Model KABAM (K_{OW} (based) Aquatic BioAccumulation Model)

Version 1.0

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Developers Environmental Fate and Effects Division (OPP-EFED) in collaboration with ORD

When to use this model

KABAM should be used for pesticides with the following characteristics:

The pesticide is a non-ionic, organic chemical.
The Log K_{OW} value is between 4 and 8.
The pesticide has the potential to reach aquatic habitats.

Model Description

KABAM is used to estimate potential bioaccumulation of hydrophobic organic pesticides in freshwater aquatic ecosystems and risks to mammals and birds consuming aquatic organisms which have bioaccumulated these pesticides. This tool can also be used to estimate pesticide concentrations in fish tissues consumed by humans (i.e., filets). The bioaccumulation portion of KABAM is based upon work by Arnot and Gobas (2004) who parameterized a bioaccumulation model based on PCBs and some pesticides (e.g., lindane, DDT) in freshwater aquatic ecosystems. KABAM relies on a chemical's octanol-water partition coefficient (K_{OW}) to estimate uptake and elimination constants through respiration and diet of organisms in different trophic levels. Pesticide tissue residues are calculated for different levels of an aquatic food web. The model then uses pesticide tissue concentrations in aquatic animals to estimate dose- and dietary-based exposures and associated risks to mammals and birds consuming aquatic organisms, using an approach that is similar to the T-REX model (USEPA 2008).

KABAM incorporates 7 trophic levels to describe bioaccumulation of a pesticide in a model aquatic food web:
1) phytoplankton
2) zooplankton (e.g., *Daphnia sp.*)
3) benthic invertebrates (e.g., *Chironomus sp* ., crayfish)
4) filter feeders (e.g., mussels, clams)
5) small fish (e.g., young of the year)
6) medium sized fish (e.g., adult bluegill)
7) larger upper-trophic level fish (e.g., largemouth bass)

Pesticide concentrations in organisms of the aquatic trophic levels listed above are used to estimate acute and chronic exposures of mammals and birds consuming aquatic organisms. The model user can define the mammals and birds of concern, by defining the body weight and diet of each bird and mammal. Default values are available for several mammals and birds of concern. Available pesticide-specific acute and chronic toxicity data for mammals and birds are used to calculate risk quotients for estimated exposures due to bioaccumulation of a pesticide in an aquatic ecosystem.

Model inputs are included in the 2 "Inputs" worksheets. The only required inputs to the KABAM tool are:

1) Log K_{OW} value of the pesticide
2) K_{OC} value of the pesticide
3) predicted pesticide concentration in sediment pore water (PRZM/EXAMS)
4) predicted pesticide concentration in water (PRZM/EXAMS)

5) available acute and chronic toxicity data for pesticide specific exposures to birds and mammals.

All other inputs in the "chemical specific inputs" and "ecosystem inputs" worksheets have default values. No input is necessary from the model user, but these parameter values can be altered according to the preferences of the user. The model user should consult the User's guide for KABAM before altering default values in the KABAM tool. If default parameter values are altered by the model user, their cells will be highlighted yellow.

The "Parameters & Calculations" worksheet allows the model user to see which parameters were incorporated into the calculation of the tissue concentrations of the pesticide of interest. This worksheet is read only.

The "Results" page includes pesticide tissue concentrations per trophic level, separate contributions of dietary and respiratory intakes to overall pesticide body concentration of aquatic organisms. It also includes bioconcentration, bioaccumulation, biomagnification and biota-sediment accumulation factors (BCF, BAF, BMF and BSAF, respectively) for aquatic organisms. In addition, this page also incorporates potential dietary and dose exposures of the pesticide of concern to mammals and birds consuming aquatic organisms. This worksheet is read only.

For a thorough description of KABAM, its assumptions, calculations, uncertainties and additional guidance, see the user's guide and technical documentation.

References

Arnot, J.A. and F.A.P.C. Gobas. 2004. A food web bioaccumulation model for organic chemicals in aquatic ecosystems. Environmental Toxicology and Chemistry, v23 (10), 2343-2355.

Mineau, P., Collins, B.T. and A. Baril. 1996. On the use of scaling factors to improve interspecies extrapolation of acute toxicity in birds. Regulatory Toxicology and Pharmacology, 24: 24-29.

USEPA. 2002. Guidance for Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides, Version II. US Environmental Protection Agency, Washington DC. Online at: http://www.epa.gov/oppefed1/models water/input_guidance2_28_02.htm.

USEPA. 2008. User's Guide: T-REX Version 1.4.1 (Terrestrial Residue Exposure model). United States Environmental Protection Agency. Environmental Fate and Effects Division.

Table 1. Chemical characteristics of pendimethalin.		
Characteristic	**Value**	**Comments/Guidance**
Pesticide Name	**pendimethalin**	**Required input**
Log K_{OW}	**5.18**	**Required input** Enter value from acceptable or supplemental study submitted by registrant or available in scientific literature.
K_{OW}	**151356**	No input necessary. This value is calculated automatically from the Log K_{OW} value entered above.
K_{OC} (L/kg OC)	**17040**	**Required input** Input value used in PRZM/EXAMS to derive EECs. Follow input parameter guidance for deriving this parameter value (USEPA 2002).
Time to steady state (T_S; days)	**44**	No input necessary. This value is calculated automatically from the Log K_{OW} value entered above.
Pore water EEC (µg/L)	**3.36**	**Required input** Enter value generated by PRZM/EXAMS benthic file. PRZM/EXAMS EEC represents the freely dissolved concentration of the pesticide in the pore water of the sediment. The appropriate averaging period of the EEC is dependent on the specific pesticide being modeled and is based on the time it takes for the chemical to reach steady state. Select the EEC generated by PRZM/EXAMS which has an averaging period closest to the time to steady state calculated above. In cases where the time to steady state exceeds 365 days, the user should select the EEC representing the average of yearly averages. The peak EEC should not be used.
Water Column EEC (µg/L)	**4.93**	**Required input** Enter value generated by PRZM/EXAMS water column file. PRZM/EXAMS EEC represents the freely dissolved concentration of the pesticide in the water column. The appropriate averaging period of the EEC is dependent on the specific pesticide being modeled and is based on the time it takes for the chemical to reach steady state. The averaging period used for the water column EEC should be the same as the one selected for the pore water EEC (discussed above).

Table 2. Input parameters for rate constants. "calculated" indicates that model will calculate rate constant.

Trophic level	k_1 (L/kg*d)	k_2 (d^{-1})	k_D (kg-food/kg-org/d)	k_E (d^{-1})	k_M* (d^{-1})
phytoplankton	calculated	calculated	0*	0*	0
zooplankton	calculated	calculated	calculated	calculated	0
benthic invertebrates	calculated	calculated	calculated	calculated	0
filter feeders	calculated	calculated	calculated	calculated	0
small fish	calculated	calculated	calculated	calculated	0
medium fish	calculated	calculated	calculated	calculated	0
large fish	calculated	calculated	calculated	calculated	0

* Default value is 0.

k_1 and k_2 represent the uptake and elimination constants respectively, through respiration.

k_D and k_E represent the uptake and elimination constants, respectively, through diet.

k_M represents the metabolism rate constant.

Table 3. Mammalian and avian toxicity data for pendimethalin. These are required inputs.				
Animal	**Measure of effect (units)**	**Value**	**Species**	**If selected species is "other," enter body weight (in kg) here.**
Avian	LD_{50} (mg/kg-bw)	1421	mallard duck	
	LC_{50} (mg/kg-diet)	4187	Northern bobwhite quail	
	NOAEC (mg/kg-diet)	141	Northern bobwhite quail	0.1
	Mineau Scaling Factor	1.15	Default value for all species is 1.15 (for chemical specific values, see Mineau et al. 1996).	
Mammalian	LD_{50} (mg/kg-bw)	1050	laboratory rat	
	LC_{50} (mg/kg-diet)	N/A	other	
	Chronic Endpoint	500	laboratory rat	
	units of chronic endpoint*	ppm		

*ppm = mg/kg-diet

Must enter mammalian body weight corresponding to LC50

Table 4. Abiotic characteristics of the model aquatic ecosystem.		
Characteristic	**Value**	**Guidance***
Concentration of Particulate Organic Carbon (X_{POC}; kg OC/ L)	0.00E+00	When using EECs generated by PRZM/EXAMS, use a value of "0" for both POC and DOC.
Concentration of Dissolved Organic Carbon (X_{DOC}; kg OC/L)	0.00E+00	
Concentration of Dissolved Oxygen (C_{OX}; mg O_2/L)	5.0	Default value is 5.0 mg O_2/L when using EECs generated by PRZM/EXAMS.
Water Temperature (T; ^oC)	13	Value is defined by the average water temperature of the EXAMS pond when using EECs generated by PRZM/EXAMS. Model user should consult output file of EXAMS to define this value.
Concentration of Suspended Solids (C_{SS}; kg/L)	3.00E-05	Default value is $3.00x10^{-5}$ kg/L when using EECs generated by PRZM/EXAMS.
Sediment Organic Carbon (OC; %)	4.0%	Default value is 4.0% when using EECs generated by PRZM/EXAMS.
*When using pesticide concentrations from monitoring data or mesocosm studies, consult Appendix B of the User's Guide for specific guidance on selecting values for these parameters.		

Table 5. Characteristics of aquatic biota of the model ecosystem.					
Trophic Level	**Wet Weight (kg)**	**% lipids**	**% NLOM**	**% Water**	**Do organisms in trophic level respire some pore water?**
sediment*	N/A	0.0%	4.0%	96.0%	N/A
phytoplankton	N/A	2.0%	8.0%	90.0%	no
zooplankton	1.0E-07	3.0%	12.0%	85.0%	no
benthic invertebrates	1.0E-04	3.0%	21.0%	76.0%	yes
filter feeders	1.0E-03	2.0%	13.0%	85.0%	yes
small fish	1.0E-02	4.0%	23.0%	73.0%	yes
medium fish	1.0E-01	4.0%	23.0%	73.0%	yes
large fish	1.0E+00	4.0%	23.0%	73.0%	no

*Note that sediment is not a trophic level. It is included in this table because it is consumed by aquatic organisms of the KABAM foodweb.
N/A = not applicable

Table 6. Diets of aquatic biota of the model ecosystem.						
	Diet for:					
Trophic level in diet	**Zoo plankton**	**Benthic Invertebrates**	**Filter Feeder**	**Small Fish**	**Medium Fish**	**Large Fish**
sediment*	0.0%	34.0%	34.0%	0.0%	0.0%	0.0%
phytoplankton	100.0%	33.0%	33.0%	0.0%	0.0%	0.0%
zooplankton		33.0%	33.0%	50.0%	0.0%	0.0%
benthic invertebrates			0.0%	50.0%	50.0%	0.0%
filter feeders				0.0%	0.0%	0.0%
small fish					50.0%	0.0%
medium fish						100.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

*Note that sediment is not a trophic level. It is included in this table because it is consumed by aquatic organisms of the KABAM foodweb.

Table 7. Identification of mammals and birds feeding on aquatic biota of the model ecosystem.		
Mammal/Bird #	**Name**	**Body weight (kg)**
Mammal 1	fog/water shrew	0.018
Mammal 2	rice rat/star-nosed mole	0.085
Mammal 3	small mink	0.45
Mammal 4	large mink	1.8
Mammal 5	small river otter	5
Mammal 6	large river otter	15
Bird 1	small CRLF 1	0.0014
Bird 2	small CRLF 2	0.0014
Bird 3	med CRLF 1	0.037
Bird 4	med CRLF 2	0.037
Bird 5	large CRLF 1	0.238
Bird 6	large CRLF 2	0.238

Table 8. Diets of mammals feeding on aquatic biota of the model ecosystem.						
	Diet for:					
Trophic level in diet	**fog/water shrew**	**rice rat/star-nosed mole**	**small mink**	**large mink**	**small river otter**	**large river otter**
phytoplankton	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
zooplankton	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
benthic invertebrates	100.0%	34.0%	0.0%	0.0%	0.0%	0.0%
filter feeders	0.0%	33.0%	0.0%	0.0%	0.0%	0.0%
small fish	0.0%	33.0%	0.0%	0.0%	0.0%	0.0%
medium fish	0.0%	0.0%	100.0%	100.0%	100.0%	0.0%
large fish	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 9. Diets of birds feeding on aquatic biota of the model ecosystem.						
	Diet for:					
Trophic level in diet	**small CRLF 1**	**small CRLF 2**	**med CRLF 1**	**med CRLF 2**	**large CRLF 1**	**large CRLF 2**
phytoplankton	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
zooplankton	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
benthic invertebrates	0.0%	100.0%	100.0%	0.0%	100.0%	0.0%
filter feeders	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
small fish	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%
medium fish	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
large fish	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 10. Input parameters and calculations relevant to derivation of C_B.							
Parameter	**Phyto plankton**	**Zoo plankton**	**Benthic Invertebrates**	**Filter Feeders**	**Small Fish**	**Medium Fish**	**Large Fish**
Equation A1							
C_B	**0.033478**	**0.02639617**	**0.029614**	**0.019629**	**0.045322**	**0.056113**	**0.08441**
C_{BD}	0.000000	0.00106233	0.002791	0.002023	0.011910	0.024155	0.053884
C_{BR}	0.03347792	0.02533384	0.02682239	0.01760542	0.03341216	0.03195764	0.03052119
C_S	0.002290						
C_{WDP}	0.00000336						
C_{WTO}	0.00000493						
k_1	10380.105	42633.007	3799.671	1697.251	758.134	338.646	151.268
k_2	1.428587	8.234715	0.672043	0.456662	0.104234	0.046560	0.020797
k_D	0.000000	0.263265	0.093410	0.046079	0.046816	0.033143	0.023463
k_E	0.000000	0.049169	0.012068	0.009056	0.004592	0.004058	0.003136
k_G	0.100000	0.012559	0.003155	0.001991	0.001256	0.000792	0.000500
k_M	0	0	0	0	0	0	0
m_o	1	1	0.95	0.95	0.95	0.95	1
m_p	0	0	0.05	0.05	0.05	0.05	0
$\Sigma (P_i * C_{Di})$	0	0.033477922	0.020537108	0.02053711	0.02800493	0.0374679	0.05611252
Φ	1.00000000						
Equation A2							
X_{POC}	0.0000000						
X_{DOC}	0.0000000						
K_{OW}	151356						
Φ	1.00000000						
Equation A4							
C_S	0.0023						
C_{SOC}	0.0573						
C_{WDP}	0.00000						
K_{OC}	17040						
OC	4%						
Equation A5							
C_{ox}	N/A	5					
E_W	N/A	0.540241488					
G_V	N/A	0.007891472	0.703328201	3.14165167	14.0332425	62.6841919	280
k_1	10380.10495	42633.00686	3799.670736	1697.25057	758.133983	338.646011	151.267617
K_{OW}	151356						
W_B	N/A	0.0000001	0.0001	0.001	0.01	0.1	1

Table 10. Input parameters and calculations relevant to derivation of C_B.							
Parameter	**Phyto plankton**	**Zoo plankton**	**Benthic Invertebrates**	**Filter Feeders**	**Small Fish**	**Medium Fish**	**Large Fish**
Equation A6							
k_1	10380.10495	42633.00686	3799.670736	1697.25057	758.133983	338.646011	151.267617
k_2	1.428587053	8.234714553	0.672042867	0.45666227	0.1042339	0.04655957	0.0207974
K_{BW}	7265.993992	5177.22947	5653.911263	3716.64286	7273.3918	7273.3918	7273.3918
K_{OW}	151356						
V_{LB}	0.02	0.03	0.03	0.02	0.04	0.04	0.04
V_{NB}	0.08	0.12	0.21	0.13	0.23	0.23	0.23
V_{WB}	0.9	0.85	0.76	0.85	0.73	0.73	0.73
β	0.35	0.035					
Equation A7							
k_G	0.1	0.012559432	0.003154787	0.00199054	0.00125594	0.00079245	0.0005
T	13						
W_B	N/A	0.0000001	0.0001	0.001	0.01	0.1	1
Equation A8							
C_{ox}	N/A	N/A	N/A	5	N/A	N/A	N/A
C_{SS}	N/A	N/A	N/A	3.00E-05	N/A	N/A	N/A
E_D	N/A	0.488900292					
G_D	N/A	5.38E-08	1.91E-05	9.42E-05	9.58E-04	6.78E-03	4.80E-02
G_V	N/A	N/A	N/A	3.14	N/A	N/A	N/A
k_D	0	2.63E-01	9.34E-02	4.61E-02	4.68E-02	3.31E-02	2.35E-02
K_{OW}	151356						
T	N/A	13					
W_B	N/A	0.0000001	0.0001	0.001	0.01	0.1	1

Table 10. Input parameters and calculations relevant to derivation of C_B.							
Parameter	**Phyto plankton**	**Zoo plankton**	**Benthic Invertebrates**	**Filter Feeders**	**Small Fish**	**Medium Fish**	**Large Fish**
Equation A9							
C_{ox}	N/A	N/A	N/A	5	N/A	N/A	N/A
C_{SS}	N/A	N/A	N/A	3.00E-05	N/A	N/A	N/A
E_D	N/A	0.4889					
G_D	N/A	0.0000	0.0000	0.0000942	0.0010	0.0068	0.0480
G_F	N/A	0.000000	0.000013	0.000066	0.000644	0.004403	0.030845
G_V	N/A	N/A	N/A	3.1417	N/A	N/A	N/A
k_E	0	0.0492	0.0121	0.0091	0.0046	0.0041	0.0031
K_{GB}	N/A	0.2657	0.1840	0.2800	0.1459	0.1885	0.2080
K_{OW}	N/A	151356					
T	N/A	13					
V_{LB}	N/A	0.03	0.03	0.02	0.04	0.04	0.04
V_{LD}	N/A	0.02	0.01650	0.0165	0.03	0.035	0.04
V_{LG}	N/A	0.007966	0.005876	0.005876	0.003571	0.004311	0.004979
V_{NB}	N/A	0.12	0.21	0.13	0.23	0.23	0.23
V_{ND}	N/A	0.08	0.0796	0.0796	0.165	0.22	0.23
V_{NG}	N/A	0.03186	0.02835	0.02835	0.09819	0.13548	0.14315
V_{WB}	N/A	0.85	0.76	0.85	0.73	0.73	0.73
V_{WD}	N/A	0.9	0.9039	0.9039	0.805	0.745	0.73
V_{WG}	N/A	0.9602	0.9658	0.9658	0.8982	0.8602	0.8519
W_B	N/A	0.0000001	0.0001	0.001	0.01	0.1	1
β	N/A	0.035	0.035	0.035	0.035	0.035	0.035
ε_L	N/A	0.72	0.75	0.75	0.92	0.92	0.92
ε_N	N/A	0.72	0.75	0.75	0.6	0.6	0.6
ε_W	N/A	0.25	0.25	0.25	0.25	0.25	0.25
Calculation of BCF values							
C_{BCF}	0.03582135	0.025523741	0.02742995	0.01803129	0.03528686	0.03528686	0.03585782

See Appendix A of KABAM user's guide and technical documentation for equation details.

Table 11. Estimated concentrations of pendimethalin in ecosystem components.				
Ecosystem Component	**Total concentration (µg/kg-ww)**	**Lipid normalized concentration (µg/kg-lipid)**	**Contribution due to diet (µg/kg-ww)**	**Contribution due to respiration (µg/kg-ww)**
Water (total)*	5	N/A	N/A	N/A
Water (freely dissolved)*	5	N/A	N/A	N/A
Sediment (pore water)*	3	N/A	N/A	N/A
Sediment (in solid)**	2,290	N/A	N/A	N/A
Phytoplankton	33,478	1673896	N/A	33,477.92
Zooplankton	26,396	879872	1,062.33	25,333.84
Benthic Invertebrates	29,614	987123	2,791.31	26,822.39
Filter Feeders	19,629	981437	2,023.31	17,605.42
Small Fish	45,322	1133053	11,909.94	33,412.16
Medium Fish	56,113	1402813	24,154.87	31,957.64
Large Fish	84,405	2110133	53,884.14	30,521.19
* Units: µg/L; **Units: µg/kg-dw				

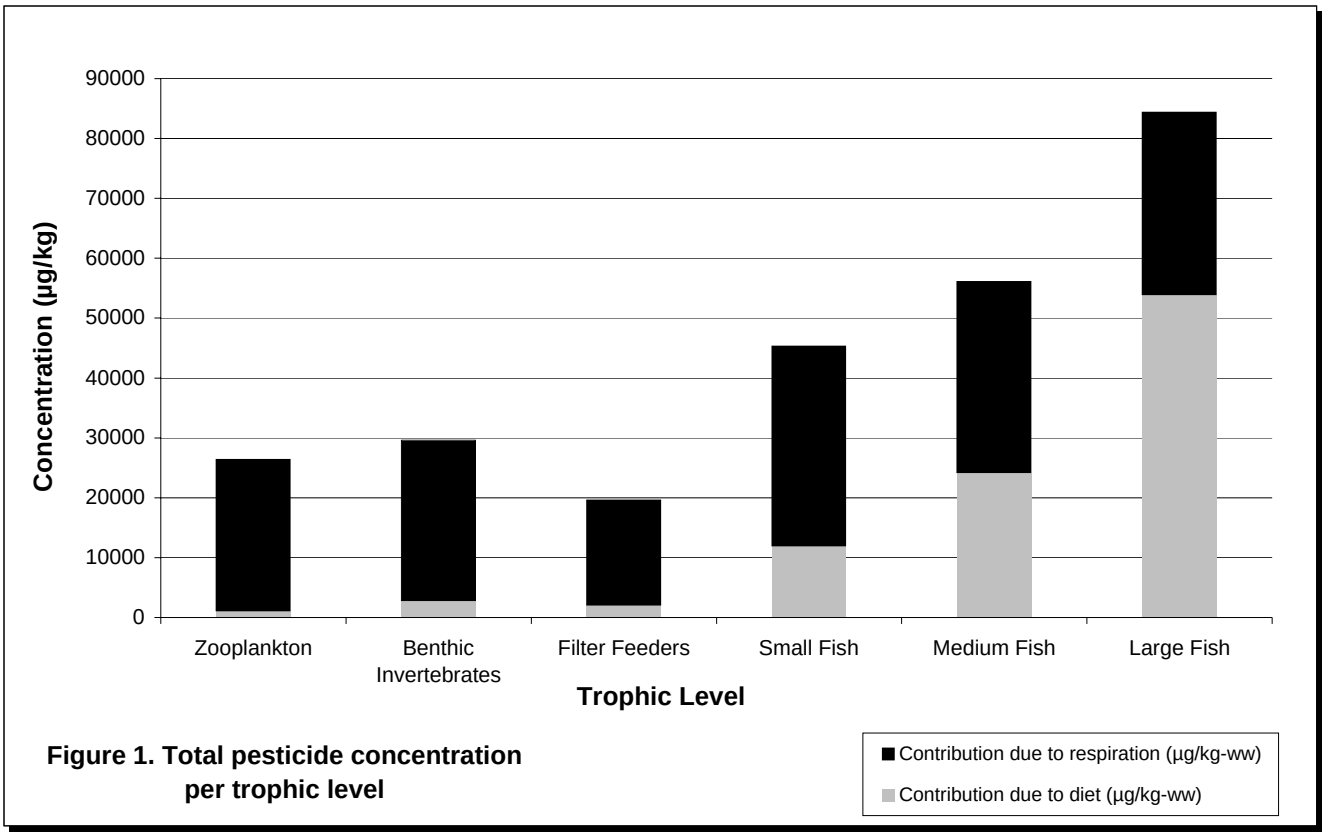

Figure 1. Total pesticide concentration per trophic level

Table 12. Total BCFand BAF values of pendimethalin in aquatic trophic levels.

Trophic Level	Total BCF (µg/kg-ww)/(µg/L)	Total BAF (µg/kg-ww)/(µg/L)
Phytoplankton	7266	6791
Zooplankton	5177	5354
Benthic Invertebrates	5564	6007
Filter Feeders	3657	3981
Small Fish	7158	9193
Medium Fish	7158	11382
Large Fish	7273	17121

Table 13. Lipid-normalized BCF, BAF, BMF and BSAF values of pendimethalin in aquatic trophic levels.

Trophic Level	BCF (µg/kg-lipid)/(µg/L)	BAF (µg/kg-lipid)/(µg/L)	BMF (µg/kg-lipid)/(µg/kg-lipid)	BSAF (µg/kg-lipid)/(µg/kg-OC)
Phytoplankton	363300	339533	N/A	29
Zooplankton	172574	178473	0.53	15
Benthic Invertebrates	185463	200228	1.17	17
Filter Feeders	182873	199074	1.16	17
Small Fish	178939	229828	1.21	20
Medium Fish	178939	284546	1.32	25
Large Fish	181835	428019	1.50	37

Table 14. Calculation of EECs for mammals and birds consuming fish contaminated by pendimethalin.

Wildlife Species	Biological Parameters				EECs (pesticide intake)	
	Body Weight (kg)	Dry Food Ingestion Rate (kg-dry food/kg-bw/day)	Wet Food Ingestion Rate (kg-wet food/kg-bw/day)	Drinking Water Intake (L/d)	Dose Based (mg/kg-bw/d)	Dietary Based (ppm)
Mammalian						
fog/water shrew	0.02	0.140	0.585	0.003	17.331	29.61
rice rat/star-nosed mole	0.1	0.107	0.484	0.011	15.243	31.50
small mink	0.5	0.079	0.293	0.048	16.459	56.11
large mink	1.8	0.062	0.229	0.168	12.860	56.11
small river otter	5.0	0.052	0.191	0.421	10.721	56.11
large river otter	15.0	0.042	0.157	1.133	13.263	84.41
Avian						
small CRLF 1	0.0	0.577	5.767	0.001	193.0583	33.48
small CRLF 2	0.0	0.577	2.403	0.001	71.1576	29.61
med CRLF 1	0.0	0.184	0.766	0.006	22.6944	29.61
med CRLF 2	0.0	0.184	0.681	0.006	30.8730	45.32
large CRLF 1	0.2	0.096	0.400	0.023	11.8521	29.61
large CRLF 2	0.2	0.096	0.356	0.023	19.9620	56.11

Table 15. Calculation of toxicity values for mammals and birds consuming fish contaminated by pendimethalin.

Wildlife Species	Toxicity Values			
	Acute		Chronic	
	Dose Based (mg/kg-bw)	Dietary Based (mg/kg-diet)	Dose Based (mg/kg-bw)	Dietary Based (mg/kg-diet)
Mammalian				
fog/water shrew	2204.90	N/A	52.50	500
rice rat/star-nosed mole	1495.72	N/A	35.61	500
small mink	986.06	N/A	23.48	500
large mink	697.25	N/A	16.60	500
small river otter	540.09	N/A	12.86	500
large river otter	410.38	N/A	9.77	500
Avian				
small CRLF 1	495.12	4187.00	N/A	141
small CRLF 2	495.12	4187.00	N/A	141
med CRLF 1	809.14	4187.00	N/A	141
med CRLF 2	809.14	4187.00	N/A	141
large CRLF 1	1069.75	4187.00	N/A	141
large CRLF 2	1069.75	4187.00	N/A	141

Table 16. Calculation of RQ values for mammals and birds consuming fish contaminated by pendimethalin.				
	Acute		Chronic	
Wildlife Species	Dose Based	Dietary Based	Dose Based	Dietary Based
Mammalian				
fog/water shrew	0.008	N/A	0.330	0.059
rice rat/star-nosed mole	0.010	N/A	0.428	0.063
small mink	0.017	N/A	0.701	0.112
large mink	0.018	N/A	0.775	0.112
small river otter	0.020	N/A	0.834	0.112
large river otter	0.032	N/A	**1.357**	0.169
Avian				
small CRLF 1	**0.39**	0.008	N/A	0.2
small CRLF 2	**0.14**	0.007	N/A	0.2
med CRLF 1	0.028	0.007	N/A	0.2
med CRLF 2	0.04	0.011	N/A	0.3
large CRLF 1	0.011	0.007	N/A	0.2
large CRLF 2	0.02	0.013	N/A	0.4