Coleoptera and Diptera larvae	20.0			
		Herbivorous insects	5.0			
		Detritivores (Collembola and Isopoda)	5.0			on DW basis

Appendix A4: Diet of mammals of "lower trophic level". Only the quantitatively important prey species of raptors are shown. (continued)

species	season, site, soil conditions, etc.	diet components	relative weight (%)	quantitative data available ?	reference	comment
Sorex araneus (Common Shrew)	control site (no Cd contamination)	Lumbricidae	45.0		Ma et al. (1991)	diet at a Cd polluted site is slightly different
		Coleoptera larvae	8.5			
		Coleoptera adults	8.0			
		Arachnida	11.0			stomach dissection method
		Lepidoptera larvae	7.0			
		Diptera larvae	2.5			
		Opilionida	4.0			
		undetermined material	14.0			
Crocidura russula (Greater White-tooted Shrew)		assumption: comparable with diet of Sorex araneus		no		
Talpa europaea (Mole)	meadows	Lumbricidae	80	yes	Oppermann (1968)	
		Coleoptera larvae	10			
		Diptera larvae	10			
	deciduous forests	Lumbricidae	65			
		Coleoptera larvae	15			
		Diptera larvae	10			
		Lepidoptera larvae	10			
	pine forests	Lumbricidae	30			
		Coleoptera larvae	65			
		Diptera larvae	5			

Appendix A5: Diet (%) of birds of "lower trophic" level in quantitative terms . For some species assumptions are made to quantify data (see section 2.1).

bird family	bird species		quant. data available ?	leaves	fruits	seeds	tubers	worms	gastropods	Insect larvae	caterpillars	insects	isopods	spiders	TOTAL (%)
Phasianidae, Galliformes	Perdix perdix	(Partridge)	no	33		33	33								100
Phasianidae, Galliformes	Phasianus colchicus	(Pheasant)	partly	31		31	31	4	4						100
Columbidae, Columbiformes	Columba livia	(Domestic Pigeon)	no	33		33	33								100
Columbidae, Columbiformes	Columba palumbus	(Wood Pigeon)	no	25	25	25	25								100
Corvidae, Passeriformes	Corvus monedula	(Jackdaw)	partly		14	14		8	8	4	4	40	8		100
Corvidae, Passeriformes	Garrulus glandarius	(Jay)	partly	13	13	75									100
Turdidae, Passeriformes	Turdus merula	(Blackbird)	partly		50			18	5	5	5	18			100
Turdidae, Passeriformes	Turdus pilaris	(Fieldfare)	yes		50			40	3		2	5			100
Turdidae, Passeriformes	Turdus philomelos	(Song Thrush)	yes		31			9	30			30			100
Turdidae, Passeriformes	Erithacus rubecula	(Robin)	no		25			11	11	11	11	11	11	11	100
Turdidae, Passeriformes	Phoenicurus spp.	(Redstarts)	no								25	75			100
Sturnidae, Passeriformes	Sturnus vulgaris	(Starling)	partly		23					39	26	13			100
Ploceidae, Passeriformes	Passer domesticus	(House Sparrow)	yes		2	93						5			100
Fringillidae, Passeriformes	Fringilla coelebs	(Chaffinch)	partly		25	25						50			100
Fringillidae, Passeriformes	Carduelis cannabina	(Linnet)	no			75					10	10		5	100
Paridae, Passeriformes	Parus spp.	(Great and Blue Tit)	yes	8	8	8					25	50			100
Alaudidae, Passeriformes	Alauda arvensis	(Skylark)	partly	14		41		15				15		15	100
Hirundinidae, Passeriformes	Hirundo rustica	(Swallow)	yes									100			100

Appendix A6: Diet of mammals of "lower trophic level" in quantitative terms. For some species assumptions are made to quantify data (see section 2.1).

family	species	quantitative data ?	leaves	fruits	seeds	tubers	worms	Mollusca	Larvae insecta	Larvae Lepidop.	Insecta	Isopoda	Arachnida	TOTAL (%)
Microtidae, Orde: Rodentia	Microtus agrestis (Field Vole)	yes	100.0											100.0
Idem	Microtus arvalis (Common Vole)	yes	100.0											100.0
Idem	Arvicola terrestris (Water Vole)	no	100.0											100.0
Idem	Clethrionomys glareolus (Bank Vole)	yes	55.0	5.0	32.0						8.0			100.0
Idem	Cricetus cricetus (Common Hamster)	yes	50.0		35.0	5.0		5.0			5.0			100.0
Leporidae, Order: Lagomorpha	Lepus europaeus (Hare)	no	75.0			25.0								100.0
Idem	Oryctolagus cuniculus (Rabbit)	no	75.0			25.0								100.0
Muridae, Order: Rodentia	Apodemus sylvaticus (Wood Mouse)	yes	10.0	10.0	75.0						5.0			100.0
Idem	Mus musculus (House Mouse)	no			75.0					25.0				100.0
Idem	Micromys minutus (Harvest Mouse)	no			75.0				25.0					100.0
Idem	Rattus norvegicus (Brown Rat)	no	33.3	33.3	33.3									100.0
Soricidae, Order: Insectivora	Sorex araneus (Common Shrew)	yes					52.3		12.8	8.2	9.3		17.4	100.0
Idem	Crocidura russula	no					52.3		12.8	8.2	9.3		17.4	100.0
Talpidae, Order: Insectivora	Talpa europaea (Mole)	yes					80.0		20.0					100.0

Appendix A7: Three ways to construct food webs of eight selected raptorial birds, in order to apply these for calculation of bioaccumulation of the selected chemicals.

A: most differentiated diet (only used for Cd).

Food item	Sparrowhawk		Goshawk		Buzzard		Kestrel		Long-eared Owl		Tawny Owl		Barn Owl		Little Owl		
	birds	mammals	birds	mammals	birds	mammals	birds	mammals	birds	mammals	birds	mammals	birds	mammals	birds	mammals	invert.
Leaves	1.0	0.0	20.7	7.5	2.9	50.6	0.0	95.1	0.1	77.3	0.2	24.0	0.0	57.2	0.0	10.4	0.0
Fruits	23.0	0.0	18.1	0.0	0.6	3.2	0.0	0.1	3.0	1.1	12.2	3.4	0.1	1.8	0.1	1.8	0.0
Seeds	36.0	0.0	23.2	0.0	8.9	4.3	0.0	2.9	3.6	7.9	4.8	10.4	6.6	8.3	5.0	11.8	0.0
Tubers	0.0	0.0	20.1	2.5	2.6	6.5	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Worms	8.8	0.0	2.8	0.0	0.3	13.4	0.0	0.6	1.0	0.0	6.0	10.5	0.0	12.8	0.0	20.8	23.5
Mollusca	3.2	0.0	1.0	0.0	0.3	0.4	0.0	0.0	0.6	0.0	3.4	0.0	0.0	0.0	0.0	0.0	0.0
Larv. Ins.	6.0	0.0	0.9	0.0	0.1	3.4	0.0	0.9	1.5	0.0	0.5	2.6	0.0	3.1	0.0	5.8	0.0
Larv. Lep.	5.8	0.0	0.9	0.0	0.1	0.0	0.0	0.1	1.3	0.0	1.2	0.6	0.0	2.8	0.0	0.7	9.0
Insecta	15.2	0.0	2.4	0.0	1.0	1.3	0.0	0.1	1.9	0.7	6.2	1.7	0.4	2.6	0.3	0.7	9.4
Isopoda	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arachnida	0.8	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.0	1.4	0.0	4.3	0.0	0.0	0.0
Total	100.0	0.0	90.0	10.0	16.8	83.2	0.0	100.0	12.9	87.1	34.6	56.3	7.1	92.9	5.4	51.9	41.9

B: Diet to be used for methyl mercury (with pooled groups).

	Sparrowhawk		Goshawk		Buzzard		Kestrel		Long-eared Owl		Tawny Owl		Barn Owl		Little Owl		
	birds	mammals	birds	mammals	birds	mammals	birds	mammals	birds	mammals	birds	mammals	birds	mammals	birds	mammals	invert.
leaves & seeds	37.0	0.0	43.8	7.5	11.8	55.0	0.0	98.0	3.7	85.3	5.0	34.4	6.6	65.5	5.0	22.2	0.0
fruits	23.0	0.0	18.1	0.0	0.6	3.2	0.0	0.1	3.0	1.1	12.2	3.4	0.1	1.8	0.1	1.8	0.0
tubers	0.0	0.0	20.1	2.5	2.6	6.5	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Invertebrates	40.0	0.0	8.0	0.0	1.8	18.6	0.0	1.9	6.3	0.7	17.4	16.8	0.4	25.6	0.3	27.9	41.9
Total	100.0	0.0	90.0	10.0	16.8	83.2	0.0	100.0	12.9	87.1	34.6	56.3	7.1	92.9	5.4	51.9	41.9

C: Diet to be used for organic compounds (with pooled groups and Annelida included in soft-bodied invertebrates).

	Sparrowhawk		Goshawk		Buzzard		Kestrel		Long-eared Owl		Tawny Owl		Barn Owl		Little Owl		
	birds	mammals	birds	mammals	birds	mammals	birds	mammals	birds	mammals	birds	mammals	birds	mammals	birds	mammals	invert.
leaves and fruits	24.0	0.0	38.8	7.5	3.4	53.8	0.0	95.2	3.0	78.4	12.4	27.4	0.1	59.0	0.1	12.2	0.0
seeds	36.0	0.0	23.2	0.0	8.9	4.3	0.0	2.9	3.6	7.9	4.8	10.4	6.6	8.3	5.0	11.8	0.0
tubers	0.0	0.0	20.1	2.5	2.6	6.5	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Soft-bodied invert.	18.0	0.0	4.8	0.0	0.6	17.1	0.0	1.5	3.1	0.0	9.9	13.0	0.0	15.9	0.0	26.6	23.5
Hard-bodied invert.	22.0	0.0	3.2	0.0	1.2	1.4	0.0	0.4	3.2	0.7	7.4	3.8	0.4	9.6	0.3	1.3	18.4
Total	100.0	0.0	90.0	10.0	16.8	83.2	0.0	100.0	12.9	87.1	34.6	56.3	7.1	92.9	5.4	51.9	41.9

Appendix A8: Three ways to construct food webs of two selected beast of prey species, in order to apply these for calculation of bioaccumulation of selected chemicals.

A: most differentiated diet (only used for cd)

Food item	Weasel		Badger			
	birds	mammals	birds	mammals	invert.	
Leaves	4.7	51.2	0.1	4.4	14.0	
Fruits	5.1	3.7	0.5	0.2	2.0	
Seeds	8.0	8.2	0.4	1.8	19.0	
Tubers	4.4	1.5	0.0	0.6	0.0	
Worms	1.4	3.2	0.3	3.2	27.0	
Gastropods	0.7	0.0	0.1	0.0	1.0	
Insect larvae	0.8	0.8	0.1	0.8	0.0	
Caterpillars	1.2	0.2	0.1	0.2	0.0	
Insects	3.1	0.6	0.3	0.3	18.0	
Isopods	0.2	0.0	0.0	0.0	0.0	
Spiders	0.5	0.5	0.2	0.4	0.0	
Total	30.0	70.0	2.0	12.0	81.0	rest: 5% amphibians

B: Diet to be used for methyl mercury (with lumped groups).

	Weasel		Badger			
	birds	mammals	birds	mammals	invert.	
leaves & seeds	12.7	59.4	0.5	6.2	33.0	
fruits	5.1	3.7	0.5	0.2	2.0	
tubers	4.4	1.5	0.0	0.6	0.0	
invertebrates	7.8	5.4	1.0	4.9	46.0	
total	30.0	70.0	2.0	12.0	81.0	0.0 rest: 5% amphibians

C: Diet to be used for organic compounds (with lumped groups)

	Weasel		Badger			
	birds	mammals	birds	mammals	invert.	
leaves and fruits	9.8	54.9	0.6	4.7	16.0	
seeds	8.0	8.2	0.4	1.8	19.0	
tubers	4.4	1.5	0.0	0.6	0.0	
soft-bodied invert.	2.9	4.0	0.4	4.0	28.0	
hard-bodied invert.	4.9	1.4	0.5	1.0	18.0	
total	30.0	70.0	2.0	12.0	81.0	rest: 5% amphibians

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Appendix B

Metabolic rate of birds and mammals

APPENDIX B1: Allometric regressions of BMR, EMR, FMR and maximum energy expenditure of birds and mammals. Metabolic rates (BMR, EMR, FMR) are expressed in kJ/d, body weight (BW) is expressed in grams.

BMR		
Birds, non-passeriformes	$\log BMR = 0.349 + 0.723 \log BW$ (1)	Lasiewski and Dawson (1967)
Birds, passeriformes	$\log BMR = 0.559 + 0.724 \log BW$ (2)	idem
Birds, non-passeriformes	$\log BMR = 0.287 + 0.734 \log BW$ (3)	Aschoff and Pohl (1970)
Birds, passeriformes	$\log BMR = 0.504 + 0.726 \log BW$ (4)	idem
all birds (n=263)	$\log BMR = 0.530 + 0.677 \log BW$ (5)	Gavrilov (in: Daan et al., 1989)
Sea birds	$\log BMR = 0.419 + 0.721 \log BW$	Ellis (1984)
Mammals	$\log BMR = 0.221 + 0.75 \log BW$ (6)	Kleiber (1961)
Mammals	$\log BMR = 0.318(SD=0.014) + 0.693(SD=0.11) \log BW$ (7)	Hayssen and Lacy (1985): (n=293)
Mammals on family level (n=78)	$\log BMR = 0.371 + 0.67 \log BW$ (8)	Bennett and Harvey (1987)
Small mammals (weight <20kg) (n=366)	$\log BMR = 0.3135(SD=0.020) + 0.677(SD=0.008) \log BW$ (9)	Heusner (1991)
Large mammals (n=25)	$\log BMR = 0.7295(SD=0.037) + 0.679(SD=0.009) \log BW$ (10)	Heusner (1991)
EMR		
Nonpasserine birds (at 30 °C and 15 hour photoperiod (n=70))	$\log EMR = 0.658 + 0.664 \log BW$ (SD=0.743)(11)	Ellis (1984)
FMR (with corresponding BMR)		
Birds (n=26)	$\log BMR = 0.552 + 0.684 \log BW$ (12)	Daan et al. (1990 a,b)
Birds (n=28)	$\log FMR_{par} = 1.140 + 0.659 \log BW$ (13)	idem
Mammals (n=15)	$\log FMR_{par} = 0.987 + 0.634 \log BW$ (14)	Daan et al. (1990b)
Birds (n=47)	$\log BMR = 0.431 + 0.68 \log BW$ (15)	Bennett and Harvey (1987)
	$\log FMR = 1.80 + 0.61 \log BW$ (16)	idem
Birds	$\log FMR = 1.12 + 0.605 \log BW$ (17)	Walsberg (1983)
Birds (n=38)	$\log FMR = 0.982 + 0.661 \log BW$ (18)	Williams (1988)
Breeding birds (n=23)	$\log FMR = 1.16 + 0.651 \log BW$ (19)	Koteja (1991)
Mammals (n=37)	$\log FMR = 0.885 + 0.613 \log BW$ (20)	idem
Mammals, eutherians (n=18)	$\log FMR = 0.817 + 0.633 \log BW$ (21)	idem
Mammal, marsupials (n=9)	$\log FMR = 1.173 + 0.527 \log BW$ (22)	idem
Mammals, eutherians (n=23)	$\log FMR = 0.525 + 0.813 \log BW$ (23)	Nagy (1987)
Marsupials (n=13)	$\log FMR = 1.072 + 0.576 \log BW$ (24)	idem
Birds (n=25)	$\log FMR = 1.037 + 0.640 \log BW$ (25)	idem
Passerine birds	$\log FMR = 0.949 + 0.749 \log BW$ (26)	idem
Nonpasserine birds	$\log FMR = 0.681 + 0.749 \log BW$ (27)	idem
Birds, passerines (average weight 28.6 g) (n=13)	$\log FMR_{par} = 1.232 + 0.57 \log BW$ (28)	Masman et al. (1989)
Birds, nonpasserines (average weight 2529 g) (n=19)	$\log FMR_{par} = 1.245 + 0.62 \log BW$ (29)	Masman et al. (1989)
Mammals (n=15)	$\log DME_{lactation} = 0.987 + 0.728 \log BW$ (30)	Daan et al. (1992)
	$\log Max.\ FMR = 1.070 + 0.72 \log BW$ (31)	
Breeding birds (n=30)	$\log FMR_{par} = 1.141 + 0.65 \log BW$ (32)	Masman et al. (1989)
Maximum energy expenditure		
Mammals (7.2 gr - 263 kg)	$\log Max.\ MR = 1.152 + 0.79 \log BW$ (33)	Taylor et al.(1980)
Mammals	$\log BMR = 0.342 + 0.745$ (SD=0.021) $\log BW$ (34)	Koteja (1987)
Mammals	$\log Max.MR = 1.043 + 0.841$ (SD=0.033) $\log BW$ (35)	idem

APPENDIX B2. Metabolic rates of six bird species

	weight (g)	BMR (kJ/d)	EMR (kJ/d)	FMR (kJ/d)	EMR/BMR	FMR/BMR	FMR/EMR
Aptenodyptes patagonica	13000	2245	2269	6851	1.12	3.1	2.72
Cepphus grille	420	306	285	640	0.85	3.8	2.46
Estrildo troglodytus	6.7	11	24.3	57.4	2.21	5.2	2.36
			22.6		2.06		2.54
Eudyptes chrysolophus	3900	748	1211	4077	1.62	5.5	3.37
Parus major	18	28	38.6	101	1.38	3.6	2.62
			45.1		1.61		2.40
Sturna vulgaris	76	78.8	117.6	301.5	1.49	3.8	2.56
average (n=6)					1.45	4.17	2.68
SD					0.44	0.96	0.35

Small differences in the weight of the same species of birds used to determine the metabolic rates (less than 5 %) is corrected for, using the Ellis regression (11) for EMR and the Gavrilov regression (5) for BMR.

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Appendix C

Caloric content of food types

Appendix C1. Caloric values (fresh weight and dry weight in kJ/g) of several food types. Average values and ranges calculated from the data listed in Appendix C2.

Food type	Fresh Weight				Dry weight			
	Mean	Std	N	Range	Mean	Std	N	Range
Fungi	0.6		2	0.5 - 0.7	16.7	5.3	12	5.0 - 21.8
Moss			0		19.7		1	
Conifer needles			0		21.3	0.6	5	20.5 - 22.3
Conifer seed kernels	24.8	2.0	5	22.8 - 28.4	28.4	3.1	18	18.6 - 32.4
Conifer seeds			0		25.6	2.5	14	19.7 - 29.8
Plant leaves	0.9	0.6	7	0.3 - 2.3	16.1	3.6	29	6.3 - 29.0
Plant stems			0		17.0	0.7	6	16.3 - 17.9
Plant roots	1.5	0.7	3	0.8 - 2.4	16.3	1.8	6	13.0 - 19.8
Plant tissue			0		17.4	1.0	24	15.9 - 19.4
Plant fruit	2.5	1.5	11	1.0 - 5.8	16.5	5.1	16	7.7 - 22.2
Plant seed kernels	15.6		1		22.3	3.9	9	18.1 - 30.8
Plant seeds	19.9	6.3	4	16.4 - 29.4	20.9	2.3	106	17.9 - 31.4
Tree seed kernels	21.5	6.9	15	6.9 - 31.8	24.5	5.0	26	15.0 - 33.6
Tree seeds			0		21.1	2.4	24	16.0 - 25.1
Annelids	3.0	0.6	3	2.3 - 3.4	19.9	2.6	7	14.9 - 22.2
Molluscs	3.8	1.2	8	2.1 - 5.6	21.2	1.9	4	19.3 - 23.5
Chelicerata			0		22.0	3.3	27	12.4 - 27.5
Crustacea	4.4	1.4	12	3.1 - 8.5	15.0	4.0	12	9.4 - 23.4
Insecta	7.2	1.6	10	3.2 - 8.8	24.2	2.7	40	18.1 - 30.9
Insect larvae	5.2	3.3	8	1.9 - 11.5	19.4	5.3	7	11.8 - 28.7
Caterpillars			0		22.2		1	
Chilopoda			0		23.6	1.3	6	21.6 - 25.2
Diplopoda			0		18.1	0.8	5	17.2 - 19.1
Amphibians	0.7		1		6.9		1	
Fish	6.2	1.9	58	2.9 - 11.2	19.2	4.0	34	12.0 - 27.3
Birds	7.9	2.1	49	3.5 - 12.2	22.5	2.9	34	17.5 - 27.8
Mammals	7.1	1.1	19	5.2 - 10.1	22.3	2.9	62	16.5 - 28.1
Fodder (birds)	13.7	2.8	6	11.3 - 17.4	15.0	2.6	18	12.7 - 19.7
Fodder (mammals)	16.8		2	11.8 - 22.8	15.0		2	12.6 - 17.3

Appendix C2. Underlying data for caloric values of several food types. Caloric content (kJ/g) is expressed on basis of fresh weight (FW), dry weight (DW) basis and ash free dry weight (AFW). When available water percentage (%H2O) and ash percentage of total dry matter (%ash) are also shown. Rf. = reference.

Group/species	Remark	FW	DW	AFW	%H20	%ash	Rf
ANNELIDA:							
Allolobophora chloritica			21.5				60
Aphrodite aculeata		2.3	14.9		84.8		9
Dendrobaena sp.			22.2				60
Earthworms			19.3				25
Fridericia sp.			21.8				60
Lumbricidae sp.		3.4	18.8		82.0		53
Lumbricidae sp.		3.3	21.0	23.6	84.4	0.8	62
Polychaeta		2.7					4
Tubifex tubifex		1.9					24
CHELICERATA:							
Anahita animosa			23.9	25.1			59
Camisia biurus			26.8	27.6		3.0	39
Carabodes labyrinthicus			21.2	22.0		5.4	39
Chthoius ischnocheles			20.4				60
Damaeus onustus			19.4				60
Drassyllus virginiana			23.4	24.2			59
Eupelops sp.			23.3	24.9		6.4	39
Hilaira frigida			23.4	24.1		3.2	39
Liebstadia similis			22.4	23.6		4.7	39
Macrocheles sp.			19.0				60
Mitopus morio			22.5	23.2		2.8	39
Mitopus morio			23.2	24.0		3.7	39
Nemastoma lugubre			15.7				60
Neobisium muscorum			21.2				60
Paradamaeus clavipes			21.9	23.2		5.6	39
Parasitus sp.			22.9				60
Pardosa palustris	instar 1			25.7			50
Pardosa palustris	instar 7			24.8			50
Pardosa palustris	instar 7			25.0			50
Pardosa palustris			24.9	25.4		1.7	39
Pardosa palustris			24.1	24.6		2.2	39
Pardosa palustris	instar 2			25.6			50
Pardosa palustris	instar 8			24.9			50
Pardosa palustris	instar 4			25.3			50
Pardosa palustris	instar 8			24.1			50
Pardosa palustris	instar 5			25.0			50
Pardosa palustris	instar 6			25.0			50
Pardosa palustris	instar 5			25.0			50
Pardosa palustris	instar 3			25.2			50

Group/species	Remark	FW	DW	AFW	%H20	%ash	Rf
Pardosa palustris	instar 6			24.5			50
Pergamasus crassipes			21.9				60
Pergamus sp.			25.0	26.2		4.4	39
Phidippus sp.			22.7	23.9			59
Phthiracarus sp.			12.4	21.0		41.0	39
Platynothrus sp.			22.4	23.2		3.7	39
Schizocosa sp.			22.8	23.9			59
Steganacarus magnus			15.7				60
Trombididae			27.5	28.9		4.9	39
Xysticus sp.			25.0	25.7			59
CHILOPODA:							
Brachygeophilu truncorum			24.7				60
Chilopoda			25.2	26.4			59
Geophilus insculptus			22.9				60
Lithobius calcaratus			24.6				60
Lithobius curtipes			22.5				60
Lithobius variegatus			21.6				60
CRUSTACEA:							
Amphipoda		3.9					4
Armadillidium nasatum		4.0	13.9		63.2		58
Armadillidium vulgare		3.7	10.9		65.8		58
Crangon crangon		4.1	16.5		74.9		9
Cylisticus convexus		3.6	14.1		66.7		58
Daphnia sp.			18.5				25
Eupagurus bernhardus		5.3	13.8		61.7		9
Euphasia superba		8.5					24
Meganyctiphanes norvigica		4.1					4
Metoponorthus pruinosus		3.1	15.9		71.6		58
Nephrops norvegicus		5.1	13.2		61.1		9
Portunus holsatus		3.1	11.1		71.9		9
Stenonema sp.			23.4				25
Thysanoessa inermis		4.1					4
Trichoniscus pusillus			18.8				60
Uca and other crabs			9.4				25
DIPLOPODA:							
Blaniulus sp.			17.4				60
Cylindroiulus punctatus			19.1				60
Glomeris marginata			18.2				60
Ophyiulus pilosus			18.9				60
Polydesmus angustus			17.2				60
FUNGI:							

Group/species	Remark	FW	DW	AFW	%H20	%ash	Rf
Cantharel		0.5	5.0		90.0		61
Champignon		0.7	6.7		90.0		61
Musci sp.	spore		18.1				42
Peridermium harknessii			21.1	21.8		3.0	49
Rhizopogon sp.	gleba		20.3	20.9		3.0	49
Russula decolorans	gills		20.0	22.4		10.5	49
Russula decolorans	pileal c.		16.7	18.1		7.9	49
Russula decolorans	stalk		17.6	18.4		4.6	49
Suillus tomentosus	mixed		18.4	19.7		6.6	49
Suillus tomentosus	pileal c.		17.5	18.2		3.9	49
Suillus tomentosus	gills		21.8	23.3		6.5	49
Suillus tomentosus	stalk		17.1	17.5		2.5	49
INSECTA:							
Acheta domesticus			24.0	25.4			59
Acridiidae		8.1	25.2		67.9		6
Acridiidae	larvae	8.2					24
Amara praetermissa			25.1	25.5		1.7	39
Anapothrips secticornis			26.8	27.3		1.8	39
Anisoptera		8.0	24.6		67.3		6
Arctorthezia cataphracta			30.9	31.6		1.8	39
Arpedium brachypterum			25.0	25.6		2.5	39
Atheta alpestris			21.3	24.0		11.2	39
Atheta arctica			26.4	27.4		3.7	39
Atheta graminicola			26.3	26.9		2.3	39
Atheta islandica			30.1	31.3		3.8	39
Calamistis fusca		7.3					24
Calathus melanocephalus			24.6	25.4		3.2	39
Calliphoridae		7.5	23.3		67.6		6
Cerapteryx graminis	larvae	5.6	22.4	23.7	75.0	1.4	53
Crickets		6.5	23.2		72.0		33
Dolichopus sp. larvae			23.7				60
Empididae sp.	imago	5.9	21.7		73.0		53
Entomobrya sp.			20.9				60
Evarthrus sp.			25.0	25.2			59
Feronia madida			20.8				60
Helophorus glacialis			24.7	24.9		0.8	39
Insects		3.2					4
Isometa olivacea			23.9	25.2		4.9	39
Isometa viridis			24.0	24.6		2.4	39
Lepidoptera larvae			22.2	24.1			59
Myrmecina americana			22.9	23.8			59
Notiophilus aquaticus			25.5	26.7		3.2	39
Othius puntulatus			22.4				60
Otiorrhynchus dubius			23.6	24.1		2.3	39
Chrysochus auratus	adult	8.8	21.9	23.2	60	5.6	62

Group/species	Remark	FW	DW	AFW	%H20	%ash	Rf
Oxypoda annularis			30.1	31.3		3.9	39
Parcoblatta sp.			23.0	23.9			59
Patrobus atrorufus			24.6	24.9		1.1	39
Patrobus septentrionus			24.5	24.9		1.6	39
Quedius boopoides			26.6	27.3		2.6	39
Quedius boops			26.0	26.9		3.1	39
Quedius fulvicollis			27.6	28.5		3.2	39
Schistocerca sp.			22.5				25
Staphylinus sp.			23.4				60
Tenebrio moliter	larvae	11.5	28.7	29.3	59.7	0.5	62
Tipula excisa	instar 2	3.4	18.8	24.0	82.0	3.9	20
Tipula excisa	instar 3	1.9	11.8	22.9	84.0	7.8	20
Tipula excisa	instar 4	2.0	15.2	22.0	87.0	4.0	20
Tipula excisa	instar 4	5.0	19.9	24.7	75.0	4.9	20
Tipula excisa	pupae m.	3.3	18.1	22.7	82.0	3.6	20
Tipula excisa	pupae f.	5.1	22.2	25.8	77.0	3.2	20
Tipula excisa	adult m.	8.2	20.0	22.9	59.0	5.2	20
Tipula excisa	adult f.	8.1	19.8	24.1	59.0	7.4	20
Tipula paludosa	larvae	4.0	19.0	20.9	79.0	1.9	53
Tomocerus longicornis			24.5				60
Tomocerus sp.			23.2	25.4			59
MOLLUSCA:							
Arion hortensis			20.2				60
Dreissena polymorpha		2.6					24
Gonatid squid	squid	5.3					43
Limax maximus			21.9				60
Littorina sp		3.6					24
Loligo reynaudi	squid	4.5					24
Modiolus sp.			19.3				25
Morotenthis ingens	squid	5.6	23.5		76.0		8
Mussel		3.9					24
Mytilus edulis		3.0					24
Oyster		2.1					24
MOSS:							
Mosses			19.7	20.1		2.1	14
TREE SEEDS:							
Acer platanoides			21.2	22.7		6.6	18
Acer pseudoplatanus			19.1	20.5		6.6	18
Acer saccharinum			20.2				30
Alnus glutinosa			22.0	22.8		3.3	18
Alnus incana			22.0	22.6		2.5	18
Betula papyrifera			23.6				27

Group/species	Remark	FW	DW	AFW	%H20	%ash	Rf
Betula papyrifera			22.3				27
Betula verrucosa			16.0				27
Betula verrucosa			21.5	22.3		3.5	18
Carpinus betulus			20.4	20.9		2.6	18
Corylus avellana				33.6			10
Corylus avellana			25.0	25.4		1.7	18
Fagus silvatica			25.1	25.9		3.1	18
Fraxinus excelsior			23.9				27
Fraxinus excelsior			22.0	23.0		4.1	18
Fraxinus nigra			23.6				27
Fraxinus nigra			23.6				30
Quercus petraea			18.8	19.2		1.8	18
Quercus robur			18.5	18.8		1.6	18
Quercus sessilis				17.4			10
Robinia pseudoacacia			20.8	21.8		4.3	18
Robinia pseudoacacia			15.9				27
Tilia cordata			18.1				27
Tilia cordata			21.2	22.5		5.7	18
Ulmus laevis			20.5	22.0		7.1	18
Ulmus laevis			19.9				27
TREE SEED KERNELS:							
Acer campestre			23.2				27
Acer platanoides		20.9	24.4	25.9	14.2	5.9	18
Acer pseudoplatanus			19.2				27
Acer pseudoplatanus		15.0	21.3	22.8	29.3	6.9	18
Acer saccharinum			20.2				27
Carpinus betulus			23.4				27
Carpinus betulus			26.0				27
Carpinus betulus		23.5	27.0	28.4	12.9	5.0	18
Castanea sativa		6.9	15.0		54.0		61
Corylus avellana		30.7	33.1	34.0	7.2	2.2	18
Corylus avellana		31.8	33.6		5.4		15
Corylus avellana			28.8				27
Corylus avellana		29.3	31.2		6.0		61
Fagus silvatica			30.2				27
Fagus silvatica		25.6	29.2	30.2	12.5	3.3	18
Fagus silvatica			28.0				27
Fagus silvatica			27.2				27
Fraxinus excelsior		21.6	23.9	24.7	9.5	3.0	18
Juglans regia		27.6	29.0		5.0		61
Quercus petraea		13.8	18.4	18.7	24.6	1.8	18
Quercus petraea			17.4				27
Quercus petraea			17.0				27
Quercus robur		12.2	18.7	19.0	34.6	1.6	18

Group/species	Remark	FW	DW	AFW	%H20	%ash	Rf
Robinia pseudoacacia		19.5	22.9	24.0	14.8	4.8	18
Tilia cordata		22.4	25.3	26.3	11.5	3.7	18
Ulmus laevis		21.3	23.6	24.7	9.9	4.2	18
BIRDS:							
Anthus pratensis	4-8 days	4.6	23.0	25.2	80.0	1.7	48
Anthus pratensis	8-12 days	6.3	23.3	25.4	73.0	2.2	48
Anthus pratensis	>16 days	7.5	22.1	24.4	66.0	3.3	48
Anthus pratensis	0-4 days	3.8	22.4	25.1	83.0	1.9	48
Anthus pratensis	12-16 days	7.2	23.2	25.4	69.0	2.7	48
Anthus pratensis	adults	7.9	22.0	24.6	64.1	3.7	48
Aythya affinis	wild		23.3				51
Aythya affinis	6 weeks	9.7	27.1		64.3		51
Aythya affinis	12 weeks	12.2	27.8		56.0		51
Aythya affinis	10 weeks	11.6	26.8		56.6		51
Aythya affinis	1 week	7.2	24.9		71.1		51
Aythya affinis	4 weeks	9.7	27.0		64.1		51
Aythya affinis	9 weeks	10.8	26.8		59.6		51
Aythya affinis	8 weeks	11.0	27.4		60.0		51
Aythya affinis	7 weeks	9.9	25.8		61.7		51
Aythya affinis	11 weeks	10.9	26.4		58.8		51
Aythya affinis	5 weeks	10.0	26.8		62.6		51
Aythya affinis	3 weeks	9.0	26.6		66.3		51
Aythya affinis	2 weeks	7.6	25.8		70.7		51
Dendrocygna autumnalis	pipped	8.0	25.1		68.1		7
Dendrocygna autumnalis	2 weeks	5.9	23.0		75.1		7
Dendrocygna autumnalis	3 weeks	6.7	20.1		67.0		7
Dendrocygna autumnalis	4 weeks	8.0	22.6		65.5		7
Dendrocygna autumnalis	5 weeks	8.8	23.4		62.4		7
Dendrocygna autumnalis	6 weeks	10.0	23.9		57.0		7
Dendrocygna autumnalis	7 weeks	8.8	23.4		58.8		7
Dendrocygna autumnalis	9 weeks	9.2	22.2		58.1		7
Gallus domesticus	1 day, lab.	5.0	21.7		76.8		52
Gallus domesticus	1 day, lab.		24.6				31
Gallus domesticus	1 day	6.7	19.9		66.2		62
Gallus domesticus	46 days	7.2	18.9		62.1		62
Gallus domesticus	60 days	7.5	19.7		61.8		62
Gallus domesticus	92 days	7.6	19.9		62.0		62
Gallus domesticus	180 days	7.3	19.6		62.6		62
Gallus domesticus	65 days	6.2	20.1		69.2		62
Haematopus ostralegus	juvenile		22.7				35
Larus argentatus	1 day	9.1	18.5		51.0		62
Larus argentatus	19 days	8.5	18.1		52.8		62
Larus argentatus	26 days	7.0	18.3		61.5		62
Larus argentatus	37 days	7.7	18.1		57.3		62
Limosa limosa	juvenile		21.3				35

Group/species	Remark	FW	DW	AFW	%H20	%ash	Rf
Meleagris gollopavo	1 day, lab.	8.7	26.3		66.9		12
Numida meleagris	adult	5.8	20.3		71.3		62
Passer domesticus		7.8	21.8		65.6		54
Passer domesticus	1 day	3.5	18.4		82.4		3
Passer domesticus	16 days	7.0	17.5		68.6		3
Passer domesticus	adult				64.7		3
Streptopelia risoria	1 day	4.2					5
Streptopelia risoria	38 days	8.4					5
Streptopelia risoria	adult	9.5					5
Streptopelia risoria	1 day	4.0	21.2		81.2		62
Streptopelia risoria	8 days	4.4	20.2		78.2		62
Streptopelia risoria	18 days	6.4	19.7		67.2		62
Streptopelia risoria	28 days	8.0	20.2		60.4		62
Streptopelia risoria	38 days	8.4	20.5		58.9		62
Streptopelia risoria	adult	9.5	20.9		54.8		62
Vanellus vanellus	juvenile		24.1				35
MAMMALS:							
Apodemus agrarius	winter	20.2		22.6		10.6*	17
Apodemus agrarius	autumn		22.2	24.6		9.8*	17
Apodemus agrarius	summer		22.6	25.4		11.1*	17
Apodemus agrarius		6.9					17
Apodemus flavicollis	summer		22.4	25.5		11.9*	17
Apodemus flavicollis		6.1					17
Apodemus flavicollis	winter		18.3	21.1		13.4*	17
Apodemus flavicollis	autumn		22.1	25.3		12.7*	17
Apodemus sylvaticus		8.0	21.7		63.1		54
Blarina brevicauda			18.2				23
Clethrionomys glareolus	d 10 L		25.4	27.9	74.6		46
Clethrionomys glareolus	d 1 O		26.8	30.1	83.2		46
Clethrionomys glareolus	d 3 L		26.7	29.5	81.6		46
Clethrionomys glareolus	d 1 L		23.3	26.2	84.5		46
Clethrionomys glareolus	d 50-70 O		28.1	30.9	63.7		46
Clethrionomys glareolus	d 6 L		25.9	28.4	78.2		46
Clethrionomys glareolus	autumn		21.6	24.3		11.2*	17
Clethrionomys glareolus	d 3 O		26.0	29.2	82.5		46
Clethrionomys glareolus	d 10 O		26.6	29.1	72.5		46
Clethrionomys glareolus	d 30 L		26.4	29.1	66.1		46
Clethrionomys glareolus	winter		18.7	21.5		13.0*	17
Clethrionomys glareolus	d 20 O		26.3	29.1	70.9		46
Clethrionomys glareolus	d 20 L		24.6	27.3	73.0		46
Clethrionomys glareolus	d 6 O		27.0	29.4	75.2		46
Clethrionomys glareolus	summer		21.6	24.3		10.8*	17
Clethrionomys glareolus		6.1					17
Clethrionomys glareolus	d 50-70 L		27.6	30.1	60.9		46
Lepus americanus		5.5	19.5	23.6	72.0	4.9	44

Group/species	Remark	FW	DW	AFW	%H20	%ash	Rf
Lepus europaeus	wild	7.9	23.8	27.2	67.0	4.1	38
mice			21.6				25
mice	lab.young	5.2	26.0		80.0		1
Micromys minutus		7.6	23.8		67.0		54
Microtus agrestis		6.1	20.9	24.2	70.8	4.1	19
Microtus arvalis	May		21.3				35
Microtus arvalis	Jul.		21.6				35
Microtus arvalis	summer		21.4	24.4		12.0*	17
Microtus arvalis	Nov.		21.6				35
Microtus arvalis	Jan.		21.6				35
Microtus arvalis	Mar.		21.4				35
Microtus arvalis	Sep.		21.1				35
Microtus arvalis	winter		18.3	21.0		13.1*	17
Microtus arvalis	autumn		21.3	24.4		12.8*	17
Microtus arvalis		6.2					17
Microtus arvalis		7.7	23.5		67.0		54
Microtus ochrogaster			18.2				23
Microtus pennsylvanicus	+ C.gapperi	7.2	22.4	25.9	68.0	4.3	44
Microtus pennsylvanicus	adult		19.4				16
Microtus pennsylvanicus	juvenile		20.2				16
Microtus pennsylvanicus	adult		18.8				16
Microtus pennsylvanicus	adult		19.6				16
Mus musculus	laboratory	8.3	25.1		66.9		54
Mus musculus	laboratory	10.1	26.8		62.2		12
Mus musculus	laboratory		23.8				26
Mus musculus			16.5				23
Mus musculus	laboratory	6.8	22.6		69.7		52
Napaeozapus insignis		6.8	23.0	26.4	70.3	3.8	44
Oryzomys palustris	laboratory		24.5				26
Peromyscus leucopus		7.9	23.1	26.1	65.9	4.4	44
Peromyscus leucopus			18.1				23
Peromyscus maniculatus			18.8				23
Sciurus carolinensis		7.7	23.2	26.6	66.7	3.9	44
Sorex araneus	summer		18.6	20.9		10.8*	17
Sorex araneus	autumn		19.6	21.8		10.2*	17
Sorex araneus	summer		21.6				35
Sorex araneus	winter		19.0	21.5		11.8*	17
Soricidae		7.1	22.7		68.8		54
FISH:							
Ammoditidae		6.5					24
Ammoditidae		5.8					24
Ammodytes hexapterus		5.1					43
Ammodytes hexapterus		7.3	20.0		63.5		37
Barbus conchonius		2.9	12.0		75.9		62
Bathilagidae		3.2					43

Group/species	Remark	FW	DW	AFW	%H20	%ash	Rf
Clupea harengus		7.7					56
Clupea harengus		4.3	20.2		78.5		9
Clupea harengus		5.7	21.7		73.6		9
Clupea harengus		9.8					56
Clupea harengus		7.6					56
Clupea harengus		5.7	23.2		75.5		9
Clupea harengus pallasi		9.1					43
Clupea pallasi		11.2					56
Clupea sprattus		7.4	25.6		71.0		9
Clupea sprattus		5.4	23.2		76.9		9
Clupidae		10.9					4
Cottus perplexus		5.2	22.1		76.5		62
Electrone carlsbergi		7.0	23.5		70.2		8
Gadidae		5.7					4
Gadus morhua		3.8	18.6		79.6		9
Gadus morhua		3.9	19.9		80.3		9
Gobiomorphus cotidianus		5.4	21.1		74.6		52
Gobius giuris		4.1	16.2		74.6		62
Ilex illecebrosus		4.3	19.7		78.2		37
Krefftichthys anderssoni		8.1	26.4		69.3		8
Limanda limanda		5.5	21.3		74.0		9
Limanda limanda		4.2	19.6		78.4		9
Mallotus villosus		4.2	19.4		78.4		37
Mallotus villosus		5.5					43
Maurolicus meulleri		5.7					24
Merlangius merlangus		3.4	18.7		81.8		9
Merlangus merlangus		4.1					24
Oncorhynchus keta		6.7	15.1	15.7	55.7	3.7	62
Oncorhynchus nerka		5.7	14.4	15.0	60.3	3.7	62
Oncorhynchus nerka		5.4	14.0	14.6	61.4	3.8	62
Oncorhynchus garbusha		7.1	16.9	17.5	58.3	3.4	62
Oncorhynchus garbusha		6.6	15.1	15.6	56.5	3.6	62
Oncorhynchus tshawytscha		5.7	15.3	15.7	62.6	2.5	62
Oncorhynchus kisutch		5.8	14.4	15.0	59.9	4.1	62
Oncorhynchus masu		7.2	15.8	16.3	54.4	3.6	62
Oncorhynchus masu		6.6	14.5	15.0	54.8	3.5	62
Osmerus eperlanus			22.9				32
Paradiplospinus gracilis		4.6	21.8		78.9		8
Pleurogrammus monopterygius		6.6					43
Pleuronectidae		5.0					43
Pollachius virens		5.1					24
Salmo gairdneri		5.6					24
Salmo salar		6.2	15.3	16.0	59.8	4.4	62
Salmo salar		5.8	14.9	15.6	60.8	4.5	62
Salmonidae		8.4					43
Scomber scombrus		10.3	27.3		62.3		37

Group/species	Remark	FW	DW	AFW	%H20	%ash	Rf
Scomberesox saurus		6.8	22.7		70.1		37
Sprattus sprattus		5.7					24
Sprattus sprattus		7.1					24
Sprattus sprattus		10.9					24
Sprattus sprattus		9.7					24
Sprattus sprattus		5.6					24
Theraga chalcogramma		5.9					43
AMPHIBIANS:							
Rana hexadactyla	tadpole	0.7	6.9		89.1		62
FODDER (BIRDS):							
Bobwhite breeding			13.1				21
Bobwhite growing			13.1				21
Bobwhite starter		12.5					22
Bobwhite starter			13.1				21
Chicken mash			18.4				57
Duck Growena			18.3				41
Duck Starter			18.7				51
Duck starter		12.5					22
Japanese breeding			14.1				21
Japanese growing			14.1				21
Kwartel afmest			15.0				21
Kwartel foktoom		11.4	12.9		11.6		21
Kwartel leg			14.1				21
Kwartel opfok		11.3	12.8		11.6		21
Kwartel start			14.1				21
Pheasant breeding			13.1				21
Pheasant growing			12.7				21
Pheasant starter			13.1				21
Spelderholt		16.9					24
Turkey starter		17.4	19.0	21.1	8.6	9.1	36
"Soft-bill mix"			19.7				3
FODDER (MAMMALS):							
CLEA CR-2		11.8	12.6		6.0		40
Pelsi food		22.8					24
Rodent diet			17.3				34
PLANT SEED KERNELS:							
Ambrosia trifida			30.8				55
Cannabis sativa			24.7				55
Cannabis sativa			24.7				55
Helianthus annuus			22.0				55
Oats		15.6	18.1	18.4	15.0	1.5	11
Polygonum pensylvanicum			20.1				55

Group/species	Remark	FW	DW	AFW	%H20	%ash	Rf
Polygonum pensylvanicum			20.1				55
Setaria faberi			20.0				55
Setaria faberi			20.0				55
PLANT SEEDS:							
Abutilon theophrasti			21.1				30
Amaranthus retroflexus			19.4				30
Amaranthus (retroflexus)			19.1				55
Ambrosia artemissifolia			22.1				30
Ambrosia trifida			22.1				28
Ambrosia trifida			21.7				28
Ambrosia trifida			22.7				28
Ambrosia trifida			24.3				30
Ambrosia trifida			22.1				28
Ambrosia trifida			22.0				28
Andropogon furcatus			21.2				30
Arctium sp.			20.8				30
Aster sp.			24.0				30
Avena/Hordeum			17.9				??
Brassica sp.			19.3				30
Bromus inermis			18.8				30
Bromus japonica			18.3				28
Bromus japonica			18.1				28
Bromus japonica			18.1				28
Bromus japonica			18.4				28
Bromus japonica			18.2				28
Carex sp.			21.6				42
Carex sp.			20.0				30
Chenopodium sp.			20.6				30
Cornus drummondi			20.7				28
Cornus drummondi			20.9				28
Cornus drummondi			20.0				28
Cornus drummondi			20.6				28
Cornus drummondi			20.9				28
Cyperus erythrorhizos			21.8				30
Datura stramonium			24.6				30
Digitaria ischaemum			19.3				30
Digitaria sanguinalis			18.3				30
Echinochloa crusgalli		16.4	18.3	19.4	10.3	5.1	36
Echinochloa crusgalli			18.5				30
Echinochloa crusgalli			20.2				30
Elymus virginicus			19.7				30
Euphorbia maculata			22.3				30
Galium sp.			18.9				30
Geum canadense			20.9				30
Geum canadense			23.8				30

Group/species	Remark	FW	DW	AFW	%H20	%ash	Rf
Gleditsia triacanthos			18.1				30
Glycine max			22.3				30
green wheat		2.4	19.7	20.3	87.6	0.4	11
Helianthus annuus			23.5				28
Helianthus annuus			23.4				28
Helianthus annuus			23.3				28
Helianthus annuus			23.4				28
Helianthus annuus			23.3				28
Helianthus annuus		29.4		31.4		6.3	45
Ipomoea purpurea			20.7				30
Leonurus cardiaca			24.2				30
Lespedeza stipulacea			20.8				30
Melilotus alba			19.6				30
Mollugo verticillata			18.2				30
Muhlenbergia schreberi			19.2				30
Panicum capillare			19.7				30
Panicum dicotomiflorum			19.5				30
Panicum miliaceum		17.2		19.7		12.9	45
Pastinaca sativa			25.5				30
Phytolacca americana			21.9				30
Plantago sp.			21.8				30
Polygonum convolvulus			19.3				30
Polygonum pennsylvanicum			18.9				30
Polygonum scandens			20.2				30
Rhus aromatica			22.8				28
Rhus aromatica			22.0				28
Rhus aromatica			22.2				28
Rhus aromatica			22.1				28
Rhus aromatica			21.9				28
Rhus glabra			21.6				28
Rhus glabra			21.2				28
Rhus glabra			21.8				28
Rhus glabra			22.6				28
Rhus glabra			21.8				28
Rumex crispus			20.0				30
Sanicula canadensis			24.9				30
Setaria faberii			19.2				30
Setaria faberii			18.7				30
Setaria lutenscens			18.8				30
Setaria lutescens			18.7				28
Setaria lutescens			18.4				28
Setaria lutescens			18.6				28
Setaria lutescens			18.2				28
Setaria lutescens			18.2				28
Setaria viridis			19.0				30
Sida spinosa			20.7				30

Group/species	Remark	FW	DW	AFW	%H20	%ash	Rf
Sida spinosa			21.1				30
Smilax hispida			19.1				30
Solanum rostratum			25.2				28
Solanum rostratum			25.1				28
Solanum rostratum			24.7				28
Solanum rostratum			25.4				28
Solanum rostratum			25.5				28
Symphoricarpos orbiculatus			19.8				28
Symphoricarpos orbiculatus			19.5				28
Symphoricarpos orbiculatus			19.3				28
Symphoricarpos orbiculatus			19.4				28
Symphoricarpos orbiculatus			19.5				28
Taraxacum officinale			21.4				30
Teucrium canadense			20.5				30
Trifolium pratense			20.9				30
Triticum aestivum			18.2				30
Verbena urticaefolia			23.0				30
wheat		16.7		19.4		14.2	29
Zea mays			18.1				30
seeds			21.2				16
CONIFER NEEDLES:							
Picea sp.	buds		20.5				42
Picea glauca			20.7	21.4		3.3	13
Picea mariana			21.3	21.8		2.3	13
Picea sp.			21.7				42
Pinus contorta			22.3				42
CONIFER SEEDS:							
Abies alba			28.3	28.8		1.9	18
Larix decidua			23.1	23.6		2.1	18
Picea abies			27.2	28.4		4.0	18
Picea glauca			26.4				27
Picea glauca			27.7				27
Picea mariana			25.3				27
Pinus cembra			25.7	25.9		0.9	18
Pinus contorta			25.1				27
Pinus flexilis			29.8				27
Pinus lambertiana			27.1				27
Pinus ponderosa			23.5				27
Pinus silvestris			25.6	27.0		4.9	18
Pinus silvestris			19.7				27
Pseudotsuga taxifolia			25.1				27
CONIFER SEED KERNELS:							
Abies alba		24.1	29.7	30.4	19.0	2.3	18

Group/species	Remark	FW	DW	AFW	%H20	%ash	Rf
Abies amabilis			30.4	31.9		4.6*	49
Abies lasiocarpa			29.8	31.4		5.2*	49
Larix decidua		23.6	27.2	28.2	13.3	3.3	18
Picea abies		22.8	25.2	26.1	9.5	3.8	18
Picea abies			25.5				27
Picea engelmannii			29.8	31.5		5.4*	49
Pinus cembra			28.4				27
Pinus cembra		28.4	32.4	33.3	12.4	2.7	18
Pinus contorta			28.5	30.4		6.1*	49
Pinus contorta			28.4				27
Pinus koraiensis			29.1				27
Pinus monticola			31.0	32.6		4.8*	49
Pinus nigra			18.6				27
Pinus ponderosa			31.7	33.3		4.9*	49
Pinus silvestris		25.3	27.1	28.4	6.9	4.3	18
Pseudotsuga menziessii			29.8	31.5		5.3*	49
Tsuga heterophylla			28.5	30.2		5.5*	49
PLANT FRUIT:							
Banana		2.6	17.3		85.0		33
Dogwood	pulp/skin	5.2	21.5		76.0		33
Grape	pulp/skin	3.3	17.6		81.0		33
Prunus sp.		2.2	15.6		86.0		61
Ribes nigrum		1.7	11.1		85.0		61
Ribes rubrum		1.0	7.7		87.0		61
Ribes uva-crispa		1.7	13.9		88.0		61
Rubus idaeus		1.3	11.2		88.0		61
Rubus sp.		1.6	11.9		87.0		61
Vaccinium deliciosa			22.2	22.8		2.8	49
Vaccinium mambranaceum	green		21.2				42
Vaccinium mambranaceum	ripe		20.7				42
Vaccinium sp.		1.2	9.0		87.0		61
Vaccinium vitis-idaea	new		19.7				42
Vaccinium vitis-idaea	over-win.		20.6				42
Vibernum sp.	pulp/skin	5.8	22.2		74.0		33
PLANT LEAVES:							
Agrostis tenuis			16.7				19
Agrostis tenuis			17.2				19
Agrostis tenuis			17.2				19
Beta sp.		1.0	14.3		93.0		61
Brassica sp.		1.2	11.7		90.0		61
Carex nigra			17.2				19
Dactylus glomerata			17.2				19
Dactylus glomerata			16.7				19
Dactylus glomerata	young		19.1	20.3		5.7	14
Dactylus glomerata	bases		16.9	17.8		5.1	14

Group/species	Remark	FW	DW	AFW	%H20	%ash	Rf
Dactylus glomerata			16.7				19
Deschampsia caespitosa			16.7				19
Deschampsia caespitosa			17.6				19
Deschampsia caespitosa			17.2				19
Deschampsia flexuosa			17.2				19
Deschampsia flexuosa			17.2				19
Festuca rubra			17.6				19
Greens	mixed	2.3	16.5	17.9	86.2	1.1	11
Lactuca sativa			16.7				58
Lactuca sativa		0.5	8.3		94.0		61
Leaves	n=57		17.7				16
Mixed grass			18.8	20.0		6.1	14
Phleum pratense	old		18.9				2
Phleum pratense	new		19.2				2
Portulaca oleracea		0.3	6.6		95.0		61
Spinacia oleracea		0.5	6.3		92.0		61
Trifolium sp.			18.9				2
Vaccinium mambranaceum			20.8				42
Valeriana locusta		0.8	14.0		94.0		61
PLANT ROOTS:							
Daucus carota		1.2	13.0		91.0		61
Daucus carota		2.4	16.7		85.7		15
Raphanus sativus		0.8	16.8		95.0		61
Roots	n=57		19.8				16
Scirpus americanus			16.7				2
Spartina alterniflora			16.6				2
Spartina patens			18.0				2
PLANT STEMS:							
Dactylus glomerata	+bases		16.7				19
Dactylus glomerata	+bases		16.3				19
Dactylus glomerata	+bases		16.3				19
Equisetum sp.	+tips		17.8				42
Juncus effusus			16.7				19
Stems and branches	n=57		17.9				16
PLANT TISSUE:							
Agrostis canina	a.s.		19.4	19.9		2.5	14
Anthoxanthum odoratum	a.s.		18.5	18.8		1.6	14
Cirsium arvense			16.5				16
Dactylus glomerata	a.s.		16.8	17.6		4.3	14
Daucus carota			16.4				16
Dead grass			17.8				16
Dead grass			16.4				16
Festuca rubra	a.s.		17.8	18.4		3.0	14

Group/species	Remark	FW	DW	AFW	%H20	%ash	Rf
Grass and herbs			16.7				16
Herbs combined			16.0				16
Herbs combined			16.6				16
Holcus lanatus	a.s.		18.6	19.3		3.7	14
Juncus sp.	a.s.		19.4	19.7		1.6	14
Linaria vulgaris			18.2				16
Linaria vulgaris			17.9				16
Plantago sp.			15.9				16
Poa compressa			17.2				16
Poa compressa			17.5				16
Poa compressa			16.7				16
Poa compressa			17.5				16
Poa compressa			18.0				16
Poa compressa			16.8				16
Trifolium repens			17.1				16
Verbascum thapsus			16.7				16

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Appendix D

Assimilation efficiency of food types

Appendix D1: Percentages of metabolizable energy of several food types for birds. Average values and ranges calculated from the data listed in Appendix D3.

Food type	Mean (%)	Standard deviation	N	Range
Birds	74.9	6.8	8	68 - 85.5
Fish	77.9	4.0	15	69.2 - 84.9
Fodder	73.3	9.6	41	42.4 - 88.3
Fruit	55.8	14.0	8	36.5 - 77
Insects	67.3	10.1	10	56 - 82.7
Insect larvae	77.8	5.3	8	70 - 86.1
Invertebrates	81.3	-	1	
Mammals	74.6	7.2	39	61 - 94.3
Meat	87.0	8.0	2	79 - 95
Plants leaves	37.2	6.9	6	30.1 - 52.2
Plants needles	33.2	4.8	3	29.7 - 40
Seeds (whole)	70.5	18.8	39	17.3 - 90.4
Seeds (kernel)	75.9	12.7	13	47 - 91

Appendix D2. Percentages of metabolizable energy of several food types for mammals. Average values and ranges calculated from the data listed in Appendix D3.

Food type	Mean (%)	Standard deviation	N	Range
Fodder	86.1	13.0	3	71.2 - 95
Insects	85.5	6.5	4	78 - 93
Mammals	79.2	11.2	6	62.7 - 90.1
Plants beechmast	89	-	1	
Plants leaves	49.5	16.8	25	<20 - 89.8
Seeds (whole)	87.0	6.1	4	78 - 91
Seeds (kernel)	89.5	0.5	2	89 - 90

Appendix D3 Percentages of metabolizable energy (M.E.%) of several food types for birds.

Food type	Species	M.E. %	Ref.
BIRDS:			
Anas platyrhynchos	Haliaeetus leucocephalus	85.2	15
birds, 3 species[a]	Falco tinnunculus	75.2	24
Gallus domesticus	Tyto alba	72.5	20
Gallus domesticus	Circus approximans	70.2	29
Gallus domesticus	Falco tinnunculus	71.3	20
Gallus domesticus	Falco tinnunculus	71	17
Meleagris gallopavo	Bubo virginianus	85.5	7
Passer domesticus	Asio otus	68	31
FISH:			
Anchovy	Morus capensis	76.1	15
Anchovy	Speniscus demersus	76.5	15
Anchovy	Morus capensis	74.2	15
Gobiomorphus cotidianus	Circus approximans	81.1	29
Horse-mackerel	Corvus corone	81.2	15
Pilchard	Morus capensis	79.4	15
Pollack	Phalacrocorax auritus	84.9	15
Salmon	Haliaeetus leucocephalus	75	17
species unknown	Pygoscelis adeliae	80	15
species unknown	Pelecanus onocrotalus	73	15
species unknown	Rissa tridactyla	76	15
species unknown	Mycteria americana	79	15
Sprattus sprattus	Sterna hirunda	81	21
Sprattus sprattus	Sterna sandvicensus	82	21
stockfish	Morus capensis	69.2	15
FODDER:			
Balanced mash	Colinus virginianus	78.3	15
Balanced mixture	Spizella arborea	77	15
Chicken crumbs	Sturnus vulgaris	75	15
Chicken mash	Junco hyemalis	87.4	15
Chicken mash	Volatinia jacarina	79.5	15
Chicken mash	Passer domesticus	88.3	15
Chicken mash	Taeniopygia castanotis	76.2	15
Chicken mash	Sporophila aurita	78.6	15
Chicken mash	Cyanocitta cristata	75.5	15
Chicken mash	Arremenops rufivirgatus	69.5	15
Chicken mash	Passer domesticus	80.5	15
Chicken mash	Spizella pusilla	92	15
Chicken mash	Passer domesticus	86	15
Chicken mash	Sporophila nigricollis	74.4	15

Food type	Species	M.E. %	Ref.
Chicken mash	Zonotrichia albicollis	85.6	15
Chicken starter	Passer domesticus	42.4	15
Chicken starter	Carduelis hornemanni	72	15
Chicken starter	Zonotrichia albicollis	66.8	15
Chicken starter	Passer domesticus	71	15
Chicken starter	Passer domesticus	68.1	15
Chicken starter	Passer montanus	73.3	15
Chicken starter	Passerculus sandwichensis	69	15
Chicken starter	Spiza americana	70	15
Chicken starter	Carduelis flammea	72	15
Chicken starter	Dendrocygna autumnalis	68	15
Chicken starter	Passer domesticus	52.2	15
Duck Growena	Anas discors	72	25
Duck Growena	Anas discors	76	25
Duck growena	Anas discors	75	15
Duck Starter	Aythya affinis	69.0	28
High protein poultry food	Agelaius phoeniceus	69.6	15
Mink pellets	Haematopus ostralegus	86	15
Paste food	Cyanopica cyanus	52.4	15
Purina duck starter	Fulica americana	76.8	15
Purina duck starter	Anas rubripes	77.8	15
Purina wild bird breeder	Lagopus lagopus	71.8	15
P-18	Colinus virginianus	73.2	15
P-18	Colinus virginianus	72.7	15
Standard mixture	Passer domesticus	69.1	15
Standard mixture	Passer domesticus	61.4	15
Turkey starter	Anas acuta	73.6	15
FRUIT:			
Banana	Turdus migratorius	77	22
Banana	Sturnus vulgaris	74	22
Fruit (pulp and skin)	Turdus migratorius	55	22
Fruit (pulp and skin)	Sturnus vulgaris	55	22
Fruits	Bombycilla cadrorum	36.5	15
Juniper berries	Myadestes townsendi	37.6	15
Mistletoe berries	Phainopepla nitens	49	15
Mistletoe berries	Carpodacus mexicanus	62	15
INSECTS:			
Bees	Merops apiaster	56	15
Bees and dragonflies	Merops apiaster	59.1	15
Crickets	Sturnus vulgaris	73	22
Crickets	Turdus migratorius	71	22
Crickets	Colinus virginianus	82.7	15
Diptera larvae	Lanius collurio	70	15

Food type	Species	M.E. %	Ref.
Dragonflies	Merops apiaster	62	15
Insects	Sturnus vulgaris	65.2	15
Insects	Merops viridis	57	2
Insects	Phylloscopus trochilus	67	14
Insects	Hirundo tahitica	68	2
Mealworms	Cistithorus palustris	75.9	15
Mealworms	Parus ater	86.1	15
Mealworms	Passerculus sandwichensis	75	15
Mealworms	6 species	75.3	15
Mealworms	Parus caeruleus	84.1	15
Mealworms	Calidris alba	75.9	15
Natural food	Sturnus vulgaris	64	30
Natural food	Telmatodytes palustris	76	18
Natural food	Delichon urbica	70	2
Natural food	Riparia riparia	70	14
Natural food	Parus ater	67	18
Natural food	Hirundo rustica	70	14
Natural food	Passer montanus	75	15
Natural food	Passer domesticus	80.2	15
Silkworms	Cyanopica cyanus	80.1	15
INVERTEBRATES:			
squid	Aptenodytes patagonicus	81.3	15
MAMMALS:			
Apodemus sylvaticus	Asio otus	79	31
Ground squirrels	Falco mexicanus	82.5	15
Jack rabbits	Aquila chrysaetos	74.4	15
Jack rabbits	Haliaeetus leucocephalus	75.4	15
Mice	Otus asio	75	15
Mice	Falco tinnunculus	81	15
Mice	Asio otus	80	15
Micromys minutus	Asio otus	61	31
Microtus arvalis	Falco tinnunculus	66	19
Microtus arvalis	Falco tinnunculus	72	19
Microtus arvalis	Falco tinnunculus	72.4	24
Microtus arvalis	Falco tinnunculus	66.8	24
Microtus arvalis	Falco tinnunculus	62.2	24
Microtus arvalis	Falco tinnunculus	66.2	24
Microtus arvalis	Falco tinnunculus	69.8	24
Microtus arvalis	Asio otus	68	31
Microtus arvalis	Falco tinnunculus	67.8	24
Microtus arvalis	Falco tinnunculus	67.6	24
Mus musculus	Nyctea scandiaca	94.3	4
Mus musculus	Nyctea scandiaca	81	4

Food type	Species	M.E. %	Ref.
Mus musculus	Tyto alba	77	19
Mus musculus	Athena noctua	74	19
Mus musculus	Circus approximans	75.5	29
Mus musculus	Strix aluco	80	4
Mus musculus	Falco tinnunculus	78.4	24
Mus musculus	Strix aluco	78	19
Mus musculus	Nyctea scandiaca	85.2	4
Mus musculus	Asio otus	79	31
Mus musculus	Falco tinnunculus	77	17
Mus musculus	Bubo virginianus	84.9	7
Mus musculus	Asio otus	76.5	4
Mus musculus	Falco tinnunculus	80	19
Mus musculus	Tyto alba	75	4
Rats	Nyctea scandiaca	74.6	15
Rattus norvegicus	Nyctea scandiaca outdoors	74	11
Rattus norvegicus	Nyctea scandiaca outdoors	80	11
Rattus norvegicus	Nyctea scandiaca indoors	70	11
Sorex araneus	Falco tinnunculus	64.8	24
Soricidae	Asio otus	62	31
MEAT:			
beef	Bubulcus ibis	95	15
lean beef heart	Tyto alba	79	15
PLANT LEAVES:			
Alfalfa	Anas acuta	33.9	15
Juncus jerardi	Branta canadensis	39.5	15
Lolium perenne (mainly)	Branta leucopsis (tame)	34	8
Spartina alterniflora	Branta canadensis	30.1	15
Spartina alterniflora	Branta bernicla	34.2	15
Spartina patents	Branta bernicla	51.2	15
PLANT NEEDLES:			
Pine needles	Dendragapus canadensis	29.8	15
Pine needles	Tetrao urogallus	40	15
Pinus contorta	Canachitus canadensis	29.7	26
SEEDS (WHOLE):			
Amaranthus (retroflexus)	Melospiza melodia	71	32
Amaranthus (retroflexus)	Melospiza melodia	86	32
Barnyardgrass seeds	Anas acuta	66.7	15
Cobnuts	Parus major	80.4	15
Corn	Colinus virginianus	85.6	15
corn	Agelaius phoeniceus	90.4	15
Echinochloa walteri	Anas platyrhynchos	62.7	15

Food type	Species	M.E. %	Ref.
Echinochloa walteri	Anas acuta	61.8	15
foxtail	Cardinalis cardinalis	73	15
foxtail	Melospiza melodia	88.5	15
giant ragweed	Colinus virginianus	76	15
grand nuts	Parus caeruleus	76.8	15
grand nuts	Parus major	80.2	15
hemp	Cardinalis cardinalis	73	15
hemp	Melospiza melodia	83	15
Leersia oryzoides	Anas acuta	63.1	15
Leersia oryzoides	Anas platyrhynchos	67.1	15
millet	Uroloncha domestica	89.2	15
pigweed	Melospiza melodia	80	15
Polygonum pensylvanicum	Anas platyrhynchos	23.4	15
Polygonum pensylvanicum	Anas acuta	27.1	15
ragweed	Melospiza melodia	57	15
ragweed	Cardinalis cardinalis	73	15
Sagittaria latifolia	Anas platyrhynchos	59.4	15
Scirpus validus	Anas acuta	17.3	15
Scirpus validus	Anas platyrhynchos	20.2	15
Scott's pine seeds	Parus major	78	15
Scott's pine seeds	Parus caeruleus	74.8	15
Scott's pine seeds	Parus ater	80.9	15
smartweed	Melospiza melodia	55	15
smartweed	Cardinalis cardinalis	71	15
sorghum	Colinus virginianus	84.6	15
sorghum	Colinus virginianus	86.1	15
Sorghum vulgare	Dendrocygna autumnalis	80.1	15
Sorghum vulgare	Dendrocygna autumnalis	88.8	15
sunflower	Cardinalis cardinalis	73.5	15
sunflower seeds	Parus ater	81.3	15
sunflower seeds	Parus major	81	15
sunflower seeds	Coccothrautes vespertinus	83.9	15
SEEDS (KERNEL):			
Ambrosia trifida	Richmondena cardinalis	68	32
Cannabis sativa	Richmondena cardinalis	54	32
Cannabis sativa	Melospiza melodia	75	32
Helianthus annuus	Richmondena cardinalis	67	32
Polygonum pensylvanicum	Richmondena cardinalis	81	32
Setaria faberi	Melospiza melodia	85	32
Setaria faberi	Richmondena cardinalis	47	32
Ambrosia trifida	Richmondena cardinalis	86	32
Cannabis sativa	Richmondena cardinalis	84	32
Cannabis sativa	Melospiza melodia	83	32
Helianthus annuus	Richmondena cardinalis	85	32

Food type	Species	M.E. %	Ref.
Setaria faberi	Melospiza melodia	91	32
Setaria faberi	Richmondena cardinalis	80	32
UNIQUE DIET:			
shelled shrimp + anchovies	Eudocimus albus	80	15
horse-shoe crab eggs	Calidris alba	38.6	15
insects and meat	Hirundo rustica	72	14
mammals and birds	Buteo platypterus	74.1	15
mixed insects and seeds	Callipepla gambelii	60.4	15
poultry feed, green plants	Tetrao urogallus	66	15

[a] comprising: Haematopus ostralegus, Limosa limosa, Vanellus vanellu

Appendix D4 Percentages of metabolizable energy (M.E.%) of several food types for mammals.

Food type	Species	M.E. %	Ref.
FODDER:			
Dog food	Blarina brevicauda	92	3
Rodent food	Sciurus carolinensis	71.2	23
Dog food	Sorex cinereus	95	3
INSECTS:			
Larch sawfly	Microsorex hoyi	83	3
Larch sawfly	Sorex arcticus	88	3
Larch sawfly	Sorex cinereus	93	3
Larch sawfly	Blarina brevicauda	78	3
MAMMALS:			
Sciurus carolinensis	Felis rufus	74.9	27
Lepus americanus	Felis rufus	62.7	27
Small mammals	Felis rufus	71.6	27
Odocoilus virginianus	Felis rufus	85.8	27
Microtus pennsylvanicus	Mustela rixosa	89.9	12
Mice	Cryptotis parva	90.1	1
PLANT BEECHMAST:			
Fagus silvatica	Clethrionomys glareolus	89	5
PLANT SEED KERNELS:			
Oats	Apodemus agrarius	89	6
Oats	Microtus arvalis	90	6
PLANT LEAVES:			
Dactylus glomerata	Microtus agrestis	54	13
mixed grass	Microtus agrestis	59	9
Deschampsia flexuosa	Microtus arvalis	50	13
Deschampsia flexuosa	Microtus agrestis	53	13
Dactylus glomerata	Microtus agrestis	19	9
Alfalfa	Microtus pennsylvanicus	89.8	12
Deschampsia caespitosa	Microtus arvalis	31	13
Agrostis tenuis	Microtus agrestis	52	13
Dactylus glomerata	Microtus agrestis	52	13
Greens	Clethrionomys glareolus	72	6
Dactylus glomerata	Microtus arvalis	50	13
Agrostis tenuis	Microtus agrestis	60	13
Deschampsia flexuosa	Microtus arvalis	47	13
Deschampsia flexuosa	Microtus agrestis	50	13
Deschampsia caespitosa	Microtus arvalis	50	13

Food type	Species	M.E. %	Ref.
Dactylus glomerata	Microtus arvalis	49	13
Deschampsia caespitosa	Microtus agrestis	54	13
Festuca rubra	Microtus agrestis	48	13
Agrostis tenuis	Microtus arvalis	56	13
Festuca rubra	Microtus arvalis	44	13
Deschampsia caespitosa	Microtus agrestis	33	13
Agrostis tenuis	Microtus arvalis	48	13
Agrostis canina	Microtus agrestis	79	9
Dactylus glomerata	Microtus agrestis	19	9
Dactylus glomerata	Microtus agrestis	19	9
PLANT SEEDS:			
Hazelnuts/carrots	Glis glis	87.8	10
Hazelnuts	Glis glis	88.1	10
Wheat (green)	Microtus arvalis	65	6
Quercus sessilis	Apodemus flavicollis	78	5
Corylus avellana	Apodemus flavicollis	91	5
Oatmeal	Clethrionomys glareolus	85	5
MISCELLANEOUS FOOD TYPES:			
Compound (plant)	Apodemus agrarius	89	6
Mixed 1 (plant)	Clethrionomys glareolus	85	5
Mixed 2 (plant)	Apodemus flavicollis	89	5
Lettuce, carrots,oatmeal	Microtus pennsylvanicus	82.2	12

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Appendix E

Pollutant assimilation efficiency

Appendix E: Studies reporting on the influence of several factors on assimilation efficiency of cadmium, methylmercury and organic compounds.
(CdMt = cadmium metallothionein, CdPht = cadmium phytochelatin)

Organism	feed	chemical form	conc. tested (ppm)	Assimilation Efficiency (% total)	variable	correction factor assimilation efficiency	reference	comment
CADMIUM								
Rattus norvegicus	lab. food with porcine liver	CdMt and CdCl2	0.3 and 3 30 90		chemical form (ratio CdMt/CdCl2)	1 0.6 0.35	Groten (1992)	Concerning a chronic feeding exp. (10 months). Exposure to CdMt induced lower toxicity than to CdC2, which corresponded with the lower uptake of CdMt. Eight potentially effective minerals were tested and only Fe significantly reduced Cd accumulation (by 70–80%), this effect was slightly stronger in inorganic as compared to biologically incorporated Cd.
Rattus norvegicus	1. semi–synthetic diet 2. lobster digestive gland 3. porcine liver/kidney	CdCl2 CdMt CdMt	21		chemical form (ratio CdMt/CdCl2)	0.5	Uthe and Chou (1979)	
Mus musculus	commercial diet	CdMt and CdCl2	20		chemical form (ratio CdMt/CdCl2)	0.5	Cherian (1983)	CdCl2 and purified CdMt were added with a gastric tube.
Mus musculus	oysters		0.4	0.83			Hardy et al. (1984)	
Rattus norvegicus	1. basal diet 2. basal diet with mussels 3. basal diet with spinach	CdCl2 CdMt CdPht	30		chemical form (ratio CdMt/CdCl2) (ratio CdPht/CdCl2) (ratio CdMt/CdCl2) (ratio CdPht/CdCl2)	kidney: 1 kidney: 1 liver: 0.5 liver: 0.5	Sinkeldam et al. (1989)	A 4 week feeding exp. In plants phytochelatins bind Cd and are functionally analogous with metallothioneins. Spinach and mussels were unsuitable as food because the condition of the rats was affected seriously.
Rattus norvegicus	1. commercial diet 2. commercial diet with lettuce	CdSO4 Cd in lettuce (CdPht?)	27	0.9–1.2	chemical form	1	Welch et al. (1978)	A single dose was applied.

Appendix E: Studies reporting on the influence of several factors on assimilation efficiency of cadmium, methylmercury and organic compounds. (continued)

Organism	feed	chemical form	conc. tested (ppm)	Assimilation Efficiency (% total)	variable	correction factor assimilation efficiency	reference	comment
ORGANIC COMPOUNDS								
ORGANOCHLORINES: chlorobenzenes, chlorophenyls, octochlorostyrene								
Carassius auratus (goldfish)	low lipid diet (< 0.2%) medium lipid diet (6.3%) high lipid diet (13.5%)		8–41	26–66	% fat in diet Kow	1 1	Gobas et al. (1993)	Kow of the test chemicals ranged from 4.5 to 8.3. Results suggest that absorption is predominantly controlled by chemical difussion rather than lipid cotransport.
HYDROPHOBIC COMPOUNDS								
fish (general)	not reported			approx 50	Kow % fat in diet % protein in diet	1 not rep. not rep.	Sijm and Opperhuizen in: Nagel and Loskill (1991)	Assimilation efficiency depends on digestibility and type of food, being either lipid or protein like. Kow seems less important for the assimilation efficiency.
PCBs								
Poecilia reticulata (guppy)	commercial fish food		approx 8		age (ratio juvenile/adult)	0.5–0.7	Sijm et al. (1992)	Assimilation efficiency can be explained by the assimilation of the food.
PCB6								
Physa integra (freshwater snail)	synthetic fish food			10–70	food quantity dose: 0.5% (low) dose: 1% (medium) dose: 2% (high) (ratio high/medium) (ratio low/medium)	 5.4 0.8	Parkerton (1992)	Dose in mg dry food/mg body weight/day
Di–2–ethyl–phthalate (DEHP)								
Physa integra (freshwater snail)	synthetic fish food			10–70	food quantity dose: 0.5% (low) dose: 1% (medium) dose: 2% (high) (ratio high/medium) (ratio low/medium)	 3.4 0.7	Parkerton (1992)	Dose in mg dry food/mg body weight/day
BENZO(A)PYRENE								
Rattus norvegicus (males)	commercial diet		unknown	20	dietary fat %	1	Lahrer et al. (1984)	intraduodenally addition of the PAH in olive oil, with 50 umol (low fat) and 500 umol (high fat) oil.

Appendix E: Studies reporting on the influence of several factors on assimilation efficiency of cadmium, methylmercury and organic compounds. (continued)

Organism	feed	chemical form	conc. tested (ppm)	Assimilation Efficiency (% total)	variable	correction factor assimilation efficiency	reference	comment
METHYL MERCURY								
Vertebrates (general)	not reported	given as salt,protein, or naturally present in fish		95 95	chemical form matrix-binding	1 1	Clarkson et al. (1984)	
Felis domesticus	fish	fish contaminated with MeHg and 'clean' fish to which MeHg was added		> 90	matrix-binding	1	Albanus et al. (1972)	

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Appendix F

Species sensitivity (birds)

APPENDIX F. A CONCISE OVERVIEW OF THE TOXICOKINETIC AND TOXICODYNAMIC ASPECTS OF THE POLLUTANTS

DIELDRIN

The primary targets of dieldrin are supposed to be in the nervous system. Before targeting dieldrin probably needs to be transformed to aldrin-(trans)diol. The parent compound is stored in adipose tissue. Further biotransformation could occur to more hydrophillic substances as dihydrols (phase I), that can be conjugated (phase II) and excreted. The MFO system in the liver is considered to be the main detoxifier.

LINDANE

The primary targets of lindane are probably in the nervous system Lindane is partly dehydrochlorinated. The detoxification rate is higher in comparison with more lipophilic organochlorines as partitioning to adipose tissue will be less.

DDT (AND METABOLITES)

The primary targets of DDT are supposed to be in the nervous system and probably in the shell gland of the female oviduct. Clinical effects are excitation, ataxia, and convulsions. Storage in adipose tissue may prevent DDT from reaching the targets. Effects of DDT and its metabolites on the population level of birds are due to eggshell thinning leading to increased breakage of eggs, but also to disturbance of the estrogen metabolism affecting the reproduction. DDT is considered to be transformed primarily by the MFO system in the liver.

PENTACHLOROPHENOL (PCP)

There is little known about biotransformation of PCP in terrestrial systems (IPCS, 1987). The OH^- group makes PCP more suitable for elimination. In general PCP is not expected to accumulate in birds, partly because of its extensive binding to plasma protein. In some studies however high concentrations of PCP in raptorial birds were found: in dead snail kites (*Rosthramus sociabilis*) up to 46.6 mg PCP/kg (liver), and in pectoral muscles of white-tailed eagles (*Haliaëtus albicilla*) up to 8.6 mg PCP/kg w.w. (IPCS, 1987). The dead snail kites were found in the vicinity of PCP-treated rice fields in Surinam. In 1072 chicken livers and 723 chicken fat samples low residues were found (most < 0.01 mg/kg) (IPCS, 1987). PCP can uncouple the oxidative phosphorylation after short-term exposure, leading a.o. to an increased metabolic rate.

CADMIUM

Cadmium is supposed to be transported in blood bound to e.g. albumin. Only a small fraction might be transported via metallothionein. Primary targets are especially in the kidney, but also in the liver. Furthermore calcium metabolism could be affected. Targeting is supposed to occur by unbound cadmium or the free cadmium ion (Klaassen et al, 1986).
Cadmium appears not to interfere with the MFO system after 45 days

exposure to a low dose (100 μg/g feed). As it may increase the amount of circulating lipids cadmium could increase the accumulation of lipophilic compounds as was shown in the Japanese quail (*Coturnix coturnix japonica*) by Leonzio et al (1992).

INORGANIC MERCURY

The primary targets appear to be in the kidney and liver, but probably also in the central nervous system causing localized lesions (Hill and Soares, 1984). Inorganic mercury is expected to have a low accumulating potence.

ORGANIC MERCURY

The primary targets appear to be in the liver and in the nervous system. Detoxification of methyl mercury is probably via demethylation in the liver but also in the kidneys (Norheim and Frøslie, 1978). Methyl mercury accumulates relatively easily in comparison with inorganic mercury. Accumulation of methyl mercury is not so much due to lipophilicy of CH_3 Hg^+ as it is to electric neutrality. Neutral species as $HgCl_2$ and CH_3 HgCl diffuse through the membrane, whereas ionic species as CH_3 Hg^+ and $HgCl^+$ react with ionic groups on the outside of the membrane (Boudou et al, 1983). It appears from a subacute experiment from Hill and Soares (1984) that in the Japanese quail (*Coturnix coturnix japonica*) methyl-mercury is much more toxic than inorganic mercury (LC_{50}s: 47 and 5086 mg/kg feed, respectively).

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Appendix G

NOECs of birds and mammals

Appendix G1. Oral and dietary toxicity data of the selected chemicals to birds. Values are listed as reported in the literature, and converted to a mg/kg food value.
NOECs are corrected to NOECs for eight selected raptorial bird species in field conditions by using correctons for metabolic rate, caloric content and assimilation efficiency of food.

LC50= (sub)acute mortality, NOEC= no observed effect concentration (effect recorded is specified).
mo=mortality, re=reproduction, gr=growth.
up=update with respect to Romijn et al. (1991b), ra=raptorial species, se=selected NOEC for derivation of a bird NOEC.
SP=sparrowhawk, GO=goshawk, BU=buzzard, KE=kestrel, LO=long-eared owl, TA=tawny owl, BA=barn owl, LI=little owl.

(1) NOEC value derived by applying a factor 2 on the lowest concentration tested, which caused <20% effect relative to the control group, or a factor 3 on the lowest concentration which caused 20-50% effect relative to the control group.
(2) NOEC derived by applying a factor 10 on the value obtained from the literature to compensate for the uncertainty in establishing a (chronic) NOEC from short time (<1 month) studies.
(3) Egg shell thinning may lead to egg breakage when it exceeds 20 %. When possible the NOEC is selcted at this level by extrapolation.
(4) Contaminant concentration has to be expressed on a WW-basis. For concentrations on DW basis a factor is applied depending on the dry matter percentage of the food.
(5) Reported value was not compensated for the relative contribution of the CH3Hg group to the molecular weight of the compound with which the study was carried out.
(6) Species name not specified, hence treated as a species of quail different from Coturnix coturnix japonica or Colinus virigianus.

Parameter	species	exposure period	reported value	converted value		reference			SP	GO	BU	KE	LO	TA	BA	LI
LINDANE																
LC50	Coturnix c. japonica	5 days	425	425		Hill et al. (1975)			95	94	85	83	85	72	84	66
	Phasianus colchicus	5 days	561	561		Hill et al. (1975)			125	124	112	110	112	96	111	87
	Colinus viriginianus	5 days	882	882		Hill et al. (1975)			197	195	176	172	175	150	174	137
	Anas platyrhynchos	5 days	>5000	>5000		Hill et al. (1975)			0	0	0	0	0	0	0	0
NOEC mo	Gallus domesticus	27 days	16	1.6	(2)	Harrison et al. (1963)		se	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.2
re	Anas platyrhynchos	8 weeks	200	100	(1)	Chakravarty et al. (1986)			22.4	22.1	20.0	19.5	19.9	17.0	19.7	15.5
DIELDRIN																
LC50	Numida meleagris	5 days	107	107		Wiese et al. (1969)			24	24	21	21	21	18	21	17
	Colinus viriginianus	5 days	166	166		Hill et al. (1975)			37	37	33	32	33	28	33	26
	Coturnix c. japonica	5 days	278	278		Hill et al. (1975)			62	61	56	54	55	47	55	43
	Phasianus colchicus	5 days	570	570		Hill et al. (1975)			128	126	114	111	113	97	112	88
	Anas platyrhynchos	5 days	1500	1500		Hill et al. (1975)			336	331	300	293	298	255	296	232
	Anas platyrhynchos	4 days	165	165		Nebeker et al. (1992)	up		37	36	33	32	33	28	33	26
NOEC mo	Quail (6)	162 days	0.5	0.5		DeWitt (1956)		se	0.11	0.11	0.10	0.10	0.10	0.09	0.10	0.08
re	Anas platyrhynchos	> 1 year	1.6	0.8	(1)	Lehner and Egbert (1969)		se	0.18	0.18	0.16	0.16	0.16	0.14	0.16	0.12
mo	Numida meleagris	21 months	1.5	1.5		Wiese and Basson (1967)		se	0.34	0.33	0.30	0.29	0.30	0.26	0.30	0.23
re	Phasianus colchicus	br. period	2.0	2.0		DeWitt (1956)		se	0.45	0.44	0.40	0.39	0.40	0.34	0.39	0.31
mo	Colinus viriginianus	34 weeks	2.5	2.5		Fergin and Schafer (1977)		se	0.56	0.55	0.50	0.49	0.50	0.43	0.49	0.39
re	Numida meleagris	21 months	5.0	5.0		Wiese and Basson (1967)			1.12	1.10	1.00	0.98	0.99	0.85	0.99	0.77
re	Gallus domesticus	13 months	10	10		Brown et al. (1974)		se	2.24	2.21	2.00	1.95	1.99	1.70	1.97	1.55
mo,re	Coturnix c. japonica	18 weeks	10	10		Walker et al. (1969)		se	2.24	2.21	2.00	1.95	1.99	1.70	1.97	1.55
gr	Coturnix c. japonica	158 days	10	10		Stickel et al. (1969)	up		2.24	2.21	2.00	1.95	1.99	1.70	1.97	1.55
re	Colinus viriginianus	34 weeks	10	10		Fergin and Schafer (1977)			2.24	2.21	2.00	1.95	1.99	1.70	1.97	1.55

Appendix G1. Oral and dietary toxicity data of the selected chemicals to birds. Values are listed as reported in the literature, and converted to a mg/kg food value. (continued)

Parameter	species	exposure period	reported value	converted value		reference			SP	GO	BU	KE	LO	TA	BA	LI
DDT (total)																
LC50	Cyanocitta cristata	5 days	415	415		Hill et al. (1971)			93	92	83	81	83	71	82	64
	Passer domesticus	5 days	415	415		Hill et al. (1971)			93	92	83	81	83	71	82	64
	Phasianus colchicus			500		geometric mean value			112	110	100	98	99	85	99	77
	,,	5 days	311	311		Hill et al. (1975)			70	69	62	61	62	53	61	48
	,,	5 days	804	804		Stickel and Heath (1964)			180	178	161	157	160	137	159	124
	Richmondea car.	5 days	535	535		Hill et al. (1971)			120	118	107	104	106	91	105	83
	Coturnix c. japonica	5 days	568	568		Hill et al. (1975)			127	125	114	111	113	97	112	88
	Agelaius phoeniceus	10 days	1000	1000		DeWitt et al. (1963)			224	221	200	195	199	170	197	155
	Colinus variginianus			1015		geometric mean value			227	224	203	198	202	173	200	157
	,,	5 days	881	881		Stickel and Heath (1964)			197	195	176	172	175	150	174	136
	,,	5 days	1170	1170		Hill et al. (1971)			262	258	234	228	233	199	231	181
	Anas platyrhynchos			1279		geometric mean value			286	282	256	250	254	218	252	198
	,,	5 days	875	875		Stickel and Heath (1964)			196	193	175	171	174	149	173	135
	,,	5 days	1869	1869		Hill et al. (1971)			418	413	374	365	372	318	368	289
	Rallus longirostris	5 days	1612	1612		Van Velzen and Keitzer (1975)			361	356	322	315	321	275	318	250
NOECre	Streptopelia risoria	8 days	10	0.5	(1,2)	Peakall (1970)		se	0.11	0.11	0.10	0.10	0.10	0.09	0.10	0.08
re	Gallus domesticus			0.6		geometric mean value		se	0.14	0.14	0.12	0.12	0.12	0.10	0.12	0.09
	,,	10 weeks	< 0.1	0.05	(1)	Sauter and Steele (1972)			0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	,,	2 months	7.5	7.5		Smith et al. (1970)			1.68	1.66	1.50	1.46	1.49	1.28	1.48	1.16
mo	Molothrus ater	13 days	< 100	3.3		Van Velzen et al. (1972)		se	0.74	0.73	0.66	0.64	0.66	0.56	0.65	0.51
re	Anas platyrhynchos	2 years	3.3	3.3		Heath et al. (1972)		se	0.74	0.73	0.66	0.64	0.66	0.56	0.65	0.51
re	Coturnix c. japonica	12 weeks	10	10		Davison et al. (1976)		se	2.24	2.21	2.00	1.95	1.99	1.70	1.97	1.55
mo	Colinus virigianus	63 days	50	17	(2)	Coburn and Treichler (1946)		se	3.80	3.75	3.40	3.32	3.38	2.89	3.35	2.63
gr	Colinus virigianus	5 days	200	20	(1)	Hill et al. (1971)			4.47	4.42	4.00	3.91	3.98	3.41	3.94	3.10
re	Phasianus colchicus	8 weeks	< 100	50	(1)	Genelly and Rudd (1956)		se	11.18	11.04	10.00	9.76	9.94	8.51	9.86	7.74
re	Falco sparverius			5.6		geometric mean value	up ra	se	2.26	2.23	2.02	1.97	2.01	1.72	1.99	1.56
	,,	5.5 months	0.3	3	(3)	Lincer (1975)	up ra		1.20	1.18	1.07	1.05	1.07	0.91	1.06	0.83
	,,	?	< 3	6	(3)	Peakall et al. (1973)	up ra		2.40	2.37	2.14	2.10	2.13	1.83	2.12	1.66
	,,	> 2 years	< 2.8	10	(3)	Wiemeyer and Porter (1970)	up ra		4.00	3.95	3.57	3.49	3.56	3.05	3.53	2.77
re	Otus asio	> 1 year	2.8	2.8		McLane and Hall (1972)	up ra	se	1.20	1.18	1.07	1.04	1.06	0.91	1.05	0.83
PCP																
LC50	Colinus viriginianus	5 days	3400	3400		Hill et al. (1975)			761	751	680	664	676	579	670	526
	Phasianus colchicus	5 days	4331	4331		Hill et al. (1975)			969	956	866	846	861	738	854	670
	Anas platyrhynchos	5 days	4500	4500		Hill et al. (1975)			1007	994	900	879	895	766	887	697
	Coturnix c. japonica	5 days	5204	5204		Hill et al. (1975)			1164	1149	1040	1016	1035	886	1026	806
NOECre	Gallus domesticus			245		geometric mean value			55	54	49	48	49	42	48	38
re	,,	8 weeks	100	100		Stedman et al. (180)		se	22	22	20	20	20	17	20	15
re	,,	8 weeks	600	600		Prescott et al. (1982)			134	133	120	117	119	102	118	93

Appendix G1. Oral and dietary toxicity data of the selected chemicals to birds. Values are listed as reported in the literature, and converted to a mg/kg food value. (continued)

Parameter	species	exposure period	reported value		converted value		reference			SP	GO	BU	KE	LO	TA	BA	LI
INORGANIC MERCURY																	
LC50	Phasianus colchicus	5 days	2805		2805		Hill et al. (1975)			627	619	561	548	558	478	553	434
	Anas platyrynchos	5 days	> 3700		>3700		Fitzhugh et al. (1950)			0	0	0	0	0	0	0	0
	Coturnix c. japonica				4063		geometric mean value			909	897	812	793	808	692	801	629
	,,	5 days	4385		4385		Hill et al. (1975)			981	968	877	856	872	747	865	679
	,,	5 days	3764		3764		Hill and Soares (1984)			842	831	753	735	749	641	742	583
NOEC re	Coturnix c. japonica	1 year	4		4		Hill and Schafner (1975)		se	0.89	0.88	0.80	0.78	0.80	0.68	0.79	0.62
re	Gallus domesticus	3 weeks	100		10	(2)	Scott (1975)			2.24	2.21	2.00	1.95	1.99	1.70	1.97	1.55
mo,gr	Gallus domesticus	16 weeks	125	(4)	125		Parkhurst and Thaxton (1973)			27.96	27.61	24.99	24.41	24.86	21.29	24.64	19.35
METHYL-MERCURY																	
LC50	Coturnix c. japonica	5 days	40.2		40.0		Hill and Soares (1984)			8.9	8.8	8.0	7.8	8.0	6.8	7.9	6.2
NOEC re	Anas plathyrynchos	3 generations	0.5		0.25	(1)	Heinz (1979)		se	0.06	0.06	0.05	0.05	0.05	0.04	0.05	0.04
mo,gr	Anas plathyrynchos	20 days	3.3		0.36	(2,5)	Gardiner (1972)			0.08	0.08	0.07	0.07	0.07	0.06	0.07	0.06
mo,gr	Phasianus colchicus	20 days	3.3		0.36	(2,5)	Gardiner (1972)		se	0.08	0.08	0.07	0.07	0.07	0.06	0.07	0.06
mo	Gallus domesticus				0.56		geometric mean value		se	0.12	0.12	0.11	0.11	0.11	0.09	0.11	0.09
	,,	3 weeks	12.0		0.86	(2,5)	Fimreite (1970)			0.19	0.19	0.17	0.17	0.17	0.15	0.17	0.13
	,,	20 days	3.3		0.36	(2,5)	Gardiner (1972)			0.08	0.08	0.07	0.07	0.07	0.06	0.07	0.06
mo	Coturnix c. japonica	9 weeks	2.0		1.70	(5)	Hill and Soares (1984)		se	0.38	0.38	0.34	0.33	0.34	0.29	0.34	0.26
mo	Colinus virginianus	6 weeks	4.3		4.30		Spann et al. (1986)		se	0.96	0.95	0.86	0.84	0.86	0.73	0.85	0.67
mo	Poephila guttata	77 days	2.5		2.9	(4)	Scheuhammer (1988)	up	se	0.65	0.64	0.58	0.57	0.58	0.49	0.57	0.45
mo,gr	Buteo jamaicensis	12 weeks	3.9		3.9		Fimreite and Karstad (1971)	up ra	se	1.56	1.54	1.39	1.36	1.39	1.19	1.37	1.08
CADMIUM																	
LC50	Gallus domesticus	20 days	562		562		Pritzl et al. (1974)			126	124	112	110	112	96	111	87
	Phasianus colchicus	5 days	767		767		Hill et al. (1975)			172	169	153	150	153	131	151	119
	Coturnix c. japonica	5 days	1584		1584		Hill et al. (1975)			354	350	317	309	315	270	312	245
	Anas platyrhynchos	5 days	> 3065		>3065		Hill et al. (1975)			0	0	0	0	0	0	0	0
NOEC gr	Meleagris galopavo	2 weeks	2		0.2	(2)	Supplee (1961)		se	0.04	0.04	0.04	0.04	0.04	0.03	0.04	0.03
re	Anas platyrhynchos	90 days	1.6		1.6		White et al. (1978)		se	0.36	0.35	0.32	0.31	0.32	0.27	0.32	0.25
mo,re	Gallus domesticus	48 weeks	12		12		Leach et al. (1978)		se	2.68	2.65	2.40	2.34	2.39	2.04	2.37	1.86
gr	Coturnix c. japonica	6 weeks	75		38	(1)	Richardson et al. (1974)		se	8.50	8.39	7.60	7.42	7.56	6.47	7.49	5.88
re	Streptopelia risoria	5 months	1.7		1.9	(4)	Scheuhammer (1987)	up	se	0.43	0.42	0.38	0.37	0.38	0.32	0.37	0.29

Appendix G2: Oral and dietary toxicity data of the selected chemicals to mammals. Values are listed as reported in the literature, and converted to a mg/kg food value. NOECs are corrected to NOECs for two selected raptorial beast of prey species in field conditions by using correction factors for matabolic rate, caloric content and assimilation efficiency of food.

LEGENDS

LC50= (sub)acute mortality, NOEC= no observed effect concentration (effect recorded is specified).
mo=mortality, re=reproduction, gr=growth.
up=update, ra=raptorial species, se=selected NOEC for derivation of a bird NOEC.
WE=Weasel, BG=Badger

(1) NOEC value derived by applying a factor 2 on the lowest concentration tested, which caused <20% effect relative to the control group, or a factor 3 on the lowest concentration which caused 20–50% effect relative to the control group.
(2) NOEC derived by applying a factor 10 on the value obtained from the literature to compensate for the uncertainty in establishing a (chronic) NOEC from short time (<1 month) studies
(3) value reported in the literature in mg/kg body weight. These values were converted into a mg/kg food value with a body weight/daily food intake factor: 40 for Canis domesticus, 33.3 for Oryctolagus cuniculus, 20 for Macaca spec. and Rattus norvegicus, 8.3 for Microtus spec. and Mus musculus, and 5.7 for Saimura sciureus.
(4) reported value was not compensated for the relative contribution of the CH3Hg group to the molecular weight of the compound with which the study was carried out.
(5) Contaminant concentration have to be expresed on a WW-basis. For concentrations on DW basis a factor is applied depending on the dry matter percentage of the food.

Parameter	species	exposure period	reported value		converted value		reference		WE	BG
LINDANE										
LC50	Peromyscus polionotus	4 days	1000		1000		Wolfe and Esher (1980)		158	123
NOECre	Mus musculus	9 days	30	(3)	25	(2)	Frohberg and Bauer (1972)	se	3.9	3.1
re	Oryctolagus cuniculus	12 days	10	(3)	33	(2)	Palmer and Lovell (1971)		5.2	4.1
re	Rattus norvegicus	90 days	5	(3)	100		Trifonova et al. (1970)		15.8	12.3
mo	Rattus norvegicus				141		geometric mean value		22.3	17.4
	"	2 years	400		400		Fitzhugh et al. (1950)		63.0	49.2
	"	90 days	50		50		Van Velsen (1984)		7.9	6.1

Appendix G2: Oral and dietary toxicity data of the selected chemicals to mammals. Values are listed as reported in the literature, and converted to a mg/kg food value. (continued)

Parameter	species	exposure period	reported value		converted value		reference			WE	BG
DIELDRIN											
LC50	Microtus canicaudus	30 days	40	(3)	333		Cholakis et al. (1981)			52	41
	Microtus orchrochaster	30 days	105	(3)	872		Cholakis et al. (1981)			137	107
	Blerina brevicaudus	17 days	66		206	(5)	Blus (1978)	up		48	37
NOEC mo	Mus musculus	2 years	1		1		Hunt et al. (1975)		se	0.16	0.12
re	Macaca mulatta	6 years	1		1		Wright et al. (1978)		se	0.16	0.12
re	Rattus norvegicus	life time	1.25		1.25		Harr et al. (1970)		se	0.20	0.15
re	Mus musculus	6 generations	3		3		Keplinger et al. (1970)			0.47	0.37
mo	Blerina brevicaudus	14 days	50		5	(2)	Blus (1978)		se	0.79	0.61
gr	Canis domesticus	25 months	0.2	(3)	8		Fitzhugh et al. (1964)		se	1.26	0.98
mo	Canis domesticus				9		geometric mean value			1.41	1.10
	,,	25 months	0.2	(3)	8		Fitzhugh et al. (1964)			1.26	0.98
	,,	270 days	10		10		Treon and Cleveland (1955)			1.58	1.23
mo	Rattus norvegicus	2 years	10		10		Fitzhugh et al. (1964)			1.58	1.23
mo	Damaliscus dorcas p.	90 days	15		15		Wiese et al. (1973)		se	2.36	1.84
DDT (total)											
LC50	Blerina brevicaudus	17 days	651		651		Blus (1978)	up		151	118
NOEC re	Rattus norvegicus	7 months	20		20		Clement and Okey (1974)		se	3.2	2.5
re	Mus musculus	6 generations	25		25		Klepinger et al. (1970)		se	3.9	3.1
mo	Saimura sciureus	6 months	5	(3)	28.4		Cranmer et al. (1972)		se	4.5	3.5
mo	Microtus pennsylvanicus	31 days	1000		100	(1)	Coburn and Treichler (1946)		se	15.8	12.3
mo,gr	Macaca mulatta	7.5 years	200		200		Durham et al. (1963)		se	31.5	24.6
mo	Canis domesticus	4 years	400		400		Lehman (1965)		se	63.0	49.2
PCP											
LC50	no data found										
NOEC re	Rattus norvegicus	5 months	50		55		geometric mean value		se	9	7
	,,	3.5 months	60		50		Exon and Koller (1982,1983)			8	6
	,,				60		Welsh et al. (1987)			9	7
gr	Rattus norvegicus				100		geometric mean value			16	12
	,,	3 months	3	(3)	50		Knudsen et al. (1974)			8	6
	,,	8 months	100		100		Goldstein et al. (1977)			16	12

Appendix G2: Oral and dietary toxicity data of the selected chemicals to mammals. Values are listed as reported in the literature, and converted to a mg/kg food value. (continued)

Parameter	species	exposure period	reported value		converted value		reference			WE	BG
	,,	8 months	100		100		Kimbrough and Linder (1978)			16	12
	,,	2 year	10	(3)	200		Schwetz et al. (1978)			32	25
gr	Mus musculus	2 year	200		200		NTP (1979)			32	25
mo	Mus musculus	6 months	600		600		NTP (1979)			95	74
INORGANIC MERCURY											
LC50	no data found										
NOEC gr	Mus musculus	560 days	20		20		Ganser and Kirschner (1985)		se	3.2	2.5
METHYL-MERCURY											
LC50	no data found										
NOEC gr	Macaca spec.	1 year	0.01	(3)	0.22	(4)	Kawasaki et al. (1986)		se	0.03	0.03
gr,re	Rattus norvegicus	3 generations	0.5		0.43	(4)	Verschuuren et al. (1976)		se	0.07	0.05
mo	Mustela vison	93 days	1.1		1.20	(4)	Wobeser et al. (1975)	ra	se	0.14	0.11
gr	Mus musculus	60 days	0.25	(3)	2.25	(4)	Berthoud et al. (1976)		se	0.35	0.28
CADMIUM											
LC50	no data found										
NOEC gr	Macaca mulatta	3 years	3		3		Nomiyama et al. (1987)		se	0.47	0.37
gr	Ovis amon aries	191 days	15		15		Doyle et al. (1974)		se	2.36	1.84
gr	Rattus norvegicus				20.0		geometric mean value		se	3.23	2.52
	,,	2 years	10		10		Loeser (1980)			1.58	1.23
	,,	90 days	42		42		Prigge (1978)			6.62	5.16
mo	Rattus norvegicus				21		geometric mean value			3.34	2.61
	,,	6 months	45		45		Fitzhugh and Meiller (1941)			7.09	5.53
	,,	41 weeks	10		10		Sugawara and Sugawara (1974)			1.58	1.23
gr	Bos primigenius taurus	12 weeks	40		40		Powell et al. (1964)		se	6.30	4.92
gr	Sus scrofa domesticus				45		geometric mean value		se	7.05	5.50
	,,	5 months	40		40		Kranjc et al. (1986)			6.30	4.92
	,,	6 weeks	50		50		Cousins et al. (1973)			7.88	6.15

APPENDIX G (NOECs of birds and mammals)

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Appendix H

BCFs and BAFs for the selected chemicals: geometric means, log-transformed means and standard deviations

Appendix H1. A survey of BCFs (kg dry soil/kg wet tissue) and BAFs (kg wet food/kg wet tissue) for all selected chemicals for separate plant and animal groups.
Geometric means and log transformed means and standard deviations (WW basis) are shown.

	DDT	Dieldrin	Lindane	PCP	MeHg	Cd
MEAN BCF						
Leaves	0.05	0.04	0.15	0.82	0.06	0.07
Fruits					0.01	0.01
Seeds	1.02		2.71	0.05		0.46
Tubers	0.00	0.06	0.86		0.01	0.05
Earthworms	0.17	0.36	0.46	1.51	8.28	3.74
Gastropods	0.68	0.32		0.002		1.67
Larvae Ins.	0.46					0.85
Caterpillars						0.25
Insects	0.63	0.59	0.64	0.06		0.54
Isopods	2.76			0.03		7.37
Spiders			0.03	0.13		6.37
Birds	4.25	1.18	0.098	0.014	0.94	0.053
Mammals	1.42	0.63	0.106	0.080	3.39	0.034
LN (MEAN−BCF)						
Leaves	−3.03	−3.25	−1.90	−0.20	−2.82	−2.63
Fruits					−4.82	−5.03
Seeds	0.02		1.00			−0.77
Tubers	−6.35	−2.79	−0.15		−4.25	−2.96
Earthworms	−1.76	−1.01		0.41	2.11	1.32
Gastropods	−0.38	−1.13				0.51
Larvae Ins.	−0.77					−0.16
Caterpillars			−0.18			−1.40
Insects	−0.45	−0.54	−0.44	−2.87		−0.61
Isopods						2.00
Spiders				−2.04		1.85
Birds	1.45	0.17			−0.06	
Mammals	0.35	−0.47				
LN (STD−BCF)						
Leaves	1.22	1.50	1.83	1.32	0.47	1.35
Fruits					1.11	1.91
Seeds	0.28		0.26			1.30
Tubers	3.57	0.95	1.99		1.22	0.87
Earthworms	0.59	0.67		1.46	0.01	0.81
Gastropods	1.87	0.44				0.91
Larvae Ins.	2.93					1.07
Caterpillars			0.20			0.47
Insects	1.58	1.03	2.91	1.81		1.24
Isopods						0.67
Spiders				1.36		0.78
Birds	0.11	1.12			0.22	
Mammals	0.33	0.64				

Appendix H2. Number of determinations of BCFs (kg dry soil/kg wet tissue) and BAFs (kg wet food/kg wet tissue). For vertebrates only laboratory experiments are used, for invertebrates and plants both laboratory and field experiments are used.

		DDT	Dieldrin	Lindane	PCP	MeHg	Cd
Plants	leaves	15	10	11	7	4	31
	fruits					2	2
	seeds	2		2	1		14
	tubers	7	4	2		5	8
Earthworms		6	10	0	8	2	71
Gastropods		14	2		1		15
Larvae of insects		3					5
Caterpillars							4
Insects		23	17	2	3		42
Isopods		1			1		3
Spiders				1	2		11
Birds	body					5	
	carcass	3	11			5	
	muscle		3	2	6	20	27
	liver	3	8	2	7	24	35
	kidney		3	2	7	24	31
	fat	14	13	7	5		
Mammals	body	8			1		
	carcass		6		1		
	muscle			2		6	3
	liver	3	12	2	1	9	38
	kidney			2		9	38
	fat	8	17	14	1		

Appendix H3. A survey of geometric means, log transformed means and standard deviations of BCFs, of the selected chemicals in plant parts. BCFs in kg dry soil/kg plant tissue on DW and WW basis. Mean dry matter percentages applied are 8.5, 16.9, 75.6 and 14.1 for vegetation (leaves), fruits, seeds and tubers, respectively.

	mean BCF (DW)	mean BCF (WW)	ln(meanBCF) (WW)	ln(stdBCF) (WW and DW)
DDT				
vegetation (leaves)	0.58	0.05	−3.03	1.22
fruits	0.00			
seeds	1.35	1.02	0.02	0.28
tubers	0.01	0.002	−6.35	3.57
Dieldrin				
vegetation (leaves)	0.46	0.04	−3.25	1.50
fruits				
seeds				
tubers	0.43	0.06	−2.79	0.95
Lindane				
vegetation (leaves)	1.76	0.15	−1.90	1.83
fruits				
seeds	3.59	2.71	1.00	0.26
tubers	6.08	0.86	−0.15	1.99
PCP				
vegetation (leaves)	9.65	0.82	−0.20	1.32
fruits				
seeds	0.07	0.05		
tubers				
Me−Hg				
vegetation (leaves)	0.70	0.06	−2.82	0.47
fruits	0.05	0.01	−4.82	0.78
seeds				
tubers	0.10	0.01	−4.28	1.09
Cd				
vegetation (leaves)	0.82	0.07	−2.63	1.35
fruits	0.05	0.01	−5.03	1.91
seeds	0.61	0.46	−0.77	1.30
tubers	0.36	0.05	−2.96	0.87

Appendix H4. BCFs (kg dry soil/kg wet tissue) and BAFs (kg wet food/kg wet tissue) for the four organic compounds after lumping.
Geometric means, log transformed means and standard deviations (WW basis) are shown.

	DDT	Dieldrin	Lindane	PCP
MEAN BCF				
Leaves & fruits	0.05	0.04	0.15	0.82
Seeds	1.02	0.04 *	2.71	0.05
Tubers	0.002	0.06	0.86	0.82 *
Soft−bodied inv.	0.45	0.36	0.46 **	0.72
Hard−bodied inv.	0.68	0.59	0.34	0.07
Birds	4.25	1.18	0.098	0.014
Mammals	1.42	0.63	0.106	0.080
LN (MEAN−BCF)				
Leaves & fruits	−3.03	−3.25	−1.90	−0.20
Seeds	0.02		1.00	
Tubers	−6.35	−2.79	−0.15	
Soft−bodied inv.	−0.79	−1.03	−0.78	−0.32
Hard−bodied inv.	−0.39	−0.54	−1.44	−2.70
Birds	1.45	0.17		
Mammals	0.35	−0.47		
LN (STD−BCF)				
Leaves & fruits	1.22	1.50	1.83	1.32
Seeds	0.28		0.26	
Tubers	3.57	0.95	1.99	
Soft−bodied inv.	1.81	0.63		2.60
Hard−bodied inv.	1.57	1.03	2.94	1.41
Birds	0.11	1.12		
Mammals	0.33	0.64		

*: no experimental value available, therefore the BCF for plant leaves is used
**: no reliable experimental value available, therefore a QSAR is used

Appendix H5: BCFs (kg dry soil/kg wet food) and BAFs (kg wet food/kg wet tissue) for methyl mercury after lumping.
Geometric means, log transformed means and standard deviations (WW basis) are shown.

	BCF or BAF
MEAN BCF	
leaves & seeds	0.06
fruits	0.01
tubers	0.01
invertebrates	8.28
birds	0.94
mammals (raptors)	3.97
LN (MEAN-BCF)	
leaves & seeds	-2.83
fruits	-4.82
tubers	-4.25
invertebrates	2.11
Birds	-0.06
Mammals (raptors)	-
LN (STD-BCF)	
leaves & seeds	0.48
fruits	1.11
tubers	1.22
invertebrates	0.01
Birds	0.21
Mammals (raptors)	

Appendix H6: BAFs (kg wet food/kg wet tissue) of six selected chemicals in the target organs and tissues of terrestrial birds and mammals in laboratory experiments. Geometric means, log transformed means and standard deviations on WW-basis are shown, together with the relative organ and tissue weights used in the model calculations.
n.a. means not available

BIRDS, GEOMETRIC MEANS

	DDT	Dieldrin	Lindane	PCP	MeHg	Cd	relative weight
Body	4.25	1.18	n.a.	n.a.	0.94	n.a.	1.000
Fat	5.61	12.46	1.03	0.06	n.a.	n.a.	0.089
Kidney	n.a.	0.32	0.05	0.12	2.80	2.72	0.008
Liver	1.86	0.62	0.02	0.07	2.82	0.92	0.020
Muscle	n.a.	0.30	0.01	0.02	1.04	0.04	0.312
Body (calculated)*	0.54	1.22	0.096	0.014	0.40	0.053	

*) For birds it is assumed that BAFbody can be calculated with :
BAFbody = 0.089*BAFfat + 0.008*BAFkidney + 0.02*BAFliver + 0.312*BAFmuscle

MAMMALS, GEOMETRIC MEANS

	DDT	Dieldrin	Lindane	PCP	MeHg	Cd	relative weight
Body	1.42	0.63	n.a.	0.08	n.a.	n.a.	1.000
Fat	6.22	3.80	0.64	0.05	n.a.	n.a.	0.094
Kidney	n.a.	n.a.	0.27	n.a.	12.00	0.74	0.014
Liver	0.11	0.15	0.00	0.24	6.67	0.26	0.050
Muscle	n.a	n.a.	0.08	n.a.	5.50	0.02	0.526
Body (calculated)*	0.59	0.36	0.106	0.017	3.39	0.034	

*) For mammals it is assumed that BAFbody can be calculated with :
BAFbody = 0.094*BAFfat + 0.014*BAFkidney + 0.05*BAFliver + 0.526*BAFmuscle

BIRDS, LOG TRANSFORMED MEANS AND STANDARD DEVIATIONS

		DDT	Dieldrin	Lindane	PCP	MeHg	Cd
Body	mean	1.45	0.17			−0.06	
	SD	0.11	1.12			0.22	
Fat	mean	1.72	2.52	0.03	−2.79		
	SD	1.69	0.91	1.19	1.39		
Kidney	mean		−1.14	−3.11	−2.13	1.03	1.00
	SD		0.28	0.16	1.29	0.65	1.32
Liver	mean	0.62	−0.48	−3.91	−2.72	1.04	−0.08
	SD	0.27	1.16	0.98	1.13	0.67	0.92
Muscle	mean		−1.21	−4.61	−3.99	0.04	−3.31
	SD		0.54	–	1.20	0.36	1.67

MAMMALS, LOG TRANSFORMED MEANS AND STANDARD DEVIATIONS

		DDT	Dieldrin	Lindane	PCP	MeHg	Cd
Body	mean	0.35	−0.47				
	SD	0.33	0.64				
Fat	mean	1.83	1.33	−0.45			
	SD	0.86	1.38	0.88			
Kidney	mean			−1.32		2.48	−0.30
	SD			1.54		0.65	0.97
Liver	mean	−2.25	−1.89			1.90	−1.35
	SD	0.55	0.92			0.77	0.75
Muscle	mean			−2.65		1.70	−3.70
	SD			1.34		0.33	1.57

Appendix H7: Survey of total BAF (kg wet food/kg wet tissue) from soil to food of toppredator species and MPCs i soil (mg/kg dry soil), by means of 5, 25, 50 and 75 percentiles of the distributions.

	BAF			MPC			
	25	50	75	5	25	50	75
DDT							
SP *	2.43	3.34	5.30	0.015	0.09	0.27	0.758
GO	1.13	1.47	2.04	0.036	0.24	0.62	1.68
BU	0.24	0.36	0.72	0.090	0.70	2.10	6.5
KE	0.10	0.16	0.29	0.250	1.80	5.10	15.2
LO	0.18	0.25	0.39	0.200	1.20	3.20	9.6
TA	0.36	0.55	1.05	0.063	0.39	1.25	3.78
BA	0.33	0.52	1.04	0.070	0.50	1.53	4.79
LI	0.35	0.62	1.35	0.040	0.30	1.04	3.29
WE	0.32	0.42	0.69	1.600	8.8	21.90	55
BG *	0.41	0.63	1.14	0.750	4.1	11.90	30.5
dieldrin							
SP *	0.39	0.78	1.57	0.078	0.48	1.495	4.76
GO	0.19	0.37	0.74	0.210	1.34	4.26	13.07
BU	0.08	0.13	0.20	0.470	2.28	5.84	14.91
KE	0.03	0.06	0.11	0.530	3.99	12.32	37.40
LO	0.06	0.10	0.16	0.600	4.02	11.61	32.30
TA	0.11	0.17	0.27	0.310	1.43	3.78	10.20
BA	0.11	0.18	0.28	0.290	1.49	3.96	10.51
LI	0.23	0.33	0.47	0.130	0.52	1.23	2.87
WE	0.09	0.14	0.23	0.470	2.62	7.38	20.29
BG *	0.38	0.46	0.58	0.130	0.55	1.36	3.11
lindane							
SP	0.109	0.131	0.19	0.34	0.11	0.13	0.19
GO	0.077	0.104	0.18	0.36	1.93	3.31	4.43
BU	0.033	0.048	0.09	0.66	3.42	6.45	9.42
KE	0.016	0.027	0.06	0.85	4.73	11.05	18.91
LO	0.028	0.037	0.07	0.96	4.64	8.25	11.20
TA	0.032	0.041	0.06	0.7	4.05	6.44	8.14
BA	0.039	0.053	0.10	0.47	3.22	5.80	7.87
LI *	0.140	0.190	0.48	0.043	0.52	1.30	1.71
WE	0.034	0.047	0.08	9.4	49.30	82.05	113.21
BG *	0.690	0.830	1.24	0.36	2.48	3.68	4.44
PCP							
SP	0.004	0.008	0.02	105	1112.0	2731.0	5502.0
GO	0.006	0.009	0.02	230	1200.6	2408.8	3931.8
BU	0.030	0.060	0.14	16	138.8	327.4	653.4
KE	0.033	0.072	0.17	28	118.5	269.8	589.6
LO	0.021	0.046	0.10	50	194.9	431.2	955.9
TA	0.012	0.025	0.06	29	280.4	675.5	1365.1
BA	0.030	0.070	0.17	15	118.9	286.0	602.4
LI *	0.100	0.200	1.00	0.90	15.5	62.3	207.0
WE	0.018	0.037	0.09	18	101.9	234.8	483.6
BG *	0.300	0.600	1.60	0.32	4.2	11.8	27.1
MeHg							
SP	2.78	3.15	3.6	0.011	0.041	0.093	0.207
GO	0.53	0.60	0.7	0.055	0.217	0.488	1.087
BU	5.17	5.22	5.3	0.007	0.026	0.058	0.128
KE	0.79	0.86	0.9	0.038	0.154	0.346	0.774
LO	0.40	0.44	0.5	0.070	0.285	0.659	1.508
TA	3.56	3.63	3.7	0.008	0.030	0.068	0.154
BA	7.88	7.94	8.0	0.004	0.017	0.038	0.084
LI *	8.18	8.23	8.3	0.0033	0.013	0.027	0.060
WE	1.49	1.53	1.6	0.013	0.039	0.073	0.140
BG *	3.99	4.03	4.0	0.0040	0.011	0.020	0.037
Cd							
SP	0.040	0.056	0.080	0.300	3.00	11.00	43.00
GO	0.013	0.019	0.029	0.750	8.00	31.00	126.00
BU	0.015	0.022	0.033	0.710	7.00	26.00	100.00
KE	0.004	0.006	0.010	2.000	24.00	93.00	353.00
LO	0.003	0.005	0.009	2.400	27.00	109.00	425.00
TA	0.016	0.023	0.032	0.550	6.00	21.00	84.00
BA	0.026	0.036	0.051	0.450	4.00	15.00	63.00
LI *	0.660	1.038	1.648	0.012	0.10	0.40	1.80
WE	0.009	0.012	0.018	24.000	95.50	213.00	472.40
BG *	0.980	1.458	2.272	0.160	0.61	1.44	3.14

*: indicate the avian and the mammalian species with the lowest MPCs.

Appendix H8: Summary of average cadmium BCFs in invertebrates (geometric means, log transformed mean and standard deviations, in kg dry soil/kg wet tissue)
A distinction is made between BCFs on based on soil, litter, and food (trophic) concentrations.

Taxonomic group	BCF soil	BCF litter	BCF trophic	n soil	n litter	n trophic	percentage dry matter
Isopoda	7.44	1.13	1.13	3	44	44	0.33
Arachnida	6.43	1.15	1.25	11	39	19	0.30
Annelida	3.76	1.84	3.76	11	18	18	0.18
Mollusca	1.71	0.80	0.95	15	7	15	0.17
Diplopoda	1.00	0.20	0.20	5	7	7	0.31
Larvae (Col+Diptera)	0.86	0.42	0.30	5	9	9	0.20
Chilopoda	0.70	0.11	0.11	2	6	–	0.31
Insecta (herbivorous)	0.55	0.13	0.43	19	30	35	0.31
Insecta (all)	0.46	0.12	0.34	42	76	64	0.31
Coleoptera (adult)	0.41	0.06	0.21	21	35	18	0.31
Insecta (detritivorous)	0.27	0.31	0.31	2	11	11	0.31
Larvae (Lepidoptera)	0.25	0.14	0.60	4	7	7	0.20

Taxonomic group	ln (mean BCF) soil	ln (mean BCF) litter	ln (mean BCF) trophic	ln (std BCF) soil	ln (std BCF) litter	ln (std BCF) trophic
Isopoda	2.01	0.13	0.13	0.5	1.0	1.0
Arachnida	1.86	0.14	0.22	0.7	0.8	0.6
Annelida	1.33	0.61	1.33	1.0	0.7	1.0
Mollusca	0.54	−0.22	−0.05	0.9	0.7	0.9
Diplopoda	−0.00	−1.62	−1.61	0.8	0.8	0.8
Larvae (Col+Diptera)	−0.15	−0.86	−1.19	1.0	0.6	1.5
Chilopoda	−0.35	−2.24	−2.24	0.1	0.1	0.1
Insecta (herbivorous)	−0.59	−2.05	−0.83	1.2	1.4	1.0
Insecta (all)	−0.77	−2.14	−1.07	1.2	1.3	1.0
Coleoptera (adult)	−0.90	−2.74	−1.55	1.3	1.2	0.9
Insecta (detritivorous)	−1.30	−1.17	−1.17	0.9	1.3	1.3
Larvae (Lepidoptera)	−1.39	−1.99	−0.51	0.4	0.7	1.2

Not all invertebrate groups are used in the model
Quantitatively important food items are:
- Isopoda (isopods)
- Arachnida (spiders)
- Annelida (earthworms)
- Mollusca (gastropods)
- Larvae of Coleoptera and Diptera (larvae of insects)
- Larvae of Lepidoptera (caterpillars)
- Insecta (all) (insects, adult)

Appendix H9: Average BAFs (geometric means) for cadmium for small mammals under field conditions.
A: BAFs based on food concentrations (kg wet food/kg wet tissue), B: BAFs based on soil concentrations (kg dry soil/kg wet tisssue).
These values are calculated from the data shown in Appendix N7.

A

	BAF on DW basis			BAF on WW basis			Number of determinations		
	herbivores	omnivores	carnivores	herbivores	omnivores	carnivores	herbivores	omnivores	carnivores
Body	0.60	0.79	1.42	2.10	0.42	1.99	16	8	18
Kidney	3.44	3.20	3.94	12.04	1.71	5.52	16	8	17
Liver	1.38	0.85	4.25	4.83	0.45	5.95	8	6	8
Muscle	0.25	0.13	0.36	0.88	0.07	0.50	14	11	16

B

	BAF on DW basis			BAF on WW basis			Number of determinations		
	herbivores	omnivores	carnivores	herbivores	omnivores	carnivores	herbivores	omnivores	carnivores
Body	0.30	0.27	5.07	0.09	0.08	1.52	4	3	6
Kidney	1.40	1.83	35.17	0.42	0.55	10.55	10	6	10
Liver	0.53	0.47	41.67	0.16	0.14	12.50	10	6	10
Muscle	0.40	0.20	3.73	0.12	0.06	1.12	6	6	6

The three functional groups comprise the species:
Herbivores: Field Vole (Microtus agrestis)
Omnivores: Wood Mouse (Apodemus sylvaticus)
Carnivores: Common Shrew (Sorex araneus) and Mole (Talpa europea).
Dry matter percentage (estimated) is 30% for mammals and 8.5, 56.2, 21.8 and 18.4% in the food of Field Vole, Wood Mouse, Common Shrew and Mole, respectively.

Appendix I

BCFs and BAFs for DDT

App. I1. Experimentally derived bioconcentration factors (BCF) for DDT (and residues) for plants available in literature. Only BCFs based on soil concentrations are considered.

Group	Species	field/ laboratory	Soil type	Csoil (mg/kg)	BCF	WW/DW	Reference
leaves							
Plants (in general)	DDE				0.11	DW	Travis and Arms (1988)
Barley plants	DDT	lab			0.32	plant WW, soil DW	Trapp et al. (1990)
Alfalfa	DDT	field	not rep.	1.39	0.08	plant WW, soil DW	Edwards (1970)
Rutabages			sandy loam	24.8	0.04		
Maize (Zea mays)	DDT (bound DDT)	lab (2 w)			0.16	DW	Verma and Pillai (1991)
	DDT (bound and extractable)				0.10		
Rice (Oryza sativa)	DDT (bound DDT)	lab (2 w)			0.55		
	DDT (bound and extractable)				0.18		
Gram (Cloer arietinum)	DDT (bound DDT)	lab (20 d)			1.60		
	DDT (bound and extractable)				0.66		
Alfalfa	DDT	field (1 season)	clay (3.6% o.m.)	0.57	0.018	plant WW, soil DW	Harris and Sans (1969)
			sandy loam (1.4% o.m.)	0.23	0.089		
Corn			clay (3.6% o.m.)	0.57	0.070		
			sandy loam (1.4% o.m.)	0.23	0.53		
Oats			clay (3.6% o.m.)	0.57	0.053		
Ryegrass (Lolium perenne)	DDT + DDE	field (1 season)	sandy (3% o.m.)	23.4	1.34	plant WW, soil DW	Voerman and Besemer (1975)
seeds							
Gram (Cloer arietinum)	DDT (bound DDT)	lab (20 d)			1.11	DW	Verma and Pillai (1991)
	DDT (bound and extractable)				1.64		
tubers							
Carrot	DDT	field	sandy loam	24.8	0.13	plant WW, soil DW	Edwards (1970)
Potato			sandy loam	24.8	0.07		
Carrot	DDT	field(1 season)	clay (3.6% o.m.)	0.57	0.000	plant WW, soil DW	Harris and Sans (1969)
			sandy loam (1.4% o.m.)	0.23	0.000		
Potato			clay (3.6% o.m.)	0.57	0.000		
			sandy loam (1.4% o.m.)	0.23	0.000		
Sugar beet (root)			clay (3.6% o.m.)	0.57	0.053		

App I2. Experimentally derived bioconcentration factors (BCF) for DDT (residues) for invertebrates available in literature. Only BCFs are based on soil concentrations are considered.

Group	Species	field/ laboratory	Soil type	Csoil (mg/kg)	BCF	WW/DW	Reference
Soft-bodied invertebrates							
Gastropods	Lehmannia valentiana	lab		11.1	9.21	DW	Forsyth and Peterle (1982)
	not rep.	field		9.75	2.41		Davis (1968)
	slug spp.	field	loam	3.39	5.53	DW	Gish (1970)
			sandy loam	15.3	2.25		
			sandy loam	15.3	2.95		
			silt	2.94	17.93		
	snail spp.		sandy loam	15.3	0.14		
			silt	2.94	1.05		
			silt	2.94	0.83		
	Agriolimax reticulatus	field	silty clay	2.1	8.48	WW	Davis (1968)
			sandy loam	16.0	2.32		
	Arion spp.		silty clay	2.1	3.29		
	Slug spp.	field		543.7	0.02	WW	Forsyth et al. (1983)
	Slug spp.	field		not rep.	2.3-3.7	WW	Edwards (1970)
Insect larvae	Beetle larvae	field	silty clay loam	0.10	3.75	DW	Gish (1970)
			sandy loam	0.02	33.17		
	Firefly larvae	field		543.7	0.02	WW	Forsyth et al. (1983)
Hard-bodied invertebrates							
Insects	Beetles	field		0.33	4.03	not rep.	Davis and Harrisson (1966)
				9.75	0.43		
Insects	Harpalus spp.	field	peaty loam (29% water)	0.30	0.67	WW	Davis (1968)
			peaty loam (29% water)	0.30	0.07		
			peaty loam (29% water)	0.30	0.27		
			peaty loam (29% water)	0.80	0.37		
			silty clay (19.5% water)	0.02	3.50		
			loam (19.5% water)	0.02	5.00		
			clay loam (19.5% water)	0.10	2.00		
			sandy clay (12.5% water)	0.43	5.12		

Group	Species	field/ laboratory	Soil type	Csoil (mg/kg)	BCF	WW/DW	Reference
			fine sandy loam (19.5%)	0.75	0.80		
			silty clay (19.5% water)	2.10	1.52		
			sandy loam (19.5% water)	16.0	0.33		
	Agonum spp.		peaty loam (29% water)	0.30	0.33		
			peaty loam (29% water)	0.30	0.27		
			loam (19.5% water)	0.02	5.00		
			clay loam (19.5% water)	0.10	4.00		
			sandy clay (12.5% water)	0.43	0.14		
			fine sandy loam (19.5%)	0.75	0.93		
	Staphilinidae		peaty loam (29% water)	0.30	0.67		
			clay loam (19.5% water)	0.10	2.00		
	Elateridae		loam (19.5% water)	0.02	2.50		
	Carabidae	field		543.7	0.01	WW	Forsyth et al. (1983)
Isopods	Tracheoniscus rathkei	lab		11.1	8.37	DW	Forsyth et al. (1982)

App I3. Experimentally derived bioconcentration factors (BAF) for DDT for organs and tissues in birds available in literature. Concerning laboratory experiments. For model calculations dry weight concentrations have to be converted to wet weight concentrations by assuming dry matter percentages of 90 and 30 for commercial (basal) feed and body tissue, respectively.

Organ/Tissue	Exp. duration	Juv./adult	Feed type	Cfood (mg/kg)	BAF	WW/DW basis	Reference
fat							
Gallus domesticus	10 w	ad, fem	basal	20	1.27	WW	Scott (1977)
				100	1.37		
Gallus domesticus		juv, m	commercial (DDT added in feed)	not rep.	30	WW	Kan (1978) (review)
					7-15		
					10		
					6-8		
					12		
					30		
					6-15		
					10		
					11		
Poultry			DDT added in feed		12.3	not rep.	Garten and Trabalka (1983)
Small birds			DDT added in feed		0.04		
Small birds			DDE added in feed		4.47		
liver							
Coturnix c. japonica	12 w	juv (2 m), m	DDE added in feed	5	2.28	WW (feed in DW)	Dieter (1974)
				25	1.37		
				100	2.07		
carcass							
Coturnix c. japonica	12 w	juv (2 m), m	DDE added in feed	5	5.06	WW (feed in DW)	Dieter (1974)
				25	5.01		
				100	4.16		

App 14. Experimentally derived bioaccumulation factors (BAF) for DDT for organs and tissues in mammals available in literature. Concerning laboratory experiments. For model calculations dry weight concentrations have to be converted to wet weight concentrations by assuming dry matter percentages of 90 and 30 for commercial (basal) feed and body tissue, respectively.

Organ/Tissue	Exp. duration	Juv./adult	Feed type	Cfood (mg/kg)	BAF	WW/DW basis	Reference
fat							
Rattus norvegicus	295 d (aver.)	ad, m	synthetic diet	7.92	2.03	not rep.	Adams et al. (1974)
	244 d (aver.)	ad, fem	synthetic diet	7.92	2.37		
Rattus norvegicus			DDT added		18.5	WW	Geyer et al. (1980)
			DDE added		10.3	WW	
Mus musculus	4 generations	juv, m	DDT added, commercial diet	100	9.80	not rep.	Deichman et al. (1975)
		juv, fem		100	9.50		
Rodents			DDT added		2.45	not rep.	Garten and Trabalka (1983)
			DDE added		10.72		
liver							
Rattus norvegicus	295 d (aver.)	juv, m	synthetic diet	7.92	0.11	not rep.	Adams et al. (1974)
	244 d (aver.)	juv, fem	synthetic diet	7.92	0.06		
,, weanling	exposure via the mother only			7.92	0.18		
body							
Mus musculus	4 generations	juv, m	DDT added, commercial diet	100	1.54	not rep.	Deichman et al. (1975)
		juv, fem		100	1.89		
Blerina brevicauda	17 d	ad, m	DDT added, mixture	400	1.68	WW	Blus (1978)
					1.95		
Blerina brevicauda	3 y	ad	arthropoda	13.4	1.31	WW	Forsyth and Peterle (1984)
		juv		13.0	1.77		
Microtus pennsylvanicus	3 y	ad	herbs	6.0	0.85	WW	Forsyth and Peterle (1984)
		juv		7.8	0.90		

Appendix I5. BCFs (kg dry soil/kg wet tissue) and BAFs (kg wet food/kg wet tissue) for DDT (total) for raptorial, aquatic and domestic birds and mammals and from field data.
Concentrations are given in mg/kg unless stated otherwise.

species	field/lab exp.	experimental period	juvenile/adult sexe (start weight)	feed or soil type	DDT form	DW/WW or lipid basis	conc. feed	organ type	conc. organ	BCF organ	BCF rep.	reference	Comment
BIRDS OF PREY													
American Kestrel (Falco sparverius)	lab	11 days	adults	commercial diet DW% food is 39.8%	0.4–250 DDE	WW	0.40	body	137.06	342.65		Henny and Meeker (1981)	internal DDE was determined after
							2.00		154.50	77.25			2 weeks on clean food
							10.00		241.70	24.17			
							50.00		677.70	13.55			y = 137.7 + 10.9x for body
							250.00		2857.70	11.43			y = 0.359 + 0.174x for brain y = 5607 + 257x for fat
							0.40	brain	0.43	1.08			y = 0.179 + 0.132x for plasma
							2.00		0.71	0.36			
							10.00		2.10	0.21			r=0.65 for body
							50.00		9.06	0.18			r=0.97 for brain
							250.00		43.86	0.18			r=0.41 for fat r=0.95 for plasma
							0.40	fat	5709.80	14274.50			
							2.00		6121.00	3060.50			
							10.00		8177.00	817.70			
							50.00		18457.00	369.14			
							250.00		69857.00	279.43			
							0.40	plasma	0.23	0.58			
							2.00		0.44	0.22			
							10.00		1.50	0.15			
							50.00		6.79	0.14			
							250.00		33.18	0.13			
American Kestrel (Falco sparverius)	lab	4 months	adults	laboratory mice	DDE	WW	6.00	carcase	35.30	5.88		Rudolph et al. (1983)	carcase contains total body burden
							6.00	fat	489.70	81.62			
							6.00	blood	1.65	0.27			
							6.00	brain	3.80	0.63			
American Kestrel (Falco sparverius)	lab	12–16 months	adults		DDE	WW	2.80	brain	14.90	5.32		Porter and Wiemeyer (1972)	weight loss of 16% on average (of the 11 birds)
							2.80	liver	24.00	8.57			
							2.80	carcase	70.00	25.00			residue ranges are also indicated
					DDE	DW	10.00	brain	65.80	6.58			residues on lipid weight basis are also determined
							10.00	liver	88.10	8.81			
							10.00	carcase	204.20	20.42			digestive tract, feet, beak, and feathers were removed
							10.00	skin	601.90	60.19			
							10.00	body	291.70	29.17			
					DDE	lipid		brain	0.23				
								liver	1.19				
								carcase	1.91				
								skin	1.80				
								body	1.78				
Barn Owl (Tyto alba)	lab	2 years	adults	meat diet (a commercial bird of prey diet and rodents)	DDE	WW	3.00	carcase	112.00	37.33		Mendenhall et al. (1983)	DDE caused egg shell thinning, egg breakage, embryo mortality and reduced production per pair (67% reduction)
							3.00		78.00	26.00			
							3.00	egg	41.00	13.67			0.5 ppm dieldrin did neither affect the accumulation of DDE, nor the toxic effects of DDE

Appendix I5. BCFs (kg dry soil/kg wet tissue) and BAFs (kg wet food/kg wet tissue) for DDT (total) for raptorial, aquatic and domestic birds and mammals and from field data. (continued)
Concentrations are given in mg/kg unless stated otherwise.

species	field/lab exp.	experimental period	juvenile/adult sexe (start weight)	feed or soil type	DDT form	DW/WW or lipid basis	conc. feed	organ type	conc. organ	BCF organ	BCF rep.	reference	Comment
BIRDS – AQUATIC – LAB													
Herring Gull (Larus argentatus)	lab/field		adult and juv.	fish (Alewife)	DDE	WW	3.23	carcase	163.00	50.46		Anderson and Hickey (1976)	equilibrium level is reported
			adult		DDT+TDE	WW	2.05	carcase	6.00	2.93			DDE conc. are the highest when fat reserves are the lowest (prior to the breeding season)
			juvenile		DDT+TDE	WW	2.05	carcase	13.00	6.34			
					DDT–R		5.28		169.00	32.01			carcase: feathers, feet, wings and beak removed
													on whole body basis % fat (mean) is 9.3 for alewife, 8 for adult birds and 15 for juvenile birds
													DDE accumulation results also from conversion of DDT !
\White Pelican (Pelecanus erythrorhynchos)	lab	10 weeks		fish	DDT–R	WW	72.00	liver	135.00	1.88		Greichus et al. (1975)	no effect on growth
							72.00	brain	34.60	0.48			relative liver weight decreased by the treatment
							72.00	carcase	859.00	11.93			residues were determined after the treatment followed by a 2 week period with food stress
							72.00	feathers	47.90	0.67			
Double–crested Cormorant (Phalacrocorax a. auritus)		9 weeks	juveniles, males	fish	DDT–R	WW	5.00	liver	11.00	2.20		Greichus and Hannon (1973)	no increase in mortality
							12.50		79.70	6.38			bioaccumulation at 12.5 ppm DDT–R was also determined in birds stressed by a one–half decrease in food
							25.00		177.00	7.08			
							5.00	brain	4.37	0.87			relative liver weight decreased by the treatment
							12.50		6.30	0.50			
							25.00		26.70	1.07			
							5.00	carcass	23.60	4.72			
							12.50		104.00	8.32			
							25.00		242.00	9.68			
			juveniles, females				5.00	liver	2.61	0.52			
							12.50		62.10	4.97			
							25.00		185.00	7.40			
							5.00	brain	2.91	0.58			
							12.50		7.94	0.64			
							25.00		71.40	2.86			
							5.00	carcass	34.00	6.80			
							12.50		103.00	8.24			
							25.00		207.00	8.28			
BIRDS –TERRESTRIAL – FIELD													
American Robin (Turdus migratorius)	field			partly earthworms	DDT–R	WW	0.10	body	4.22	43.51		Dimond et al. (1970)	BCF for earthworms can be calculated too (see Romijn et al. 1991b)
							0.16		5.29	33.69			
							0.13		3.48	26.77			
							0.32		2.26	7.17			it is assumed that the birds eat only earthworms

Appendix I5. BCFs (kg dry soil/kg wet tissue) and BAFs (kg wet food/kg wet tissue) for DDT (total) for raptorial, aquatic and domestic birds and mammals and from field data. (continued)
Concentrations are given in mg/kg unless stated otherwise.

species	field/lab exp.	experimental period	juvenile/adult sexe (start weight)	feed or soil type	DDT form	DW/WW or lipid basis	conc. feed	organ type	conc. organ	BCF organ	BCF rep.	reference	Comment
													%DDE ranged from 7 – 12
Thrushes	field			partly earthworms	DDT–R	WW						Collett and Harrison (1968)	BCF for earthworms can be calculated too (sse Romijn et al. 1991b)
Blackbird (Turdus merula)			adult				18.30	b. muscle	59.00	3.22			
			juvenile				18.30	b. muscle	9.30	0.51			it is assumed that the birds eat only earthworms
Song Thrush (Turdus philomelos)			adult				18.30	b. muscle	27.10	1.48			
			juvenile				18.30	b. muscle	26.90	1.47			composition of ppDDTs is reported, %DDE is 50 in birds and 27 in worms
Blackbird (Turdus merula)	field		found dead	earthworms	DDT–R	not rep.	8.77	liver	222.30	25.35		Bailey et al. (1974)	uncertainties are; dietary proportion of earthworms and and the (food) habitat of the bird
							8.77	muscle	181.30	20.67			
			shot				8.77	liver	51.20	5.84			lower case study
Song Thrush (Turdus philomelos)			found dead				8.77	liver	282.80	32.25			
							8.77	muscle	152.10	17.34			
BIRDS – AQUATIC – FIELD													
Adelie Penguin	field		adult	fish	DDE	WW (ppb)	0.50	body	25.00	50.00		Subramanian et al. (1986)	subcutaneous and abdominal fat contain about 80% of body burden DDE conc on fat weight basis ranged from 162 to 804 ppb for the birds
Herring Gull (Larus argentatus)	field		adult	fish (Alewife)	DDT	WW	0.02	body	0.05	3.33	3.20	Braune and Norstrom (1989)	liver–body ratio is 0.8 (lipid basis)
							0.02	liver	0.01	0.67			egg–body ratio is 0.6 (lipid basis)
							0.02	egg	0.03	2.00			
			adult	fish (Alewife)	DDE	WW	0.16	body	14.00	87.50	85.00		
							0.16	liver	3.50	21.88			
							0.16	egg	5.40	33.75			
BEASTS OF PREY													
Mink (Mustela vison)	lab	10 w	males, 3 m	standard ration	DDT–R	not rep. (WW ?)	150.00	adipose	534.00	3.56		Aulerich et al. (1972)	DDT–R content plateaued at about 4 weeks
													in fact 100 ppm DDT and 50 ppm DDD were applied in the diet
													at 100 ppm DDT no toxic effects occur
MAMMALS – AQUATIC – FIELD													
Weddell Seal	field		adult	fish	DDE	WW (ppb)	0.50	body	40.00	80.00		Subramanian et al. (1986)	

Appendix I5. BCFs (kg dry soil/kg wet tissue) and BAFs (kg wet food/kg wet tissue) for DDT (total) for raptorial, aquatic and domestic birds and mammals and from field data. (continued)
Concentrations are given in mg/kg unless stated otherwise.

species	field/lab exp.	experimental period	juvenile/adult sexe (start weight)	feed or soil type	DDT form	DW/WW or lipid basis	conc. feed	organ type	conc. organ	BCF organ	BCF rep.	reference	Comment
various	review				DDT−R	WW						Edwards (1970)	
earthworms				soil							0.67−73		Edwards, C.A. 1970. Persistent pesticides in the environment, p 78, CRC Press, Chem. Rubber Co. Ohio.
beetles				soil							0.31−2.81		
slugs				soil							2.33−3.70		
Pheasant				diet			10.00	body?	29.10		2.91		
Bald Eagle				diet			5.00	brain	0.70		0.10		
				diet			5.00	liver	1.90		0.40		
				diet			5.00	fat	35.70		7.10		
various	review					not rep.				BCF(QSAR)		Garten and Trabalka (1983)	review of literature and QSAR are compared
poultry					DDT			fat			12.30		
birds (small)					DDT			fat		2.39	0.04		avian fat: logBCF = −2.743 + 0.542*logKow (r2=0.54)
rodents					DDT			fat		0.51	2.45		
cow					DDT			fat			1.12		nonruminant fat: logBCF = −3.849 + 0.617*logKow (r2=0.35)
swine					DDT			fat			0.74		
sheep					DDT			fat			0.59		ruminant fat: logBCF = −3.935 + 0.511*logKow (r2=0.34)
birds (small)					DDE			fat		2.61	4.47		care must be taken with substitution of QSAR for lab. feeding studies
rodents					DDE			fat		0.56	10.72		
cow					DDE			fat			3.16		
													strong correlations exist between bioaccumulation of organic compounds in rodents with other mammals and also with birds
													regression between water solubility and BCF is also determined and has a higher r
DOMESTIC ANIMALS													
Cow	lab	4 weeks		diet	DDT−R?			beef fat			0.90	Kenaga (1980)	no comment on DDT metabolites
Swine	lab	4 weeks		diet	DDT−R?			fat			0.40	Kenaga (1980)	regr. logBCF = −3.457 + 0.5*logKow with r = 0.79
													equilibrium is assumed
													lower class review as Garten and Trabalka (1983) stated
Cow (lactating)	review	>4 months		dry feed	DDT	DW		meat			0.23	Travis and Arms (1988)	DW% of grass is 15%, so on WW basis the BCF is a factor 6.7 higher than on DW basis
						WW					1.50		
					DDE	DW					0.39		
						WW					2.62		

Appendix I5. BCFs (kg dry soil/kg wet tissue) and BAFs (kg wet food/kg wet tissue) for DDT (total) for raptorial, aquatic and domestic birds and mammals and from field data. (continued)
Concentrations are given in mg/kg unless stated otherwise.

species	field/lab exp.	experimental period	juvenile/adult sexe (start weight)	feed or soil type	DDT form	DW/WW or lipid basis	conc. feed	organ type	conc. organ	BCF organ	BCF rep.	reference	Comment
FIELD DATA													
Old–field ecosystem	field	5 years			DDT–R	DW for soil WW for biota	543.70					Forsyth et al. (1983)	An appropriate calculation of DDT concentrations in the soil is problematic and only an estimation for the surface conc. of the soil is reported in the article. It is decided to calculate the average DDT conc. from the period 1969 to 1974 in the upper 6 cm soil layer. For most animals and plants residues are determined for each year and the average over the period 69–74 is shown here In earthworms, slugs and firefly larvae residues decreased in the 5–year period after application of DDT, while the reverse occurred in isopods, crickets, carabid beetles, grasses and forbs. In Meadow Vole and Masked Shrew, which feeds on lepidopterous larvae, residues increased, whereas in the Short–tailed Shrew, which feeds primarily on earthworms, residues decreased with time. Care must be taken with calculation of BCFs, because the diets are not exactly known and some animals may have feeded outside the DDT–treated area
Roots							543.70		1.60	0.00			
Grasses							543.70		5.00	0.01			
Forbs							543.70		3.23	0.01			
Earthworms							543.70		19.30	0.04			
Isopods							543.70		4.75	0.01			
Slugs							543.70		8.25	0.02			
Nemobius (Cricket)							543.70		4.85	0.01			
Gryllus (Cricket)							543.70		3.84	0.01			
Grasshoppers							543.70		3.47	0.01			
Firefly larvae							543.70		9.23	0.02			
Carabid beetles							543.70		3.15	0.01			
Microtus pennsylvanicus							5.00	body	3.75	0.75			
(Meadow Vole)							5.00	fat	6.00	1.20			
							5.00	liver	8.00	1.60			
							5.00	muscle	6.00	1.20			
							5.00	brain	6.00	1.20			
Blarina brevicauda							19.30	body	42.80	2.22			
(Short–tailed Shrew)							19.30	fat	200.00	10.36			
							19.30	liver	10.00	0.52			
							19.30	skin	9.00	0.47			
Sorex cinereus								body	7.50				
(Masked Shrew)								muscle	7.00				
								viscera	8.00				
								skin	15.00				
Scalopus aquaticus		measured in 1971					21.53	liver	11.10	0.52			
(Eastern Mole)							21.53	brain	3.20	0.15			
Mustela nivalis		measured in 1973						fat	4.1–31.0				
(Weasel)								liver	0.0–9.7				
								muscle	1.6–8.7				
								brain	2.4–7.6				
Thamnophis sirtalis		measured: 1970–1973					19.30	fat	40.00	2.07			
(Garter Snake)							19.30	liver	6.00	0.31			
							19.30	muscle	6.00	0.31			
Terrestrial food web	field	up to 2 years			DDT–R		71.30					Rudd et al. (1981)	In vegetation the residues were very high but declined until a steady state was reached after about 60 days. In herbivore insects residues declined and later stabilized. Unfortunately residue determinations for soil and animals can not always be compared in all samples, so caution must be , in addition the exact diet in not always known BCFs are calculated from residues in animal lipid and plant fresh weight!
Vegetation		60 d		soil		WW–basis	71.30		130.00	1.82			
Lepidoptera (adult)		96 d		soil		lipid basis	71.30	lipid	8.80	0.12			
Larvae (Lepidoptera)		32 d		soil			71.30	lipid	22.02	0.31			
Coleopera (herb.)		8 d		soil			71.30	lipid	16.80	0.24			
Orthoptera		96 d		soil			71.30	lipid	15.00	0.21			
Homoptera & Hemiptera		32 d		soil			71.30	lipid	3.00	0.04			
Coccinellid beetles		48 d		soil			71.30	lipid	2.00	0.03			
Arachnids		96 d		soil			71.30	lipid	23.00	0.32			
Lepidoptera (adult)		96 d		vegetation		lipid basis	130.00	lipid	8.80	0.07			
Larvae (Lepidoptera)		32 d		vegetation			130.00	lipid	22.02	0.17			
Coleoptera (herb.)		8 d		vegetation			130.00	lipid	16.80	0.13			
Orthoptera		96 d		vegetation			130.00	lipid	15.00	0.12			
Homoptera & Hemiptera		32 d		vegetation			130.00	lipid	3.00	0.02			
Loggerhead Shrike		230 d						lipid	35.00				
(Lanius ludovicianus)		1 year						lipid	180.00				
		2 years						lipid	557.20				
Mice		100 d						lipid	2.84				
		1 year						lipid	5.27				

Appendix J

BCFs and BAFs for dieldrin

App J1. Experimentally derived bioconcentration factors (BCF) for dieldrin for plants available in literature. Only BCFs based on soil concentrations are considered.

Group	Species	field/ laboratory	Soil type	Csoil (mg/kg)	BCF	WW/DW	Reference
leaves							
	Plants (in general)				0.10	DW	Travis and Arms (1988)
	Barley plants	lab			0.55	plant WW, soil DW	Trapp et al. (1990)
	Legume foliage	field	not rep.	0.05	0.05	plant WW, soil DW	Edwards (1970)
	Alfalfa	field(1 season)	clay (3.6% o.m.)	1.12	0.018	plant WW, soil DW	Harris and Sans (1969)
			sandy loam (1.4% o.m.)	0.57	<0.018		
	Sugar beet tops		clay (3.6% o.m.)	1.12	0.027		
	Ryegrass (Lolium perenne)	field (1 season)	sandy (3% o.m.)	4.23	0.63	plant WW, soil DW	Voerman and Besemer (1975)
	Corn		clay (3.6% o.m.)	1.12	0.018	plant WW, soil DW	Harris and Sans (1969)
			sandy loam (1.4% o.m.)	0.57	0.018		
	Oats		clay (3.6% o.m.)	1.12	0.018		
tubers							
	Carrot	field	clay soil	0.48	0.23	plant WW, soil DW	Edwards (1970)
	Carrot	field (1 season)	clay (3.6% o.m.)	1.12	0.027	plant WW, soil DW	Harris and Sans (1969)
	Potato		clay (3.6% o.m.)	1.12	0.036		
	Sugar beet (root)		clay (3.6% o.m.)	1.12	0.063		

App J2. Experimentally derived bioconcentration factors (BCF) for dieldrin for invertebrates available in literature. Only BCFs are based on soil concentrations are considered.

Group	Species	field/ laboratory	Soil type	Csoil (mg/kg)	BCF	WW/DW	Reference
Soft-bodied invertebrates							
Gastropods	Agriolimax reticulatus	field	sandy clay (19.5% water)	0.3	0.27	WW	Davis (1968)
	Slug spp.	field		0.44	0.48	WW	Edwards (1970)
Hard-bodied invertebrates							
Insects	Harpalus spp.	field	peaty loam (29% water)	0.20	0.25	WW	Davis (1968)
			peaty loam (29% water)	0.70	0.06		
			peaty loam (29% water)	0.20	0.45		
			peaty loam (29% water)	0.08	1.25		
			silty clay (19.5% water)	0.04	2.00		
			clay loam (19.5% water)	0.03	0.33		
			sandy clay (12.5% water)	0.10	0.90		
			sandy clay (19.5% water)	0.04	1.00		
			fine sandy clay (19.5% water)	0.08	1.25		
	Agonum spp.		peaty loam (29% water)	0.20	0.50		
			peaty loam (29% water)	0.70	0.29		
			clay loam (19.5% water)	0.03	2.00		
			sandy clay (12.5% water)	0.10	0.60		
			sandy clay (19.5% water)	0.04	2.50		
			fine sandy clay (19.5% water)	0.10	1.25		
	Staphilinidae		peaty loam (29.5% water)	0.20	1.00		
			clay loam (19.5% water)	0.03	2.67		

App J3. Experimentally derived bioconcentration factors (BAF) for dieldrin for organs and tissues in birds available in literature. Concerning laboratory experiments. For model calculations dry weight concentrations have to be converted to wet weight concentrations by assuming dry matter percentages of 90 and 30 for commercial (basal) feed and body tissue, respectively.

Organ/Tissue	Exp. duration	Juv./adult	Feed type	Cfood (mg/kg)	BAF	WW/DW basis	Reference
fat							
Gallus domesticus		juv, m	commercial	not rep.	47	WW	Kan (1978) (review)
					15-17		
					11		
					70		
					13		
					10-13		
					11		
Poultry					10.72	not rep.	Garten and Trabalka (1983)
Small birds					8.91		
Mallard	24 d	juv, 1-day-old	commercial	0.30	10.87	WW	Nebeker et al. (1992)
Turdus ericetorum	6 w	ad, 75 g	earthworms	0.32	1.35	WW	Jefferies and Davis (1968)
				3.06	11.97		
				5.69	11.00		
kidney							
Turdus ericetorum	6 w	ad, 75 g	earthworms	0.32	0.25	WW	Jefferies and Davis (1968)
				3.06	0.43		
				5.69	0.30		
liver							
Coturnix c. japonica	158 d	ad		10	9.35	WW	Stickel et al. (1969)
				10	0.61		
				10	0.27		
Columba livia	180 d	ad, m	not rep.	50	0.53	not rep.	Robinson et al. (1967)
Turdus ericetorum	6 w	ad, 75 g	earthworms	0.15	0.20	WW	Jefferies and Davis (1968)
				0.32	0.50		
				3.06	0.55		
				5.69	0.48		

Organ/Tissue	Exp. duration	Juv./adult	Feed type	Cfood (mg/kg)	BAF	WW/DW basis	Reference
muscle							
Turdus ericetorum	6 w	ad, 75 g	earthworms	0.32	0.16	WW	Jefferies and Davis (1968)
				3.06	0.39		
				5.69	0.42		
body							
Coturnix c. japonica	158 d	ad		10	3.57	WW	Stickel et al. (1969)
				10	2.17		
				10	1.80		
Turdus ericetorum	6 w	ad, 75 g	earthworms	0.15	0.13	WW	Jefferies and Davis (1968)
				0.32	0.28		
				3.06	0.44		
				5.69	0.71		
Gallus domesticus	37 w	ad, 1-y-old, m	commercial	0.04	2.45	WW	Davison (1973)
				2	2.93		
		ad, 1-y-old, fem		0.04	1.63		
				2	3.39		

App J4. Experimentally derived bioconcentration factors (BAF) for DDT for organs and tissues in mammals available in literature. Concerning laboratory experiments. For model calculations dry weight concentrations have to be converted to wet weight concentrations by assuming dry matter percentages of 90 and 30 for commercial (basal) feed and body tissue, respectively.

Organ/Tissue	Exp. duration	Juv./adult	Feed type	Cfood (mg/kg)	BAF	WW/DW basis	Reference
fat							
Rattus norvegicus	295 d (aver.)	ad, m	synthetic diet	1.68	0.13	not rep.	Adams et al. (1974)
	244 d (aver.)	ad, fem	synthetic diet	1.68	0.74		
Rattus norvegicus	8 w	ad, m	commercial	25	2	WW	Baron and Walton (1971)
Rattus norvegicus	8 w	ad, m	commercial	10	1.72	WW	Robinson et al. (1969)
Rattus norvegicus	2 y	juv, m	commercial	0.03	2.14	WW	Walker et al. (1969)
				0.11	2.36		
				1.00	1.49		
				9.66	2.04		
,,		juv, fem	commercial	0.03	11.11	WW	Walker et al. (1969)
				0.11	8.16		
				1.00	13.90		
				9.66	5.98		
Rattus norvegicus	3 m	both	not rep.	1	38	not rep.	Quaife et al. (1967)
				10	17		
				50	18		
Rattus norvegicus	6 m	fem, 3-5 m	Purina chow	50	3.7	not rep.	Deichmann et al. (1968)
Rodents					4.27	not rep.	Garten and Trabalka (1983)
liver							
Rattus norvegicus	295 d (aver.)	juv, m	synthetic diet	1.68	0.02	not rep.	Adams et al. (1974)
	244 d (aver.)	juv, fem	synthetic diet	1.68	0.04		
Rattus norvegicus	8 w	ad, m	commercial	10	0.09	WW	Robinson et al. (1969)
Rattus norvegicus	2 y	juv, m	commercial	0.03	0.21	WW	Walker et al. (1969)
				0.11	0.14		
				1.00	0.16		
				9.66	0.15		
,,		juv, fem	commercial	0.03	0.40	WW	Walker et al. (1969)
				0.11	0.32		
				1.00	0.43		
				9.66	0.31		

Organ/Tissue	Exp. duration	Juv./adult	Feed type	Cfood (mg/kg)	BAF	WW/DW basis	Reference
Rattus norvegicus	6 m	fem, 3-5 m	Purina chow	50	0.16	not rep.	Deichmann et al. (1968)
body							
Blerina brevicauda	17 d	ad, m	meat diet (32% d.m.)	50	1.22	WW	Blus (1978)
		ad, fem			1.10		
Rattus norvegicus	39 w	m, 96-d-old	commercial	0.04	0.32		Davison (1973)
				2.0	0.26		
		fem, 115-d-old		0.04	0.80		
				2.0	0.68		

Appendix J5. BCFs (kg dry soil/kg wet tissue) and BAFs (kg wet food/kg wet tissue) for dieldrin for raptorial, aquatic and domestic birds and mammals and from field data. Dieldrin concentrations are in mg/kg unless otherwise stated.

species	field/lab exp.	exp. period	juvenile/adult sexe (start weight)	feed or soil type	toxic effect	DW/WW or lipid basis	conc. feed	organ type	conc. organ	BCF organ calulated	BCF organ reported	reference	Comment
BIRDS OF PREY													
Barn Owl (Tyto alba)	lab	2 years	adults, males	meat diet		WW	0.58	carcase	9.60	16.55		Mendenhall et al. (1983)	Dieldrin did not reduce breeding succes and it did not intoxicate the adults
			adults, females				0.58		9.20	15.86			
							0.58	egg	8.10	13.97			3 ppm DDE did neither affect the accumulation of dieldrin,
Prairie Falcon (Falco mexicanus)	lab	11 d	immature	dosed starlings		WW	29.00	adipose	694.00	23.93		Enderson and Berger (1970)	one of the three birds died after treatment
							29.00		370.00	12.76			before treatment dieldrin conc. in adipose was 2.1 ppm
					died		29.00	liver	29.00	1.00			adipose residues were on fat basis, the others on wet basis
					died		29.00	muscle	17.50	0.60			
							29.00	brain	3.04	0.10			
							29.00		2.80	0.10			
					died		29.00		11.00	0.38			
Owls (various spp.)	lab		juv. and ad.	mice		not rep.	0.60	liver	24.00	40.00		Jones et al. (1978)	lower case study
							0.60		28.00	46.67			dieldrin came from sawdust used as bedding for the mice
							0.60	brain	15.00	25.00			
BIRDS – AQUATIC													
Herring Gull (Larus argentatus)	field		adult	fish (Alewife)		WW	0.02	body	0.28	16.47	16.00	Braune and Norstrom (1989)	liver–body ratio is 1.1 (lipid basis) egg–body ratio is 0.63 (lipid basis)
							0.02	liver	0.12	7.06			
							0.02	egg	0.12	7.06			
Shag (Phalacrocorax aristotelis)	field		0.5–8 years old	fish		WW	0.016	body	1.0	62.5		Robinson et al. (1967)	Monitoring of fish and birds from the farne islands, Northumberland
BEASTS OF PREY													
Mink (Mustela vison)	lab	10 w	males, 3 m	standard ration		not rep.	2.50	adipose	20.90	8.36		Aulerich et al. (1972)	steady state was reached after 4 weeks
DOMESTIC ANIMALS AND QSARs													
Cow	lab & QSAR	4 weeks		diet			25.00	beef fat	75.00	3.00	3.00	Kenaga (1980)	
							10		16.00	1.60	1.60		
Swine	lab & QSAR	4 weeks		diet			25.00	fat	44.00	1.76	1.76	Kenaga (1980)	regr. logBCF = –3.457 + 0.5*logKow with r = 0.79
							10.00		8.00	0.80	0.80		
							2.50		6.70	2.68	2.68		equilibrium is assumed
							1.00		1.80	1.80	1.80		lower class review as Garten and Trabalka (1983) stated

Appendix J5. BCFs (kg dry soil/kg wet tissue) and BAFs (kg wet food/kg wet tissue) for dieldrin for raptorial, aquatic and domestic birds and mammals and from field data. (continued)
Dieldrin concentrations are in mg/kg unless otherwise stated.

species	field/lab exp.	exp. period	juvenile/adult sexe (start weight)	feed or soil type	toxic effect	DW/WW or lipid basis	conc. feed	organ type	conc. organ	BCF organ calulated	BCF organ reported	reference	Comment
various	review									BCF(QSAR)		Garten and Trabalka (1983)	review of literature and QSAR are compared
poultry								fat			10.72		avian fat: logBCF = −2.743 + 0.542*logKow (r2=0.54)
birds (small)								fat		1.13	8.91		nonruminant fat: logBCF = −3.849 + 0.617*logKow (r2=0.35)
rodents								fat		0.22	4.27		ruminant fat: logBCF = −3.935 + 0.511*logKow (r2=0.34)
cow								fat			2.00		care must be taken with substitution of QSAR for lab. feeding studies
swine								fat			1.62		strong correlations exist between bioaccumulation of organic compounds in rodents with other mammals and also with birds
sheep								fat			2.75		regression between water solubility and BCF is also determined and has a higher r
Rattus norvegicus	QSAR					WW		adipose				Geyer et al. (1980)	regr: logBCF = −0.56*logWS + 1.20 (r = −0.80) WS = water solubility (ug/l)
Cow (nonlactating)	review	> 4 months		dry feed		DW WW					0.06 0.43	Travis and Arms (1988)	DW% of grass is 15%, so the BCF is a factor 6.7 higher on WW basis!!

Appendix K

BCFs and BAFs for lindane

App K1. Experimentally derived bioconcentration factors (BCF) for lindane for plants available in literature.

Group	Species	field/ laboratory	Soil type	Csoil (mg/kg)	BCF	WW/DW	Reference
leaves							
	Plants (in general)				0.39	DW	Travis and Arms (1988)
	Pea vines	field	sandy loam	1.70	0.90	plant WW, soil DW	Edwards (1970)
	Cabage leaves				0.22		
	Maize (Zea mays)	lab (2 w)	pot soil ?		0.22 0.36	DW	Verma and Pillai (1991)
	Rice (Oryza sativa)				0.38 0.33		
	Gram (Cloer arietinum)				2.99 1.90		
	Rice (Oryza sativa)	lab (3 d)		0.772	1.95	plant WW, soil DW	Kiritani and Kawahara (1973)
	Ryegrass (Lolium perenne)	field (1 season)	sandy (3% o.m.)	0.22	3.04	plant WW, soil DW	Voerman and Besemer (1975)
seeds							
	Gram (Cloer arietinum)				2.98 4.32	DW	Verma and Pillai (1991)
tubers							
	Carrot	field	sandy loam	1.7	3.50	plant WW, soil DW	Edwards (1970)
	Potato			3.0	0.21		

App K2. Experimentally derived bioconcentration factors (BCF) for lindane for invertebrates available in literature. Only BCFs based on soil concentrations are applied in model calculations.

Group	Species	field/ laboratory	Soil type Exp. duration	Csoil (mg/kg)	BCFsoil	Cfood (mg/kg)	BCFfood	WW	Reference
Soft-bodied invertebrates									
no bioaccumulation studies									
Hard-bodied invertebrates									
Caterpillars	opzoeken Cardbox	lab	opzoeken	1 50 200		0.05 3.40 14.10	1.00 0.68 0.87	WW	Dugast (1980)
Insects	Hymenoptera (ant sp.)	lab	5 w	n.r.	0.06	2,8,16	0.06	WW	Debouge and Thome (1989)
	Nephotetix cincticeps (leafhopper)	lab	2 d	0.772	6.92	1.504	3.55	WW	Kiritani and Kawahara (1973)
Spiders	Lycosa pseudoannulata (leafhopper)	lab	10 d	0.772	0.032	5.34	0.005	WW	Kiritani and Kawahara (1973)

App K3. Experimentally derived bioconcentration factors (BAF) for lindane for organs and tissues in birds available in literature. Concerning laboratory experiments. For model calculations dry weight concentrations have to be converted to wet weight concentrations by assuming dry matter percentages of 90 and 30 for commercial (basal) feed and body tissue, respectively.

Organ/Tissue	Exp. duration	Juv./adult	Feed type	Cfood (mg/kg)	BAF	WW/DW basis	Reference
fat							
Gallus domesticus		juv, m	commercial	not rep.	2 2 2 3	WW	Kan (1978) review
Poultry					1.51	not rep.	Garten and Trabalka (1983)
Coturnix c. japonica	2 w	juv, 4 w	caterpillars and commercial	3.6 5.0	0.18 0.19	WW	Dugast (1980)
kidney							
Coturnix c. japonica	2 w	juv, 4 w	caterpillars and commercial	3.6 5.0	0.05 0.04	WW	Dugast (1980)
liver							
Coturnix c. japonica	2 w	juv, 4 w	caterpillars and commercial	3.6 5.0	0.01 0.04	WW	Dugast (1980)
muscle							
Coturnix c. japonica	2 w	juv, 4 w	caterpillars and commercial	3.6 5.0	0.01 0.01	WW	Dugast (1980)

App K4. Experimentally derived bioconcentration factors (BAF) for lindane for organs and tissues in mammals available in literature. Concerning laboratory experiments. For model calculations dry weight concentrations have to be converted to wet weight concentrations by assuming dry matter percentages of 90 and 30 for commercial (basal) feed and body tissue, respectively.

Organ/Tissue	Exp. duration	Juv./adult	Feed type	Cfood (mg/kg)	BAF	WW/DW basis	Reference
fat							
Rattus norvegicus	20 m	juv, fem	commercial	100 800	1.20 0.55	not rep.	Fitzhugh et al. (1950)
Rattus norvegicus	295 d (average) 244 d (average)	juv, m F1 gen. juv, m F3 gen. juv, fem F1 gen juv, fem F3 gen	synthetic diet synthetic diet	0.72 0.72 0.72 0.72	0.20 0.13 0.36 0.50	not rep.	Adams et al. (1974)
Rattus norvegicus	review			not rep.	1		IPCS (1992b)
Rattus norvegicus					1.40	WW	Geyer et al. (1980)
Rattus norvegicus	12 w	m, 200 g	not rep.	25 50	0.40 0.20	WW	Jacobs et al. (1974)
Rattus norvegicus	60 d	ad, m	Purina chow	50 50 50	1.55 1.49 1.66	WW	Baron et al. (1975)
Rodents					1.35	not rep.	Garten and Trabalka (1983)
kidney							
Rattus norvegicus	20 m	juv, fem	commercial	100 800	0.80 0.09	not rep.	Fitzhugh et al. (1950)
liver							
Rattus norvegicus	20 m	juv, fem	commercial	100 800	0.80 0.09	not rep.	Fitzhugh et al. (1950)
muscle							
Rattus norvegicus	20 m	juv, fem	commercial 800	100 0.03	0.20	not rep.	Fitzhugh et al. (1950)

Appendix K5. BCFs (kg dry soil/kg wet tissue) and BAFs (kg wet food/kg wet tissue) for lindane for domestic animals and from food chain studies.
Lindane concentrations are given in mg/kg unless otherwise stated.

species	field/lab exp.	exp. period	juvenile/adult sexe (start weight)	feed type	DW, WW or lipid basis	conc. feed	organ type	conc. organ	BCF organ calculated	BCF organ reported	reference	Comment
VARIOUS												
various									BCF(QSAR)		Garten and Trabalka (1983)	Review of exp. data and QSARs.
poultry							fat			1.51		avian fat: logBCF = −2.743 + 0.542*logKow
small birds							fat		0.17			nonruminant fat: logBCF = −3.849 + 0.617*logKow
rodents							fat		0.03	1.35		ruminant fat: logBCF = −3.935 + 0.511*logKow
cow							fat			0.91		Care must be taken with substitution of QSAR for laboratory feeding studies.
												Strong correlations exist between bioaccumulation of organic compounds in rodents with other mammals and also with birds.
												Regression between water solubility and BAF is also determined and has a higher r.
food chain comprising:	lab										Dugast (1980)	In the controls the lindane conc. was too low (0.03 ppm) for an appropriate calculation of BAFs in quail.
Barley				soil	WW	1	plant	0.05	0.05			
						50		3.40	0.07			
						200		14.10	0.07			
Caterpillar				barley plant		0.05	body	0.05	1.00			
						3.40		2.30	0.68			
						14.10		12.20	0.87			
Japanese Quail		2 weeks	juv., 4 weeks	caterpillars and pelleted food		3.6	muscle	0.03	0.01			
						3.6	liver	0.05	0.01			
						3.6	kidney	0.17	0.05			
						3.6	fat	0.65	0.18			
						3.6	gut	0.08	0.02			
				pelleted food		5.0	muscle	0.04	0.01			
						5.0	liver	0.19	0.04			
						5.0	kidney	0.22	0.04			
						5.0	fat	0.95	0.19			
						5.0	gut	0.18	0.03			
						5.0	egg	0.19	0.04			
food chain	lab				soil in DW, biota in WW						Kiritani and Kawahara (1973)	technical BHC was used and the 4 isomeres were determined
												BAFs can be based on both soil and food (plant, leafhopper) conc.
Rice plant		3 d			soil:	0.772		1.504	1.948			
Leafhopper (Nephotettix cincticeps)		2 d			food:	1.504		5.339	3.550			
					soil:	0.772		5.339	6.916			
Spider (Lycosa pseudoannulata)		10 d			food:	5.339		0.025	0.005			
					soil:	0.772		0.025	0.032			

Appendix K5. BCFs (kg dry soil/kg wet tissue) and BAFs (kg wet food/kg wet tissue) for lindane for domestic animals and from food chain studies. (continued)
Lindane concentrations are given in mg/kg unless otherwise stated.

species	field/lab exp.	exp. period	juvenile/adult sexe (start weight)	feed type	DW, WW or lipid basis	conc. feed	organ type	conc. organ	BCF organ calculated	BCF organ reported	reference	Comment
DOMESTIC ANIMALS												
Cow	lab	4 weeks		diet		25 10	beef fat	100 10	65 4	0.70 0.40	Kenaga (1980)	regr. logBCF = −3.457 + 0.5*logKow with r = 0.79 equilibrium is assumed A lower class review as Garten and Trabalka (1983) stated.
Cow (nonlactating)		> 4 weeks		dry feed	DW WW		meat			0.13 0.89	Travis and Arms (1988)	DW% of grass is 15%, so the BAF is a factor 6.7 higher on WW basis.

Appendix L

BCFs and BAFs for PCP

App L1. Experimentally derived bioconcentration factors (BCF) for PCP for plants available in literature.

Group	Species	field/ laboratory	Soil type	Csoil (mg/kg)	BCF	WW/DW	Reference
leaves							
Plants (in general)		review			< 0.99	DW	Wild and Jones (1992)
Soybean	(Glycine max), shoot	lab, 90 d	mixture (2% o.m.)	4.0	1.53	plant WW, soil DW	Casterline et al. (1985)
Soybean	(Glycine max), stem			4.0	2.95		
Soybean	(Glycine max), leaf			4.0	1.39		
Soybean	(Glycine max), pod			4.0	0.19		
Spinach	(Spinacia oleracea), shoot	lab, 64 d	mixture (2% o.m.)	5.4	1.73	plant WW, soil DW	Casterline et al. (1985)
seeds							
Soybean	(Glycine max), seeds	lab, 90 d	mixture (2% o.m.)	4.0	0.05	plant WW, soil DW	Casterline et al. (1985)

App L2. Experimentally derived bioconcentration factors (BCF) for PCP for invertebrates available in literature. Only BCFs based on soil concentrations are applied in model calculations.

Group	Species	field/ laboratory	Soil type Exp. duration	Csoil (mg/kg)	BCFsoil	Cfood (mg/kg)	BCFfood	WW	Reference
Soft-bodied invertebrates									
Gastropods	Cepeanemoralis	field	19 d	not rep.	0.00			WW	Haque et al. (1988)
Hard-bodied invertebrates									
Insects	Falsomia candida	field	19 d	not rep.	0.46			WW	Haque et al. (1988)
	Falsomia candida	lab	30 d			8.70	0.28	food in DW,	Gruttke et al.(1988)
	Springtails	lab	10 d			87.0	0.43	WW	IPCS (1989)
	Beetles (5 spp.)	field	19 d	not rep.	0.02			WW	Haque et al. (1988)
	Nebria brevicollis	lab	12 d			380	0.01	WW	Gruttke et al.(1988)
	Beetles	lab	10 d			37	0.12	WW	IPCS (1989)
	Earwigs (Dermaptera)	field	19 d	not rep.	0.02			WW	Haque et al. (1988)
Spiders	Pardosa prativage	field	19 d	not rep.	0.05			WW	Haque et al. (1988)
	Opiliones spp.	field	19 d	not rep.	0.34			WW	Haque et al. (1988)
Isopods	Porcellio scaber	field	19 d	not rep.	0.03			WW	Haque et al. (1988)

App L3. Experimentally derived bioconcentration factors (BAF) for PCP for organs and tissues in birds available in literature. Concerning laboratory experiments. For model calculations dry weight concentrations have to be converted to wet weight concentrations by assuming dry matter percentages of 90 and 30 for commercial (basal) feed and body tissue, respectively.

Organ/Tissue	Exp. duration	Juv./adult	Feed type	Cfood (mg/kg)	BAF	WW/DW basis	Reference
fat							
Gallus domesticus	8 w	m, 1-day-old	not rep.	600 1200 2400	0.02 0.02 0.03	WW	Prescott et al. (1982)
Gallus domesticus	8 w	both, 1-day-old	commercial	1-1000	0.42	WW	Stedman et al. (1980)
Poultry					0.17	not rep.	Garten and Trabalka (1983)
kidney							
Gallus domesticus	8 w	m, 1-day-old	not rep.	600 1200 2400	0.10 0.09 0.08	WW	Prescott et al. (1982)
Gallus domesticus	8 w	both, 1-day-old	commercial	1 10 100 1000	1.64 0.19 0.05 0.03	WW	Stedman et al. (1980)
liver							
Gallus domesticus	8 w	m, 1-day-old	not rep.	600 1200 2400	0.06 0.06 0.09	WW	Prescott et al. (1982)
Gallus domesticus	8 w	both, 1-day-old	commercial	1 10 100 1000	0.58 0.07 0.02 0.02	WW	Stedman et al. (1980)
muscle							
Gallus domesticus	8 w	m, 1-day-old	not rep.	600 1200 2400	0.01 0.01 0.01	WW	Prescott et al. (1982)

Organ/Tissue	Exp. duration	Juv./adult	Feed type	Cfood (mg/kg)	BAF	WW/DW basis	Reference
Gallus domesticus	8 w	both, 1-day-old	commercial	1	0.20	WW	Stedman et al. (1980)
				10	0.02		
				100	0.01		
				1000	0.00		

App L4. Experimentally derived bioconcentration factors (BAF) for PCP for organs and tissues in mammals available in literature. Concerning laboratory experiments. For model calculations dry weight concentrations have to be converted to wet weight concentrations by assuming dry matter percentages of 90 and 30 for commercial (basal) feed and body tissue, respectively.

Organ/Tissue	Exp. duration	Juv./adult	Feed type	Cfood (mg/kg)	BAF	WW/DW basis	Reference
fat							
Rattus norvegicus					0.05	WW	Geyer et al. (1980)
liver							
Microtus ochregaster	5 d	? nakijken	Zea mays	6.30	0.24	WW ?	Lu et al. (1978)
carcass							
Microtus ochregaster	5 d	? nakijken	Zea mays	6.30	0.02	WW ?	Lu et al. (1978)
body							
Microtus ochregaster	5 d	? nakijken	Zea mays	6.30	0.08	WW ?	Lu et al. (1978)

Appendix M

BCFs and BAFs for methyl mercury and inorganic mercury

App M1. Experimentally derived bioconcentration factors (BCF) for methyl mercury for plants available in literature.

Group	Species	field/ laboratory	Soil type	Csoil (mg/kg)	BCF	WW/DW	Reference
leaves							
Lettuce, head		garden	? nakijken	0.023	1.30	DW	Cappon (1987)
Lettuce, leaves					0.59		
Spinach					0.74		
Swiss Chard					0.42		
fruit							
Pepper		garden	? nakijken	0.023	0.022	DW	Cappon (1987)
Tomato					0.105		
tubers							
Beet		garden	? nakijken	0.023	0.227	DW	Cappon (1987)
Carrot					0.118		
Onion					0.288		
Radish					0.092		
Turnip					0.013		

App M2. Experimentally derived bioconcentration factors (BCF) for methyl mercury for invertebrates available in literature.

Group	Species	field/ laboratory	Food type Exp. duration	Csoil (mg/kg)	BCFsoil	Cfood (mg/kg)	BCFfood	WW	Reference
Soft-bodied invertebrates									
Larvea of insects	Chysopa carnea	field	10 d, aphids			3.42	4.6	WW	Haney and Lipsey (1973)
						3.20	3.8		
						1.61	5.8		
						0.27	2.1		
Hard-bodied invertebrates									
Insects	Aphid (Macrosiphum gei)	field	10 d, tomato plant			0.98	3.5	WW	Haney and Lipsey (1973)
						0.65	4.9		
						0.79	2.0		
						0.19	1.4		
	Ant (Formica aquilonia)	field	3 w, fish			3.2	0.1	n.r.	Nuorteva et al. (1978)
	Blowfly (Calliphoridae spp.)	one cyclus,	flesh				4.3	WW	Nuorteva and Nuorteva (1982)
							4.3		
							4.3		
							4.3		
							4.3		
							4.3		

App M3. Experimentally derived bioconcentration factors (BAF) for methyl mercury for organs and tissues in birds available in literature. Concerning laboratory experiments. Dry weight concentrations were converted to wet weight concentrations by assuming dry matter percentages of 90 and 30 for commercial (basal) feed and body tissue, respectively.

Organ/Tissue	Exp. duration	Juv./adult	Feed type	Cfood (mg/kg)	BAF	WW/DW basis	Reference
kidney							
Gallus domesticus	30 d	juv, 5 days	commercial	0.33	2.3	WW	Gardiner (1972)
				3.3	1.5		
				33.0	1.2		
Gallus domesticus	18 w	ad, fem	grain	14.25	3.0	not rep.	Tejning and Vesterberg (1964)
Gallus domesticus	6 w	ad, fem	commercial	2.2	6.0	WW	Tejning (1967)
				4.5	4.0		
				9.0	5.3		
	12 w			4.6	6.7		
				9.2	5.2		
Phasianus colchicus	30 d	juv, 5 days	commercial	0.33	1.7	WW	Gardiner (1972)
				3.3	1.6		
				33.0	1.7		
Duck	30 d	juv, 5 days	commercial	0.33	2.8	WW	Gardiner (1972)
				3.3	1.5		
				33.0	1.8		
Anas platyrynchos	3 generations	ad	dry duck mash	0.5	3.2	WW	Heinz (1979)
Anas platyrynchos	2 w	ad	commercial mash	8.0	2.2	WW	Stickel et al. (1977)
Poephila guttata	76 d	ad	commercial finch mash	1.0	8.8	WW, diet DW	Scheuhammer (1988)
				2.5	8.6		
				5.0	9.8		
Agelaius phoeniceus	11 d	not rep.	turkey starter	40	2.1	WW	Finley et al. (1979)
Sturnus vulgaris	8 d	first year		40	2.2		
Molothrus ater	10 d	ad		40	1.5		
Quiscalus quiscalu	6 d	not rep.		40	1.1		

Organ/Tissue	Exp. duration	Juv./adult	Feed type	Cfood (mg/kg)	BAF	WW/DW basis	Reference
liver							
Gallus domesticus	30 d	juv, 5 days	commercial	0.33	2.1	WW	Gardiner (1972)
				3.3	1.4		
				33.0	1.4		
Gallus domesticus	18 w	ad, fem	grain	14.25	3.0	not rep.	Tejning and Vesterberg (1964)
Gallus domesticus	6 w	ad, fem	commercial	2.2	7.6	WW	Tejning (1967)
				4.5	4.7		
				9.0	6.6		
	12 w			4.6	5.9		
				9.2	6.0		
Phasianus colchicus	30 d	juv, 5 days	commercial	0.33	1.3	WW	Gardiner (1972)
				3.3	1.3		
				33.0	1.5		
Duck	30 d	juv, 5 days	commercial	0.33	1.9	WW	Gardiner (1972)
				3.3	1.7		
				33.0	2.0		
Anas platyrynchos	3 generations	ad	dry duck mash	0.5	3.0	WW	Heinz (1979)
Anas platyrynchos	2 w	ad	commercial mash	8.0	2.1	WW	Stickel et al. (1977)
Poephila guttata	76 d	ad	commercial finch mash	1.0	8.8	WW, diet DW	Scheuhammer (1988)
				2.5	8.2		
				5.0	9.0		
Agelaius phoeniceus	11 d	not rep.	turkey starter	40	2.3	WW	Finley et al. (1979)
Sturnus vulgaris	8 d	first year		40	2.6		
Molothrus ater	10 d	ad		40	1.7		
Quiscalus quiscalu	6 d	not rep.		40	1.3		
muscle							
Gallus domesticus	30 d	juv, 5 days	commercial	0.33	0.9	WW	Gardiner (1972)
				3.3	0.7		
				33.0	0.7		
Gallus domesticus	18 w	ad, fem	grain	14.25	1.1	not rep.	Tejning and Vesterberg (1964)
Gallus domesticus	6 w	ad, fem	commercial	2.2	1.3	WW	Tejning (1967)
				4.5	1.7		

Organ/Tissue	Exp. duration	Juv./adult	Feed type	Cfood (mg/kg)	BAF	WW/DW basis	Reference
				9.0	1.5		
	12 w			4.6	1.9		
				9.2	1.7		
Phasianus colchicus	30 d	juv, 5 days	commercial	0.33	0.9	WW	Gardiner (1972)
				3.3	0.6		
				33.0	0.9		
Duck	30 d	juv, 5 days	commercial	0.33	1.3	WW	Gardiner (1972)
				3.3	0.7		
				33.0	0.9		
Anas platyrynchos	3 generations	ad	dry duck mash	0.5	1.7	WW	Heinz (1979)
Agelaius phoeniceus	11 d	not rep.	turkey starter	40	1.1	WW	Finley et al. (1979)
Sturnus vulgaris	8 d	first year		40	1.0		
Molothrus ater	10 d	ad		40	0.7		
Quiscalus quiscalu	6 d	not rep.		40	0.8		
carcass							
Agelaius phoeniceus	11 d	not rep.	turkey starter	40	1.0	WW	Finley et al. (1979)
Sturnus vulgaris	8 d	first year		40	0.9		
Molothrus ater	10 d	ad		40	0.8		
Quiscalus quiscalu	6 d	not rep.		40	0.7		
Anas platyrynchos	2 w	ad	commercial mash	8.0	0.6	WW	Stickel et al. (1977)
body							
Agelaius phoeniceus	11 d	not rep.	turkey starter	40	1.1	WW	Finley et al. (1979)
Sturnus vulgaris	8 d	first year		40	1.1		
Molothrus ater	10 d	ad		40	0.8		
Quiscalus quiscalu	6 d	not rep.		40	0.7		
Anas platyrynchos	2 w	ad	commercial mash	8.0	1.1	WW	Stickel et al. (1977)

App M4. Experimentally derived bioconcentration factors (BAF) for methyl mercury for organs and tissues in mammals available in literature. Concerning laboratory experiments. Dry weight concentrations were converted to wet weight concentrations by assuming dry matter percentages of 90 and 30 for commercial (basal) feed and body tissue, respectively.

Organ/Tissue	Exp. duration	Juv./adult	Feed type	Cfood (mg/kg)	BAF	WW/DW basis	Reference
kidney							
Rattus norvegicus	104 w	both ?	commercial	0.1 0.5 2.5	38.1 16.7 12.9	not rep.	Verschuuren et al. (1976)
Mustela vison	32 d	ad, both	commercial	5.0	7.5	WW	Aulerich et al. (1974)
Mustela vison	93 d	ad, fem	commercial mink foof	1.1	20.4	WW	Wobeser et al. (1976)
Mustela vison	100 d	ad, fem	commercial mink food	2.28	16.7	WW	Jernelov et al. (1976)
Mustela furo X M.putorius	35 d 58 d	ad, fem	commercial food	7.0 5.0	6.1 7.7	WW	Hanko et al. (1970)
Cat	60-83 d	ad, both	fish	6	5.2	WW	Albanus et al. (1972)
liver							
Rattus norvegicus	104 w	both ?	commercial	0.1 0.5 2.5	1.8 3.4 4.4	not rep.	Verschuuren et al. (1976)
Mustela vison	32 d	ad, both	commercial	5.0	11.1	WW	Aulerich et al. (1974)
Mustela vison	93 d	ad, fem	commercial mink foof	1.1	23.0	WW	Wobeser et al. (1976)
Mustela vison	100 d	ad, fem	commercial mink food	2.28	14.5	WW	Jernelov et al. (1976)
Mustela furo X M.putorius	35 d 58 d	ad, fem	commercial food	7.0 5.0	6.4 6.3	WW	Hanko et al. (1970)
Cat	60-83 d	ad, both	fish	6	6.5	WW	Albanus et al. (1972)
muscle							
Mustela vison	32 d	ad, both	commercial	5.0	5.0	WW	Aulerich et al. (1974)
Mustela vison	93 d	ad, fem	commercial mink foof	1.1	7.1	WW	Wobeser et al. (1976)

Organ/Tissue	Exp. duration	Juv./adult	Feed type	Cfood (mg/kg)	BAF	WW/DW basis	Reference
Mustela vison	100 d	ad, fem	commercial mink food	2.28	9.6	WW	Jernelov et al. (1976)
Mustela furo X M.putorius	35 d	ad, fem	commercial food	7.0	4.1	WW	Hanko et al. (1970)
	58 d			5.0	4.4		
Cat	60-83 d	ad, both	fish	6	4.5	WW	Albanus et al. (1972)

Appendix M5. BAFs (kg wet food/kg wet tissue) for methyl mercury for raptorial birds studied in laboratory experiments.
Methyl mercury concentrations are given in mg/kg, unless stated otherwise.

species	field/lab exp.	exp. period	juvenile/adult sexe	DW/WW basis	feed type	Hg form applied	conc. feed	organ type	Hg form in body	conc. organ	BCF organ	reference	comment
BIRDS OF PREY													
Chicken (Gallus domesticus)	lab	5–6 weeks		WW	wheat in diet	methyl–Hg–dicyandiamide	8	liver	methyl	10.0	1.3	Borg et al. (1970)	The goshawks lost body weight, appetite and showed muscular weakness and ataxia.
							8	muscle		40.0	5.0		
Goshawk (Accipiter gentilis)					chicken organs	mainly methyl–Hg	13	liver	total	113.0	8.7		After 30–47 days all hawks died.
							13	kidney		129.5	10.0		Methyl–Hg % of total Hg in liver, kidney, muscle and brain is 93, 76, 100 and 85%, respectively.
							13	muscle		46.3	3.6		
							13	brain		42.0	3.2		
							13	feather		5.2	0.4		
							13	liver	methyl	102.0	7.8		
							13	kidney		98.5	7.6		
							13	muscle		46.0	3.5		
							13	brain		42.0	3.2		
					chicken muscle		10	liver	total	144.0	14.4		
							10	kidney		131.0	13.1		
							10	muscle		39.0	3.9		
							10	brain		41.0	4.1		
							10	feather		1.7	0.2		
							10	liver	methyl	138.0	13.8		
							10	kidney		98.0	9.8		
							10	muscle		39.0	3.9		
							10	brain		26.0	2.6		
Kestrel (Falco tinnunculus)	lab	21.5 d	adult, males	not rep.		methyl–Hg dosed mice	13.3	liver		68.5	5.2	Koeman et al. (1971)	Lower case study: it is not indicated to which of both experiments the birds belonged.
							13.3	kidney		61.5	4.6		
							13.3	muscle		31.0	2.3		
							13.3	brain		22.5	1.7		Intoxication was observed in all birds.
		52 d	adult, both sexes			alternate dosed and clean mice	6.65	liver		97.0	14.6		
							6.65	kidney		86.0	12.9		
							6.65	muscle		41.0	6.2		
							6.65	brain		31.5	4.7		
Red–tailed Hawk (Buteo jamaicensis)	lab	12 weeks	1–year–old	not rep.		methyl–Hg–dosed chickens	3.9	liver		1.8	0.5	Fimreite and Karstad (1971)	Lower case study: feed Hg–conc. is not clear, only the liver Hg conc. is determined, which will induce an underestimation of the BCF.
							3.9	muscle		0.9	0.2		
							3.9	brain		1.4	0.4		
							7.2	liver		18.8	2.6		The same experiment was also conducted in a shorter period: 4 weeks.
							7.2	muscle		10.5	1.5		
							7.2	brain		2.4	0.3		At the two highest Hg dietary levels toxic effects were observed: neurological, weight loss, and mortality.
							10.0	liver		20.0	2.0		
							10.0	muscle		11.4	1.1		
							10.0	brain		3.1	0.3		

Appendix M6. BCFs (kg dry soil/kg plant tissue) for mercury (inorganic, methyl, total) for plant parts. Plant tissue in wet weight and concentrations in mg/kg, unless stated otherwise.

species/group	field/lab. exp.	soil type	Hg form		conc. soil	conc. tissue	BCF reported	BCF calculated	reference	comment
grass	field			min. soil conc	0.01	0.02		1.82	Wiersma et al. (1985)	regr.: y = 0.0098x + 0.0182
				mean soil conc	0.24	0.02		0.09		
				max. soil conc	3.2	0.05		0.02		
wheat (grains)	field			mean soil conc.	0.11	0.01		0.05		
barley				mean soil conc.	0.08	0.01		0.09		DW basis
oats				mean soil conc.	0.09	0.01		0.10		
carrot				mean soil conc.	0.08	0.03		0.31		
apple				mean soil conc.	0.18	0.01		0.04		DW basis
leaves and stems							0.90		Baes et al. (1984)	In: Bockting and van den Berg (1992)
fruits and seeds							0.20			
potatoos							0.00		Sauerbeck (1989)	In: Bockting and van den Berg (1992)
vegetables							0.01 – >0.1			
potatoos							0.02		Bockting and van den Berg (1992)	
vegetables							0.03			
vegetation							0.04		Travis and Blaylock (in press)	
Leafy:		garden soil	total Hg						Cappon (1987)	on DW basis
Lettuce, head					0.430	0.139		0.324		
Lettuce, leaf					0.430	0.074		0.173		
Spinach					0.430	0.074		0.171		
Swiss Chard					0.430	0.064		0.150		
Tuberous:										
Beet					0.430	0.027		0.064		
Carrot					0.430	0.013		0.031		
Onion					0.430	0.036		0.084		
Radish					0.430	0.025		0.058		
Turnip					0.430	0.011		0.025		
Fruit:										
Cucumber					0.430	0.003		0.007		
Pepper					0.430	0.008		0.019		
Squash					0.430	0.009		0.020		
Tomato					0.430	0.027		0.062		
Bean					0.430	0.004		0.010		
Leafy:			inorganic Hg							
Lettuce, head					0.406	0.110		0.270		
Lettuce, leaf					0.406	0.061		0.150		
Spinach					0.406	0.057		0.139		
Swiss Chard					0.406	0.055		0.135		

Appendix M6. BCFs (kg dry soil/kg plant tissue) for mercury (inorganic, methyl, total) for plant parts. Plant tissue in wet weight and concentrations in mg/kg, unless stated otherwise. (continued)

species/group	field/lab. exp.	soil type	Hg form	conc. soil	conc. tissue	BCF reported	BCF calculated	reference	comment
Tuberous:									
Beet				0.406	0.022		0.055		
Carrot				0.406	0.011		0.026		
Onion				0.406	0.030		0.073		
Radish				0.406	0.023		0.056		
Turnip				0.406	0.011		0.026		
Fruit:									
Cucumber				0.406	0.003		0.007		
Pepper				0.406	0.008		0.019		
Squash				0.406	0.009		0.021		
Tomato				0.406	0.024		0.059		
Bean				0.406	0.004		0.011		
Leafy:			methyl–Hg						
Lettuce, head				0.023	0.030		1.301		
Lettuce, leaf				0.023	0.013		0.585		
Spinach				0.023	0.017		0.742		
Swiss Chard				0.023	0.010		0.415		
Tuberous:									
Beet				0.023	0.005		0.227		
Carrot				0.023	0.003		0.118		
Onion				0.023	0.007		0.288		
Radish				0.023	0.002		0.092		
Turnip				0.023	0.000		0.013		
Fruit:									
Pepper				0.023	0.001		0.022		
Tomato				0.023	0.002		0.105		
Plantago spp.	field			0.30		0.60		Siegel et al. (1987)	on DW basis
				0.30		2.60			BCF depends on the soil conc.!!
Equisetum spp.				0.30		0.25			
				0.30		2.60			target (background) value is selected
Festuca rubra	field			0.11	0.10		0.97	Bull et al. (1977)	on DW basis
				3.81	4.01		1.05		airborne Hg is included
Digitaria	field	not rep.		0.01	0.07		4.65	Siegel et al. (1975)	on DW basis
Andropogon				0.01	0.08		5.52		

Appendix M7. BCFs (kg dry soil/kg wet tissue) and BAFs (kg wet food/kg wet tissue) for inorganic mercury for invertebrates, mammals and birds from laboratory and field experiments. Inorganic mercury concentrations are given in mg/kg, unless stated otherwise.

species	field/lab exp.	exp. period	juvenile/adult sexe	DW or WW basis	feed type	Hg form applied	conc. feed	organ type	Hg form in body	conc. organ	BCF organ	reference	comment
INVERTEBRATES													
Blowfly	lab	one cyclus	adult	WW	seal liver	methyl-Hg (3-6%)	36	body			0.50	Nuorteva and Nuorteva (1982)	ratio DW-WW in flies was 3.8 blowflies are sacrosaprophagous insects
Blowfly	lab	5 d	larvae	WW	fish (trout)	mainly inorganic Hg	0.66	body		1	1.52	Nuorteva et al. (1980)	
		11.5 d	puparium				0.66			1	1.52		
		20 d	adult				0.66			0.4	0.61		
Larvae (flies) (Diptera)	field			DW	mushrooms	prob. mainly inorg. Hg	16.30	body	total	5.44	0.33	Lodenius (1981)	The low bioaccumulation indicates that only a small part of the total Hg content of the fungi is in the form of methylmercury. Can not be used for derivation of BCF for inorganic Hg.
Larvae (gnats) (Diptera)							1.90	body		0.35	0.18		
BIRDS													
Japanese Quail (Coturnix c. japonica)	lab	12 weeks	2 months	diet in DW organ in WW?	commercial diet	mercuric chloride	4	liver		0.25	0.06	Dieter (1974)	Carcass is skinned bird without beaks, feet, wings, and viscera except for heart, testes and kidneys.
							8			0.64	0.08		
							4	carcass		0.05	0.01		No effect on growth.
							8			0.11	0.01		
MAMMALS													
Mink (Mustela vison)	lab	135 d	adults, both sexes	WW-basis	basal diet	mercuric chloride	10	liver		3.16	0.32	Aulerich et al. (1974)	No Hg poisoning occurred.
							10	kidney		32.80	3.28		Dry matter percentage of the feed can be estimated at 50%.
							10	muscle		0.12	0.01		
							10	brain		0.24	0.02		
							10	spleen		0.35	0.03		
							10	lung		0.19	0.02		
							10	heart		0.15	0.02		
							10	hair		1.23	0.12		

Appendix N

BCFs and BAFs for cadmium

App N1. Experimentally derived bioconcentration factors (BCF) for Cd for plants available in literature. Only BCFs based on soil concentrations are considered. Only field data available.

Group	Species	field/ laboratory	Soil type	Csoil (mg/kg)	BCF	WW/DW	Reference
Cadmium							
leaves							
Fine-leaved grass		field		0.75	0.23	DW	Hunter and Johnson (1982)
				3.10	0.35		
				8.50	2.00		
Cover vegetation				0.75	0.53		
				3.10	0.52		
				8.50	3.60		
Vegetation (many species)		field	deciduous forest	1.51	1.69	DW	Grodzinska et al. (1987)
				3.02	4.75		
			pine forest	1.75	0.64		
				1.05	1.90		
Vegetation		field		0.30	1.57	DW	Ma et al. (1991)
				0.30	1.77		
				2.90	0.11		
				2.90	0.17		
Above plant parts (incl. grass)		field	control soil	0.06	0.33	DW	Alberici et al. (1989)
			sludge-treated	0.39	0.33		
Springwheat leaves		not rep.	acid cambisol pH 5.6	2	5.49	DW	Kloke et al. (1984)
				4	6.03		
Springwheat nodes				2	5.22		
				4	4.29		
Springwheat internodes				2	2.68		
				4	3.21		
Grass		field	min. Cd conc:	0.2	0.61	DW	Wiersma et al. (1985)
			mean Cd conc:	1.00	0.14		
			max. Cd conc:	14.0	0.03		
Grass		field	'long term'	0.8	0.23		Sauerbeck and Styperek (1988)
Leaves and stems					0.55		Bockting and van den Berg (1992)
Lettuce					1.05		
Cabbages					0.23		
Spinach					1.85		
Vegetables (average)					0.70		

Group	Species	field/ laboratory	Soil type	Csoil	BCF (mg/kg)	WW/DW	Reference
fruits							
	Apple	field	min. Cd conc:	0.5	0.01	DW	Wiersma et al. (1985)
	Fruits (in general)				0.15		Bockting and van den Berg (1992)
seeds							
	Wheat (grains)	field	mean Cd conc:	0.6	0.15	DW	Wiersma et al. (1985)
	Barley		mean Cd conc:	0.5	0.31		
	Oats		mean Cd conc:	0.4	0.26		
	Seeds (in general)				0.15		Bockting and van den Berg (1992)
	Springwheat flour	not rep.	acid cambisol pH 5.6	2	1.07	DW	Kloke et al. (1984)
				4	0.91		
	Springwheat bran			2	1.61		
				4	1.74		
	Springwheat chaf			2	2.81		
				4	1.47		
	Winterbarley (grain)	field	'long term'	0.8	0.22		Sauerbeck and Styperek (1988)
	Summer barley (grain)			0.8	0.11		
	Oats (grain)			0.8	0.43		
	Corn (Zea mays)			0.8	0.12		
tubers							
	Potatoes	field			0.15		Bockting and van den Berg (1992)
	Carrots				0.87		
	Radish				0.17		
	Sugar beet (root)	field	'long term'	0.8	0.36		Sauerbeck and Styperek (1988)
	Fodder beet (root)			0.8	0.35		
	Potato			0.8	0.41		
	Potato				0.15		Bockting and van den Berg (1992)
	Carrot	field	mean Cd conc:	0.3	1.67	DW	Wiersma et al. (1985)

App N2. Experimentally derived bioconcentration factors (BCF) for Cd for invertebrates available in literature. Only BCFs based on soil concentrations are considered.

Group	Species	field/ lab	Soil type	Csoil (mg/kg)	BCF	WW/DW	Reference
soft-bodied invertebrates							
Gastropods	snails and slugs	field		0.1	11.4	DW	Knutti et al. (1988)
				0.1	14.2		
				0.1	18.8		
				0.1	34.3		
				0.1	59.5		
				2.0	38.2	DW	Grodzinska et al. (1987)
				4.75	6.6		
	slugs (2 spp.)			1.1	4.82	DW	Greville and Morgan (1991)
				1.1	6.36		
				1.1	8.45		
				1.1	7.09		
				13.0	3.42		
				13.0	3.72		
				13.0	4.13		
				13.0	5.01		
Insect larvae	Coleoptera	field		0.3	10.0	DW	Ma et al. (1991)
				0.3	15.0		
	Diptera			2.9	1.03		
	Coleoptera			2.9	2.72		
				2.9	3.28		
hard-bodied invertebrates							
Caterpillars		field	sandy	0.3	0.67	DW	Ma et al. (1991)
				0.3	2.00		
				2.9	1.10		
				2.9	1.55		
Insects	Various species	field		0.1	0.05	DW	Knutti et al. (1988)
				0.1	0.12		
				0.1	0.18		
				0.1	0.21		
				0.1	0.73		
				0.1	0.79		
				0.1	0.79		
				0.1	0.91		
				0.1	0.92		
				0.1	0.96		
				0.1	1.03		

Group	Species	field/ lab	Soil type	Csoil (mg/kg)	BCF	WW/DW	Reference
				0.1	1.06		
				0.1	1.06		
				0.1	1.40		
				0.1	1.72		
				0.1	1.75		
				0.1	1.77		
				0.1	1.89		
				0.1	2.35		
				0.1	2.59		
				0.1	2.68		
				0.1	2.86		
				0.1	2.88		
				0.1	3.11		
				0.1	3.16		
				0.1	3.69		
				0.1	4.16		
				0.1	10.70		
				0.1	15.20		
				0.1	18.50		
				0.1	18.60		
	Coleoptera	field	sandy	0.3	3.67		Ma et al. (1991)
				0.3	9.00		
				2.9	2.66		
				2.9	2.66		
	Coleoptera	field		2.77	2.34		Grodzinska et al. (1987)
				2.77	2.22		
	Collembola			3.27	0.90		
				3.27	0.36		
	Diptera and Coleoptera	field		0.4	3.00		Hunter and Johnson (1988)
				1.6	2.81		
				3.6	3.03		
Isopods		field		0.1	13.7		Knutti et al. (1988)
				0.1	16.9		
				0.1	48.1		
Spiders		field		0.1	25.5		Knutti et al. (1988)
				0.1	34.7		
				0.1	54.0		
		field	sandy	0.3	20.3		Ma et al. (1991)
				0.3	22.7		
				0.3	29.3		
				0.3	56.7		
				2.9	5.52		
				2.9	5.52		

Group	Species	field/ lab	Soil type	Csoil (mg/kg)	BCF	WW/DW	Reference
				2.9	13.8		
				2.9	25.5		

App N3. Experimentally derived bioconcentration factors (BAF) for Cd for organs and tissues in birds available in literature. Concerning laboratory experiments. Dry weight concentrations were converted to wet weight concentrations by assuming dry matter percentages of 90 and 30 for commercial (basal) feed and body tissue, respectively.

Organ/Tissue	Exp. duration	Juv./adult	Feed type	Cfood (mg/kg)	BAF	WW/DW basis	Reference
KIDNEY							
Gallus domesticus	2 w	juv, m	basal	0.21	1.86	DW (fat free)	Leach et al. (1979)
				3.0	3.09		
				12.0	4.14		
	12 w	ad, fem		3.0	10.27		
				12.0	7.72		
	48 w	ad, fem		0.22	77.7		
				3.0	91.3		
				12.0	59.0		
Gallus domesticus	4 w	juv, m	commercial	5	0.28	WW	Nezel and Vogt (1977)
				10	0.36		
	7 w	juv, m		5	1.12		
				10	1.31		
	21 w	ad, fem		0.1	5.0		
				5	4.8		
				10	8.0		
	47 w	ad, fem		0.1	10.0		
				5	16.0		
				10	16.0		
Coturnix c. japonica	2 w	juv	basal	0.15	0.31	WW	Jacobs et al. (1983)
			basal extra Zn	0.15	0.24		
Coturnix c. japonica	45 d	ad, m	commercial	100	6.5	DW	Leonzio et al. (1992)
Coturnix c. japonica	2 w	m	basal + 20% honey bees	0.12	6.8	DW	Stoewsand et al. (1987)
		fem		0.12	12.4		
Sturnus vulgaris	22 w	ad	not rep.	10.27	11.3	DW	Pilastro et al. (1993)
				55.23	5.6		
Anas platyrynchos	90 d	ad (1st y)	commercial	1.6	2.89	WW	White and Finley (1978)
				15.2	3.57		
Anas platyrynchos	6 w	juv, m	basal	10	5.17	DW	DiGiulio and Scanlon(1985)
				50	3.73		
Aix sponsa	3 m	juv (1 week)	turkey starter	2.18	2.15	WW	Mayack et al. (1981)
				7.61	8.13		

Organ/Tissue	Exp. duration	Juv./adult	Feed type	Cfood (mg/kg)	BAF	WW/DW basis	Reference
LIVER							
Gallus domesticus	2 w	juv, m	basal	0.21	1.10	DW (fat free)	Leach et al. (1979)
				3.0	1.58		
				12.0	1.26		
	12 w	ad, fem		3.0	3.0		
				12.0	2.2		
	48 w	ad, fem		0.22	13.6		
				3.0	11.2		
				12.0	3.5		
Gallus domesticus	4 w	juv, m	commercial	5	0.28	WW	Nezel and Vogt (1977)
				10	0.26		
	7 w	juv, m		5	0.56		
				10	0.56		
	21 w	ad, fem		0.1	1.0		
				5	0.80		
				10	0.88		
	47 w	ad, fem		0.1	5.0		
				5	1.28		
				10	1.30		
Coturnix c. japonica	2 w	juv	basal	0.15	0.15	WW	Jacobs et al. (1983)
			basal extra Zn	0.15	0.11		
Coturnix c. japonica	45 d	ad, m	commercial	100	1.97	DW	Leonzio et al. (1992)
Coturnix c. japonica	2 w	m	basal + 20% honey bees	0.12	2.50	DW	Stoewsand et al. (1987)
		fem		0.12	3.58		
Sturnus vulgaris	22 w	ad	not rep.	10.27	7.37	DW	Pilastro et al. (1993)
				55.23	3.77		
Anas platyrynchos	90 d	ad (1st y)	commercial	1.6	1.32	WW	White and Finley (1978)
				15.2	1.28		
Anas platyrynchos	6 w	juv, m	basal	10	1.44	DW	DiGiulio and Scanlon(1985)
				50	1.05		
Anas platyrynchos	3 m	juv	starter mash	0.10	1.00	WW	Cain et al. (1983)
				4.3	2.36		
				9.2	1.77		
				14.6	2.89		
Aix sponsa	3 m	juv (1 week)	turkey starter	2.18	1.03	WW	Mayack et al. (1981)
				7.61	3.52		

Organ/Tissue	Exp. duration	Juv./adult	Feed type	Cfood (mg/kg)		BAF	WW/DW basis	Reference
MUSCLES								
Gallus domesticus	2 w	juv, m	basal	0.21		0.33	DW (fat free)	Leach et al. (1979)
				3.0		0.05		
				12.0		0.02		
	48 w	ad, fem		0.22		0.55		
				3.0		0.19		
				12.0		0.14		
Gallus domesticus	4 w	juv, m	commercial	5	breast	0.00	WW	Nezel and Vogt (1977)
				10		0.00		
	4 w	juv, m		5	leg	0.01		
				10		0.00		
	7 w	juv, m		5	breast	0.00		
				10		0.00		
	7 w	juv, m		5	leg	0.01		
				10		0.01		
	21 w	ad, fem		0.1	breast	0.20		
				5		0.01		
				10		0.01		
	21 w	ad, fem		0.1	leg	0.20		
				5		0.01		
				10		0.01		
	47 w	ad, fem		0.1	breast	0.40		
				5		0.02		
				10		0.02		
	47 w	ad, fem		0.1	leg	0.50		
				5		0.04		
Anas platyrynchos	90 d	ad (1st y)	commercial	1.6		1.32	WW	White and Finley (1978)
				15.2		1.28		

App N4. Experimentally derived bioconcentration factors (BAF) for Cd for organs and tissues in mammals available in literature. Concerning laboratory experiments. Dry weight concentrations were converted to wet weight concentrations by assuming dry matter percentages of 90 and 30 for commercial (basal) feed and body tissue, respectively.

Organ/Tissue	Exp. duration	Juv./adult	Feed type	Cfood (mg/kg)	BAF	WW/DW basis	Reference
KIDNEY							
Rattus norvegicus	10 m	juv, m	basal	0.30	1.10	WW	Groten et al. (1992)
				3.0	0.82		
				30	1.74		
				90	2.01		
			basal + pig liver	0.30	1.18		
				3.0	1.07		
				30	0.74		
				90	0.65		
Rattus norvegicus	3 m	juv, m	basal	1	0.50	WW	Loeser and Lorke (1977)
				3	0.37		
				10	0.50		
				30	0.41		
		juv, fem	basal	1	1.10		
				3	0.40		
				10	0.51		
				30	0.42		
Rattus norvegicus	41 w	juv, fem	basal	10	9.14	WW	Sugawara and Sugawara (1974)
Rattus norvegicus	90 d	juv	casein	20.9	0.59	WW	Uthe and Chou (1979)
			protein	20.9	0.54		
			liver + kidneys (pig)	20.9	0.27		
			digestive gland	20.9	0.24		
Rattus norvegicus	9 w	ad, m	basal	12.5	0.14	WW	Waalkes (1986)
				25	0.26		
				50	0.18		
				100	0.16		
				200	0.12		
Rattus norvegicus	8 w	juv, m	semisynthetic + 10% grass	0.24	1.04	DW	Weigel et al. (1987)
Mus musculus	16 m	juv	rice	0.48	1.48	WW	Watanabe et al. (1986)
				1.78	1.26		
				1.75	1.29		
				47.1	2.16		
Sus scrofa domesticus	6 w	juv	basal	50	0.82	WW	Cousins et al. (1973)

Organ/Tissue	Exp. duration	Juv./adult	Feed type	Cfood (mg/kg)	BAF	WW/DW basis	Reference
Sus scrofa domesticus	130 d	juv, fem	commercial	0.47	2.62	WW	King et al. (1992)
				0.86	2.52		
				2.27	2.52		
				4.46	2.75		
				0.61	1.85		
				1.20	1.40		
LIVER							
Rattus norvegicus	10 m	juv, m	basal	0.30	0.10	WW	Groten et al. (1992)
				3.0	0.12		
				30	0.53		
				90	1.13		
			basal + pig liver	0.30	0.18		
				3.0	0.11		
				30	0.13		
				90	0.15		
Rattus norvegicus	3 m	juv, m	basal	1	0.20	WW	Loeser and Lorke (1977)
				3	0.13		
				10	0.32		
				30	0.30		
		juv, fem	basal	1	0.40		
				3	0.13		
				10	0.30		
				30	0.30		
Rattus norvegicus	41 w	juv, fem	basal	10	2.19	WW	Sugawara and Sugawara (1974)
Rattus norvegicus	90 d	juv	casein	20.9	0.25	WW	Uthe and Chou (1979)
			protein	20.9	0.28		
			liver + kidneys (pig)	20.9	0.11		
			digestive gland	20.9	0.13		
Rattus norvegicus	9 w	ad, m	basal	12.5	0.17	WW	Waalkes (1986)
				25	0.17		
				50	0.15		
				100	0.12		
				200	0.11		
Rattus norvegicus	8 w	juv, m	semisynthetic + 10% grass	0.24	0.79	DW	Weigel et al. (1987)

Organ/Tissue	Exp. duration	Juv./adult	Feed type	Cfood (mg/kg)	BAF	WW/DW basis	Reference
Mus musculus	16 m	juv	rice	0.48	0.44	WW	Watanabe et al. (1986)
				1.78	0.35		
				1.75	0.40		
				47.1	1.16		
Sus scrofa domesticus	6 w	juv	basal	50	0.10	WW	Cousins et al. (1973)
Sus scrofa domesticus	130 d	juv, fem	commercial	0.47	0.64	WW	King et al. (1992)
				0.86	0.44		
				2.27	0.41		
				4.46	0.45		
				0.61	0.49		
				1.20	0.29		
MUSCLES							
Rattus norvegicus	8 w	juv, m	semisynthetic + 10% grass	0.24	0.46	DW	Weigel et al. (1987)
Sus scrofa domesticus	6 w	juv	basal	50	0.00	WW	Cousins et al. (1973)
Sus scrofa domesticus	130 d	juv, fem	commercial	0.47-4.46	<0.3	WW	King et al. (1992)

Appendix N5. BAFs (kg wet food/kg wet tissue) for cadmium for birds from laboratory studies of lower category (less reliable or usefull).
Cd concentration are given in mg/kg unless stated otherwise.

species	exp. period	juvenile/adult sexe (start weight)	feed type	conc. feed	organ type	conc. organ	BAF organ	reference	Comment
Coturnix c. japonica (Japanese quail)	10 days	juvenile	basal diet with leaves					McKenna et al. (1992)	
			low Zn control	0.88	liver	10.65	12.10		Cd in feed in ug/gDW
			lettuce	1.10		10.84	9.85		Cd in organ in ng/gWW
			spinach	0.98		6.37	6.50		
				0.88	kidney	20.34	23.11		In ng/g on WW basis.
				1.10		26.23	23.85		
				0.98		13.46	13.73		
			high Zn	0.86	liver	10.68	12.42		In ng/g on WW basis.
				1.03		9.39	9.12		
				1.02		5.09	4.99		
				0.86	kidney	21.35	24.83		In ng/g on WW basis.
				1.03		19.86	19.28		
				1.02		9.68	9.49		
Coturnix c. japonica	6 weeks	juveniles	pur. basal diet	75.00	liver	38.00	0.51	Richardson et al. (1974)	On WW basis. Growth reduction occurred.
Streptopelia risoria	5 months	adults	synthetic semi-purified chicken diet	1.70	liver	7.10	4.18	Scheuhammer (1987)	On DW basis. Reproductive success was reduced at 15.3 ppm Cd, but in combination with 53.4 ppm Pb and 4.64 ppm Hg.
				18.20		56.30	3.09		

Appendix N6. BAFs (kg wet food/kg wet tissue) for cadmium for mammals in laboratory studies of lower category (less reliable or usefull).
Cd concentrations are expressed on WW basis, unless indicated otherwise.

species	exp. period	juvenile/adult sexe (start weight)	feed type	conc. feed	organ type	conc. organ	BAF organ	reference	Comment
Oryctolagus cuniculus	10 months	males (3 kg)	commercial diet	300.00	kidney	240.00	0.80	Nomiyama et al. (1975) in IPCS (1992)	Proteinuria, glucosuria and anemia are reported.
Oryctolagus cuniculus	6 months	males (2.6 kg)	commercial diet					Stowe et al (1972)	Cd applied in drinkwater
				160.00	liver	188.00	1.18	in IPCS (1992)	
				160.00	kidney	170.00	1.06		growth reduction
				160.00	muscle	1.00	0.01		
Guinea Pig	4 weeks	male	Swiss chard					Furr et al. (1976)	on DW basis
		juvenile	control	1.20	liver	2.00	1.67		
			contaminated 1	3.30		1.80	0.55		
			contaminated 2	4.10		2.40	0.59		
				1.20	kidney	6.20	5.17		
				3.30		7.40	2.24		
				4.10		10.60	2.59		
				1.20	muscle	0.07	0.06		
				3.30		0.05	0.02		
				4.10		0.09	0.02		
Ovis amon aries	191 days	juveniles	basal diet					Doyle et al. (1974)	At 30 and 60 ppm Cd growth reduction.
		(4 monthhs)		0.20	liver	1.69	8.45		8.4% water in feed
				5.00		14.92	2.98		
				15.00		15.72	1.05		
				30.00		62.73	2.09		
				60.00		275.94	4.60		
				0.20	kidney	4.42	22.10		
				5.00		58.86	11.77		
				15.00		187.62	12.51		
				30.00		426.81	14.23		
				60.00		768.84	12.81		
				0.20	muscle	0.03	0.15		
				5.00		0.05	0.01		
				15.00		0.09	0.01		
				30.00		0.17	0.01		
				60.00		0.43	0.01		

Appendix N6. BAFs (kg wet food/kg wet tissue) for cadmium for mammals in laboratory studies of lower category (less reliable or usefull). (continued)
Cd concentrations are expressed on WW basis, unless indicated otherwise.

species	exp. period	juvenile/adult sexe (start weight)	feed type	conc. feed	organ type	conc. organ	BAF organ	reference	Comment
Sorex araneus	12 weeks		commercial diet?					Dodds-Smith et al. (1992)	on DW basis
		males		302.00	liver	1682.10	5.57		
		females		302.00		2059.00	6.82		no steady state reached
				302.00	kidney	987.00	3.27		small weight loss induced by Cd
				302.00		1169.10	3.87		
				302.00	body	105.90	0.35		
				302.00		126.60	0.42		
LOWER CATEGORY STUDIES (CD APPLIED VIA DRINKWATER)									
Rattus norvegicus	90 days	females (180 g)	commercial food					Prigge (1978)	Cd applied in drinkwater
				25.00	liver	6.59	0.26		
				50.00		13.80	0.28		
				100.00		27.34	0.27		
				25.00	kidney	13.11	0.52		growth reduction at 50 and 100 ppm Cd
				50.00		27.22	0.54		
				100.00		36.38	0.36		
Rattus norvegicus	11 months	females (8 weeks, 125 g)	basal diet	200.00	kidney	200.00	1.00	Bernard et al. (1981) in IPCS (1992)	Cd applied in drinkwater proteinuria steady state after 8 months
Rattus norvegicus	12 weeks	males	basal diet					Fowler et al. (1975)	Cd applied in drinkwater
			normal Ca	0.20	kidney	0.28	1.40		
				2.00		2.53	1.27		no comments on toxicity
				20.00		11.38	0.57		
				200.00		31.60	0.16		
			low Ca	0.20	kidney	0.63	3.15		
				2.00		3.62	1.81		
				20.00		13.39	0.67		
				200.00		40.38	0.20		
Rattus norvegicus	120 days	males (av. 175 g.)	basal diet					Itokawa et al. (1974)	
			Ca-adequate	5.00	kidney	123.00	24.60		Cd applied in drink water
			Ca-deficient	5.00		245.00	49.00		

Appendix N6. BAFs (kg wet food/kg wet tissue) for cadmium for mammals in laboratory studies of lower category (less reliable or usefull). (continued)
Cd concentrations are expressed on WW basis, unless indicated otherwise.

species	exp. period	juvenile/adult sexe (start weight)	feed type	conc. feed	organ type	conc. organ	BAF organ	reference	Comment
									Cd in organs expressed on dry weight basis
									severe growth reductions especially under Ca-deficiency
Rattus norvegicus	91 weeks	males (av. 150 g.)	basal diet					Kajikawa et al. (1981)	on wet weight basis?
				200.00	kidney-cortex	140.00	0.70		Cd applied in drinkwater
				200.00	kidney-medulla	34.00	0.17		Cd reduced growth
									steady state after 45 weeks
Rattus norvegicus	8.5 months	males	commercial pellets					Kawai et al. (1976) in IPCS (1992)	Cd applied in drinkwatwer
				10.00	kidney	12.24	1.22		
				50.00		38.42	0.77		
				100.00		100.06	1.00		Histological changes at 50 ppm Cd and higher.
				200.00		156.26	0.78		
				10.00	liver	4.20	0.42		
				50.00		29.80	0.60		
				100.00		78.10	0.78		
				200.00		143.10	0.72		
Rattus norvegicus	3 months	female (150 g)	diet unknown					Kawamura et al. (1978) in IPCS (1992)	Cd applied in drinkwater
			control	50.00	kidney	63.90	1.28		Cd conc in organ on DW basis
			low Ca	50.00		90.40	1.81		metabolical and histological effects
Rattus norvegicus	48-55 d.	adult males (av. 220 g.)	basal diet					Prigge et al. (1977)	on wet weight basis?
				25.00	liver	5.36	0.21		
				50.00		7.07	0.14		Cd applied in drinkwater
				100.00		21.57	0.22		at 100 ppm Cd reduced growth
				25.00	kidney	8.81	0.35		
				50.00		13.20	0.26		
				100.00		36.68	0.37		

Appendix N6. BAFs (kg wet food/kg wet tissue) for cadmium for mammals in laboratory studies of lower category (less reliable or usefull). (continued)
Cd concentrations are expressed on WW basis, unless indicated otherwise.

species	exp. period	juvenile/adult sexe (start weight)	feed type	conc. feed	organ type	conc. organ	BAF organ	reference	Comment
Mus musculus	12–16 m.	juveniles	basal diet	5.00	kidney	4.52	0.90	Schroeder et al. (1963a)	Cd applied in drinkwater
									after 18 months mortality increased
Mus musculus	6 months	juveniles (28 days)	basal diet					Koller et al. (1975)	Cd applied in drinkwater
				3.00	kidney	2.78	0.93		
				300.00		41.60	0.14		kidney lesions occurred
Apodemus sylvaticus	30 days	age 50 days	basal diet					Cooke et al. (1990a)	Cd applied in drinkwater
				10.00	liver	6.13	0.61		
									An approach of the dietary intake in the field situation.
				10.00	kidney	15.30	1.53		
Cryoptotis parva (Least Shrew)	2 weeks	adult	earthworms					Brueske and Barrett (1991)	on DW basis
			control	8.22	liver	0.18	0.02		
			contaminated	28.87		0.44	0.02		weight loss induced by Cd.
				8.22	kidney	0.32	0.04		
				28.87		0.39	0.01		

Appendix N7. Underlying data for BAFs (kg wet food/kg wet tissue) for cadmium in small mammals under field conditions.

species	feed type	site, season	conc. feed	organ type	conc. organ	BAF organ	reference	Comment
MAMMALS – FIELD								
CATEGORY 1 STUDIES								
Microtus agrestis	fine – leaved grass						Hunter and Johnson (1982)	on DW basis
		control	0.23	liver	0.66	2.87		
		intermediate	1.10		1.42	1.29		no comment on toxic effects
		refinery	2.00		7.71	3.86		
			0.23	kidney	1.30	5.65		toxic effects for S. araneus may be expected to have occurred at the both polluted sites.
			1.10		4.06	3.69		
			2.00		23.30	11.65		
			0.23	muscle	0.14	0.61		
			1.10		0.51	0.46		
			2.00		0.46	0.23		
			0.23	brain	0.12	0.52		
			1.10		0.33	0.30		
			2.00		0.23	0.12		
			0.23	bone	0.57	2.48		
			1.10		1.44	1.31		
			2.00		1.59	0.80		
			0.23	body	0.15	0.65		
			1.10		1.00	0.91		
			2.00		1.52	0.76		
Apodemus sylvaticus	vegetation, seeds fruits, invertebtates		0.20	liver	0.51	2.55		
			1.00		1.38	1.38		
			2.10		1.46	0.70		
			0.20	kidney	1.46	7.30		
			1.00		5.51	5.51		
			2.10		7.40	3.52		
			0.20	muscle	0.19	0.95		
			1.00		0.06	0.06		
			2.10		0.20	0.10		
			0.20	brain	0.13	0.65		
			1.00		0.11	0.11		
			2.10		0.03	0.01		
			0.20	bone	0.85	4.25		
			1.00		0.94	0.94		
			2.10		1.50	0.71		
			0.20	body	0.20	1.00		
			1.00		1.20	1.20		
			2.10		1.50	0.71		
Sorex araneus	invertebrates		1.50	liver	25.40	16.93		
			7.50		237.30	31.64		
			12.80		280.00	21.88		
			1.50	kidney	25.70	17.13		
			7.50		139.40	18.59		
			12.80		193.00	15.08		
			1.50	muscle	1.70	1.13		
			7.50		3.20	0.43		
			12.80		4.80	0.37		
			1.50	brain	1.41	0.94		
			7.50		0.75	0.10		
			12.80		2.36	0.18		
			1.50	bone	3.65	2.43		
			7.50		3.30	0.44		
			12.80		3.00	0.23		
			1.50	body	2.20	1.47		
			7.50		21.50	2.87		
			12.80		28.10	2.20		
Microtus agrestis	grass (4 spp)						Hunter et al. (1989)	feed concentrations are derived from Hunter et al. (1987c)
		control	1.00	liver	0.70	0.70		
		1 km site	1.60		8.70	5.44		
		refinery	3.60		22.70	6.31		on DW basis
			1.00	kidney	1.70	1.70		
			1.60		23.90	14.94		In Sorex Cd accumulation proceded linearly with age (dry weight) for both liver and kidney
			3.60		88.80	24.67		
			1.00	pancreas	1.60	1.60		
			1.60		2.10	1.31		
			3.60		2.50	0.69		In Sorex, kidney and liver contain 39% and 93% of total Cd body burden, at control site and refinery site, respectively
			1.00	brain	0.22	0.22		
			1.60		0.30	0.19		
			3.60		0.31	0.09		
			1.00	lung	1.05	1.05		The authors expect a population effect (adults) at the polluted sites
			1.60		1.12	0.70		
			3.60		1.95	0.54		

Appendix N7. Underlying data for BAFs (kg wet food/kg wet tissue) for cadmium in small mammals under field conditions. (continued)

species	feed type	site, season	conc. feed	organ type	organ conc. organ	BAF organ	reference	Comment
			1.00	testis	0.93	0.93		
			1.60		0.96	0.60		
			3.60		1.23	0.34		
			1.00	muscle	0.12	0.12		
			1.60		0.36	0.22		
			3.60		0.50	0.14		
			1.00	bone	0.54	0.54		
			1.60		1.21	0.76		
			3.60		1.65	0.46		
			1.00	hair	0.28	0.28		
			1.60		0.61	0.38		
			3.60		1.12	0.31		
			1.00	body	0.58	0.58		
Apodemus sylvaticus	seeds, fruits, green plants, invertebrates		1.05	liver	0.40	0.38		
			1.55		1.80	1.16		
			3.00		18.20	6.07		
			1.05	kidney	2.00	1.90		
			1.55		8.50	5.48		
			3.00		41.70	13.90		
			1.05	pancreas	2.00	1.90		
			1.55		1.60	1.03		
			3.00		1.10	0.37		
			1.05	brain	0.12	0.11		
			1.55		0.13	0.08		
			3.00		0.12	0.04		
			1.05	lung	0.51	0.49		
			1.55		0.68	0.44		
			3.00		0.80	0.27		
			1.05	testis	0.85	0.81		
			1.55		0.93	0.60		
			3.00		0.96	0.32		
			1.05	muscle	0.16	0.15		
			1.55		0.15	0.10		
			3.00		0.22	0.07		
			1.05	bone	0.54	0.51		
			1.55		1.10	0.71		
			3.00		0.89	0.30		
			1.05	hair	0.42	0.40		
			1.55		0.60	0.39		
			3.00		1.08	0.36		
Sorex araneus	invertebrates		1.88	liver	13.60	7.23		
			16.20		245.00	15.12		
			55.00		578.00	10.51		
			1.88	kidney	20.50	10.90		
			16.20		156.00	9.63		
			55.00		253.00	4.60		
			1.88	pancreas	2.20	1.17		
			16.20		10.20	0.63		
			55.00		28.10	0.51		
			1.88	brain	1.25	0.66		
			16.20		1.42	0.09		
			55.00		2.40	0.04		
			1.88	lung	2.33	1.24		
			16.20		1.85	0.11		
			55.00		2.51	0.05		
			1.88	testis	2.41	1.28		
			16.20		3.03	0.19		
			55.00		2.82	0.05		
			1.88	muscle	1.12	0.60		
			16.20		3.27	0.20		
			55.00		4.76	0.09		
			1.88	bone	2.04	1.09		
			16.20		2.84	0.18		
			55.00		4.25	0.08		
			1.88	hair	0.54	0.29		
			16.20		1.11	0.07		
			55.00		1.63	0.03		
			1.88	body	3.20	1.70		
			55.00		93.30	1.70		
			55.00		47.50	0.86		

Appendix N7. Underlying data for BAFs (kg wet food/kg wet tissue) for cadmium in small mammals under field conditions. (continued)

species	feed type	site, season	conc. feed	organ type	organ conc. organ	BAF organ	reference	Comment
Microtus agrestis	cover vegetation						Andrews et al. (1984)	on DW basis
		control	1.21	liver	1.14	0.94		
		polluted	4.75		1.88	0.40		All shrews were under 6 months of age
			1.21	kidney	1.75	1.45		
			4.75		5.21	1.10		Unknown whether Cd induced toxic effects, but this
			1.21	muscle	0.32	0.26		may be expected to occur
			4.75		1.27	0.27		at the polluted site.
			1.21	femur	0.43	0.36		
			4.75		0.69	0.15		
			1.21	heart	0.74	0.61		
			4.75		1.02	0.21		
			1.21	body	0.88	0.73		
			4.75		1.84	0.39		
Sorex araneus	invertebrates		2.10	liver	2.85	1.36		
			23.20		235.80	10.16		
			2.10	kidney	4.13	1.97		
			23.20		158.10	6.81		
			2.10	muscle	0.81	0.39		
			23.20		8.04	0.35		
			2.10	femur	1.00	0.48		
			23.20		1.89	0.08		
			2.10	heart	2.03	0.97		
			23.20		49.10	2.12		
			2.10	body	1.19	0.57		
			23.20		52.70	2.27		
Microtus agrestis	grasses						Cooke et al. (1990b)	on dry weight basis
		control	1.63	liver	1.10	0.67		
		polluted	2.30		1.80	0.78		The populations existed juveniles and young adults.
			1.63	kidney	1.70	1.04		
			2.30		5.27	2.29		No difference in response between males and females.
			1.63	femur	0.46	0.28		
			2.30		0.67	0.29		On the polluted site
			1.63	body	0.91	0.56		body weight of A.sylvaticus was sign. lower
			2.30		1.76	0.77		Probably on dry weight basis.
Apodemus sylvaticus	seeds, fruits, leaves, etc.		1.54	liver	0.26	0.17		
			2.80		0.71	0.25		Gut content was used for estimation of food conc..
			1.54	kidney	1.28	0.83		
			2.80		1.78	0.64		
			1.54	femur	0.19	0.12		
			2.80		0.19	0.07		
			1.54	body	0.52	0.34		
			2.80		1.08	0.39		
Sorex araneus	invertebrates		3.50	liver	2.90	0.83		
			48.00		219.00	4.56		
			3.50	kidney	4.10	1.17		
			48.00		149.00	3.10		
			3.50	femur	1.00	0.29		
			48.00		2.20	0.05		
			3.50	body	1.20	0.34		
			48.00		51.40	1.07		
Microtus agrestis	grasses, herbs						Ma et al. (1991)	on DW basis
		control,s	0.30	liver	0.12	0.40		
		, autumn	0.28		0.13	0.46		For Sorex toxic effects
		pol, sum.	0.53		0.19	0.36		can be expected at the
		, autumn	0.48		0.57	1.19		polluted site.
			0.30	kidney	0.09	0.30		
			0.28		0.22	0.79		
			0.53		1.00	1.89		
			0.48		2.70	5.63		
Sorex araneus	invertebrates		10.20	liver	10.00	0.98		
			22.10		30.00	1.36		
			38.00		77.00	2.03		
			48.70		180.00	3.70		
			10.20	kidney	14.00	1.37		
			22.10		31.00	1.40		
			38.00		81.00	2.13		
			48.70		126.00	2.59		

Appendix N7. Underlying data for BAFs (kg wet food/kg wet tissue) for cadmium in small mammals under field conditions. (continued)

species	feed type	site, season	conc. feed	organ type	conc. organ	BAF organ	reference	Comment
Talpa europea	earthworms						Ma (1987)	on DW basis
		uncontaminated	19.00	liver	30.00	1.58		
		contaminated 1	79.00		227.00	2.87		Nephrotoxicity is likely
		contaminated 2	114.00		172.00	1.51		at the polluted sites.
			19.00	kidney	59.00	3.11		
			79.00		224.00	2.84		
			114.00		221.00	1.94		
Talpa europea	earthworms (Lumbricus rubellus)		77.00	kidney	197.00	2.56	Denneman (1990)	on DW basis toxicity is not considered.
Microtus agrestis	herbage						Beardsley et al. (1978)	on DW basis
		unpolluted	0.21	liver	1.00	4.76		
		polluted	0.71		5.00	7.04		no comment on toxicity
			0.21	kidney	5.00	23.81		
			0.71		8.00	11.27		
			0.21	brain	0.40	1.90		
			0.71		0.20	0.28		
			0.21	femur	0.10	0.48		
			0.71		0.30	0.42		
			0.21	r.carcase	1.00	4.76		
			0.71		1.00	1.41		

LOWER CATEGORY STUDY

species	feed type	site, season	conc. feed	organ type	conc. organ	BAF organ	reference	Comment
Clethrionomys glareolus (Bank Vole)	vegetation						Wlostowski (1987)	unclear are diet and whether it is on WW or DW basis
		spring	6.00	liver	15.20	2.53		
		autumn	6.00		8.50	1.42		
		autumn	5.00		7.20	1.44		
Apodemus agrarius	vegetation							
		spring	6.00	liver	16.20	2.70		
		autumn	6.00		7.00	1.17		
		autumn	5.00		7.00	1.40		

REFERENCES APPENDICES H - N (BCFs and BAFs for the selected chemicals)

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Appendix O

Relative organ weights of birds and mammals

Appendix O1. Relative organ and tissue weights of food (prey) types. Expressed as percentages of body weight (WW basis). Average values calculated from the data presented in Appendix O2.

		organ/tissue	mean	SD	N	Min	Max
Birds	juveniles	kidney	0.8	0.2	2	0.6	1.1
		liver	2.5	0.9	3	1.4	3.6
		muscle	n.d.				
		fat	n.d.				
	adults	kidney	0.8	0.3	4	0.4	1.2
		liver	2.0	1.2	10	0.3	4.9
		muscle	31.2	10.7	4	15.2	43.0
		fat	8.9	9.0	18	0.5	35.0
Mammals	juveniles	kidney	n.d.				
		liver	n.d.				
		muscle	n.d.				
		fat	20.0	–	1	–	–
	adults	kidney	1.4	0.7	25	0.5	3.9
		liver	5.0	1.3	23	2.5	7.4
		muscle	52.6	12.7	6	32.9	73.0
		fat	9.4	7.7	16	0.6	35.0
Earthworms		fat	1.2	–	2	0.7	1.7
Caterpillars		fat	13.3	–	1	–	–
Collembolans		fat	4.0	–	1	–	–
Isopods		fat	2.9	1.1	5	1.5	4.7
Plant leaves		fat	1.6	0.4	2	1.3	1.8

Appendix O2: Relative organ and tissue weights and fat percentages of organs and tissues of several food types.

species	age, sex lab/field	treatment, season, dead, alive	organ type	rel. weight (% of BW)	%lipid in organ	reference	comment
BIRDS							
Coturnix c. japonica	2-weeks		liver	3.55		Jacobs et al. (1983)	on WW basis
			kidney	1.06			
			duodenum	1.49			
			jej.-ileum	1.73			
Coturnix c. japonica	20-weeks		liver	2.44		Dieter (1974)	on WW basis
Coturnix c. japonica	adults		liver	1.53		Leonzio et al. (1992)	
		Cd added	liver	1.75			
Anas platyrhynchos	juveniles (32 weeks)		liver	1.42		DiGiulio and Scanlon (1985)	on WW basis
			kidney	0.61			
			brain	0.40			
			testes	0.71			
Anas platyrhynchos	juveniles (12 weeks)		liver	2.55		Cain et al. (1983)	on WW basis? youger birds have higher liver weights: at 4 and 8 weeks 3.70 and 3.30 g., resp.
Anas platyrhynchos	adults	low Cd	liver	0.33		White and Finley (1978)	on WW basis
		high Cd		0.49			
			liver	2.5		Ronis and Walker (1989)	birds on average
Birds (in general)			fat	4 - 35		Garten and Trabalka (1983)	
Sparrowhawk (Accipiter nisus)		found dead	fat	0.64-8.88		Bogan and Newton (1977)	sparrowhawks found dead
Bald eagle			carcase		0.5-22.0	Barbehenn and Reichel (1981)	
			brains		4.5-9,2		
migratory insectivores	19 spp.		lipids	8.13		DeWeese et al. (1986)	prey species of the peregrine falcon in the USA in the breeding season
migratory omnivores	7 spp.		lipids	4.31			
migratory granivores	1 spp.		lipids	3.80			birds were plucked, and the beak, tarsis, and entire gastrointestinal tract removed
nonmigrat. omnivores	10 spp.		lipids	4.04			
nonmigrat. granivores	1 spp.		lipids	6.60			
White-crowned sparrow (a migratory passarine)	adults		lipids			King and Farner (1956)	increase in energy intake resulted in fat storage
			in januari	10			
			in march	5			
			2nd half april	20			
Song Thrush (Turdus ericetorum)	adult, 75 g		liver	4.85		Jefferies and Davis (1968)	on WW basis
			muscle	28.25			
	n = 4		fat	1.25			the remainder was composed of: alimentary tract, glandular tissue, preen gland, gonads and ducts, lungs and trachea, blood auricles, skin, eyes.
			brain	1.55			
			heart	0.73			
			kidney (2)	1.21			
			remainder	13.75			
			gut contents	3.86			the missing part (24.19%) may be beak and feet (not rep.)
			feathers	6.72			
			bones	13.64			
			alim. tract	4.00			weight of both breast muscles (pectoralis major and supra-coricoideus formed 53.5% of total muscle weight
			total	75.81			
Homing Pigeon	BE: 330-460 g	unstressed	omental fat		85.90	Findlay and de Freitas (1971)	stress was created by starvation for 6 days, when the birds had lost 18-20% of initial BW and 50-75% of total carcase lipid.
			heart		5.79		
			brain		9.78		
			b. muscle		3.33		
			liver		4.27		
			plasma		1.19		in unstressed birds the DDT conc on lipid basis was fairly constant: approx. 1000 ppm, in stressed birds it was doubled in fat, breast muscle, and heart and not in the other organs
			erythrocytes		0.54		
					% lipid		
		stressed	omental fat		42.30		
			heart		3.98		
			brain		9.51		
			b. muscle		3.30		
			liver		4.98		
			plasma		1.32		
			erythrocytes		0.57		
			muscle	44 *		Findlay and de Freitas (1971)	*) as a percentage of the plucked carcass
Pheasant (Phasianus colchicus)			muscle	43.00		Tejning (1967)	
			liver	2.17			
			kidney	0.43			
			feathers	0.015			

Appendix O2: Relative organ and tissue weights and fat percentages of organs and tissues of several food types. (continued)

species	age, sex lab/field	treatment, season, dead, alive	organ type	rel. weight (% of BW)	%lipid in organ	reference	comment
American Kestrel			fat	18		Henny and Meeker (1981)	
			fat		86.8		
			brain		6.5		
Blue-winged Teal (Anas discors)			total body		2-34	White et al. (1981)	no significant effects of sexe, age, and season (fall or spring)
		on average:	total body		8.83		
Black-eared Kite (Milvus migrans lineatus)	adults		liver	1.79		Honda et al. (1986)	on WW-basis
			kidney	0.68			
			pectoral muscle	15.68			
			femoral muscle	22.61			
			heart	1.14			
			lungs	1.35			
			skin	9.50			
			bone	16.50			
			feathers	14.56			
			rest	16.19			
Coturnix c. japonica	adult	dead	liver		1.6	Stickel et al. (1969)	dieldrin dosed diet (2-250 ppm) was used
		survived			9.2		
		dead	brain		8.2		residues in dead and in surviving birds were measured separately
		survived			8.2		
		dead	carcass		1.2		
		survived			6.3		carcass comprised body minus brain, liver, bill, feet, wings, skin, and gastrointestinal tract
Birds (22 sp.)	mainly adults		fat	19.2		Daan et al. (1990)	On lean DW-basis.
			breast muscle	11.0			
			leg muscle	4.2			The mean DW% is 40,6
			liver	2.3			
			kidney	0.7			The mean fat% on WW-basis is 7,8
			brain	0.6			
			heart	0.8			The rest fraction comprised skeleton, and remaining muscles and organs.
			skin	4.4			
			feathers	19.0			
			digestive tract	4.5			
			rest	32.5			

MAMMALS

species	age, sex lab/field	treatment, season, dead, alive	organ type	rel. weight (% of BW)	%lipid in organ	reference	comment
Mammals (in general)			fat	4 - 35		Garten and Trabalka (1983)	
Oryctolagus cunuculus	6 months	average	liver	2.50		Stowe et al. (1972)	on WW basis
			kidney	0.48			
			pancreas	0.04			
			brain	0.26			
			heart	0.21			
			lungs	0.45			
			spleen	0.04			
			adrenals	0.01			
			thyroid	0.01			
Apodemus sylvaticus	field		liver	3.89		Ma et al. (1989)	on WW basis
			kidney	1.23			
Clethrionomys glareolus	field		liver	5.01			
			kidney	1.20			
Sorex araneus	field		liver	6.02			
			kidney	1.70			
Sorex araneus	lab (7-9 g)		liver	4.95		Dodds-Smith et al. (1992)	on WW basis
			kidney	1.54			
		+ Cd	liver	5.77			on WW basis
			kidney	1.41			
			liver	4.35			on DW basis
			kidney	1.34			
		+ Cd	liver	4.72			on DW basis
			kidney	1.29			
Sorex araneus	field	- Cd	liver	7.00		Hunter et al. (1989)	on DW basis
			kidney	1.50			
Rattus norvegicus	males 553 g		liver	3.30		Lewi and Marsboom (1981)	Wistar age 5 months
			kidney	0.62			
			adrenal	0.03			
			brain	0.37			
			gonad	0.54			
			heart	0.28			
			lung	0.65			
			pancreas	0.33			
			spleen	0.19			
			thymus	0.09			
			thyroid	0.08			
	females 249 g		liver	3.31			
			kidney	0.68			

Appendix O2: Relative organ and tissue weights and fat percentages of organs and tissues of several food types. (continued)

species	age, sex lab/field	treatment, season, dead, alive	organ type	rel. weight (% of BW)	%lipid in organ	reference	comment
			adrenal	0.04			
			brain	0.57			
			gonad	0.05			
			heart	0.33			
			lung	0.73			
			pancreas	0.42			
			spleen	0.21			
			thymus	0.11			
			thyroid	0.10			
Rattus norvegicus	500 g		liver	3.90		Journal of Pharmaceutical Sciences	
			kidney	0.70		vol 72, no 10 pp: 1111	
			muscle	49.00			on WW basis
			fat	7.00			
			pancreas	0.40			
			gut	2.30			
			gut lumen	1.80			
			heart	0.20			
			lungs	0.40			
			spleen	0.30			
			plasma	3.90			
Mus musculus	22 g		kidney	1.50		Journal of Pharmaceutical Sciences	
			muscle	59.00		vol 72, no 10 pp: 1111	
			fat	n.d.			on WW basis
			pancreas	n.d.			
			gut	6.80			
			gut lumen	6.80			
			heart	0.40			
			lungs	0.50			
			spleen	0.50			
			plasma	4.50			
Oryctolagus cuniculus	2330 g		kidney	3.90		Journal of Pharmaceutical Sciences	
			muscle	57.90		vol 72, no 10 pp: 1111	
			fat	n.d.			on WW basis
			pancreas	n.d.			
			gut	5.20			
			gut lumen	n.d.			
			heart	0.30			
			lungs	0.70			
			spleen	0.04			
			plasma	3.00			
lab. rat en lab. mouse	BW rat: 300 g		liver	4.00		Ramsey and Andersen (1984)	Sprague-Dawley rat (males)
	BW mouse: 22 g		muscle	73.00			
			fat	9.00			on WW basis
lab. mouse			fat	9.60		Wijnandts (1984)	
Apodemus sylvaticus	field			2.80			
Microtus arvalis	field	summer	fat	10.30		Masman et al. (1986)	prey of the kestrel
		winter		13.90			on DW basis
		summer	protein	75.80			
		winter		71.40			
		summer	ash	13.20			
		winter		14.60			
Sorex araneus	field	summer	fat	9.30			
			protein	80.50			
			ash	10.60			
Crocidura russula			liver	5.93		Bartels et al. (1979)	BW C. russula is 8.95 g (+1.55)
			kidney	1.56			
			fat	14.10			on WW basis
			adrenals	0.02			
			lungs	0.80			
			heart	0.72			
			spleen	1.06			
Microtus drummondi (Meadow Vole)			liver	4.60			BW M. drummondi = 23 g
			kidney	1.50			
			fat	n.d.			
			adrenals	0.03			
			lungs	1.70			
			heart	0.70			
			spleen	n.d.			
Man			liver	2.30			BW Man = 67 kg
			kidney	0.40			
			fat	n.d.			
			adrenals	0.02			
			lungs	0.70			
			heart	0.40			
			spleen	0.25			
Sorex araneus	young adults (BW is 7.0 g)	summer	adipose, brown	1.32		Pucek (1965)	WW basis
			liver	7.20			
			kidney	2.09			
			heart	1.08			
			brain	3.77			
			spleen	1.28			
	Young adults	winter	adipose, brown	1.26			

Appendix O2: Relative organ and tissue weights and fat percentages of organs and tissues of several food types. (continued)

species	age, sex lab/field	treatment, season, dead, alive	organ type	rel. weight (% of BW)	%lipid in organ	reference	comment
	(BW is 5.8 g)		liver	?			
			kidney	2.08			
			heart	1.28			
			brain	3.81			
			spleen	0.34			
	old adults	summer	adipose, brown	0.95			
	(BW is 11.0 g)		liver	7.11			
			kidney	1.80			
			heart	1.06			
			brain	2.04			
			spleen	1.12			
Talpa europaea	BW is 85 g		liver	5.8		Pucek (1965)	
			kidney	1.2			
			spleen	1.1			
Mus musculus	BW is 10.3 g		liver	5.93			
			kidney	1.48			
			spleen	0.48			
			brain	3.86			
Apodemus sylvaticus	BW is 11.28 g		liver	7.43			
			kidney	1.79			
			spleen	0.55			
			brain	4.98			
Lab. rat	males, 6 m		liver	4.14		Verschuuren et al. (1976)	
			kidneys	0.716			
			brain	0.482			
			heart	0.264			
	females, 6 m		liver	4.44			
			kidneys	0.919			
			brain	0.767			
			heart	0.365			
Wood Mouse		polluted	body		5.7	Prins (1982)	Field data from a polluted area (Volger–
(Apodemus sylvaticus)		clean			11.3		meerpolder)
Common Shrew		polluted	body		3.2		
(Sorex araneus)		clean			3.8		
Lab. rat			muscle	32.85		RIVM, TOX (pers. com.)	
			liver	4.5			
			kidney	0.78			
			fat	0.57			
Rat	weanlings						
	males		carcass	20		Bernadies and deDennis (1977)	
			liver		2.6		
Human	adult		adipose (fatty)		61.4–87.3	M. Zeilmaker RIVM (pers. com.)	
			average		71.4		
			muscle, cardic		2.4–10.0		
					6.2		
			muscle,skeletal		1.6–6.8		
					4.2		
			liver		1.5–7.8		
					4.6		
			kidney		2.8–6.9		
					4.8		
			brain		9–17		
					–		
			skin		5.2–13.5		
					9.4		
			bones		1		
			hair		2.3		
			blood		0.65		
PLANTS AND INVERTEBRATES							
caterpillar				13.3		Winter and Streit (1993)	
leaves				1.3			
Italian Ryegrass (Lolium multiforum)			fat	1.8		Weigel et al. (1987)	
Lumbricus rubellus		autumn			0.7–1.7	Van Gestel (pers. com.)	
Oniscus asellus		autumn			1.5–2.6		
Philescia muscorum		autumn			1.5–3.2		
		winter			3.3		
		summer			2.0		
					4.7		
Orchesella cincta					4.0		
Lithobius spp.		summer			3.8		

REFERENCES APPENDIX O (relative organ weights of birds and mammals)

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Appendix P

Water content of food types and organs of birds and mammals

Appendix P1: Water content of food types. Average values calculated from the data presented in Appendices P2 and C.

Food type)	mean	sd	N	min	max
Annelida	82.0	1.8	5	79.0	84.8
Chelicerata (Arachnida)	69.7		1		
Chilopoda	68.0		1		
Crustacea	66.7	6.8	10	53.3	76.7
Diplopoda					
Fungi	90.0	0.0	2	90.0	90.0
Insecta (all)	71.1	8.9	24	51.0	87.0
Coleoptera	60.9		1		
Larvae	79.8	4.4	7	75.0	87.0
Insecta (rest)	69.4	7.2	9	59.0	82.0
Mollusca	82.6	4.7	3	76.0	86.3
Moss					
Tree seeds					
Tree seed kernels	16.8	13.1	15	5.0	54.0
Birds *	66.6	6.6	40	56.0	83.0
Mammals *	73.0	7.6	37	60.9	86.0
Fish	74.5	5.4	19	62.3	81.8
Fodder (birds)	9.3	0.7	2	8.6	10.0
Fodder (mammals)	7.3	1.0	3	6.0	8.4
Plant seed kernels	15.0		1		
Plant seeds	24.4	28.4	6	6.3	87.6
Conifer needles					
Conifer seeds					
Conifer seed kernels	12.2	4.1	5	6.9	19.0
Plant fruits	83.1	5.5	13	71.1	88.0
Plant leaves	91.5	3.4	10	85.0	95.5
Plant roots	90.6	3.8	3	85.7	95.0
Plant stems					
Plant tissue					
Plant tubers	85.9	6.0	2	79.8	91.9

* Water content of birds and mammals depends on several factors, especially on age. An appropriate estimation for water content in both birds and mammals is 70%.

Appendix P2: Water content of food types. These are a supplement to the data concerning water content in Appendix C.

species/feed	season, age, etc.	treatment	organ type	% water	reference	comments
BIRDS						
birds in general			kidney	80.0	IPCS (1992b)	
migratory insectovores	19 spp.		body	65.1	DeWeese et al. (1986)	Prey species of the peregrine falcon in the USA in the breeding season.
migratory omnivores	7 spp.		body	67.6		
migratory granivores	1 spp.		body	69.3		Birds were plucked, and the beak, tarsis and entire gastrointestinal tract removed.
nonmigrat. omni.	10 spp.		body	68.9		
nonmigrat. granivores	1 spp.		body	67.8		
Meadow pipit (Anthus pratensis)	2 weeks		body	84.0	Skar (1970)	
	adult		body	64.0		
Coturnix c. japonica	adults	dieldrin dosed				
		died	liver	30.0	Stickel et al. (1969)	Carcass comprised body minus brain, liver, bill, feet, wings, skin, and gastro-intestinal tract.
		survived		35.2		
		died	brain	23.8		
		survived		23.0		
		died	carcass	28.5		
		survived		31.8		
birds (22 sp.)			body	59.4	Daan et al. (1990)	
Passer domesticus				65.6	Wijnandts (1984)	
birds (average)	summer			73.6	Masman et al. (1986)	
birds (in general)	adults			72.5		In adults water and fat are inversely proportional to each other In juveniles, the water content is higher in altricial than in precocials.
MAMMALS						
Talpa europea	field population		kidney	74.7	Ma (1987)	These water percentages may also be used for other small mammals (Ma et al. 1991).
			liver	71.4		
Sorex araneus	adults	control	body	67.1	Dodds-Smith et al. (1992)	
			liver	71.1		
			kidney	71.4		
		302 ppm Cd	body	67.2		
			liver	73.2		
			kidney	70.0		
Microtus agrestis				79.1	Hansson and Grodzinski (1970)	
Mus musculus				69.7	Tollan (1988)	
Mus musculus				66.9	Wijnandts (1984)	
Microtus arvalis				67.0		
Micromys minutus				67.0		
Apodemus sylvaticys				63.1		
Soricidae				68.8		
Sorex araneus	summer			69.3	Masman et al. (1986)	
Microtus arvalis	summer			72.0		
	winter			67.7		
laboratory mouse (M. musculus)	new-born			83.3	Robbins (1983)	
laboratory rat (R. norvegicus)				86.0		
domestic rabbit (O. cuniculus)				84.6		
Common Vole (M. arvalis)				83.5		
Bank Vole (C. glareolus)				84.5		
Old-field Mouse				83.3		
mammals (in general)	adults			68.7-70.1	Robbins (1983)	on fat-free basis
Rattus norvegicus			bone	34.0	Marco Zeilmaker RIVM (pers. com.)	For rabbit dry matter percentages were comparable with those of rats.
			brain	78-83.3		
			kidney	74-88.6		
			liver	70-86		
			lung	78.7-82.0		
			muscles	75.5-78.4		
			skin	56.7-64.7		
			spleen	78.0		
			testis	68-85		
Human			bone	12-23		
			brain	77.4		
			kidney	76.6		
			liver	74.5		
			lung	71.8-84.0		

Appendix P2: Water content of food types. These are a supplement to the data concerning water content in Appendix C. (continued)

species/feed	season, age, etc.	treatment	organ type	% water	reference	comments
Human			muscles	70.0–80.9		
			skin	75.0		
			spleen	77.0		
			testis	82.7		
			blood	79–80.8		
			hair	4–13		
			fat	11.4–30.5		
			fat on aver.	21.2		
			body	60.0		
INVERTEBRATES						
snails and slugs	5 spp.		body	85.4	Knutti et al. (1988)	
annelids	3 spp.			81.7		
spiders	4 spp.			69.7		
woodlice	3 spp.			53.3		
centipeds	2 spp.			68.0		
dipeds	5 spp.			54.7		
grasshoppers, bugs, earwigs, plant–lice etc.	5 spp.			68.2		
beetles (groundbeatles, lady bugs)	15 spp.			60.9		
ants	5 spp.			67.0		
butterflies	4 spp.			51.0		
hovering flies				67.0		
lacewings				59.0		
earthworms				75–83	Romijn et al. (1991b)	
Leatherjacket (Tipula paludosa)				79.0	Westerterp et al. (1982)	
Earthworms (Lumbricidae)				82.0		
caterpillars (Cerapteryx graminis)				75.0		
flies (Diptera)				73.0		
flies (Diptera)				73.7	Nuorteva and Nuorteva (1982)	
isopods				76.7	Forsyth et al. (1983)	
firefly larvae				76.3		
crickets				76.3		
earthworms				82.3		
slugs				86.3		
VEGETATIVE MATERIAL						
grass				85.0	Hansson (1971)	
lettuce				95.5	Ng et al. (1982)	in Bockting and v.d. Berg (1992)
spinach				90.7		
raspberry				84.2	Ng et al. (1982)	in Bockting and v.d. Berg (1992)
carrot				91.9	Wiersma et al. (1985)	
grains				15.0		
apple				85.7		
tree seeds (19 European spp)				9 – 15	Grodzinski and Sawicka–Kapusta (1970)	
plant litter				10–90	M.P.M. Janssen RIVM (pers. com.)	Very variable, depending on rainfall, type of litter etc..
LABORATORY FODDER						
commercial starter–grower duck ration				10.0	DiGiulio and Scanlon (1985)	
commercial diet for quails, pheasants, chickens and ducks				10 – 11	Hope Farms Woerden (M.E. Keij, pers. com.)	
basal diet for lambs				8.4	Doyle et al. (1974)	
commercial pelleted food (CLEA CR–2) for rabbits				6.0	Nomiyama et al. (1975)	
laboratory rat diet				5 – 10	G. Meyer RIVM (pers. comm.)	

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