Proposed Agenda for General Electric EPA Meeting
November 6, 1995
EPA Region 1, New York, NY

I. Introductions (10:00-10:15) — John Haggard

II. Description of the basic approach (10:15-10:35) — Paul Price
   - A. Description of Microexposure Monte Carlo
   - B. What questions need to be answered for the Hudson River?
     1. Exposure characterization
        - a. Baseline analysis
        - b. Evaluation or remedies
     2. Developing toxicologically relevant measures of dose

III. Specific topics (10:35-11:30) — Paul Price
   - A. Uncertainty and variability
   - B. Determining fish concentrations: species selection, concentration selection, cooking loses, and cooking preferences
   - C. Temporal changes in concentrations of PCBs in fish
   - D. Temporal changes in angler behaviors
   - E. Durations of exposure
   - F. Dose rate determinations
   - G. Discussion

redundant

IV. Software Issues (11:30-12:00) — Cynthia Curry
   - A. Software programs used
   - B. Description of the code
   - C. Key operations
     1. Look-up tables
     2. Binary decisions
     3. Design of loops
     4. @Risk/EXCEL functions

Lunch (12:00-1:00)

V. Computer demonstration (1:00-3:30) — Cynthia Curry
   - A. Demonstration of operation
   - B. Step through the program
   - C. Discussion

VI. Departure (3:30)

GE Corporate
Environmental Programs

John G. Haggard
Engineering Project Manager
Hudson River

General Electric Company
1 Computer Drive South, Albany, NY 12205
518 458-6619, Dial Comm: 8*920-9000
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August 11, 1995

Mr. Douglas J. Tomchuk
Remedial Project Manager
USEPA
290 Broadway, 20th Floor
New York, NY 10007-1866

Dear Mr. Tomchuk:

This letter is in response to your phone call of July 27 with Mr. Paul Price of ChemRisk. In that phone call you declined our offer to hold a meeting in either Portland or New York where ChemRisk would have explained or walked EPA through the results of the 1990 Maine Angler Survey. Instead you requested that we send you a copy of the raw data on fish consumption collected in the 1990 survey along with a copy of the analysis used to develop our final estimates. We are disappointed that you would not take us up on our offer to explain this important information and we hope you reconsider.

Enclosed with this letter are the materials you requested:

- A diskette containing the raw data in a fixed-format ASCII file (mefish.dat);
- A copy of the survey instrument annotated to link survey question responses with variable names in the raw data file;
- A template document identifying where specific variables are located within the raw data file for each respondent;
- A copy of the command sequence with interpretive comments that develops the raw data into consumption rates (written in SYSTAT's DATA programming language);
- A copy on diskette (mefshcmd.cmd) of the command sequence *without* interpretive comments that could be used in SYSTAT to replicate the analysis;
- A copy of a summary table of fish consumption rates based on the variables in the final file as created by the command sequence;
- A reprint of the Ebert et al. (1993) article from *North American Journal of Fisheries Management* in which the survey results are published; and
- The original report prepared by ChemRisk in July 1992 that contains information not included in the journal article.

We trust that these technical details will help to make the analysis more understandable and useable by scientists on your staff and your contractors. Please place a copy of this information in the Site Administrative record. If you have any questions concerning the enclosed materials please contact Russell Keenan at (207) 774-0012. We would be pleased to answer any questions that arise as you use the data and interpretive materials.

Sincerely,

John G Haggard NUH

John G. Haggard
Engineering Project Manager

Enclosures

cc, with enclosures:
Barbara Beck, Ph.D.
Jackie Moya

cc, without enclosures:
Kevin Garrahan
Russ Keenan, Ph.D.
Marian Olsen

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Data Sources for MicroExposure Program of Fish Consumption for the Hudson River

Parameter	Location	Source
Probability of Mortality	INPUT.XLS	National Center for Health Statistics. 1990. Vital Statistics of the United States: 1987. Vol. II - Mortality, Part A. U.S. Department of Health and Human Services, Hyattsville, MD. (cited in Johnson and Capel, 1992). Johnson, T. and J. Capel. 1992. A Monte Carlo Approach to simulating residential occupancy periods and its application to the general U.S. population. EPA-450/3-92-011.
Probability of Intercounty Mobility	INPUT.XLS	U.S. Department of Commerce. 1991. Current Population Reports, Series P-20, No. 456, Geographic Mobility: March 1987 to March 1990. Government Printing Office, Washington, D.C.
Probability of Angling Cessation	INPUT.XLS*	Extracted from ChemRisk's 1991 Maine Angler Survey (data from category: rivers and streams, consuming anglers).
Age Frequency	INPUT.XLS	Extracted from ChemRisk's 1991 Maine Angler Survey (data from category: rivers and streams, consuming anglers).
Gender Probability	MACROH.XLS ($B$38)	Extracted from ChemRisk's 1991 Maine Angler Survey (data from category: rivers and streams, consuming anglers).
Fish Consumption Rate	INPUT.XLS	Extracted from ChemRisk's 1991 Maine Angler Survey (data from category: rivers and streams, consuming anglers).
Body Weight	INPUT.XLS	EPA, 1989. Exposure Factors Handbook. U.S. Environmental Protection Agency, Office of Health and Environmental Assessment. EPA/600/8-89/043. July.
Cooking Loss	MACROH.XLS ($E$139)	Sherer, R.A. and P.S. Price. 1993. The effect of cooking processes on PCB levels in edible fish tissue. QA Good Practice, Reg., and Law. Vol. 2., No. 4.
Cooking Preference	MACROH.XLS ($E$139)	Extracted from ChemRisk's 1991 Maine Angler Survey.
Species Preference	INPUT.XLS	Connelly, N.A., B.A. Knuth, and C.A. Bisogni. 1992. Effects of the Health Advisory Changes on Fishing Habits and Fish Consumption in New York Sport Fisheries. Human Dimension Research Unit, Department of Natural Resources, State College of Agriculture and Life Sciences, Fernow Hall, Cornell University, Ithaca, NY. Report for the New York Sea Grant Institute. September. Project No. R/FHD-2-PD.
Lipid Fraction of Fish Mass	MACROH.XLS ($B$24:$B$35)	NYDEC data, 1973-1992 (average by species).

* Incorporated in Probability of Intercounty Mobility.

Definition of Variables Used in Microexposure Program of Fish Consumption for the Hudson River

Presented to

U.S. EPA Region II
New York, NY
November 6, 1995

ChemRisk®
A Division of McLaren/Hart
Environmental Engineering

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The attached table provides a list of variables used in the Microexposure program, including locations, units, and definitions. This table, which presents variables in alphabetical order, is intended to aid the analyst as he or she steps through the model, tracking consumption rates, intake rates, etc. It will be especially helpful when the analyst attempts to identify differences between, for example, int16, AROC16, DOSE16, DOSEsum16, and sum1016!

As a note, in developing variable names for the program, the term "intake" was defined as the mass of PCBs consumed as a result of fish consumption. This term was switched to "dose" once the angler's "intake" was divided by his or her body weight.

Definitions of Variables Used in Microexposure Program of Fish Consumption for the Hudson River

Variable	Macro Location(s)	Units	Definition
A	ANGLER(); EXITLOOP	years	age of angler
ADD16	EXITLOOP()	mg/kg-day	angler's Average Daily Dose of Aroclor 1016
ADD21	EXITLOOP()	mg/kg-day	angler's Average Daily Dose of Aroclor 1221
ADD54	EXITLOOP()	mg/kg-day	angler's Average Daily Dose of Aroclor 1254
ADDT	EXITLOOP()	mg/kg-day	angler's Average Daily Dose of Total PCBs
adj1016	HARVEST(); FishRate()	mg	intake of Aroclor 1016 after accounting for excess of fish masses consumed
adj1221	HARVEST(); FishRate()	mg	intake of Aroclor 1221 after accounting for excess of fish masses consumed
adj1254	HARVEST(); FishRate()	mg	intake of Aroclor 1254 after accounting for excess of fish masses consumed
adjTPCB	HARVEST(); FishRate()	mg	intake of Total PCBs after accounting for excess of fish masses consumed
AROC16	HARVEST(); SUMDOSES()	mg	final intake of Aroclor 1016 (based on decline and cooking loss factors)
AROC21	HARVEST(); SUMDOSES()	mg	final intake of Aroclor 1221 (based on decline and cooking loss factors)
AROC54	HARVEST(); SUMDOSES()	mg	final intake of Aroclor 1254 (based on decline and cooking loss factors)
BWP	ANGLER(); BW()	%ile	body weight percentile of angler
bwrange	BW()	unitless	range of cells containing body weight data in INPUT.XLS
Conc1016	HARVEST()	mg	Aroclor 1016 concentration of individual fish selected (lipid normalized)
Conc1221	HARVEST()	mg	Aroclor 1221 concentration of individual fish selected (lipid normalized)
Conc1254	HARVEST()	mg	Aroclor 1254 concentration of individual fish selected (lipid normalized)
cookloss	HARVEST()	unitless	fraction of PCB intake lost as a result of cooking method selected
counter	INITIALIZE2(); HARVEST()	unitless	conditional: if equal to "0", RATEFQ2 not satisfied; if "1", RATEFQ2 satisfied
dieage	EXITLOOP()	years	sets the variable "A" to age at death if angler dies
dier	EXITLOOP()	unitless	equal to "0" if angler dies based on demographics, "1" if angler lives
DOSE16	SUMDOSES(); EXITLOOP()	mg/kg	final intake of Aroclor 1016 divided by angler's body weight
DOSE16sum	INITIALIZE(); SUMDOSES()	mg/kg	tracks sum of yearly Aroclor 1016 doses for angler
DOSE21	SUMDOSES(); EXITLOOP()	mg/kg	final intake of Aroclor 1221 divided by angler's body weight
DOSE21sum	INITIALIZE(); SUMDOSES()	mg/kg	tracks sum of yearly Aroclor 1221 doses for angler
DOSE54	SUMDOSES(); EXITLOOP()	mg/kg	final intake of Aroclor 1254 divided by angler's body weight
DOSE54sum	INITIALIZE(); SUMDOSES()	mg/kg	tracks sum of yearly Aroclor 1254 doses for angler
dr	HARVEST()	unitless	decline rate of PCBs, based on 1st order kinetics
err1016	FishRate()	mg	quantifies excess intake of Aroclor 1016 due to consumption of excess fish masses
err1221	FishRate()	mg	quantifies excess intake of Aroclor 1221 due to consumption of excess fish masses
err1254	FishRate()	mg	quantifies excess intake of Aroclor 1254 due to consumption of excess fish masses
errTPCB	FishRate()	mg	quantifies excess intake of Total PCBs due to consumption of excess fish masses
excess	INITIALIZE2(); FishRate()	g	the difference of total fish masses consumed in one year and the selected annual fish consumption rate
exitrange	EXITLOOP()	unitless	range of cells in INPUT.XLS associated with mortality and mobility
exposure	EXITLOOP()	years	total number of years angler was exposed; same as exposure duration
FishData	HARVEST()	unitless	range of cells corresponding to fish sampling data in INPUT.XLS
FishMass	HARVEST(); FishRate()	g	mass of individual fish selected
G	ANGLER(); BW(); EXITLOOP()	unitless	gender of angler selected; "0" if male selected, "1" if female selected

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Definitions of Variables Used in Microexposure Program of Fish Consumption for the Hudson River

Variable	Macro Location(s)	Units	Definition
hibw	BW()	kg	body weight associated with hibwperc
hibwperc	BW()	%ile	higher boundary of BWP selected
ID	HARVEST()	unitless	identifies individual fish selected from INPUT.XLS
int16	HARVEST(); FishRate()	mg	Intake of Aroclor 1016 associated with individual fish selected
int21	HARVEST(); FishRate()	mg	Intake of Aroclor 1221 associated with individual fish selected
int54	HARVEST(); FishRate()	mg	Intake of Aroclor 1254 associated with individual fish selected
intTPCB	HARVEST(); FishRate()	mg	Intake of Total PCBs associated with individual fish selected
iteration	SUPERMACRO()	unitless	tracks number of anglers modeled; set equal to "1" for the first angler selected
k	INITIALIZE(); HARVEST()	unitless	rate constant for 1st order decline of PCB concentrations
LADD16	EXITLOOP()	mg/kg-day	angler's Lifetime Average Daily Dose of Aroclor 1016
LADD21	EXITLOOP()	mg/kg-day	angler's Lifetime Average Daily Dose of Aroclor 1221
LADD54	EXITLOOP()	mg/kg-day	angler's Lifetime Average Daily Dose of Aroclor 1254
LADDT	EXITLOOP()	mg/kg-day	angler's Lifetime Average Daily Dose of Total PCBs
lipamel	INITIALIZE(); HARVEST()	unitless	lipid fraction of American eel (estimated from NYDEC data, 1973 - 1992)
lipb	INITIALIZE(); HARVEST()	unitless	lipid fraction of bass (estimated from NYDEC data, 1973 - 1992)
lipbb	INITIALIZE(); HARVEST()	unitless	lipid fraction of brown bullhead (estimated from NYDEC data, 1973 - 1992)
lipblc	INITIALIZE(); HARVEST()	unitless	lipid fraction of black crappie (estimated from NYDEC data, 1973 - 1992)
lipblg	INITIALIZE(); HARVEST()	unitless	lipid fraction of bluegill (estimated from NYDEC data, 1973 - 1992)
lipchp	INITIALIZE(); HARVEST()	unitless	lipid fraction of chain pickerel (estimated from NYDEC data, 1973 - 1992)
lipnop	INITIALIZE(); HARVEST()	unitless	lipid fraction of northern pike (estimated from NYDEC data, 1973 - 1992)
lippksd	INITIALIZE(); HARVEST()	unitless	lipid fraction of pumpkinseed (estimated from NYDEC data, 1973 - 1992)
liprb	INITIALIZE(); HARVEST()	unitless	lipid fraction of rock bass (estimated from NYDEC data, 1973 - 1992)
lipweye	INITIALIZE(); HARVEST()	unitless	lipid fraction of walleye (estimated from NYDEC data, 1973 - 1992)
lipwp	INITIALIZE(); HARVEST()	unitless	lipid fraction of white perch (estimated from NYDEC data, 1973 - 1992)
lipyp	INITIALIZE(); HARVEST()	unitless	lipid fraction of yellow perch (estimated from NYDEC data, 1973 - 1992)
lobw	BW()	kg	body weight associated with lobwperc
lobwperc	BW()	%ile	lower boundary of BWP selected
mobility	EXITLOOP()	unitless	range of cells in MACROH.XLS that contain pmove and pstay
mortality	EXITLOOP()	unitless	range of cells in MACROH.XLS that contain pdeath and plive
moveage	EXITLOOP()	years	sets the variable "A" to age upon moving if angler moves
mover	EXITLOOP()	unitless	equal to "0" if angler moves or stops angling based on demographics, "1" if angler stays
pdeath	EXITLOOP()	unitless	probability that angler dies based on demographic data
plive	EXITLOOP()	unitless	probability that angler lives based on the complement of pdeath
pmove	EXITLOOP()	unitless	probability that angler moves or stops angling based on demographic data
pstay	EXITLOOP()	unitless	probability that angler does not move/stop angling based on the complement of pmove
quartile	ANGLER()	unitless	one of 4 ascending ranges of fish consumption rates
rangex	ANGLER()	unitless	equal to the quartile selected for angler
RATEFQ1	EXPOSURELOOP()	g/day	daily fish consumption rate selected for angler

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Definitions of Variables Used in Microexposure Program of Fish Consumption for the Hudson River

Variable	Macro Location(s)	Units	Definition
RATEFQ2	EXPOSURELOOP(); HARVEST(); FishRate()	g/year	RATEFQ1 * 365.25 days/yr
SPECIES	HARVEST()	unitless	species selected based on species preferences
startage	ANGLER(); EXITLOOP	years	set equal to age of angler at 1st year of exposure
sum1016	INITIALIZE2(); HARVEST(); FishRate()	mg	for any given year, tracks sum of intakes of Aroclor 1016
sum1221	INITIALIZE2(); HARVEST(); FishRate()	mg	for any given year, tracks sum of intakes of Aroclor 1221
sum1254	INITIALIZE2(); HARVEST(); FishRate()	mg	for any given year, tracks sum of intakes of Aroclor 1254
sumTPCB	INITIALIZE2(); HARVEST(); FishRate()	mg	for any given year, tracks sum of intakes of Total PCBs
t	HARVEST()	years	the number of years angler has been exposed
TDOSE	SUMDOSES(); EXITLOOP()	mg/kg	final intake of total PCBs divided by angler's body weight
TDOSEsum	INITIALIZE(); SUMDOSES()	mg/kg	tracks sum of yearly Total PCB doses for angler
Totalfs	INITIALIZE2(); HARVEST(); FishRate()	g	for any given year, tracks fish masses consumed
TOTRATES	INITIALIZE(); EXPOSURELOOP()	g/year	tracks sum of annual consumption rates for angler
TPCB	HARVEST(); SUMDOSES()	mg	final intake of Total PCBs (based on decline and cooking loss factors)
TPCBConc	HARVEST()	mg	Total PCB concentration of individual fish selected (lipid normalized)
WGT	BW(); SUMDOSES()	kg	body weight interpolated between lobw and hibw

Data Sources for MicroExposure Program of Fish Consumption for the Hudson River

Parameter	Location	Source
Probability of Mortality	INPUT.XLS	National Center for Health Statistics. 1990. Vital Statistics of the United States: 1987. Vol. II - Mortality, Part A. U.S. Department of Health and Human Services, Hyattsville, MD. (cited in Johnson and Capel, 1992). Johnson, T. and J. Capel. 1992. A Monte Carlo Approach to simulating residential occupancy periods and its application to the general U.S. population. EPA-450/3-92-011.
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Fish Consumption Rate	INPUT.XLS	Extracted from ChemRisk's 1991 Maine Angler Survey (data from category: rivers and streams, consuming anglers).
Body Weight	INPUT.XLS	EPA, 1989. Exposure Factors Handbook. U.S. Environmental Protection Agency, Office of Health and Environmental Assessment. EPA/600/8-89/043. July.
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Lipid Fraction of Fish Mass	MACROH.XLS ($B$24:$B$35)	NYDEC data, 1973-1992 (average by species).

* Incorporated in Probability of Intercounty Mobility.

MICROEXPOSURE PROGRAM OF FISH CONSUMPTION FOR THE HUDSON RIVER

INPUT.XLS

November 6, 1995

ChemRisk®
A Division of McLaren/Hart
Environmental Engineering

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	A	B	C	D	E	F
1						
2	FILE:	Input Sheet for MicroExposure Program of Fish Consumption for the Hudson River				
3	LAST REVISED:	3-Nov-95				
4						
5	AGE-SPECIFIC DEMOGRAPHIC DATA					
6		AGE			PROBABILITY AN ANGLER IN THE	
7	AGE	FREQUENCY			NORTHEAST MOVES OUT OF	
8		DISTRIBUTION	PROBABILITY OF MORTALITY		COUNTY OR STOPS ANGLING	
9			Male	Female	Male	Female
10	10	6	0.00016	0.00012	0.031	0.031
11	11	6	0.00018	0.00012	0.051	0.051
12	12	6	0.00025	0.00015	0.062	0.062
13	13	6	0.00042	0.00020	0.047	0.047
14	14	6	0.00058	0.00028	0.064	0.064
15	15	6	0.00082	0.00037	0.024	0.024
16	16	6	0.00103	0.00047	0.052	0.052
17	17	6	0.00121	0.00053	0.049	0.049
18	18	6	0.00132	0.00054	0.038	0.038
19	19	3	0.00141	0.00053	0.038	0.038
20	20	5	0.00148	0.00051	0.087	0.087
21	21	3	0.00155	0.00049	0.087	0.087
22	22	7	0.00161	0.00049	0.087	0.087
23	23	12	0.00161	0.00049	0.087	0.087
24	24	11	0.00159	0.00051	0.087	0.087
25	25	10	0.00156	0.00053	0.096	0.096
26	26	14	0.00154	0.00055	0.096	0.096
27	27	16	0.00153	0.00056	0.096	0.096
28	28	10	0.00156	0.00058	0.096	0.096
29	29	13	0.00161	0.00060	0.096	0.096
30	30	16	0.00167	0.00062	0.057	0.057
31	31	12	0.00173	0.00064	0.057	0.057
32	32	12	0.00180	0.00068	0.057	0.057
33	33	14	0.00187	0.00072	0.057	0.057
34	34	18	0.00192	0.00078	0.057	0.057
35	35	8	0.00201	0.00084	0.039	0.039
36	36	17	0.00211	0.00090	0.039	0.039
37	37	13	0.00220	0.00097	0.039	0.039
38	38	12	0.00228	0.00105	0.039	0.039
39	39	10	0.00238	0.00112	0.039	0.039
40	40	13	0.00251	0.00120	0.033	0.033
41	41	12	0.00265	0.00131	0.033	0.033
42	42	18	0.00284	0.00143	0.033	0.033
43	43	10	0.00306	0.00159	0.033	0.033
44	44	8	0.00333	0.00178	0.033	0.033
45	45	11	0.00364	0.00198	0.024	0.024
46	46	6	0.00397	0.00220	0.051	0.051
47	47	10	0.00438	0.00245	0.051	0.051
48	48	5	0.00484	0.00272	0.051	0.051
49	49	6	0.00537	0.00302	0.051	0.051
50	50	11	0.00596	0.00335	0.048	0.048
51	51	3	0.00659	0.00371	0.048	0.048
52	52	9	0.00729	0.00409	0.048	0.048
53	53	1	0.00805	0.00448	0.048	0.048
54	54	1	0.00888	0.00490	0.048	0.048
55	55	6	0.00976	0.00534	0.051	0.051
56	56	6	0.01070	0.00583	0.051	0.051
57	57	4	0.01180	0.00640	0.051	0.051
58	58	5	0.01304	0.00707	0.051	0.051
59	59	7	0.01444	0.00782	0.051	0.051
60	60	8	0.01597	0.00864	0.040	0.040
61	61	2	0.01757	0.00952	0.040	0.040
62	62	2	0.01917	0.01041	0.051	0.051
63	63	5	0.02071	0.01133	0.051	0.051
64	64	4	0.02223	0.01226	0.051	0.051
65	65	8	0.02378	0.01326	0.041	0.041

	A	B	C	D	E	F
1						
2	FILE:	Input Sheet for MicroExposure Program of Fish Consumption for the Hudson River				
3	LAST REVISED:	3-Nov-95				
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7	AGE	FREQUENCY			NORTHEAST MOVES OUT OF	
8		DISTRIBUTION	PROBABILITY OF MORTALITY		COUNTY OR STOPS ANGLING	
9			Male	Female	Male	Female
66	66	0	0.02554	0.01439	0.041	0.041
67	67	4	0.02766	0.01565	0.013	0.013
68	68	1	0.03032	0.01715	0.013	0.013
69	69	1	0.03346	0.01875	0.013	0.013
70	70	3	0.03693	0.02060	0.010	0.010
71	71	3	0.04058	0.02256	0.010	0.010
72	72	2	0.04437	0.02470	0.010	0.010
73	73	4	0.04829	0.02702	0.010	0.010
74	74	1	0.05237	0.02953	0.010	0.010
75	75	2	0.05671	0.03233	0.014	0.014
76	76	1	0.06147	0.0354[illegible]	0.014	0.014
77	77	3	0.06671	0.03893	0.014	0.014
78	78	0	0.07256	0.04287	0.014	0.014
79	79	4	0.07904	0.04736	0.014	0.014
80	80	0	0.08621	0.05250	0.017	0.017
81	81	1	0.09407	0.05839	1.000	1.000
82	82	0	0.10265	0.06525	1.000	1.000
83	83	0	0.11181	0.07333	1.000	1.000
84	84	0	0.12146	0.08296	1.000	1.000
85	85	0	0.14309	0.10189	1.000	1.000
86	86	0	0.15686	0.11809	1.000	1.000
87	87	0	0.16786	0.127[illegible]	1.000	1.000
88	88	0	0.17307	0.13526	1.000	1.000
89	89	0	0.18541	0.15041	1.000	1.000
90	90	0	1.00000	1.00000	1.000	1.000

	G	H	I	J	K	L	M	N	O	P	Q	R
1												
2												
3												
4												
5		AGE-SPECIFIC BODY WEIGHT OF MALES (kg)										
6												
7	AGE											
8		Percentile										
9		0	5	10	15	25	50	75	85	90	95	100
10	10	26.9	26.9	27.9	29.4	31.3	34.5	39.1	43.2	45.8	52.7	52.7
11	11	26.8	26.8	28.8	31.5	33.2	36.4	45.2	50.3	54.4	59.7	59.7
12	12	30.5	30.5	32.1	35.4	37.3	42.1	48.8	52.2	56.5	67.3	67.3
13	13	34.4	34.4	36.2	37.7	39.3	47.7	56.4	59.6	64.1	70.9	70.9
14	14	39.9	39.9	43.1	46.3	49.3	55.5	62.7	64.7	68.7	71.9	71.9
15	15	46.0	46.0	48.7	50.3	54.3	60.2	65.4	68.6	71.8	80.3	80.3
16	16	52.2	52.2	53.9	55.0	57.8	63.6	71.7	77.7	81.2	91.1	91.1
17	17	50.4	50.4	53.1	54.6	58.8	65.7	72.2	76.5	82.3	87.9	87.9
18	18	55.5	55.5	59.3	60.9	63.8	70.9	79.1	83.9	89.4	98.3	98.3
19	19	55.5	55.5	59.3	60.9	63.8	70.9	79.1	83.9	89.4	98.3	98.3
20	20	55.5	55.5	59.3	60.9	63.8	70.9	79.1	83.9	89.4	98.3	98.3
21	21	55.5	55.5	59.3	60.9	63.8	70.9	79.1	83.9	89.4	98.3	98.3
22	22	55.5	55.5	59.3	60.9	63.8	70.9	79.1	83.9	89.4	98.3	98.3
23	23	55.5	55.5	59.3	60.9	63.8	70.9	79.1	83.9	89.4	98.3	98.3
24	24	55.5	55.5	59.3	60.9	63.8	70.9	79.1	83.9	89.4	98.3	98.3
25	25	58.4	58.4	61.9	64.6	68.4	76.7	84.6	90.2	94.2	101.7	101.7
26	26	58.4	58.4	61.9	64.6	68.4	76.7	84.6	90.2	94.2	101.7	101.7
27	27	58.4	58.4	61.9	64.6	68.4	76.7	84.6	90.2	94.2	101.7	101.7
28	28	58.4	58.4	61.9	64.6	68.4	76.7	84.6	90.2	94.2	101.7	101.7
29	29	58.4	58.4	61.9	64.6	68.4	76.7	84.6	90.2	94.2	101.7	101.7
30	30	58.4	58.4	61.9	64.6	68.4	76.7	84.6	90.2	94.2	101.7	101.7
31	31	58.4	58.4	61.9	64.6	68.4	76.7	84.6	90.2	94.2	101.7	101.7
32	32	58.4	58.4	61.9	64.6	68.4	76.7	84.6	90.2	94.2	101.7	101.7
33	33	58.4	58.4	61.9	64.6	68.4	76.7	84.6	90.2	94.2	101.7	101.7
34	34	58.4	58.4	61.9	64.6	68.4	76.7	84.6	90.2	94.2	101.7	101.7
35	35	58.8	58.8	63.9	66.6	71.2	78.9	87.3	93.6	97.7	103.5	103.5
36	36	58.8	58.8	63.9	66.6	71.2	78.9	87.3	93.6	97.7	103.5	103.5
37	37	58.8	58.8	63.9	66.6	71.2	78.9	87.3	93.6	97.7	103.5	103.5
38	38	58.8	58.8	63.9	66.6	71.2	78.9	87.3	93.6	97.7	103.5	103.5
39	39	58.8	58.8	63.9	66.6	71.2	78.9	87.3	93.6	97.7	103.5	103.5
40	40	58.8	58.8	63.9	66.6	71.2	78.9	87.3	93.6	97.7	103.5	103.5
41	41	58.8	58.8	63.9	66.6	71.2	78.9	87.3	93.6	97.7	103.5	103.5
42	42	58.8	58.8	63.9	66.6	71.2	78.9	87.3	93.6	97.7	103.5	103.5
43	43	58.8	58.8	63.9	66.6	71.2	78.9	87.3	93.6	97.7	103.5	103.5
44	44	58.8	58.8	63.9	66.6	71.2	78.9	87.3	93.6	97.7	103.5	103.5
45	45	59.7	59.7	64.4	66.3	70.9	78.1	88.7	94.0	98.3	104.3	104.3
46	46	59.7	59.7	64.4	66.3	70.9	78.1	88.7	94.0	98.3	104.3	104.3
47	47	59.7	59.7	64.4	66.3	70.9	78.1	88.7	94.0	98.3	104.3	104.3
48	48	59.7	59.7	64.4	66.3	70.9	78.1	88.7	94.0	98.3	104.3	104.3
49	49	59.7	59.7	64.4	66.3	70.9	78.1	88.7	94.0	98.3	104.3	104.3
50	50	59.7	59.7	64.4	66.3	70.9	78.1	88.7	94.0	98.3	104.3	104.3
51	51	59.7	59.7	64.4	66.3	70.9	78.1	88.7	94.0	98.3	104.3	104.3
52	52	59.7	59.7	64.4	66.3	70.9	78.1	88.7	94.0	98.3	104.3	104.3
53	53	59.7	59.7	64.4	66.3	70.9	78.1	88.7	94.0	98.3	104.3	104.3
54	54	59.7	59.7	64.4	66.3	70.9	78.1	88.7	94.0	98.3	104.3	104.3
55	55	59.0	59.0	63.0	65.4	69.4	76.8	84.8	89.8	93.7	101.4	101.4
56	56	59.0	59.0	63.0	65.4	69.4	76.8	84.8	89.8	93.7	101.4	101.4
57	57	59.0	59.0	63.0	65.4	69.4	76.8	84.8	89.8	93.7	101.4	101.4
58	58	59.0	59.0	63.0	65.4	69.4	76.8	84.8	89.8	93.7	101.4	101.4
59	59	59.0	59.0	63.0	65.4	69.4	76.8	84.8	89.8	93.7	101.4	101.4
60	60	59.0	59.0	63.0	65.4	69.4	76.8	84.8	89.8	93.7	101.4	101.4
61	61	59.0	59.0	63.0	65.4	69.4	76.8	84.8	89.8	93.7	101.4	101.4
62	62	59.0	59.0	63.0	65.4	69.4	76.8	84.8	89.8	93.7	101.4	101.4
63	63	59.0	59.0	63.0	65.4	69.4	76.8	84.8	89.8	93.7	101.4	101.4
64	64	59.0	59.0	63.0	65.4	69.4	76.8	84.8	89.8	93.7	101.4	101.4
65	65	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0

	G	H	I	J	K	L	M	N	O	P	Q	R
1												
2												
3												
4												
5		AGE-SPECIFIC BODY WEIGHT OF MALES (kg)										
6												
7	AGE											
8		Percentile										
9		0	5	10	15	25	50	75	85	90	95	100
66	66	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
67	67	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
68	68	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
69	69	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
70	70	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
71	71	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
72	72	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
73	73	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
74	74	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
75	75	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
76	76	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
77	77	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
78	78	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
79	79	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
80	80	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
81	81	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
82	82	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
83	83	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
84	84	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
85	85	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
86	86	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
87	87	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
88	88	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
89	89	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0
90	90	53.5	53.5	57.8	60.4	65.2	73.2	81.7	86.9	90.5	96.0	96.0

	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD
1												
2												
3												
4												
5		AGE-SPECIFIC BODY WEIGHT OF FEMALES (kg)										
6												
7	AGE											
8		Percentile										
9		0	5	10	15	25	50	75	85	90	95	100
10	10	25.6	25.6	27.0	28.9	30.3	34.3	39.2	43.6	45.4	48.8	48.8
11	11	29.5	29.5	30.3	31.3	33.7	40.0	45.3	50.8	53.0	59.9	59.9
12	12	31.2	31.2	34.3	36.3	38.7	45.2	51.6	57.7	60.2	63.4	63.4
13	13	35.3	35.3	37.5	39.8	43.8	48.6	55.6	61.9	66.3	73.6	73.6
14	14	39.9	39.9	41.7	43.6	46.8	52.8	60.1	64.4	67.4	73.8	73.8
15	15	43.2	43.2	44.9	46.4	48.1	53.9	59.5	62.0	64.8	71.6	71.6
16	16	44.1	44.1	47.2	48.6	51.1	55.3	61.1	67.4	73.2	77.7	77.7
17	17	45.3	45.3	48.8	50.3	51.9	58.3	63.6	69.2	71.5	79.7	79.7
18	18	45.6	45.6	48.1	49.6	52.2	57.1	64.1	69.6	74.2	82.1	82.1
19	19	45.6	45.6	48.1	49.6	52.2	57.1	64.1	69.6	74.2	82.1	82.1
20	20	45.6	45.6	48.1	49.6	52.2	57.1	64.1	69.6	74.2	82.1	82.1
21	21	45.6	45.6	48.1	49.6	52.2	57.1	64.1	69.6	74.2	82.1	82.1
22	22	45.6	45.6	48.1	49.6	52.2	57.1	64.1	69.6	74.2	82.1	82.1
23	23	45.6	45.6	48.1	49.6	52.2	57.1	64.1	69.6	74.2	82.1	82.1
24	24	45.6	45.6	48.1	49.6	52.2	57.1	64.1	69.6	74.2	82.1	82.1
25	25	46.4	46.4	48.7	50.2	53.2	59.9	68.7	77.3	83.2	92.7	92.7
26	26	46.4	46.4	48.7	50.2	53.2	59.9	68.7	77.3	83.2	92.7	92.7
27	27	46.4	46.4	48.7	50.2	53.2	59.9	68.7	77.3	83.2	92.7	92.7
28	28	46.4	46.4	48.7	50.2	53.2	59.9	68.7	77.3	83.2	92.7	92.7
29	29	46.4	46.4	48.7	50.2	53.2	59.9	68.7	77.3	83.2	92.7	92.7
30	30	46.4	46.4	48.7	50.2	53.2	59.9	68.7	77.3	83.2	92.7	92.7
31	31	46.4	46.4	48.7	50.2	53.2	59.9	68.7	77.3	83.2	92.7	92.7
32	32	46.4	46.4	48.7	50.2	53.2	59.9	68.7	77.3	83.2	92.7	92.7
33	33	46.4	46.4	48.7	50.2	53.2	59.9	68.7	77.3	83.2	92.7	92.7
34	34	46.4	46.4	48.7	50.2	53.2	59.9	68.7	77.3	83.2	92.7	92.7
35	35	48.4	48.4	51.0	52.3	55.9	62.4	72.9	80.8	86.7	97.8	97.8
36	36	48.4	48.4	51.0	52.3	55.9	62.4	72.9	80.8	86.7	97.8	97.8
37	37	48.4	48.4	51.0	52.3	55.9	62.4	72.9	80.8	86.7	97.8	97.8
38	38	48.4	48.4	51.0	52.3	55.9	62.4	72.9	80.8	86.7	97.8	97.8
39	39	48.4	48.4	51.0	52.3	55.9	62.4	72.9	80.8	86.7	97.8	97.8
40	40	48.4	48.4	51.0	52.3	55.9	62.4	72.9	80.8	86.7	97.8	97.8
41	41	48.4	48.4	51.0	52.3	55.9	62.4	72.9	80.8	86.7	97.8	97.8
42	42	48.4	48.4	51.0	52.3	55.9	62.4	72.9	80.8	86.7	97.8	97.8
43	43	48.4	48.4	51.0	52.3	55.9	62.4	72.9	80.8	86.7	97.8	97.8
44	44	48.4	48.4	51.0	52.3	55.9	62.4	72.9	80.8	86.7	97.8	97.8
45	45	47.3	47.3	50.2	52.5	56.2	64.4	74.8	81.5	86.5	95.0	95.0
46	46	47.3	47.3	50.2	52.5	56.2	64.4	74.8	81.5	86.5	95.0	95.0
47	47	47.3	47.3	50.2	52.5	56.2	64.4	74.8	81.5	86.5	95.0	95.0
48	48	47.3	47.3	50.2	52.5	56.2	64.4	74.8	81.5	86.5	95.0	95.0
49	49	47.3	47.3	50.2	52.5	56.2	64.4	74.8	81.5	86.5	95.0	95.0
50	50	47.3	47.3	50.2	52.5	56.2	64.4	74.8	81.5	86.5	95.0	95.0
51	51	47.3	47.3	50.2	52.5	56.2	64.4	74.8	81.5	86.5	95.0	95.0
52	52	47.3	47.3	50.2	52.5	56.2	64.4	74.8	81.5	86.5	95.0	95.0
53	53	47.3	47.3	50.2	52.5	56.2	64.4	74.8	81.5	86.5	95.0	95.0
54	54	47.3	47.3	50.2	52.5	56.2	64.4	74.8	81.5	86.5	95.0	95.0
55	55	47.6	47.6	50.2	53.3	56.5	64.4	74.5	81.3	86.4	94.1	94.1
56	56	47.6	47.6	50.2	53.3	56.5	64.4	74.5	81.3	86.4	94.1	94.1
57	57	47.6	47.6	50.2	53.3	56.5	64.4	74.5	81.3	86.4	94.1	94.1
58	58	47.6	47.6	50.2	53.3	56.5	64.4	74.5	81.3	86.4	94.1	94.1
59	59	47.6	47.6	50.2	53.3	56.5	64.4	74.5	81.3	86.4	94.1	94.1
60	60	47.6	47.6	50.2	53.3	56.5	64.4	74.5	81.3	86.4	94.1	94.1
61	61	47.6	47.6	50.2	53.3	56.5	64.4	74.5	81.3	86.4	94.1	94.1
62	62	47.6	47.6	50.2	53.3	56.5	64.4	74.5	81.3	86.4	94.1	94.1
63	63	47.6	47.6	50.2	53.3	56.5	64.4	74.5	81.3	86.4	94.1	94.1
64	64	47.6	47.6	50.2	53.3	56.5	64.4	74.5	81.3	86.4	94.1	94.1
65	65	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3

	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD
1												
2												
3												
4												
5		AGE-SPECIFIC BODY WEIGHT OF FEMALES (kg)										
6												
7	AGE											
8		Percentile										
9		0	5	10	15	25	50	75	85	90	95	100
66	66	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
67	67	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
68	68	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
69	69	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
70	70	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
71	71	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
72	72	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
73	73	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
74	74	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
75	75	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
76	76	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
77	77	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
78	78	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
79	79	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
80	80	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
81	81	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
82	82	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
83	83	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
84	84	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
85	85	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
86	86	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
87	87	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
88	88	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
89	89	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3
90	90	46.2	46.2	49.8	52.3	56.3	63.8	72.8	79.1	83.6	90.3	90.3

	AF	AG
1		
2		
3		
4		
5	Fish Consumption Rate Data	
6		Ascending
7		Consumption
8		Rate
9		(g/day)
10	1	0.001
11	2	0.007
12	3	0.012
13	4	0.02
14	5	0.023
15	6	0.024
16	7	0.028
17	8	0.029
18	9	0.033
19	10	0.034
20	11	0.045
21	12	0.046
22	13	0.053
23	14	0.068
24	15	0.068
25	16	0.069
26	17	0.086
27	18	0.092
28	19	0.096
29	20	0.101
30	21	0.103
31	22	0.103
32	23	0.105
33	24	0.11
34	25	0.112
35	26	0.114
36	27	0.118
37	28	0.12
38	29	0.121
39	30	0.122
40	31	0.126
41	32	0.134
42	33	0.134
43	34	0.134
44	35	0.135
45	36	0.137
46	37	0.137
47	38	0.137
48	39	0.137
49	40	0.144
50	41	0.155
51	42	0.155
52	43	0.16
53	44	0.16
54	45	0.163
55	46	0.166
56	47	0.171
57	48	0.171
58	49	0.171
59	50	0.174
60	51	0.176
61	52	0.177
62	53	0.182
63	54	0.183
64	55	0.183
65	56	0.186

	AF	AG
1		
2		
3		
4		
5	Fish Consumption Rate Data	
6		Ascending
7		Consumption
8		Rate
9		(g/day)
66	57	0.187
67	58	0.193
68	59	0.195
69	60	0.197
70	61	0.202
71	62	0.202
72	63	0.205
73	64	0.22
74	65	0.225
75	66	0.228
76	67	0.229
77	68	0.229
78	69	0.23
79	70	0.233
80	71	0.233
81	72	0.234
82	73	0.241
83	74	0.242
84	75	0.244
85	76	0.244
86	77	0.246
87	78	0.2[illegible]9
88	79	0.26
89	80	0.264
90	81	0.264
91	82	0.269
92	83	0.269
93	84	0.269
94	85	0.269
95	86	0.269
96	87	0.269
97	88	0.269
98	89	0.274
99	90	0.274
100	91	0.274
101	92	0.283
102	93	0.283
103	94	0.285
104	95	0.291
105	96	0.294
106	97	0.296
107	98	0.309
108	99	0.311
109	100	0.316
110	101	0.32
111	102	0.32
112	103	0.326
113	104	0.328
114	105	0.329
115	106	0.334
116	107	0.336
117	108	0.336
118	109	0.338
119	110	0.342
120	111	0.342
121	112	0.342

	AF	AG
1		
2		
3		
4		
5	Fish Consumption Rate Data	
6		Ascending
7		Consumption
8		Rate
9		(g/day)
122	113	0.342
123	114	0.342
124	115	0.343
125	116	0.343
126	117	0.35
127	118	0.355
128	119	0.36
129	120	0.365
130	121	0.366
131	122	0.373
132	123	0.403
133	124	0.411
134	125	0.411
135	126	0.411
136	127	0.417
137	128	0.423
138	129	0.425
139	130	0.426
140	131	0.428
141	132	0.434
142	133	0.438
143	134	0.445
144	135	0.446
145	136	0.447
146	137	0.449
147	138	0.455
148	139	0.456
149	140	0.457
150	141	0.469
151	142	0.489
152	143	0.489
153	144	0.493
154	145	0.503
155	146	0.503
156	147	0.534
157	148	0.537
158	149	0.541
159	150	0.548
160	151	0.548
161	152	0.548
162	153	0.551
163	154	0.556
164	155	0.561
165	156	0.561
166	157	0.563
167	158	0.57
168	159	0.57
169	160	0.572
170	161	0.583
171	162	0.586
172	163	0.586
173	164	0.591
174	165	0.597
175	166	0.605
176	167	0.607
177	168	0.616

	AF	AG
1		
2		
3		
4		
5	Fish Consumption Rate Data	
6		Ascending
7		Consumption
8		Rate
9		(g/day)
178	169	0.623
179	170	0.629
180	171	0.645
181	172	0.66
182	173	0.672
183	174	0.679
184	175	0.685
185	176	0.685
186	177	0.685
187	178	0.685
188	179	0.685
189	180	0.69
190	181	0.692
191	182	0.694
192	183	0.695
193	184	0.7
194	185	0.701
195	186	0.704
196	187	0.709
197	188	0.712
198	189	0.718
199	190	0.723
200	191	0.73
201	192	0.73
202	193	0.733
203	194	0.733
204	195	0.733
205	196	0.735
206	197	0.755
207	198	0.77
208	199	0.777
209	200	0.779
210	201	0.781
211	202	0.781
212	203	0.799
213	204	0.804
214	205	0.806
215	206	0.806
216	207	0.814
217	208	0.816
218	209	0.823
219	210	0.831
220	211	0.848
221	212	0.852
222	213	0.86
223	214	0.861
224	215	0.866
225	216	0.867
226	217	0.868
227	218	0.88
228	219	0.887
229	220	0.896
230	221	0.897
231	222	0.902
232	223	0.908
233	224	0.914

	AF	AG
1		
2		
3		
4		
5	Fish Consumption Rate Data	
6		Ascending
7		Consumption
8		Rate
9		(g/day)
234	225	0.917
235	226	0.917
236	227	0.924
237	228	0.929
238	229	0.946
239	230	0.96
240	231	0.962
241	232	0.977
242	233	0.995
243	234	1.023
244	235	1.027
245	236	1.027
246	237	1.027
247	238	1.03
248	239	1.042
249	240	1.063
250	241	1.071
251	242	1.071
252	243	1.08
253	244	1.099
254	245	1.101
255	246	1.122
256	247	1.13
257	248	1.141
258	249	1.165
259	250	1.176
260	251	1.18
261	252	1.181
262	253	1.192
263	254	1.195
264	255	1.217
265	256	1.232
266	257	1.238
267	258	1.26
268	259	1.275
269	260	1.28
270	261	1.282
271	262	1.283
272	263	1.287
273	264	1.295
274	265	1.303
275	266	1.312
276	267	1.326
277	268	1.343
278	269	1.343
279	270	1.343
280	271	1.344
281	272	1.368
282	273	1.369
283	274	1.402
284	275	1.421
285	276	1.424
286	277	1.426
287	278	1.426
288	279	1.426
289	280	1.433

	AF	AG
1		
2		
3		
4		
5	Fish Consumption Rate Data	
6		Ascending
7		Consumption
8		Rate
9		(g/day)
290	281	1.437
291	282	1.443
292	283	1.446
293	284	1.466
294	285	1.477
295	286	1.48
296	287	1.484
297	288	1.49
298	289	1.505
299	290	1.524
300	291	1.528
301	292	1.542
302	293	1.546
303	294	1.556
304	295	1.599
305	296	1.612
306	297	1.627
307	298	1.67
308	299	1.679
309	300	1.679
310	301	1.68
311	302	1.684
312	303	1.711
313	304	1.725
314	305	1.728
315	306	1.759
316	307	1.777
317	308	1.778
318	309	1.818
319	310	1.848
320	311	1.851
321	312	1.865
322	313	1.865
323	314	1.907
324	315	1.931
325	316	1.946
326	317	1.954
327	318	1.958
328	319	1.965
329	320	1.969
330	321	2
331	322	2.015
332	323	2.015
333	324	2.027
334	325	2.055
335	326	2.073
336	327	2.089
337	328	2.09
338	329	2.094
339	330	2.169
340	331	2.212
341	332	2.212
342	333	2.214
343	334	2.22
344	335	2.222
345	336	2.234

	AF	AG
1		
2		
3		
4		
5	Fish Consumption Rate Data	
6		Ascending
7		Consumption
8		Rate
9		(g/day)
346	337	2.274
347	338	2.311
348	339	2.316
349	340	2.328
350	341	2.36
351	342	2.396
352	343	2.461
353	344	2.468
354	345	2.492
355	346	2.502
356	347	2.521
357	348	2.538
358	349	2.538
359	350	2.58
360	351	2.612
361	352	2.618
362	353	2.641
363	354	2.688
364	355	2.692
365	356	2.696
366	357	2.705
367	358	2.718
368	359	2.738
369	360	2.76
370	361	2.834
371	362	2.862
372	363	2.871
373	364	2.931
374	365	2.983
375	366	3.004
376	367	3.062
377	368	3.08
378	369	3.146
379	370	3.159
380	371	3.19
381	372	3.263
382	373	3.454
383	374	3.579
384	375	3.632
385	376	3.688
386	377	3.689
387	378	3.705
388	379	3.735
389	380	3.86
390	381	3.909
391	382	3.936
392	383	3.954
393	384	4.009
394	385	4.02
395	386	4.03
396	387	4.098
397	388	4.147
398	389	4.169
399	390	4.235
400	391	4.28
401	392	4.288

	AF	AG
1		
2		
3		
4		
5	Fish Consumption Rate Data	
6		Ascending
7		Consumption
8		Rate
9		(g/day)
402	393	4.292
403	394	4.339
404	395	4.34
405	396	4.427
406	397	4.489
407	398	4.586
408	399	4.599
409	400	4.662
410	401	4.687
411	402	4.765
412	403	5.035
413	404	5.073
414	405	5.105
415	406	5.165
416	407	5.373
417	408	5.374
418	409	5.398
419	410	5.492
420	411	5.628
421	412	5.665
422	413	5.719
423	414	5.743
424	415	5.821
425	416	5.867
426	417	6.01
427	418	6.069
428	419	6.117
429	420	6.117
430	421	6.192
431	422	6.231
432	423	6.278
433	424	6.349
434	425	6.478
435	426	6.717
436	427	6.744
437	428	7.118
438	429	7.428
439	430	7.869
440	431	8.403
441	432	8.881
442	433	9.144
443	434	9.645
444	435	9.728
445	436	10.631
446	437	11.418
447	438	11.445
448	439	11.637
449	440	12.006
450	441	12.465
451	442	13.667
452	443	14.168
453	444	14.364
454	445	14.416
455	446	14.444
456	447	17.741
457	448	20.015

	AF	AG
1		
2		
3		
4		
5	Fish Consumption Rate Data	
6		Ascending
7		Consumption
8		Rate
9		(g/day)
458	449	20.397
459	450	21.937
460	451	22.742
461	452	25.431
462	453	25.432
463	454	28.492
464	455	30.331
465	456	31.096
466	457	32.243
467	458	42.742
468	459	46.618
469	460	53.981
470	461	94.047
471	462	111.933
472	463	117.472
473	464	118.22

	AI	AJ	AK	AL	AM	AN
1						
2						
3						
4						
5	Percentiles Used in BW()			Species Preferences		
6						
7						
8						
9	Lobwperc	Hibwperc		Species	Number	Probability
10	0	5		Bass	0	0.582
11	5	10		Rock bass	1	0.027
12	10	15		Brown bullhead	2	0.097
13	15	25		Northern pike	3	0.027
14	25	50		Pumpkinseed	4	0.027
15	50	75		Bluegill	5	0.027
16	75	85		Black crappie	6	0.027
17	85	90		Walleye	7	0.075
18	90	95		Yellow Perch	8	0.027
19	95	100		Chain pickerel	9	0.027
20	100	100		American eel	10	0.009
21				White perch	11	0.045

	AP	AQ	AR	AS	AT	AU	AV
1							
2							
3							
4							
5				Fish Sampling Results			
6							
7	Fish ID#	Species	Lipid Norm	Lipid Norm	Lipid Norm	Lipid Norm	WGT
8			AR 1254	AR 1016	AR 1221	Total	
9			(ug/g)	(ug/g)	(ug/g)	(ug/g)	(g)
10	1	AMEL	0.5	0.5	0.5	1.5	170
11	2	AMEL	0.5	0.5	0.5	1.5	610
12	3	AMEL	0.5	0.5	0.5	1.5	730
13	4	AMEL	0.5	0.5	0.5	1.5	470
14	5	BB	0.5	0.5	0.5	1.5	410
15	6	BB	0.5	0.5	0.5	1.5	375
16	7	BB	0.5	0.5	0.5	1.5	560
17	8	BB	0.5	0.5	0.5	1.5	650
18	9	BLC	0.5	0.5	0.5	1.5	470
19	10	BLC	0.5	0.5	0.5	1.5	450
20	11	BLC	0.5	0.5	0.5	1.5	280
21	12	BLC	0.5	0.5	0.5	1.5	515
22	13	BLG	0.5	0.5	0.5	1.5	225
23	14	BLG	0.5	0.5	0.5	1.5	175
24	15	BLG	0.5	0.5	0.5	1.5	355
25	16	BLG	0.5	0.5	0.5	1.5	215
26	17	CHP	0.5	0.5	0.5	1.5	560
27	18	CHP	0.5	0.5	0.5	1.5	526
28	19	CHP	0.5	0.5	0.5	1.5	452
29	20	CHP	0.5	0.5	0.5	1.5	802
30	21	B	0.5	0.5	0.5	1.5	950
31	22	B	0.5	0.5	0.5	1.5	441
32	23	B	0.5	0.5	0.5	1.5	810
33	24	B	0.5	0.5	0.5	1.5	340
34	25	B	0.5	0.5	0.5	1.5	422
35	26	B	0.5	0.5	0.5	1.5	308
36	27	B	0.5	0.5	0.5	1.5	231
37	28	B	0.5	0.5	0.5	1.5	272
38	29	NOP	0.5	0.5	0.5	1.5	862
39	30	NOP	0.5	0.5	0.5	1.5	538
40	31	NOP	0.5	0.5	0.5	1.5	1840
41	32	NOP	0.5	0.5	0.5	1.5	1440
42	33	PKSD	0.5	0.5	0.5	1.5	136
43	34	PKSD	0.5	0.5	0.5	1.5	136
44	35	PKSD	0.5	0.5	0.5	1.5	227
45	36	PKSD	0.5	0.5	0.5	1.5	181
46	37	RB	0.5	0.5	0.5	1.5	130
47	38	RB	0.5	0.5	0.5	1.5	150
48	39	RB	0.5	0.5	0.5	1.5	150
49	40	RB	0.5	0.5	0.5	1.5	95
50	41	WEYE	0.5	0.5	0.5	1.5	1400
51	42	WEYE	0.5	0.5	0.5	1.5	1020
52	43	WEYE	0.5	0.5	0.5	1.5	1020
53	44	WEYE	0.5	0.5	0.5	1.5	975
54	45	WP	0.5	0.5	0.5	1.5	204
55	46	WP	0.5	0.5	0.5	1.5	204
56	47	WP	0.5	0.5	0.5	1.5	181
57	48	WP	0.5	0.5	0.5	1.5	318
58	49	YP	0.5	0.5	0.5	1.5	165
59	50	YP	0.5	0.5	0.5	1.5	180
60	51	YP	0.5	0.5	0.5	1.5	110
61	52	YP	0.5	0.5	0.5	1.5	322

MICROEXPOSURE PROGRAM OF FISH CONSUMPTION FOR THE HUDSON RIVER

OUTPUT.XLS

November 6, 1995

ChemRisk
A Division of McLaren/Hart
Environmental Engineering

10.3633

recycled paper

	A	B	C	D	E	F	G	H
1	FILE:	Output Sheet for MicroExposure Model of Fish Consumption						
2	LAST REVISED:	26-Oct-95						
3								
4								
5								
6								
7	ITERATION:	11						
8		Angler Characteristics						
9								
10		Angler	Gender	Age	Age	Age	Exposure	Average
11		ID	(0=M, 1=F)	at start	upon moving	at death	Duration	Consumption Rate
12				(years)	(years)	(years)	(years)	(g/day)
13		1	0	37	39	81	3	0.28
14		2	0	79	81	82	3	1.90
15		3	0	50	54	68	5	4.72
16		4	0	38	46	57	9	0.66
17		5	0	26	29	66	4	0.14
18		6	0	15	26	65	12	1.56
19		7	0	26	41	79	16	13.10
20		8	0	36	NA	68	33	10.27
21		9	1	42	44	73	3	0.17
22		10	0	40	51	90	12	0.13

10.3634

	J	K	L	M	N	O	P	Q	R
1									
2									
3									
4									
5									
6									
7									
8	LIFETIME AVERAGE DAILY DOSES (mg/kg-day)					AVERAGE DAILY DOSES (mg/kg-day)			
9									
10	Aroclor	Aroclor	Aroclor	Total		Aroclor	Aroclor	Aroclor	Total
11	1254	1016	1221			1254	1016	1221	
12									
13	3.28E-10	3.28E-10	3.28E-10	9.85E-10		3.28E-09	3.28E-09	3.28E-09	9.85E-09
14	6.73E-09	6.73E-09	6.73E-09	2.02E-08		6.73E-08	6.73E-08	6.73E-08	2.02E-07
15	1.37E-08	1.37E-08	1.37E-08	4.12E-08		1.37E-07	1.37E-07	1.37E-07	4.12E-07
16	2.59E-09	2.59E-09	2.59E-09	7.76E-09		2.01E-08	2.01E-08	2.01E-08	6.03E-08
17	1.57E-09	1.57E-09	1.57E-09	4.71E-09		1.57E-08	1.57E-08	1.57E-08	4.71E-08
18	5.02E-08	5.02E-08	5.02E-08	1.51E-07		2.93E-07	2.93E-07	2.93E-07	8.79E-07
19	1.79E-07	1.79E-07	1.79E-07	5.38E-07		7.84E-07	7.84E-07	7.84E-07	2.35E-06
20	2.71E-07	2.71E-07	2.71E-07	8.13E-07		5.75E-07	5.75E-07	5.75E-07	1.72E-06
21	5.08E-10	5.08E-10	5.08E-10	1.52E-09		5.08E-09	5.08E-09	5.08E-09	1.52E-08
22	6.69E-10	6.69E-10	6.69E-10	2.01E-09		3.90E-09	3.90E-09	3.90E-09	1.17E-08

	T	U	V	W	X	Y	Z	AA	AB	AC	AD
1											
2											
3											
4											
5											
6											
7	SUMMARY STATISTICS						SUMMARY STATISTICS				
8	LIFETIME AVERAGE DAILY DOSES (mg/kg-day)						AVERAGE DAILY DOSES (mg/kg-day)				
9											
10		Aroclor	Aroclor	Aroclor	Total			Aroclor	Aroclor	Aroclor	Total
11		1254	1016	1221				1254	1016	1221	
12	Percentile						Percentile				
13	5	4.09E-10	4.09E-10	4.09E-10	1.23E-09		5	4.09E-10	3.56E-09	3.56E-09	1.07E-08
14	10	4.90E-10	4.90E-10	4.90E-10	1.47E-09		10	3.84E-09	3.84E-09	3.84E-09	1.15E-08
15	15	5.64E-10	5.64E-10	5.64E-10	1.69E-09		15	4.32E-09	4.32E-09	4.32E-09	1.29E-08
16	20	6.37E-10	6.37E-10	6.37E-10	1.91E-09		20	4.84E-09	4.84E-09	4.84E-09	1.45E-08
17	25	8.95E-10	8.95E-10	8.95E-10	2.68E-09		25	7.74E-09	7.74E-09	7.74E-09	2.32E-08
18	30	1.30E-09	1.30E-09	1.30E-09	3.90E-09		30	1.25E-08	1.25E-08	1.25E-08	3.76E-08
19	35	1.72E-09	1.72E-09	1.72E-09	5.17E-09		35	1.64E-08	1.64E-08	1.64E-08	4.91E-08
20	40	2.18E-09	2.18E-09	2.18E-09	6.54E-09		40	1.84E-08	1.84E-08	1.84E-08	5.51E-08
21	45	2.79E-09	2.79E-09	2.79E-09	8.38E-09		45	2.25E-08	2.25E-08	2.25E-08	6.74E-08
22	50	4.66E-09	4.66E-09	4.66E-09	1.40E-08		50	4.37E-08	4.37E-08	4.37E-08	1.31E-07
23	55	6.53E-09	6.53E-09	6.53E-09	1.96E-08		55	6.50E-08	6.50E-08	6.50E-08	1.95E-07
24	60	9.53E-09	9.53E-09	9.53E-09	2.86E-08		60	9.53E-08	9.53E-08	9.53E-08	2.86E-07
25	65	1.27E-08	1.27E-08	1.27E-08	3.81E-08		65	1.27E-07	1.27E-07	1.27E-07	3.81E-07
26	70	2.47E-08	2.47E-08	2.47E-08	7.41E-08		70	1.84E-07	1.84E-07	1.84E-07	5.52E-07
27	75	4.11E-08	4.11E-08	4.11E-08	1.23E-07		75	2.54E-07	2.54E-07	2.54E-07	7.62E-07
28	80	7.60E-08	7.60E-08	7.60E-08	2.28E-07		80	3.49E-07	3.49E-07	3.49E-07	1.05E-06
29	85	1.34E-07	1.34E-07	1.34E-07	4.02E-07		85	4.76E-07	4.76E-07	4.76E-07	1.43E-06
30	90	1.88E-07	1.88E-07	1.88E-07	5.65E-07		90	5.96E-07	5.96E-07	5.96E-07	1.79E-06
31	91	1.97E-07	1.97E-07	1.97E-07	5.90E-07		91	6.15E-07	6.15E-07	6.15E-07	1.84E-06
32	92	2.05E-07	2.05E-07	2.05E-07	6.15E-07		92	6.33E-07	6.33E-07	6.33E-07	1.90E-06
33	93	2.13E-07	2.13E-07	2.13E-07	6.39E-07		93	6.52E-07	6.52E-07	6.52E-07	1.96E-06
34	94	2.21E-07	2.21E-07	2.21E-07	6.64E-07		94	6.71E-07	6.71E-07	6.71E-07	2.01E-06
35	95	2.30E-07	2.30E-07	2.30E-07	6.89E-07		95	6.90E-07	6.90E-07	6.90E-07	2.07E-06
36	96	2.38E-07	2.38E-07	2.38E-07	7.14E-07		96	7.09E-07	7.09E-07	7.09E-07	2.13E-06
37	97	2.46E-07	2.46E-07	2.46E-07	7.39E-07		97	7.28E-07	7.28E-07	7.28E-07	2.18E-06
38	98	2.54E-07	2.54E-07	2.54E-07	7.63E-07		98	7.46E-07	7.46E-07	7.46E-07	2.24E-06
39	99	2.63E-07	2.63E-07	2.63E-07	7.88E-07		99	7.65E-07	7.65E-07	7.65E-07	2.30E-06
40	MAXIMUM	2.71E-07	2.71E-07	2.71E-07	8.13E-07		MAXIMUM	7.84E-07	7.84E-07	7.84E-07	2.35E-06
41	MINIMUM	3.28E-10	3.28E-10	3.28E-10	9.85E-10		MINIMUM	3.28E-09	3.28E-09	3.28E-09	9.85E-09
42	MEAN	5.27E-08	5.27E-08	5.27E-08	1.58E-07		MEAN	1.90E-07	1.90E-07	1.90E-07	5.71E-07

10.3636

MICROEXPOSURE PROGRAM OF FISH CONSUMPTION FOR THE HUDSON RIVER

MACROH.XLS

November 6, 1995

ChemRisk®
A Division of McLaren/Hart
Environmental Engineering

10.3637

	A	B	C
1			
2			
3	MACRO NAMES	MACRO COMMANDS	COMMENTS ASSOCIATED WITH MACRO COMMANDS IN COLUMN B
4			
5	SUPERMACRO	=SET.NAME("iteration",1)	sets iteration counter to track number of anglers modeled
6		ECHO(FALSE)	turns off screen printing during simulation
7		=INITIALIZE()	runs INITIALIZE macro ($A$18); initializes variables at the onset of individual angler's exposure period
8		=ANGLER()	runs ANGLER macro ($A$38); defines exposure parameter values for individual angler
9		=EXPOSURELOOP()	runs EXPOSURELOOP macro ($A$48); simulates annual fish consumption and PCB intake by individual angler
10		=SUMMARY()	runs SUMMARY macro($J$5); writes selected parameter values to OUPUT.XLS
11		=SET.NAME("iteration",iteration+1)	advances iteration counter by one prior to modeling another angler
12		=IF(iteration<11,GOTO(B7),)	sets the number of iterations to be run during a simulation; equal to the number of anglers in sample space
13		ECHO(TRUE)	turns on screen printing during simulation
14		=PERCENTILES1()	runs PERCENTILE1 macro ($M$5); calculates and writes summary statistics for LADDs
15		=PERCENTILES2()	runs PERCENTILE2 macro ($P$5); calculates and writes summary statistics for ADDs
16		=RETURN()	ends SUPERMACRO macro
17			
18	INITIALIZE	=SET.NAME("k",0)	for first order decline (C=Coe^-kt), define PCB decline factor, k, here
19		=SET.NAME("TDOSESUM",0)	sets sum of all total PCB doses for individual angler to 0
20		=SET.NAME("DOSE21sum",0)	sets sum of all Aroclor 1221 doses for individual angler to 0
21		=SET.NAME("DOSE16sum",0)	sets sum of all Aroclor 1016 doses for individual angler to 0
22		=SET.NAME("DOSE54sum",0)	sets sum of all Aroclor 1254 doses for individual angler to 0
23		=SET.NAME("TOTRATES",0)	sets sum of all consumption rates for individual angler to 0
24		=SET.NAME("lipb",0.0074)	sets lipid fraction of bass
25		=SET.NAME("liprb",0.0044)	sets lipid fraction of rock bass
26		=SET.NAME("lipbb",0.0249)	sets lipid fraction of brown bullhead
27		=SET.NAME("lipnop",0.0068)	sets lipid fraction of northern pike
28		=SET.NAME("lippksd",0.0106)	sets lipid fraction of pumpkinseed
29		=SET.NAME("lipblg",0.0073)	sets lipid fraction of bluegill
30		=SET.NAME("lipblc",0.0118)	sets lipid fraction of black crappie
31		=SET.NAME("lipweye",0.0073)	sets lipid fraction of walleye
32		=SET.NAME("lipyp",0.0072)	sets lipid fraction of yellow perch
33		=SET.NAME("lipchp",0.0033)	sets lipid fraction of chain pickerel
34		=SET.NAME("lipamel",0.2498)	sets lipid fraction of American eel
35		=SET.NAME("lipwp",0.0254)	sets lipid fraction of white perch
36		=RETURN()	ends INITIALIZE macro
37			
38	ANGLER	=SET.NAME("G",RiskDiscrete({0,1},{0.867,0.131}))	selects gender of individual angler (0 = male, 1= female)
39		=SET.NAME("BWP",RiskUniform(0,100))	selects angler's body weight percentile
40		=SET.NAME("quartile",RiskDuniform({1,2,3,4}))	fixes consumption rate quartile for angler's exposure duration
41		=IF(quartile=1,SET.NAME("rangex",range1),IF(quartile=2,SET.NAME("rangex",range2),IF(quartile=3,SET.NAME("rangex",rang	based on quartile selected, defines range of consumption rates in INPUT.XLS to select from
42		=SET.NAME("A",RiskDiscrete(agerange,agefrequency))	selects individual angler's age at first year of exposure
43		=A	places defined starting age in MACROH.XLS
44		=SET.NAME("startage",DEREF(B43))	defines starting age variable
45		SET.NAME("expyr",1)	sets the first year of individual angler's exposure duration to one
46		=RETURN()	ends ANGLER macro
47			
48	EXPOSURELOOP	=WHILE(A<90)	runs EXPOSURELOOP macro until angler is 90 years old
49		=BW()	runs BW macro ($A$60); determines angler's body weight
50		=SET.NAME("RATEFQ1",RiskDuniform(rangex))	selects consumption rate (g/day) randomly from quartile range defined in ANGLER macro
51		=SET.NAME("RATEFQ2",RATEFQ1*365.25)	averages daily consumption rate over one year (g/year)
52		=SET.NAME("TOTRATES",TOTRATES+RATEFQ2)	tracks sum of individual angler's yearly consumption rates (g/year)
53		=HARVEST()	runs HARVEST macro ($D$5); determines characteristics of all fish harvested by a single angler for each year of exposure
54		=SUMDOSES()	runs SUMDOSES macro ($G$5); converts current year's intake (ug) to a dose (ug/kg body weight) and sums yearly doses
55		=EXITLOOP()	runs EXITLOOP macro ($G$15); determines when exposures cease for individual angler
56		=IF(dier=0,BREAK(),)	stops EXPOSURELOOP macro if angler dies
57		=NEXT()	ends WHILE loop ($B$48)
58		=RETURN()	ends EXPOSURELOOP macro

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	A	B	C
59			
60	BW	=IF(G=0,SET.NAME("bwrange",MALERANGE),SET.NAME("bwrange",FEMALERANGE))	*based on gender, selects range of body weights in INPUT.XLS to select from*
61		=SET.NAME("lobwperc",HLOOKUP(BWP,bwrange,1))	*based on BWP, determines lower boundary percentile in INPUT.XLS*
62		=SET.NAME("hibwperc",VLOOKUP(lobwperc,bwpercrange,2))	*based on BWP, determines higher boundary percentile in INPUT.XLS*
63		=SET.NAME("lobw",HLOOKUP(lobwperc,bwrange,A-8))	*selects body weight at lobwperc (kg)*
64		=SET.NAME("hibw",HLOOKUP(hibwperc,bwrange,A-8))	*selects body weight at hibwperc (kg)*
65		=SET.NAME("WGT",lobw+(BWP-lobwperc)/(hibwperc-lobwperc)*(hibw-lobw))	*determines body weight of angler by interpolation (kg)*
66		=RETURN()	*ends BW macro*

	D	E	F
1			
2			
3	MACRO NAMES	MACRO COMMANDS	COMMENTS ASSOCIATED WITH MACRO COMMANDS IN COLUMN E
4			
5	HARVEST	=INITIALIZE2()	*runs INITIALIZE2 macro ($D$166); resets variables that change for each fish harvested in a single year*
6		=WHILE(counter<1)	*conditional allows angler to continue fishing until number of fish consumed in given year satisfies RATEFQ2*
7			
8		=SET.NAME("SPECIES",RiskDiscrete(speciesx,speciesprob))	*selects fish species harvested for consumption based on species' preferences in INPUT.XLS*
9		=IF(SPECIES=0,SET.NAME("ID",RiskDuniform(IDb)),)	*If SPECIES=bass, selects a bass from specified range in INPUT.XLS*
10		=IF(SPECIES=0,SET.NAME("FishMass",VLOOKUP(ID,FishData,7)),)	*based on ID, determines whole body fish mass of bass selected (g)*
11		=IF(SPECIES=0,SET.NAME("TPCBConc",VLOOKUP(ID,FishData,6)))	*based on ID, determines total PCB concentration of bass selected (ug/g)*
12		=IF(SPECIES=0,SET.NAME("Conc1221",VLOOKUP(ID,FishData,5)))	*based on ID, determines Aroclor 1221 concentration of bass selected (ug/g)*
13		=IF(SPECIES=0,SET.NAME("Conc1016",VLOOKUP(ID,FishData,4)))	*based on ID, determines Aroclor 1016 concentration of bass selected (ug/g)*
14		=IF(SPECIES=0,SET.NAME("Conc1254",VLOOKUP(ID,FishData,3)))	*based on ID, determines Aroclor 1254 concentration of bass selected (ug/g)*
15		=IF(SPECIES=0,SET.NAME("IntTPCB",FishMass*TPCBConc*lipb))	*calculates total PCB intake associated with consumption of bass selected (ug)*
16		=IF(SPECIES=0,SET.NAME("Int21",FishMass*Conc1221*lipb))	*calculates Aroclor 1221 intake associated with consumption of bass selected (ug)*
17		=IF(SPECIES=0,SET.NAME("Int16",FishMass*Conc1016*lipb))	*calculates Aroclor 1016 intake associated with consumption of bass selected (ug)*
18		=IF(SPECIES=0,SET.NAME("Int54",FishMass*Conc1254*lipb))	*calculates Aroclor 1254 intake associated with consumption of bass selected (ug)*
19		=IF(SPECIES=1,SET.NAME("ID",RiskDuniform(IDrb)),)	*same as $F$9, except SPECIES = rock bass*
20		=IF(SPECIES=1,SET.NAME("FishMass",VLOOKUP(ID,FishData,7)),)	*same as $F$10, except SPECIES = rock bass*
21		=IF(SPECIES=1,SET.NAME("TPCBConc",VLOOKUP(ID,FishData,6)))	*same as $F$11, except SPECIES = rock bass*
22		=IF(SPECIES=1,SET.NAME("Conc1221",VLOOKUP(ID,FishData,5)))	*same as $F$12, except SPECIES = rock bass*
23		=IF(SPECIES=1,SET.NAME("Conc1016",VLOOKUP(ID,FishData,4)))	*same as $F$13, except SPECIES = rock bass*
24		=IF(SPECIES=1,SET.NAME("Conc1254",VLOOKUP(ID,FishData,3)))	*same as $F$14, except SPECIES = rock bass*
25		=IF(SPECIES=1,SET.NAME("IntTPCB",FishMass*TPCBConc*liprb))	*same as $F$15, except SPECIES = rock bass*
26		=IF(SPECIES=1,SET.NAME("Int21",FishMass*Conc1221*liprb))	*same as $F$16, except SPECIES = rock bass*
27		=IF(SPECIES=1,SET.NAME("Int16",FishMass*Conc1016*liprb))	*same as $F$17, except SPECIES = rock bass*
28		=IF(SPECIES=1,SET.NAME("Int54",FishMass*Conc1254*liprb))	*same as $F$18, except SPECIES = rock bass*
29		=IF(SPECIES=2,SET.NAME("ID",RiskDuniform(IDbb)),)	*same as $F$9, except SPECIES = brown bullhead*
30		=IF(SPECIES=2,SET.NAME("FishMass",VLOOKUP(ID,FishData,7)),)	*same as $F$10, except SPECIES = brown bullhead*
31		=IF(SPECIES=2,SET.NAME("TPCBConc",VLOOKUP(ID,FishData,6)))	*same as $F$11, except SPECIES = brown bullhead*
32		=IF(SPECIES=2,SET.NAME("Conc1221",VLOOKUP(ID,FishData,5)))	*same as $F$12, except SPECIES = brown bullhead*
33		=IF(SPECIES=2,SET.NAME("Conc1016",VLOOKUP(ID,FishData,4)))	*same as $F$13, except SPECIES = brown bullhead*
34		=IF(SPECIES=2,SET.NAME("Conc1254",VLOOKUP(ID,FishData,3)))	*same as $F$14, except SPECIES = brown bullhead*
35		=IF(SPECIES=2,SET.NAME("IntTPCB",FishMass*TPCBConc*lipbb))	*same as $F$15, except SPECIES = brown bullhead*
36		=IF(SPECIES=2,SET.NAME("Int21",FishMass*Conc1221*lipbb))	*same as $F$16, except SPECIES = brown bullhead*
37		=IF(SPECIES=2,SET.NAME("Int16",FishMass*Conc1016*lipbb))	*same as $F$17, except SPECIES = brown bullhead*
38		=IF(SPECIES=2,SET.NAME("Int54",FishMass*Conc1254*lipbb))	*same as $F$18, except SPECIES = brown bullhead*
39		=IF(SPECIES=3,SET.NAME("ID",RiskDuniform(IDnop)),)	*same as $F$9, except SPECIES = northern pike*
40		=IF(SPECIES=3,SET.NAME("FishMass",VLOOKUP(ID,FishData,7)),)	*same as $F$10, except SPECIES = northern pike*
41		=IF(SPECIES=3,SET.NAME("TPCBConc",VLOOKUP(ID,FishData,6)))	*same as $F$11, except SPECIES = northern pike*
42		=IF(SPECIES=3,SET.NAME("Conc1221",VLOOKUP(ID,FishData,5)))	*same as $F$12, except SPECIES = northern pike*
43		=IF(SPECIES=3,SET.NAME("Conc1016",VLOOKUP(ID,FishData,4)))	*same as $F$13, except SPECIES = northern pike*
44		=IF(SPECIES=3,SET.NAME("Conc1254",VLOOKUP(ID,FishData,3)))	*same as $F$14, except SPECIES = northern pike*
45		=IF(SPECIES=3,SET.NAME("IntTPCB",FishMass*TPCBConc*lipnop))	*same as $F$15, except SPECIES = northern pike*
46		=IF(SPECIES=3,SET.NAME("Int21",FishMass*Conc1221*lipnop))	*same as $F$16, except SPECIES = northern pike*
47		=IF(SPECIES=3,SET.NAME("Int16",FishMass*Conc1016*lipnop))	*same as $F$17, except SPECIES = northern pike*
48		=IF(SPECIES=3,SET.NAME("Int54",FishMass*Conc1254*lipnop))	*same as $F$18, except SPECIES = northern pike*
49		=IF(SPECIES=4,SET.NAME("ID",RiskDuniform(IDpksd)),)	*same as $F$9, except SPECIES = pumpkinseed*
50		=IF(SPECIES=4,SET.NAME("FishMass",VLOOKUP(ID,FishData,7)),)	*same as $F$10, except SPECIES = pumpkinseed*
51		=IF(SPECIES=4,SET.NAME("TPCBConc",VLOOKUP(ID,FishData,6)))	*same as $F$11, except SPECIES = pumpkinseed*
52		=IF(SPECIES=4,SET.NAME("Conc1221",VLOOKUP(ID,FishData,5)))	*same as $F$12, except SPECIES = pumpkinseed*
53		=IF(SPECIES=4,SET.NAME("Conc1016",VLOOKUP(ID,FishData,4)))	*same as $F$13, except SPECIES = pumpkinseed*
54		=IF(SPECIES=4,SET.NAME("Conc1254",VLOOKUP(ID,FishData,3)))	*same as $F$14, except SPECIES = pumpkinseed*
55		=IF(SPECIES=4,SET.NAME("IntTPCB",FishMass*TPCBConc*lippksd))	*same as $F$15, except SPECIES = pumpkinseed*
56		=IF(SPECIES=4,SET.NAME("Int21",FishMass*Conc1221*lippksd))	*same as $F$16, except SPECIES = pumpkinseed*
57		=IF(SPECIES=4,SET.NAME("Int16",FishMass*Conc1016*lippksd))	*same as $F$17, except SPECIES = pumpkinseed*
58		=IF(SPECIES=4,SET.NAME("Int54",FishMass*Conc1254*lippksd))	*same as $F$18, except SPECIES = pumpkinseed*

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	D	E	F
59		=IF(SPECIES=5,SET.NAME("ID",RiskDuniform(IDblg)),)	same as $F$9, except SPECIES = bluegill
60		=IF(SPECIES=5,SET.NAME("FishMass",VLOOKUP(ID,FishData,7)),)	same as $F$10, except SPECIES = bluegill
61		=IF(SPECIES=5,SET.NAME("TPCBConc",VLOOKUP(ID,FishData,6)))	same as $F$11, except SPECIES = bluegill
62		=IF(SPECIES=5,SET.NAME("Conc1221",VLOOKUP(ID,FishData,5)))	same as $F$12, except SPECIES = bluegill
63		=IF(SPECIES=5,SET.NAME("Conc1016",VLOOKUP(ID,FishData,4)))	same as $F$13, except SPECIES = bluegill
64		=IF(SPECIES=5,SET.NAME("Conc1254",VLOOKUP(ID,FishData,3)))	same as $F$14, except SPECIES = bluegill
65		=IF(SPECIES=5,SET.NAME("IntTPCB",FishMass*TPCBConc*lipblg))	same as $F$15, except SPECIES = bluegill
66		=IF(SPECIES=5,SET.NAME("Int21",FishMass*Conc1221*lipblg))	same as $F$16, except SPECIES = bluegill
67		=IF(SPECIES=5,SET.NAME("Int16",FishMass*Conc1016*lipblg))	same as $F$17, except SPECIES = bluegill
68		=IF(SPECIES=5,SET.NAME("Int54",FishMass*Conc1254*lipblg))	same as $F$18, except SPECIES = bluegill
69		=IF(SPECIES=6,SET.NAME("ID",RiskDuniform(IDblc)),)	same as $F$9, except SPECIES = black crappie
70		=IF(SPECIES=6,SET.NAME("FishMass",VLOOKUP(ID,FishData,7)),)	same as $F$10, except SPECIES = black crappie
71		=IF(SPECIES=6,SET.NAME("TPCBConc",VLOOKUP(ID,FishData,6)))	same as $F$11, except SPECIES = black crappie
72		=IF(SPECIES=6,SET.NAME("Conc1221",VLOOKUP(ID,FishData,5)))	same as $F$12, except SPECIES = black crappie
73		=IF(SPECIES=6,SET.NAME("Conc1016",VLOOKUP(ID,FishData,4)))	same as $F$13, except SPECIES = black crappie
74		=IF(SPECIES=6,SET.NAME("Conc1254",VLOOKUP(ID,FishData,3)))	same as $F$14, except SPECIES = black crappie
75		=IF(SPECIES=6,SET.NAME("IntTPCB",FishMass*TPCBConc*lipblc))	same as $F$15, except SPECIES = black crappie
76		=IF(SPECIES=6,SET.NAME("Int21",FishMass*Conc1221*lipblc))	same as $F$16, except SPECIES = black crappie
77		=IF(SPECIES=6,SET.NAME("Int16",FishMass*Conc1016*lipblc))	same as $F$17, except SPECIES = black crappie
78		=IF(SPECIES=6,SET.NAME("Int54",FishMass*Conc1254*lipblc))	same as $F$18, except SPECIES = black crappie
79		=IF(SPECIES=7,SET.NAME("ID",RiskDuniform(IDweye)),)	same as $F$9, except SPECIES = walleye
80		=IF(SPECIES=7,SET.NAME("FishMass",VLOOKUP(ID,FishData,7)),)	same as $F$10, except SPECIES = walleye
81		=IF(SPECIES=7,SET.NAME("TPCBConc",VLOOKUP(ID,FishData,6)))	same as $F$11, except SPECIES = walleye
82		=IF(SPECIES=7,SET.NAME("Conc1221",VLOOKUP(ID,FishData,5)))	same as $F$12, except SPECIES = walleye
83		=IF(SPECIES=7,SET.NAME("Conc1016",VLOOKUP(ID,FishData,4)))	same as $F$13, except SPECIES = walleye
84		=IF(SPECIES=7,SET.NAME("Conc1254",VLOOKUP(ID,FishData,3)))	same as $F$14, except SPECIES = walleye
85		=IF(SPECIES=7,SET.NAME("IntTPCB",FishMass*TPCBConc*lipweye))	same as $F$15, except SPECIES = walleye
86		=IF(SPECIES=7,SET.NAME("Int21",FishMass*Conc1221*lipweye))	same as $F$16, except SPECIES = walleye
87		=IF(SPECIES=7,SET.NAME("Int16",FishMass*Conc1016*lipweye))	same as $F$17, except SPECIES = walleye
88		=IF(SPECIES=7,SET.NAME("Int54",FishMass*Conc1254*lipweye))	same as $F$18, except SPECIES = walleye
89		=IF(SPECIES=8,SET.NAME("ID",RiskDuniform(IDyp)),)	same as $F$9, except SPECIES = yellow perch
90		=IF(SPECIES=8,SET.NAME("FishMass",VLOOKUP(ID,FishData,7)),)	same as $F$10, except SPECIES = yellow perch
91		=IF(SPECIES=8,SET.NAME("TPCBConc",VLOOKUP(ID,FishData,6)))	same as $F$11, except SPECIES = yellow perch
92		=IF(SPECIES=8,SET.NAME("Conc1221",VLOOKUP(ID,FishData,5)))	same as $F$12, except SPECIES = yellow perch
93		=IF(SPECIES=8,SET.NAME("Conc1016",VLOOKUP(ID,FishData,4)))	same as $F$13, except SPECIES = yellow perch
94		=IF(SPECIES=8,SET.NAME("Conc1254",VLOOKUP(ID,FishData,3)))	same as $F$14, except SPECIES = yellow perch
95		=IF(SPECIES=8,SET.NAME("IntTPCB",FishMass*TPCBConc*lipyp))	same as $F$15, except SPECIES = yellow perch
96		=IF(SPECIES=8,SET.NAME("Int21",FishMass*Conc1221*lipyp))	same as $F$16, except SPECIES = yellow perch
97		=IF(SPECIES=8,SET.NAME("Int16",FishMass*Conc1016*lipyp))	same as $F$17, except SPECIES = yellow perch
98		=IF(SPECIES=8,SET.NAME("Int54",FishMass*Conc1254*lipyp))	same as $F$18, except SPECIES = yellow perch
99		=IF(SPECIES=9,SET.NAME("ID",RiskDuniform(IDchp)),)	same as $F$9, except SPECIES = chain pickerel
100		=IF(SPECIES=9,SET.NAME("FishMass",VLOOKUP(ID,FishData,7)),)	same as $F$10, except SPECIES = chain pickerel
101		=IF(SPECIES=9,SET.NAME("TPCBConc",VLOOKUP(ID,FishData,6)))	same as $F$11, except SPECIES = chain pickerel
102		=IF(SPECIES=9,SET.NAME("Conc1221",VLOOKUP(ID,FishData,5)))	same as $F$12, except SPECIES = chain pickerel
103		=IF(SPECIES=9,SET.NAME("Conc1016",VLOOKUP(ID,FishData,4)))	same as $F$13, except SPECIES = chain pickerel
104		=IF(SPECIES=9,SET.NAME("Conc1254",VLOOKUP(ID,FishData,3)))	same as $F$14, except SPECIES = chain pickerel
105		=IF(SPECIES=9,SET.NAME("IntTPCB",FishMass*TPCBConc*lipchp))	same as $F$15, except SPECIES = chain pickerel
106		=IF(SPECIES=9,SET.NAME("Int21",FishMass*Conc1221*lipchp))	same as $F$16, except SPECIES = chain pickerel
107		=IF(SPECIES=9,SET.NAME("Int16",FishMass*Conc1016*lipchp))	same as $F$17, except SPECIES = chain pickerel
108		=IF(SPECIES=9,SET.NAME("Int54",FishMass*Conc1254*lipchp))	same as $F$18, except SPECIES = chain pickerel
109		=IF(SPECIES=10,SET.NAME("ID",RiskDuniform(IDamel)),)	same as $F$9, except SPECIES = American eel
110		=IF(SPECIES=10,SET.NAME("FishMass",VLOOKUP(ID,FishData,7)),)	same as $F$10, except SPECIES = American eel
111		=IF(SPECIES=10,SET.NAME("TPCBConc",VLOOKUP(ID,FishData,6)))	same as $F$11, except SPECIES = American eel
112		=IF(SPECIES=10,SET.NAME("Conc1221",VLOOKUP(ID,FishData,5)))	same as $F$12, except SPECIES = American eel
113		=IF(SPECIES=10,SET.NAME("Conc1016",VLOOKUP(ID,FishData,4)))	same as $F$13, except SPECIES = American eel
114		=IF(SPECIES=10,SET.NAME("Conc1254",VLOOKUP(ID,FishData,3)))	same as $F$14, except SPECIES = American eel
115		=IF(SPECIES=10,SET.NAME("IntTPCB",FishMass*TPCBConc*lipamel))	same as $F$15, except SPECIES = American eel
116		=IF(SPECIES=10,SET.NAME("Int21",FishMass*Conc1221*lipamel))	same as $F$16, except SPECIES = American eel

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117		=IF(SPECIES=10,SET.NAME("Int16",FishMass*Conc1016*lipamel))	same as $F$17, except SPECIES = American eel
118		=IF(SPECIES=10,SET.NAME("Int54",FishMass*Conc1254*lipamel))	same as $F$18, except SPECIES = American eel
119		=IF(SPECIES=11,SET.NAME("ID",RiskDuniform(IDwp)),)	same as $F$9, except SPECIES = white perch
120		=IF(SPECIES=11,SET.NAME("FishMass",VLOOKUP(ID,FishData,7)),)	same as $F$10, except SPECIES = white perch
121		=IF(SPECIES=11,SET.NAME("TPCBConc",VLOOKUP(ID,FishData,6)))	same as $F$11, except SPECIES = white perch
122		=IF(SPECIES=11,SET.NAME("Conc1221",VLOOKUP(ID,FishData,5)))	same as $F$12, except SPECIES = white perch
123		=IF(SPECIES=11,SET.NAME("Conc1016",VLOOKUP(ID,FishData,4)))	same as $F$13, except SPECIES = white perch
124		=IF(SPECIES=11,SET.NAME("Conc1254",VLOOKUP(ID,FishData,3)))	same as $F$14, except SPECIES = white perch
125		=IF(SPECIES=11,SET.NAME("IntTPCB",FishMass*TPCBConc*lipwp))	same as $F$15, except SPECIES = white perch
126		=IF(SPECIES=11,SET.NAME("Int21",FishMass*Conc1221*lipwp))	same as $F$16, except SPECIES = white perch
127		=IF(SPECIES=11,SET.NAME("Int16",FishMass*Conc1016*lipwp))	same as $F$17, except SPECIES = white perch
128		=IF(SPECIES=11,SET.NAME("Int54",FishMass*Conc1254*lipwp))	same as $F$18, except SPECIES = white perch
129			
130		=IF((Totalfs+FishMass)<RATEFQ2,SET.NAME("Totalfs",Totalfs+FishMass),FishRate())	adds current FishMass to the sum consumed for given year; if the total exceeds RATEFQ2, run FishRate macro
131		=IF((Totalfs)<RATEFQ2,SET.NAME("SumTPCB",SumTPCB+IntTPCB),)	tracks the sum of total PCB intakes (ug) if RATEFQ2 is not satisfied
132		=IF((Totalfs)<RATEFQ2,SET.NAME("Sum1221",Sum1221+Int21),)	tracks the sum of Aroclor 1221 intakes (ug) if RATEFQ2 is not satisfied
133		=IF((Totalfs)<RATEFQ2,SET.NAME("Sum1016",Sum1016+Int16),)	tracks the sum of Aroclor 1016 intakes (ug) if RATEFQ2 is not satisfied
134		=IF((Totalfs)<RATEFQ2,SET.NAME("Sum1254",Sum1254+Int54),)	tracks the sum of Aroclor 1254 intakes (ug) if RATEFQ2 is not satisfied
135		=IF(counter=1,BREAK(),)	interrupts HARVEST macro if RATEFQ2 is satisfied
136		=NEXT()	stops WHILE loop ($E$6) if RATEFQ2 is satisfied
137		=SET.NAME("t",A-startage+1)	tracks number of years individual angler has been exposed
138		=SET.NAME("dr",(1/(EXP(k*t))))	calculates decline rate of PCBs based on first order kinetics
139		=SET.NAME("cookloss",RiskDiscrete({0.22,0.15,0.27,0.56,0.26,0,0},{0.179,0.002,0.164,0.621,0.009,0.006,0.02}))	determines reduction of PCBs in fish selected based on cooking method selected
140		=SET.NAME("TPCB",adjTPCB*dr*(1-cookloss))	calculates intake of total PCBs (ug) after accounting for decline rate and cooking loss
141		=SET.NAME("AROC21",adj1221*dr*(1-cookloss))	calculates intake of Aroclor 1221 (ug) after accounting for decline rate and cooking loss
142		=SET.NAME("AROC16",adj1016*dr*(1-cookloss))	calculates intake of Aroclor 1016 (ug) after accounting for decline rate and cooking loss
143		=SET.NAME("AROC54",adj1254*dr*(1-cookloss))	calculates intake of Aroclor 1254 (ug) after accounting for decline rate and cooking loss
144		=RETURN()	ends HARVEST macro
145			
146	FishRate	=WHILE(excess=0)	executes commands in cells $E$148 - $E$163 while excess=0 (set in INITIALIZE2 macro)
147		=SET.NAME("SumTPCB",SumTPCB+IntTPCB)	adds previous sum of total PCB intakes to current intake
148		=SET.NAME("Sum1221",Sum1221+Int21)	adds previous sum of Aroclor 1221 intakes to current intake
149		=SET.NAME("Sum1016",Sum1016+Int16)	adds previous sum of Aroclor 1016 intakes to current intake
150		=SET.NAME("Sum1254",Sum1254+Int54)	adds previous sum of Aroclor 1254 intakes to current intake
151		=SET.NAME("Totalfs",Totalfs+FishMass)	adds previous sum of fish masses to current fish mass
152		=SET.NAME("counter",1)	sets CounterRate to 1, indicating that RATEFQ2 has been satisfied
153		=SET.NAME("excess",Totalfs-RATEFQ2)	sets "excess" equal to the sum of fish masses consumed during given year minus the annual consumption rate
154		=SET.NAME("errTPCB",IntTPCB*excess/Totalfs)	calculates the amount by which the intake of total PCBs, calculated in HARVEST macro, is overestimated
155		=SET.NAME("err1221",Int21*excess/Totalfs)	calculates the amount by which the intake of Aroclor 1221, calculated in HARVEST macro, is overestimated
156		=SET.NAME("err1016",Int16*excess/Totalfs)	calculates the amount by which the intake of Aroclor 1016, calculated in HARVEST macro, is overestimated
157		=SET.NAME("err1254",Int54*excess/Totalfs)	calculates the amount by which the intake of Aroclor 1254, calculated in HARVEST macro, is overestimated
158		=SET.NAME("adjTPCB",SumTPCB-errTPCB)	calculates total PCB intake (ug), adjusted after exceeding the annual consumption rate
159		=SET.NAME("adj1221",Sum1221-err1221)	calculates Aroclor 1221 intake (ug), adjusted after exceeding the annual consumption rate
160		=SET.NAME("adj1016",Sum1016-err1016)	calculates Aroclor 1016 intake (ug), adjusted after exceeding the annual consumption rate
161		=SET.NAME("adj1254",Sum1254-err1254)	calculates Aroclor 1254 intake (ug), adjusted after exceeding the annual consumption rate
162		=NEXT()	stops WHILE loop ($E$147)
163		=RETURN()	ends FishRate macro
164			
165	INITIALIZE2	=SET.NAME("counter",0)	each year, initializes CounterRate to 0 before the first fish is consumed in HARVEST macro
166		=SET.NAME("sumTPCB",0)	each year, initializes sumTPCB to 0 before the first fish is consumed in HARVEST macro
167		=SET.NAME("sum1221",0)	each year, initializes sum1221 to 0 before the first fish is consumed in HARVEST macro
168		=SET.NAME("sum1016",0)	each year, initializes sum1016 to 0 before the first fish is consumed in HARVEST macro
169		=SET.NAME("sum1254",0)	each year, initializes sum1254 to 0 before the first fish is consumed in HARVEST macro
170		=SET.NAME("Totalfs",0)	each year, initializes Totalfs to 0 before the first fish is consumed in HARVEST macro
171		=SET.NAME("excess",0)	each year, initializes "excess" to 0 before the first fish is consumed in HARVEST macro
172		=RETURN()	ends INITIALIZE2 macro

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3	MACRO NAMES	MACRO COMMANDS	COMMENTS ASSOCIATED WITH MACRO COMMANDS IN COLUMN H
4			
5	SUMDOSES	=SET.NAME("TDOSE",TPCB/WGT)	converts current year's intake of total PCBs (TPCB in ug) to dose in units ug/kg body weight
6		=SET.NAME("DOSE21",AROC21/WGT)	converts current year's intake of Aroclor 1221 (AROC21 in ug) to dose in units ug/kg body weight
7		=SET.NAME("DOSE16",AROC16/WGT)	converts current year's intake of Aroclor 1016 (AROC16 in ug) to dose in units ug/kg body weight
8		=SET.NAME("DOSE54",AROC54/WGT)	converts current year's intake of Aroclor 1254 (AROC54 in ug) to dose in units ug/kg body weight
9		=SET.NAME("TDOSEsum",TDOSEsum+TDOSE)	adds current year's dose of total PCBs (ug/kg) to the running sum of doses
10		=SET.NAME("DOSE21sum",DOSE21sum+DOSE21)	adds current year's dose of Aroclor 1221 (ug/kg) to the running sum of doses
11		=SET.NAME("DOSE16sum",DOSE16sum+DOSE16)	adds current year's dose of Aroclor 1016 (ug/kg) to the running sum of doses
12		=SET.NAME("DOSE54sum",DOSE54sum+DOSE54)	adds current year's dose of Aroclor 1254 (ug/kg) to the running sum of doses
13		=RETURN()	ends SUMDOSES macro
14			
15	EXITLOOP	=IF(G=0,SET.NAME("pdeath",VLOOKUP(A,exitrange,3)),SET.NAME("pdeath",VLOOKUP(A,exitrange,4)))	selects the probability of dying based on gender and age
16		=SET.NAME("plife",1-pdeath)	sets the probability of living based on the complement of pdeath
17		=pdeath	places defined probability of dying in MACROH.XLS
18		=plife	places defined probability of living in MACROH.XLS
19		=SET.NAME("dier",RiskDiscrete({0,1},mortality))	determines if angler dies based on selected probabilities of dying and living
20		=WHILE(dier=0)	executes series of commands if angler dies
21		=SET.NAME("dieage",A)	sets variable "A" equal to age at death
22		=SET.NAME("exposure",dieage-startage+1)	calculates the exposure duration based on starting age and age at death
23		=SET.NAME("LADDT",(TDOSEsum/365250)/70)	calculates the Lifetime Average Daily Dose of total PCBs in mg/kg-day
24		=SET.NAME("LADD21",(DOSE21sum/365250)/70)	calculates the Lifetime Average Daily Dose of Aroclor 1221 in mg/kg-day
25		=SET.NAME("LADD16",(DOSE16sum/365250)/70)	calculates the Lifetime Average Daily Dose of Aroclor 1016 in mg/kg-day
26		=SET.NAME("LADD54",(DOSE54sum/365250)/70)	calculates the Lifetime Average Daily Dose of Aroclor 1254 in mg/kg-day
27		=IF((exposure<7),SET.NAME("ADDT",(TDOSEsum/365250)/7),SET.NAME("ADDT",(TDOSEsum/365250)/exposure))	calculates the Average Daily Dose of total PCBs in mg/kg-day (if exposure duration < 7 years, averaging time = 7 years)
28		=IF((exposure<7),SET.NAME("ADD21",(DOSE21sum/365250)/7),SET.NAME("ADD21",(DOSE21sum/365250)/exposure))	calculates the Average Daily Dose of Aroclor 1221 in mg/kg-day (if exposure duration < 7 years, averaging time = 7 years)
29		=IF((exposure<7),SET.NAME("ADD16",(DOSE16sum/365250)/7),SET.NAME("ADD16",(DOSE16sum/365250)/exposure))	calculates the Average Daily Dose of Aroclor 1016 in mg/kg-day (if exposure duration < 7 years, averaging time = 7 years)
30		=IF((exposure<7),SET.NAME("ADD54",(DOSE54sum/365250)/7),SET.NAME("ADD54",(DOSE54sum/365250)/exposure))	calculates the Average Daily Dose of Aroclor 1254 in mg/kg-day (if exposure duration < 7 years, averaging time = 7 years)
31		=BREAK()	interrupts WHILE loop ($H[illegible]0)
32		=NEXT()	ends WHILE loop ($H[illegible]
33		=WHILE(dier=1)	runs series of commands if angler lives
34		=IF(G=0,SET.NAME("pmove",VLOOKUP(A,exitrange,5)),SET.NAME("pmove",VLOOKUP(A,exitrange,6)))	selects the probability of moving out of county or ceasing to angle based on gender and age
35		=SET.NAME("pstay",1-pmove)	sets the probability of not moving or not ceasing to angle based on the complement of pmove
36		=pmove	places defined probability of moving or ceasing to angle in MACROH.XLS
37		=pstay	places defined probability of not moving or not ceasing to angle in MACROH.XLS
38		=SET.NAME("mover",RiskDiscrete({0,1},mobility))	determines if angler moves or ceases to angle based on selected probabilities
39		=IF(mover=0,SET.NAME("moveage",A),)	if pmove selected, sets variable "A" equal to age at move or age at time of ceasing to angle
40		=WHILE(mover=0)	runs series of commands if angler moves or ceases to angle
41		=SET.NAME("exposure",moveage-startage+1)	calculates the exposure duration based on starting age and age at move or at time of ceasing to angle
42		=WHILE(dier=1)	runs series of commands to determine when angler dies after having moved
43		=IF(G=0,SET.NAME("pdeath",VLOOKUP(A,exitrange,3)),SET.NAME("pdeath",VLOOKUP(A,exitrange,4)))	see $H$15
44		=SET.NAME("plife",1-pdeath)	see $H$16
45		=pdeath	see $H$17
46		=plife	see $H$18
47		=SET.NAME("dier",RiskDiscrete({0,1},mortality2))	see $H$19
48		=IF(dier=1,SET.NAME("A",A+1),)	advances age of angler by one year if angler lives
49		=IF(dier=0,SET.NAME("dieage",A),)	defines age at death if angler dies
50		=NEXT()	ends WHILE loop ($H$42)
51		=SET.NAME("LADDT",(TDOSEsum/365250)/70)	calculates Lifetime Average Daily Dose of total PCBs in mg/kg-day if angler moved
52		=SET.NAME("LADD21",(DOSE21sum/365250)/70)	calculates Lifetime Average Daily Dose of Aroclor 1221 in mg/kg-day if angler moved
53		=SET.NAME("LADD16",(DOSE16sum/365250)/70)	calculates Lifetime Average Daily Dose of Aroclor 1016 in mg/kg-day if angler moved
54		=SET.NAME("LADD54",(DOSE54sum/365250)/70)	calculates Lifetime Average Daily Dose of Aroclor 1254 in mg/kg-day if angler moved
55		=IF((exposure<7),SET.NAME("ADDT",(TDOSEsum/365250)/7),SET.NAME("ADDT",(TDOSEsum/365250)/exposure))	calculates Average Daily Dose of total PCBs in mg/kg-day if angler moved (if exposure duration < 7 years, averaging time = 7 years)
56		=IF((exposure<7),SET.NAME("ADD21",(DOSE21sum/365250)/7),SET.NAME("ADD21",(DOSE21sum/365250)/exposure))	calculates Average Daily Dose of Aroclor 1221 in mg/kg-day if angler moved (if exposure duration < 7 years, averaging time = 7 years)
57		=IF((exposure<7),SET.NAME("ADD16",(DOSE16sum/365250)/7),SET.NAME("ADD16",(DOSE16sum/365250)/exposure))	calculates Average Daily Dose of Aroclor 1016 in mg/kg-day if angler moved (if exposure duration < 7 years, averaging time = 7 years)
58		=IF((exposure<7),SET.NAME("ADD54",(DOSE54sum/365250)/7),SET.NAME("ADD54",(DOSE54sum/365250)/exposure))	calculates Average Daily Dose of Aroclor 1254 in mg/kg-day if angler moved (if exposure duration < 7 years, averaging time = 7 years)
59		=BREAK()	interrupts WHILE loop ($H$40)
60		=NEXT()	ends WHILE loop ($H$40)
61		=BREAK()	interrupts WHILE loop ($H$33)
62		=NEXT()	ends WHILE loop ($H$33)
63		=IF(mover=1,SET.NAME("A",A+1),)	advances age of angler by one year if angler does not move
64		=RETURN()	ends EXITLOOP macro

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3	MACRO NAMES	MACRO COMMANDS	COMMENTS ASSOCIATED WITH MACRO COMMANDS IN COLUMN H
4			
5	SUMMARY	=SELECT(OUTPUT.XLS!$B$12)	SUMMARY macro writes values to OUTPUT.XLS summary table
6		=SELECT(OFFSET(ACTIVE.CELL(),iteration,0))	
7		=FORMULA("=macroh.xls!iteration")	counter for iteration number
8		=SELECT(OUTPUT.XLS!$C$12)	
9		=SELECT(OFFSET(ACTIVE.CELL(),iteration,0))	
10		=FORMULA("=macroh.xls!G")	gender
11		=SELECT(OUTPUT.XLS!$D$12)	
12		=SELECT(OFFSET(ACTIVE.CELL(),iteration,0))	
13		=FORMULA("=macroh.xls!startage")	age at which exposures began
14		=SELECT(OUTPUT.XLS!$E$12)	
15		=SELECT(OFFSET(ACTIVE.CELL(),iteration,0))	
16		=IF(mover=0,FORMULA("=macroh.xls!moveage"),FORMULA("NA"))	age upon moving; "NA" if angler did not move
17		=SELECT(OUTPUT.XLS!$F$12)	
18		=SELECT(OFFSET(ACTIVE.CELL(),iteration,0))	
19		=FORMULA("=macroh.xls!dieage")	age at death
20		=SELECT(OUTPUT.XLS!$H$12)	
21		=SELECT(OFFSET(ACTIVE.CELL(),iteration,0))	
22		=FORMULA("=(macroh.xls!TOTRATES/macroh.xls!exposure)/365.25")	average consumption rate throughout exposure duration
23		=SELECT(OUTPUT.XLS!$G$12)	
24		=SELECT(OFFSET(ACTIVE.CELL(),iteration,0))	
25		=FORMULA("=macroh.xls!exposure")	exposure duration
26		=SELECT(OUTPUT.XLS!$M$12)	
27		=SELECT(OFFSET(ACTIVE.CELL(),iteration,0))	
28		=FORMULA("=macroh.xls!LADDT")	Lifetime Average Daily Dose of total PCBs
29		=SELECT(OUTPUT.XLS!$J$12)	
30		=SELECT(OFFSET(ACTIVE.CELL(),iteration,0))	
31		=FORMULA("=macroh.xls!LADD54")	Lifetime Average Daily Dose of Aroclor 1254
32		=SELECT(OUTPUT.XLS!$K$12)	
33		=SELECT(OFFSET(ACTIVE.CELL(),iteration,0))	
34		=FORMULA("=macroh.xls!LADD16")	Lifetime Average Daily Dose of Aroclor 1016
35		=SELECT(OUTPUT.XLS!$L$12)	
36		=SELECT(OFFSET(ACTIVE.CELL(),iteration,0))	
37		=FORMULA("=macroh.xls!LADD21")	Lifetime Average Daily Dose of Aroclor 1221
38		=SELECT(OUTPUT.XLS!$R$12)	
39		=SELECT(OFFSET(ACTIVE.CELL(),iteration,0))	
40		=FORMULA("=macroh.xls!ADDT")	Average Daily Dose of total PCBs
41		=SELECT(OUTPUT.XLS!$O$12)	
42		=SELECT(OFFSET(ACTIVE.CELL(),iteration,0))	
43		=FORMULA("=macroh.xls!ADD54")	Average Daily Dose of Aroclor 1254
44		=SELECT(OUTPUT.XLS!$P$12)	
45		=SELECT(OFFSET(ACTIVE.CELL(),iteration,0))	
46		=FORMULA("=macroh.xls!ADD16")	Average Daily Dose of Aroclor 1016
47		=SELECT(OUTPUT.XLS!$Q$12)	
48		=SELECT(OFFSET(ACTIVE.CELL(),iteration,0))	
49		=FORMULA("=macroh.xls!ADD21")	Average Daily Dose of Aroclor 1221
50		=RETURN()	ends SUMMARY macro

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1			
2			
3	MACRO NAMES	MACRO COMMANDS	COMMENTS ASSOCIATED WITH MACRO COMMANDS IN COLUMN H
4			
5	PERCENTILES1	=SET.NAME("fiveTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5013,0.05))	*at end of simulation, calculates summary statistics of LADDs for total PCBs, Aroclor 1254, Aroclor 1221, and Aroclor 1016*
6		=SET.NAME("tenTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.1))	
7		=SET.NAME("fifteenTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.15))	
8		=SET.NAME("twentyTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.2))	
9		=SET.NAME("twentyfiveTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.25))	
10		=SET.NAME("thirtyTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.3))	
11		=SET.NAME("thirtyfiveTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.35))	
12		=SET.NAME("fortyTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.4))	
13		=SET.NAME("fortyfiveTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.45))	
14		=SET.NAME("fiftyTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.5))	
15		=SET.NAME("fiftyfiveTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.55))	
16		=SET.NAME("sixtyTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.6))	
17		=SET.NAME("sixtyfiveTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.65))	
18		=SET.NAME("seventyTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.7))	
19		=SET.NAME("seventyfiveTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.75))	
20		=SET.NAME("eightyTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.8))	
21		=SET.NAME("eightyfiveTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.85))	
22		=SET.NAME("ninetyTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.9))	
23		=SET.NAME("ninetyoneTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.91))	
24		=SET.NAME("ninetytwoTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.92))	
25		=SET.NAME("ninetythreeTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.93))	
26		=SET.NAME("ninetyfourTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.94))	
27		=SET.NAME("ninetyfiveTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.95))	
28		=SET.NAME("ninetysixTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.96))	
29		=SET.NAME("ninetysevenTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.97))	
30		=SET.NAME("ninetyeightTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.98))	
31		=SET.NAME("ninetynineTLADD",PERCENTILE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014,0.99))	
32		=SET.NAME("maxTLADD",MAX(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014))	
33		=SET.NAME("minTLADD",MIN(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014))	
34		=SET.NAME("meanTLADD",AVERAGE(OUTPUT.XLS!$M$13:OUTPUT.XLS!$M$5014))	
35		=SET.NAME("fiveLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.05))	
36		=SET.NAME("tenLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.1))	
37		=SET.NAME("fifteenLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.15))	
38		=SET.NAME("twentyLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.2))	
39		=SET.NAME("twentyfiveLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.25))	
40		=SET.NAME("thirtyLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.3))	
41		=SET.NAME("thirtyfiveLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.35))	
42		=SET.NAME("fortyLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.4))	
43		=SET.NAME("fortyfiveLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.45))	
44		=SET.NAME("fiftyLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.5))	
45		=SET.NAME("fiftyfiveLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.55))	
46		=SET.NAME("sixtyLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.6))	
47		=SET.NAME("sixtyfiveLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.65))	
48		=SET.NAME("seventyLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.7))	
49		=SET.NAME("seventyfiveLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.75))	
50		=SET.NAME("eightyLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.8))	
51		=SET.NAME("eightyfiveLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.85))	
52		=SET.NAME("ninetyLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.9))	
53		=SET.NAME("ninetyoneLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.91))	
54		=SET.NAME("ninetytwoLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.92))	
55		=SET.NAME("ninetythreeLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.93))	
56		=SET.NAME("ninetyfourLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.94))	

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57		=SET.NAME("ninetyfiveLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.95))	
58		=SET.NAME("ninetysixLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.96))	
59		=SET.NAME("ninetysevenLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.97))	
60		=SET.NAME("ninetyeightLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.98))	
61		=SET.NAME("ninetynineLADD54",PERCENTILE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014,0.99))	
62		=SET.NAME("maxLADD54",MAX(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014))	
63		=SET.NAME("minLADD54",MIN(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014))	
64		=SET.NAME("meanLADD54",AVERAGE(OUTPUT.XLS!$J$13:OUTPUT.XLS!$J$5014))	
65		=SET.NAME("fiveLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.05))	
66		=SET.NAME("tenLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.1))	
67		=SET.NAME("fifteenLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.15))	
68		=SET.NAME("twentyLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.2))	
69		=SET.NAME("twentyfiveLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.25))	
70		=SET.NAME("thirtyLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.3))	
71		=SET.NAME("thirtyfiveLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.35))	
72		=SET.NAME("fortyLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.4))	
73		=SET.NAME("fortyfiveLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.45))	
74		=SET.NAME("fiftyLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.5))	
75		=SET.NAME("fiftyfiveLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.55))	
76		=SET.NAME("sixtyLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.6))	
77		=SET.NAME("sixtyfiveLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.65))	
78		=SET.NAME("seventyLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.7))	
79		=SET.NAME("seventyfiveLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.75))	
80		=SET.NAME("eightyLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.8))	
81		=SET.NAME("eightyfiveLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.85))	
82		=SET.NAME("ninetyLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.9))	
83		=SET.NAME("ninetyoneLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.91))	
84		=SET.NAME("ninetytwoLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.92))	
85		=SET.NAME("ninetythreeLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.93))	
86		=SET.NAME("ninetyfourLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.94))	
87		=SET.NAME("ninetyfiveLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.95))	
88		=SET.NAME("ninetysixLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.96))	
89		=SET.NAME("ninetysevenLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.97))	
90		=SET.NAME("ninetyeightLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.98))	
91		=SET.NAME("ninetynineLADD16",PERCENTILE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014,0.99))	
92		=SET.NAME("maxLADD16",MAX(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014))	
93		=SET.NAME("minLADD16",MIN(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014))	
94		=SET.NAME("meanLADD16",AVERAGE(OUTPUT.XLS!$K$13:OUTPUT.XLS!$K$5014))	
95		=SET.NAME("fiveLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.05))	
96		=SET.NAME("tenLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.1))	
97		=SET.NAME("fifteenLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.15))	
98		=SET.NAME("twentyLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.2))	
99		=SET.NAME("twentyfiveLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.25))	
100		=SET.NAME("thirtyLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.3))	
101		=SET.NAME("thirtyfiveLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.35))	
102		=SET.NAME("fortyLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.4))	
103		=SET.NAME("fortyfiveLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.45))	
104		=SET.NAME("fiftyLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.5))	
105		=SET.NAME("fiftyfiveLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.55))	
106		=SET.NAME("sixtyLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.6))	
107		=SET.NAME("sixtyfiveLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.65))	
108		=SET.NAME("seventyLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.7))	
109		=SET.NAME("seventyfiveLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.75))	
110		=SET.NAME("eightyLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.8))	
111		=SET.NAME("eightyfiveLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.85))	
112		=SET.NAME("ninetyLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.9))	

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113		=SET.NAME("ninetyoneLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.91))	
114		=SET.NAME("ninetytwoLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.92))	
115		=SET.NAME("ninetythreeLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.93))	
116		=SET.NAME("ninetyfourLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.94))	
117		=SET.NAME("ninetyfiveLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.95))	
118		=SET.NAME("ninetysixLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.96))	
119		=SET.NAME("ninetysevenLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.97))	
120		=SET.NAME("ninetyeightLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.98))	
121		=SET.NAME("ninetynineLADD21",PERCENTILE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014,0.99))	
122		=SET.NAME("maxLADD21",MAX(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014))	
123		=SET.NAME("minLADD21",MIN(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014))	
124		=SET.NAME("meanLADD21",AVERAGE(OUTPUT.XLS!$L$13:OUTPUT.XLS!$L$5014))	
125			
126		=FORMULA("=macroh.xls!fiveTLADD",OUTPUT.XLS!$X$13)	*at end of simulation, writes summary statistics of LADDs for total PCBs, Aroclor 1254, Aroclor 1221, and Aroclor 1016 to OUTPUT*
127		=FORMULA("=macroh.xls!tenTLADD",OUTPUT.XLS!$X$14)	
128		=FORMULA("=macroh.xls!fifteenTLADD",OUTPUT.XLS!$X$15)	
129		=FORMULA("=macroh.xls!twentyTLADD",OUTPUT.XLS!$X$16)	
130		=FORMULA("=macroh.xls!twentyfiveTLADD",OUTPUT.XLS!$X$17)	
131		=FORMULA("=macroh.xls!thirtyTLADD",OUTPUT.XLS!$X$18)	
132		=FORMULA("=macroh.xls!thirtyfiveTLADD",OUTPUT.XLS!$X$19)	
133		=FORMULA("=macroh.xls!fortyTLADD",OUTPUT.XLS!$X$20)	
134		=FORMULA("=macroh.xls!fortyfiveTLADD",OUTPUT.XLS!$X$21)	
135		=FORMULA("=macroh.xls!fiftyTLADD",OUTPUT.XLS!$X$22)	
136		=FORMULA("=macroh.xls!fiftyfiveTLADD",OUTPUT.XLS!$X$23)	
137		=FORMULA("=macroh.xls!sixtyTLADD",OUTPUT.XLS!$X$24)	
138		=FORMULA("=macroh.xls!sixtyfiveTLADD",OUTPUT.XLS!$X$25)	
139		=FORMULA("=macroh.xls!seventyTLADD",OUTPUT.XLS!$X$26)	
140		=FORMULA("=macroh.xls!seventyfiveTLADD",OUTPUT.XLS!$X$27)	
141		=FORMULA("=macroh.xls!eightyTLADD",OUTPUT.XLS!$X$28)	
142		=FORMULA("=macroh.xls!eightyfiveTLADD",OUTPUT.XLS!$X$29)	
143		=FORMULA("=macroh.xls!ninetyTLADD",OUTPUT.XLS!$X$30)	
144		=FORMULA("=macroh.xls!ninetyoneTLADD",OUTPUT.XLS!$X$31)	
145		=FORMULA("=macroh.xls!ninetytwoTLADD",OUTPUT.XLS!$X$32)	
146		=FORMULA("=macroh.xls!ninetythreeTLADD",OUTPUT.XLS!$X$33)	
147		=FORMULA("=macroh.xls!ninetyfourTLADD",OUTPUT.XLS!$X$34)	
148		=FORMULA("=macroh.xls!ninetyfiveTLADD",OUTPUT.XLS!$X$35)	
149		=FORMULA("=macroh.xls!ninetysixTLADD",OUTPUT.XLS!$X$36)	
150		=FORMULA("=macroh.xls!ninetysevenTLADD",OUTPUT.XLS!$X$37)	
151		=FORMULA("=macroh.xls!ninetyeightTLADD",OUTPUT.XLS!$X$38)	
152		=FORMULA("=macroh.xls!ninetynineTLADD",OUTPUT.XLS!$X$39)	
153		=FORMULA("=macroh.xls!maxTLADD",OUTPUT.XLS!$X$40)	
154		=FORMULA("=macroh.xls!minTLADD",OUTPUT.XLS!$X$41)	
155		=FORMULA("=macroh.xls!meanTLADD",OUTPUT.XLS!$X$42)	
156		=FORMULA("=macroh.xls!fiveLADD54",OUTPUT.XLS!$U$13)	
157		=FORMULA("=macroh.xls!tenLADD54",OUTPUT.XLS!$U$14)	
158		=FORMULA("=macroh.xls!fifteenLADD54",OUTPUT.XLS!$U$15)	
159		=FORMULA("=macroh.xls!twentyLADD54",OUTPUT.XLS!$U$16)	
160		=FORMULA("=macroh.xls!twentyfiveLADD54",OUTPUT.XLS!$U$17)	
161		=FORMULA("=macroh.xls!thirtyLADD54",OUTPUT.XLS!$U$18)	
162		=FORMULA("=macroh.xls!thirtyfiveLADD54",OUTPUT.XLS!$U$19)	
163		=FORMULA("=macroh.xls!fortyLADD54",OUTPUT.XLS!$U$20)	
164		=FORMULA("=macroh.xls!fortyfiveLADD54",OUTPUT.XLS!$U$21)	
165		=FORMULA("=macroh.xls!fiftyLADD54",OUTPUT.XLS!$U$22)	
166		=FORMULA("=macroh.xls!fiftyfiveLADD54",OUTPUT.XLS!$U$23)	
167		=FORMULA("=macroh.xls!sixtyLADD54",OUTPUT.XLS!$U$24)	
168		=FORMULA("=macroh.xls!sixtyfiveLADD54",OUTPUT.XLS!$U$25)	

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169		=FORMULA("=macroh.xls!seventyLADD54",OUTPUT.XLS!$U$26)	
170		=FORMULA("=macroh.xls!seventyfiveLADD54",OUTPUT.XLS!$U$27)	
171		=FORMULA("=macroh.xls!eightyLADD54",OUTPUT.XLS!$U$28)	
172		=FORMULA("=macroh.xls!eightyfiveLADD54",OUTPUT.XLS!$U$29)	
173		=FORMULA("=macroh.xls!ninetyLADD54",OUTPUT.XLS!$U$30)	
174		=FORMULA("=macroh.xls!ninetyoneLADD54",OUTPUT.XLS!$U$31)	
175		=FORMULA("=macroh.xls!ninetytwoLADD54",OUTPUT.XLS!$U$32)	
176		=FORMULA("=macroh.xls!ninetythreeLADD54",OUTPUT.XLS!$U$33)	
177		=FORMULA("=macroh.xls!ninetyfourLADD54",OUTPUT.XLS!$U$34)	
178		=FORMULA("=macroh.xls!ninetyfiveLADD54",OUTPUT.XLS!$U$35)	
179		=FORMULA("=macroh.xls!ninetysixLADD54",OUTPUT.XLS!$U$36)	
180		=FORMULA("=macroh.xls!ninetysevenLADD54",OUTPUT.XLS!$U$37)	
181		=FORMULA("=macroh.xls!ninetyeightLADD54",OUTPUT.XLS!$U$38)	
182		=FORMULA("=macroh.xls!ninetynineLADD54",OUTPUT.XLS!$U$39)	
183		=FORMULA("=macroh.xls!maxLADD54",OUTPUT.XLS!$U$40)	
184		=FORMULA("=macroh.xls!minLADD54",OUTPUT.XLS!$U$41)	
185		=FORMULA("=macroh.xls!meanLADD54",OUTPUT.XLS!$U$42)	
186		=FORMULA("=macroh.xls!fiveLADD16",OUTPUT.XLS!$V$13)	
187		=FORMULA("=macroh.xls!tenLADD16",OUTPUT.XLS!$V$14)	
188		=FORMULA("=macroh.xls!fifteenLADD16",OUTPUT.XLS!$V$15)	
189		=FORMULA("=macroh.xls!twentyLADD16",OUTPUT.XLS!$V$16)	
190		=FORMULA("=macroh.xls!twentyfiveLADD16",OUTPUT.XLS!$V$17)	
191		=FORMULA("=macroh.xls!thirtyLADD16",OUTPUT.XLS!$V$18)	
192		=FORMULA("=macroh.xls!thirtyfiveLADD16",OUTPUT.XLS!$V$19)	
193		=FORMULA("=macroh.xls!fortyLADD16",OUTPUT.XLS!$V$20)	
194		=FORMULA("=macroh.xls!fortyfiveLADD16",OUTPUT.XLS!$V$21)	
195		=FORMULA("=macroh.xls!fiftyLADD16",OUTPUT.XLS!$V$22)	
196		=FORMULA("=macroh.xls!fiftyfiveLADD16",OUTPUT.XLS!$V$23)	
197		=FORMULA("=macroh.xls!sixtyLADD16",OUTPUT.XLS!$V$24)	
198		=FORMULA("=macroh.xls!sixtyfiveLADD16",OUTPUT.XLS!$V$25)	
199		=FORMULA("=macroh.xls!seventyLADD16",OUTPUT.XLS!$V$26)	
200		=FORMULA("=macroh.xls!seventyfiveLADD16",OUTPUT.XLS!$V$27)	
201		=FORMULA("=macroh.xls!eightyLADD16",OUTPUT.XLS!$V$28)	
202		=FORMULA("=macroh.xls!eightyfiveLADD16",OUTPUT.XLS!$V$29)	
203		=FORMULA("=macroh.xls!ninetyLADD16",OUTPUT.XLS!$V$30)	
204		=FORMULA("=macroh.xls!ninetyoneLADD16",OUTPUT.XLS!$V$31)	
205		=FORMULA("=macroh.xls!ninetytwoLADD16",OUTPUT.XLS!$V$32)	
206		=FORMULA("=macroh.xls!ninetythreeLADD16",OUTPUT.XLS!$V$33)	
207		=FORMULA("=macroh.xls!ninetyfourLADD16",OUTPUT.XLS!$V$34)	
208		=FORMULA("=macroh.xls!ninetyfiveLADD16",OUTPUT.XLS!$V$35)	
209		=FORMULA("=macroh.xls!ninetysixLADD16",OUTPUT.XLS!$V$36)	
210		=FORMULA("=macroh.xls!ninetysevenLADD16",OUTPUT.XLS!$V$37)	
211		=FORMULA("=macroh.xls!ninetyeightLADD16",OUTPUT.XLS!$V$38)	
212		=FORMULA("=macroh.xls!ninetynineLADD16",OUTPUT.XLS!$V$39)	
213		=FORMULA("=macroh.xls!maxLADD16",OUTPUT.XLS!$V$40)	
214		=FORMULA("=macroh.xls!minLADD16",OUTPUT.XLS!$V$41)	
215		=FORMULA("=macroh.xls!meanLADD16",OUTPUT.XLS!$V$42)	
216		=FORMULA("=macroh.xls!fiveLADD21",OUTPUT.XLS!$W$13)	
217		=FORMULA("=macroh.xls!tenLADD21",OUTPUT.XLS!$W$14)	
218		=FORMULA("=macroh.xls!fifteenLADD21",OUTPUT.XLS!$W$15)	
219		=FORMULA("=macroh.xls!twentyLADD21",OUTPUT.XLS!$W$16)	
220		=FORMULA("=macroh.xls!twentyfiveLADD21",OUTPUT.XLS!$W$17)	
221		=FORMULA("=macroh.xls!thirtyLADD21",OUTPUT.XLS!$W$18)	
222		=FORMULA("=macroh.xls!thirtyfiveLADD21",OUTPUT.XLS!$W$19)	
223		=FORMULA("=macroh.xls!fortyLADD21",OUTPUT.XLS!$W$20)	
224		=FORMULA("=macroh.xls!fortyfiveLADD21",OUTPUT.XLS!$W$21)	

	M	N	O
225		=FORMULA("=macroh.xls!fiftyLADD21",OUTPUT.XLS!$W$22)	
226		=FORMULA("=macroh.xls!fiftyfiveLADD21",OUTPUT.XLS!$W$23)	
227		=FORMULA("=macroh.xls!sixtyLADD21",OUTPUT.XLS!$W$24)	
228		=FORMULA("=macroh.xls!sixtyfiveLADD21",OUTPUT.XLS!$W$25)	
229		=FORMULA("=macroh.xls!seventyLADD21",OUTPUT.XLS!$W$26)	
230		=FORMULA("=macroh.xls!seventyfiveLADD21",OUTPUT.XLS!$W$27)	
231		=FORMULA("=macroh.xls!eightyLADD21",OUTPUT.XLS!$W$28)	
232		=FORMULA("=macroh.xls!eightyfiveLADD21",OUTPUT.XLS!$W$29)	
233		=FORMULA("=macroh.xls!ninetyLADD21",OUTPUT.XLS!$W$30)	
234		=FORMULA("=macroh.xls!ninetyoneLADD21",OUTPUT.XLS!$W$31)	
235		=FORMULA("=macroh.xls!ninetytwoLADD21",OUTPUT.XLS!$W$32)	
236		=FORMULA("=macroh.xls!ninetythreeLADD21",OUTPUT.XLS!$W$33)	
237		=FORMULA("=macroh.xls!ninetyfourLADD21",OUTPUT.XLS!$W$34)	
238		=FORMULA("=macroh.xls!ninetyfiveLADD21",OUTPUT.XLS!$W$35)	
239		=FORMULA("=macroh.xls!ninetysixLADD21",OUTPUT.XLS!$W$36)	
240		=FORMULA("=macroh.xls!ninetysevenLADD21",OUTPUT.XLS!$W$37)	
241		=FORMULA("=macroh.xls!ninetyeightLADD21",OUTPUT.XLS!$W$38)	
242		=FORMULA("=macroh.xls!ninetynineLADD21",OUTPUT.XLS!$W$39)	
243		=FORMULA("=macroh.xls!maxLADD21",OUTPUT.XLS!$W$40)	
244		=FORMULA("=macroh.xls!minLADD21",OUTPUT.XLS!$W$41)	
245		=FORMULA("=macroh.xls!meanLADD21",OUTPUT.XLS!$W$42)	
246		=RETURN()	*ends PERCENTILES1 macro*

10.3649

	P	Q	R
1			
2			
3	MACRO NAMES	MACRO COMMANDS	COMMENTS ASSOCIATED WITH MACRO COMMANDS IN COLUMN H
4			
5	PERCENTILES2	=SET.NAME("fiveTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.05))	*at end of simulation, calculates summary statistics of LADDs for total PCBs, Aroclor 1254, Aroclor 1221, and Aroclor 1016*
6		=SET.NAME("tenTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.1))	
7		=SET.NAME("fifteenTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.15))	
8		=SET.NAME("twentyTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.2))	
9		=SET.NAME("twentyfiveTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.25))	
10		=SET.NAME("thirtyTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.3))	
11		=SET.NAME("thirtyfiveTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.35))	
12		=SET.NAME("fortyTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.4))	
13		=SET.NAME("fortyfiveTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.45))	
14		=SET.NAME("fiftyTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.5))	
15		=SET.NAME("fiftyfiveTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.55))	
16		=SET.NAME("sixtyTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.6))	
17		=SET.NAME("sixtyfiveTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.65))	
18		=SET.NAME("seventyTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.7))	
19		=SET.NAME("seventyfiveTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.75))	
20		=SET.NAME("eightyTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.8))	
21		=SET.NAME("eightyfiveTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.85))	
22		=SET.NAME("ninetyTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.9))	
23		=SET.NAME("ninetyoneTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.91))	
24		=SET.NAME("ninetytwoTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.92))	
25		=SET.NAME("ninetythreeTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.93))	
26		=SET.NAME("ninetyfourTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.94))	
27		=SET.NAME("ninetyfiveTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.95))	
28		=SET.NAME("ninetysixTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.96))	
29		=SET.NAME("ninetysevenTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.97))	
30		=SET.NAME("ninetyeightTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.98))	
31		=SET.NAME("ninetynineTADD",PERCENTILE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014,0.99))	
32		=SET.NAME("maxTADD",MAX(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014))	
33		=SET.NAME("minTADD",MIN(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014))	
34		=SET.NAME("meanTADD",AVERAGE(OUTPUT.XLS!$R$13:OUTPUT.XLS!$R$5014))	
35		=SET.NAME("fiveADD54",PERCENTILE(OUTPUT.XLS!$J13:OUTPUT.XLS!$O$5014,0.05))	
36		=SET.NAME("tenADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.1))	
37		=SET.NAME("fifteenADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.15))	
38		=SET.NAME("twentyADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.2))	
39		=SET.NAME("twentyfiveADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.25))	
40		=SET.NAME("thirtyADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.3))	
41		=SET.NAME("thirtyfiveADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.35))	
42		=SET.NAME("fortyADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.4))	
43		=SET.NAME("fortyfiveADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.45))	
44		=SET.NAME("fiftyADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.5))	
45		=SET.NAME("fiftyfiveADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.55))	
46		=SET.NAME("sixtyADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.6))	
47		=SET.NAME("sixtyfiveADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.65))	
48		=SET.NAME("seventyADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.7))	
49		=SET.NAME("seventyfiveADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.75))	
50		=SET.NAME("eightyADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.8))	
51		=SET.NAME("eightyfiveADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.85))	
52		=SET.NAME("ninetyADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.9))	
53		=SET.NAME("ninetyoneADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.91))	
54		=SET.NAME("ninetytwoADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.92))	
55		=SET.NAME("ninetythreeADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.93))	
56		=SET.NAME("ninetyfourADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.94))	

	P	Q	R
57		=SET.NAME("ninetyfiveADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.95))	
58		=SET.NAME("ninetysixADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.96))	
59		=SET.NAME("ninetysevenADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.97))	
60		=SET.NAME("ninetyeightADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.98))	
61		=SET.NAME("ninetynineADD54",PERCENTILE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014,0.99))	
62		=SET.NAME("maxADD54",MAX(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014))	
63		=SET.NAME("minADD54",MIN(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014))	
64		=SET.NAME("meanADD54",AVERAGE(OUTPUT.XLS!$O$13:OUTPUT.XLS!$O$5014))	
65		=SET.NAME("fiveADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.05))	
66		=SET.NAME("tenADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.1))	
67		=SET.NAME("fifteenADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.15))	
68		=SET.NAME("twentyADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.2))	
69		=SET.NAME("twentyfiveADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.25))	
70		=SET.NAME("thirtyADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.3))	
71		=SET.NAME("thirtyfiveADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.35))	
72		=SET.NAME("fortyADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.4))	
73		=SET.NAME("fortyfiveADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.45))	
74		=SET.NAME("fiftyADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.5))	
75		=SET.NAME("fiftyfiveADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.55))	
76		=SET.NAME("sixtyADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.6))	
77		=SET.NAME("sixtyfiveADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.65))	
78		=SET.NAME("seventyADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.7))	
79		=SET.NAME("seventyfiveADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.75))	
80		=SET.NAME("eightyADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.8))	
81		=SET.NAME("eightyfiveADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.85))	
82		=SET.NAME("ninetyADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.9))	
83		=SET.NAME("ninetyoneADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.91))	
84		=SET.NAME("ninetytwoADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.92))	
85		=SET.NAME("ninetythreeADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.93))	
86		=SET.NAME("ninetyfourADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.94))	
87		=SET.NAME("ninetyfiveADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.95))	
88		=SET.NAME("ninetysixADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.96))	
89		=SET.NAME("ninetysevenADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.97))	
90		=SET.NAME("ninetyeightADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.98))	
91		=SET.NAME("ninetynineADD16",PERCENTILE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014,0.99))	
92		=SET.NAME("maxADD16",MAX(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014))	
93		=SET.NAME("minADD16",MIN(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014))	
94		=SET.NAME("meanADD16",AVERAGE(OUTPUT.XLS!$P$13:OUTPUT.XLS!$P$5014))	
95		=SET.NAME("fiveADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.05))	
96		=SET.NAME("tenADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.1))	
97		=SET.NAME("fifteenADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.15))	
98		=SET.NAME("twentyADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.2))	
99		=SET.NAME("twentyfiveADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.25))	
100		=SET.NAME("thirtyADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.3))	
101		=SET.NAME("thirtyfiveADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.35))	
102		=SET.NAME("fortyADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.4))	
103		=SET.NAME("fortyfiveADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.45))	
104		=SET.NAME("fiftyADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.5))	
105		=SET.NAME("fiftyfiveADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.55))	
106		=SET.NAME("sixtyADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.6))	
107		=SET.NAME("sixtyfiveADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.65))	
108		=SET.NAME("seventyADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.7))	
109		=SET.NAME("seventyfiveADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.75))	
110		=SET.NAME("eightyADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.8))	
111		=SET.NAME("eightyfiveADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.85))	
112		=SET.NAME("ninetyADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.9))	

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113		=SET.NAME("ninetyoneADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.91))	
114		=SET.NAME("ninetytwoADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.92))	
115		=SET.NAME("ninetythreeADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.93))	
116		=SET.NAME("ninetyfourADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.94))	
117		=SET.NAME("ninetyfiveADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.95))	
118		=SET.NAME("ninetysixADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.96))	
119		=SET.NAME("ninetysevenADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.97))	
120		=SET.NAME("ninetyeightADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.98))	
121		=SET.NAME("ninetynineADD21",PERCENTILE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014,0.99))	
122		=SET.NAME("maxADD21",MAX(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014))	
123		=SET.NAME("minADD21",MIN(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014))	
124		=SET.NAME("meanADD21",AVERAGE(OUTPUT.XLS!$Q$13:OUTPUT.XLS!$Q$5014))	
125			
126		=FORMULA("=macroh.xls!fiveTADD",OUTPUT.XLS!$AD$13)	*at end of simulation, writes summary statistics of ADDs for total PCBs, Aroclor 1254, Aroclor 1221, and Aroclor 1016 to OUTPUT.X*
127		=FORMULA("=macroh.xls!tenTADD",OUTPUT.XLS!$AD$14)	
128		=FORMULA("=macroh.xls!fifteenTADD",OUTPUT.XLS!$AD$15)	
129		=FORMULA("=macroh.xls!twentyTADD",OUTPUT.XLS!$AD$16)	
130		=FORMULA("=macroh.xls!twentyfiveTADD",OUTPUT.XLS!$AD$17)	
131		=FORMULA("=macroh.xls!thirtyTADD",OUTPUT.XLS!$AD$18)	
132		=FORMULA("=macroh.xls!thirtyfiveTADD",OUTPUT.XLS!$AD$19)	
133		=FORMULA("=macroh.xls!fortyTADD",OUTPUT.XLS!$AD$20)	
134		=FORMULA("=macroh.xls!fortyfiveTADD",OUTPUT.XLS!$AD$21)	
135		=FORMULA("=macroh.xls!fiftyTADD",OUTPUT.XLS!$AD$22)	
136		=FORMULA("=macroh.xls!fiftyfiveTADD",OUTPUT.XLS!$AD$23)	
137		=FORMULA("=macroh.xls!sixtyTADD",OUTPUT.XLS!$AD$24)	
138		=FORMULA("=macroh.xls!sixtyfiveTADD",OUTPUT.XLS!$AD$25)	
139		=FORMULA("=macroh.xls!seventyTADD",OUTPUT.XLS!$AD$26)	
140		=FORMULA("=macroh.xls!seventyfiveTADD",OUTPUT.XLS!$AD$27)	
141		=FORMULA("=macroh.xls!eightyTADD",OUTPUT.XLS!$AD$28)	
142		=FORMULA("=macroh.xls!eightyfiveTADD",OUTPUT.XLS!$AD$29)	
143		=FORMULA("=macroh.xls!ninetyTADD",OUTPUT.XLS!$AD$30)	
144		=FORMULA("=macroh.xls!ninetyoneTADD",OUTPUT.XLS!$AD$31)	
145		=FORMULA("=macroh.xls!ninetytwoTADD",OUTPUT.XLS!$AD$32)	
146		=FORMULA("=macroh.xls!ninetythreeTADD",OUTPUT.XLS!$AD$33)	
147		=FORMULA("=macroh.xls!ninetyfourTADD",OUTPUT.XLS!$AD$34)	
148		=FORMULA("=macroh.xls!ninetyfiveTADD",OUTPUT.XLS!$AD$35)	
149		=FORMULA("=macroh.xls!ninetysixTADD",OUTPUT.XLS!$AD$36)	
150		=FORMULA("=macroh.xls!ninetysevenTADD",OUTPUT.XLS!$AD$37)	
151		=FORMULA("=macroh.xls!ninetyeightTADD",OUTPUT.XLS!$AD$38)	
152		=FORMULA("=macroh.xls!ninetynineTADD",OUTPUT.XLS!$AD$39)	
153		=FORMULA("=macroh.xls!maxTADD",OUTPUT.XLS!$AD$40)	
154		=FORMULA("=macroh.xls!minTADD",OUTPUT.XLS!$AD$41)	
155		=FORMULA("=macroh.xls!meanTADD",OUTPUT.XLS!$AD$42)	
156		=FORMULA("=macroh.xls!fiveADD54",OUTPUT.XLS!$AA$13)	
157		=FORMULA("=macroh.xls!tenADD54",OUTPUT.XLS!$AA$14)	
158		=FORMULA("=macroh.xls!fifteenADD54",OUTPUT.XLS!$AA$15)	
159		=FORMULA("=macroh.xls!twentyADD54",OUTPUT.XLS!$AA$16)	
160		=FORMULA("=macroh.xls!twentyfiveADD54",OUTPUT.XLS!$AA$17)	
161		=FORMULA("=macroh.xls!thirtyADD54",OUTPUT.XLS!$AA$18)	
162		=FORMULA("=macroh.xls!thirtyfiveADD54",OUTPUT.XLS!$AA$19)	
163		=FORMULA("=macroh.xls!fortyADD54",OUTPUT.XLS!$AA$20)	
164		=FORMULA("=macroh.xls!fortyfiveADD54",OUTPUT.XLS!$AA$21)	
165		=FORMULA("=macroh.xls!fiftyADD54",OUTPUT.XLS!$AA$22)	
166		=FORMULA("=macroh.xls!fiftyfiveADD54",OUTPUT.XLS!$AA$23)	
167		=FORMULA("=macroh.xls!sixtyADD54",OUTPUT.XLS!$AA$24)	
168		=FORMULA("=macroh.xls!sixtyfiveADD54",OUTPUT.XLS!$AA$25)	

	P	Q	R
169		=FORMULA("=macroh.xls!seventyADD54",OUTPUT.XLS!$AA$26)	
170		=FORMULA("=macroh.xls!seventyfiveADD54",OUTPUT.XLS!$AA$27)	
171		=FORMULA("=macroh.xls!eightyADD54",OUTPUT.XLS!$AA$28)	
172		=FORMULA("=macroh.xls!eightyfiveADD54",OUTPUT.XLS!$AA$29)	
173		=FORMULA("=macroh.xls!ninetyADD54",OUTPUT.XLS!$AA$30)	
174		=FORMULA("=macroh.xls!ninetyoneADD54",OUTPUT.XLS!$AA$31)	
175		=FORMULA("=macroh.xls!ninetytwoADD54",OUTPUT.XLS!$AA$32)	
176		=FORMULA("=macroh.xls!ninetythreeADD54",OUTPUT.XLS!$AA$33)	
177		=FORMULA("=macroh.xls!ninetyfourADD54",OUTPUT.XLS!$AA$34)	
178		=FORMULA("=macroh.xls!ninetyfiveADD54",OUTPUT.XLS!$AA$35)	
179		=FORMULA("=macroh.xls!ninetysixADD54",OUTPUT.XLS!$AA$36)	
180		=FORMULA("=macroh.xls!ninetysevenADD54",OUTPUT.XLS!$AA$37)	
181		=FORMULA("=macroh.xls!ninetyeightADD54",OUTPUT.XLS!$AA$38)	
182		=FORMULA("=macroh.xls!ninetynineADD54",OUTPUT.XLS!$AA$39)	
183		=FORMULA("=macroh.xls!maxADD54",OUTPUT.XLS!$AA$40)	
184		=FORMULA("=macroh.xls!minADD54",OUTPUT.XLS!$AA$41)	
185		=FORMULA("=macroh.xls!meanADD54",OUTPUT.XLS!$AA$42)	
186		=FORMULA("=macroh.xls!fiveADD16",OUTPUT.XLS!$AB$13)	
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192		=FORMULA("=macroh.xls!thirtyfiveADD16",OUTPUT.XLS!$AB$19)	
193		=FORMULA("=macroh.xls!fortyADD16",OUTPUT.XLS!$AB$20)	
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208		=FORMULA("=macroh.xls!ninetyfiveADD16",OUTPUT.XLS!$AB$35)	
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213		=FORMULA("=macroh.xls!maxADD16",OUTPUT.XLS!$AB$40)	
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215		=FORMULA("=macroh.xls!meanADD16",OUTPUT.XLS!$AB$42)	
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222		=FORMULA("=macroh.xls!thirtyfiveADD21",OUTPUT.XLS!$AC$19)	
223		=FORMULA("=macroh.xls!fortyADD21",OUTPUT.XLS!$AC$20)	
224		=FORMULA("=macroh.xls!fortyfiveADD21",OUTPUT.XLS!$AC$21)	

10.3653

	P	Q	R
225		=FORMULA("=macroh.xls!fiftyADD21",OUTPUT.XLS!$AC$22)	
226		=FORMULA("=macroh.xls!fiftyfiveADD21",OUTPUT.XLS!$AC$23)	
227		=FORMULA("=macroh.xls!sixtyADD21",OUTPUT.XLS!$AC$24)	
228		=FORMULA("=macroh.xls!sixtyfiveADD21",OUTPUT.XLS!$AC$25)	
229		=FORMULA("=macroh.xls!seventyADD21",OUTPUT.XLS!$AC$26)	
230		=FORMULA("=macroh.xls!seventyfiveADD21",OUTPUT.XLS!$AC$27)	
231		=FORMULA("=macroh.xls!eightyADD21",OUTPUT.XLS!$AC$28)	
232		=FORMULA("=macroh.xls!eightyfiveADD21",OUTPUT.XLS!$AC$29)	
233		=FORMULA("=macroh.xls!ninetyADD21",OUTPUT.XLS!$AC$30)	
234		=FORMULA("=macroh.xls!ninetyoneADD21",OUTPUT.XLS!$AC$31)	
235		=FORMULA("=macroh.xls!ninetytwoADD21",OUTPUT.XLS!$AC$32)	
236		=FORMULA("=macroh.xls!ninetythreeADD21",OUTPUT.XLS!$AC$33)	
237		=FORMULA("=macroh.xls!ninetyfourADD21",OUTPUT.XLS!$AC$34)	
238		=FORMULA("=macroh.xls!ninetyfiveADD21",OUTPUT.XLS!$AC$35)	
239		=FORMULA("=macroh.xls!ninetysixADD21",OUTPUT.XLS!$AC$36)	
240		=FORMULA("=macroh.xls!ninetysevenADD21",OUTPUT.XLS!$AC$37)	
241		=FORMULA("=macroh.xls!ninetyeightADD21",OUTPUT.XLS!$AC$38)	
242		=FORMULA("=macroh.xls!ninetynineADD21",OUTPUT.XLS!$AC$39)	
243		=FORMULA("=macroh.xls!maxADD21",OUTPUT.XLS!$AC$40)	
244		=FORMULA("=macroh.xls!minADD21",OUTPUT.XLS!$AC$41)	
245		=FORMULA("=macroh.xls!meanADD21",OUTPUT.XLS!$AC$42)	
246		=FORMULA("=macroh.xls!iteration",OUTPUT.XLS!$B$7)	
247		=RETURN()	*ends PERCENTILES2 macro*

10.3654

Description of the Basic Approach to Model PCB Dose Rates from the Consumption of Fish from the Upper Hudson River

Paul Price
at
USEPA Region II
November 6, 1995

ChemRisk®
A Division of McLaren/Hart
Environmental Engineering

Topics

- ☐ MicroExposure Monte Carlo
- ☐ Answering the key question:

  What is the distribution of toxicologically relevant dose rates that will occur in anglers fishing the Upper Hudson under remedial options?

10.3656

This presentation will not focus on the source or specific values of the exposure inputs but rather on the modeling of dose rate distributions

Microexposure Event Modeling of Fish Consumption

The Traditional System of Exposure Scenarios

- Provides a simplified model of the relationship between exposures and dose rates
- Generally does not deal with time-dependent changes

Three Types of Time in Exposure Scenarios

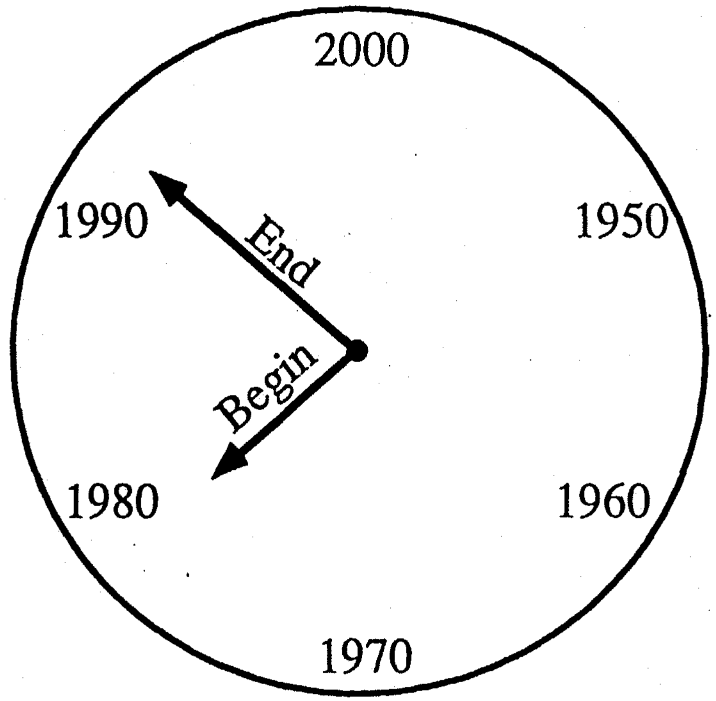
- Toxicological definition of time
- Chronological time
- Biological time

10.3660

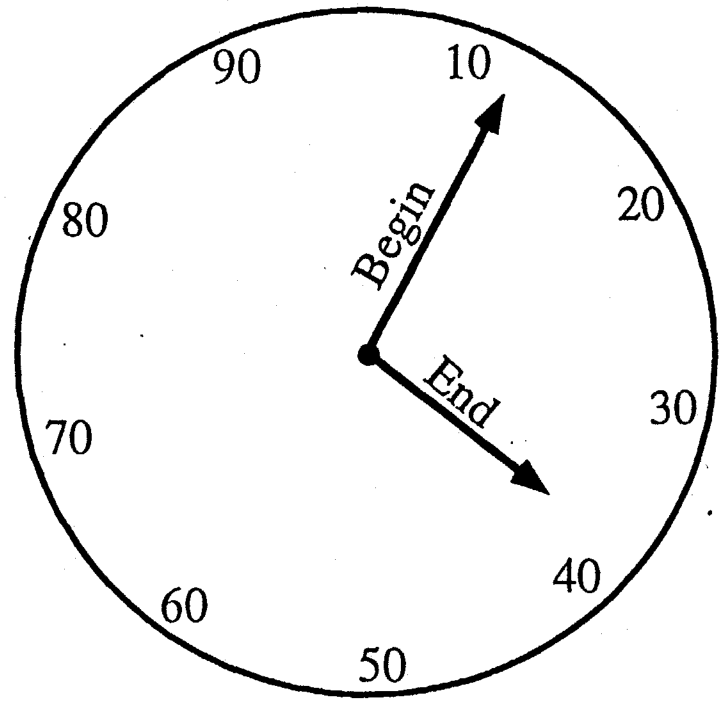
Toxicological Definitions of Time

- Determined by the duration of exposure necessary to cause an effect
  - acute
  - subchronic
  - chronic
  - lifetime

Chronological and Biological Time



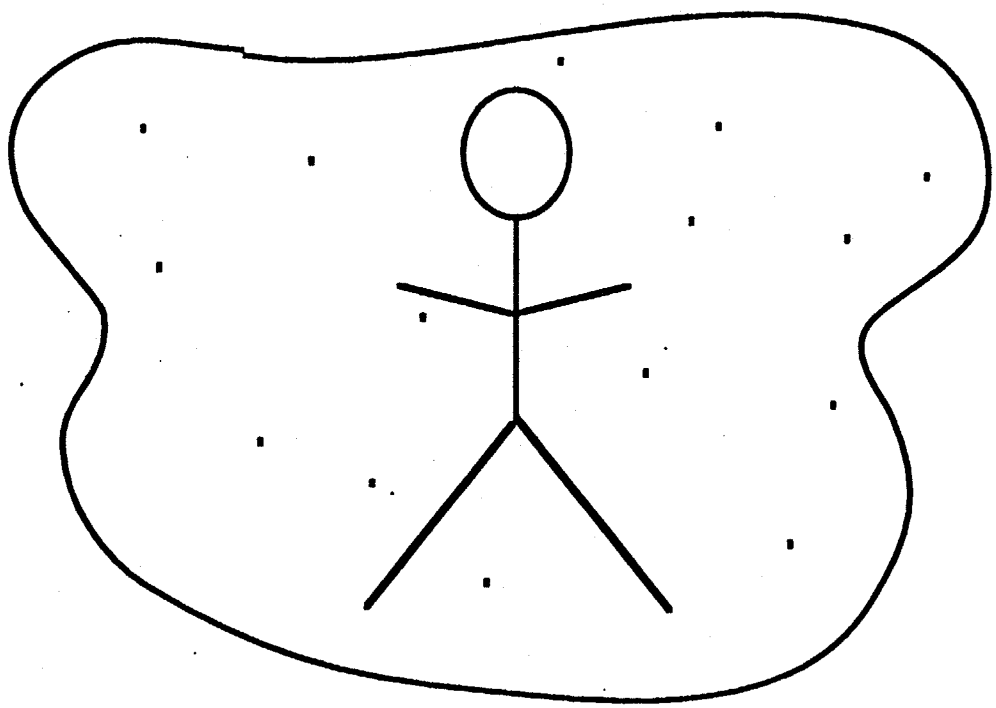
Calendar years in which
the exposures occurred



Biological age of the
exposed individual

10.3662

Scenario World View

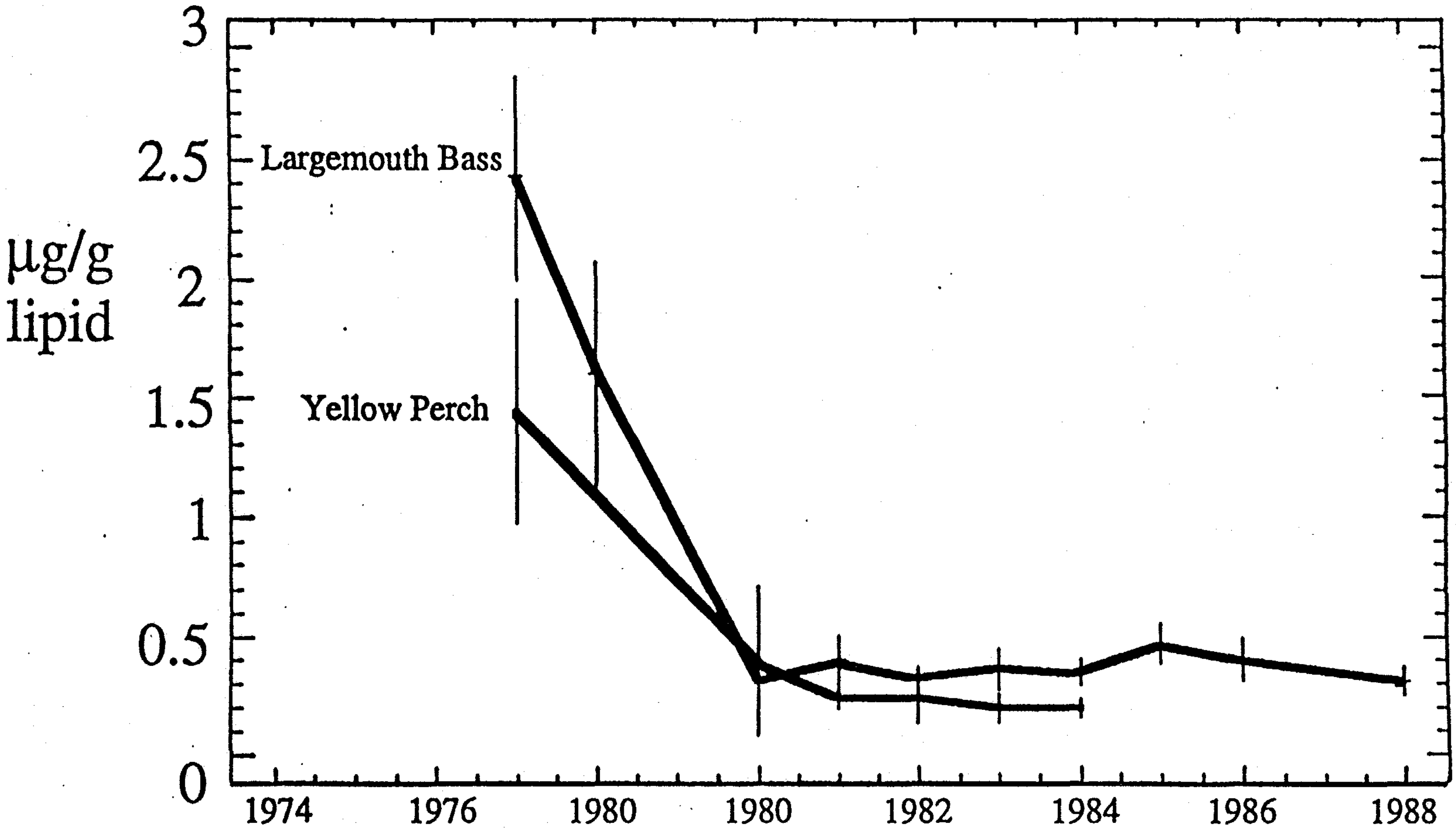


- Exposure to a fixed environmental concentration
- Constant behavior
- 30 years of exposure

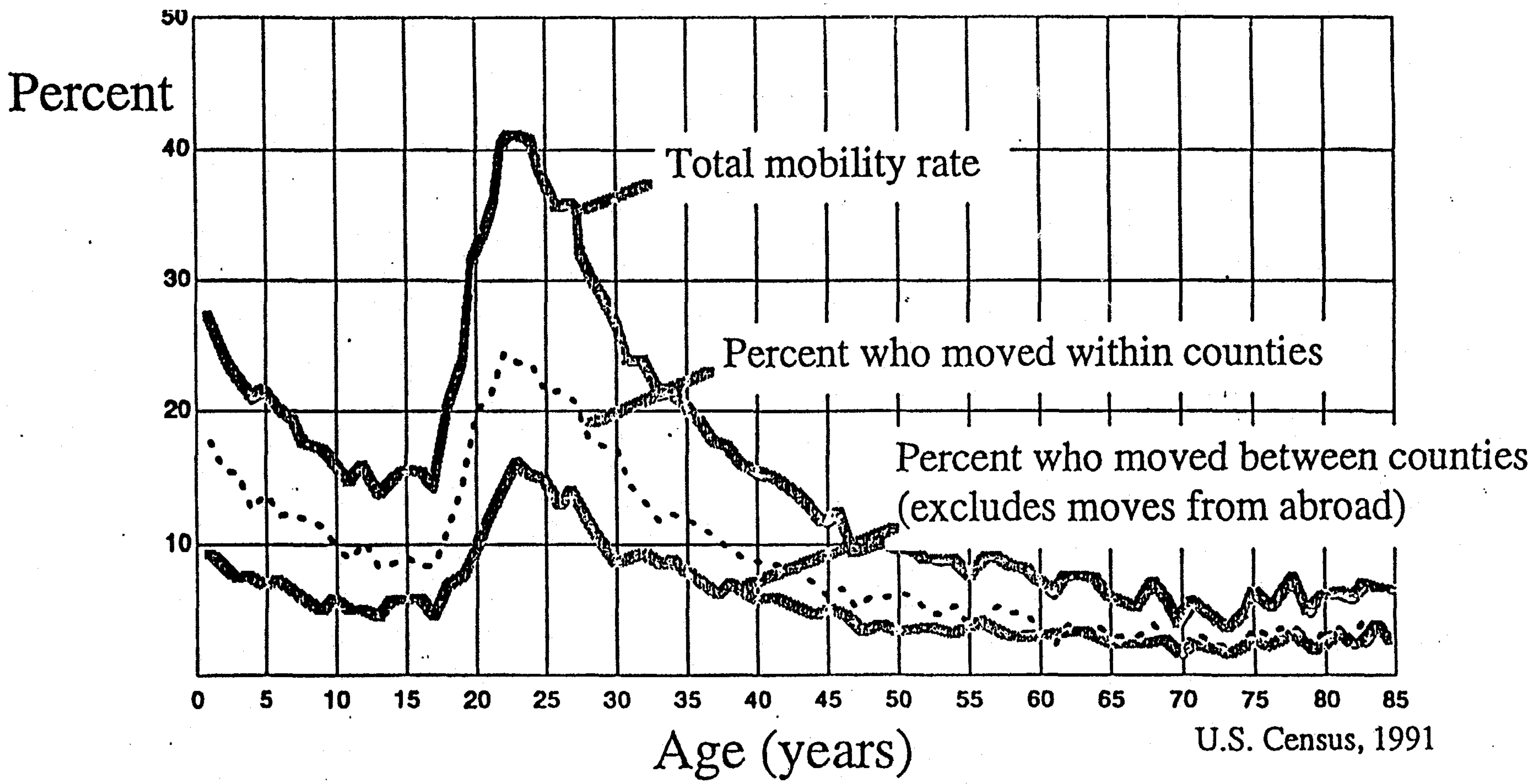
In Reality

- ❑ Environmental concentrations vary in time
  - Randomly (short-term)
  - Systematically (long-term)
- ❑ Individual's behavior is also highly variable
  - Short-term variation
  - Age-dependent (long-term)

Long-Term Variation in PCB Concentrations in Hudson River Fish



Individual's Mobility Varies by Age



10.3666

Monte Carlo Analysis of Existing Exposure Scenario Models

Uses same equation as traditional exposure calculations:

$$\text{Dose Rate} = \frac{\text{Duration x Intake Rate x Environmental Concentrations}}{\text{Lifetime x Body Weight}}$$

But replaces point estimates with distributions.

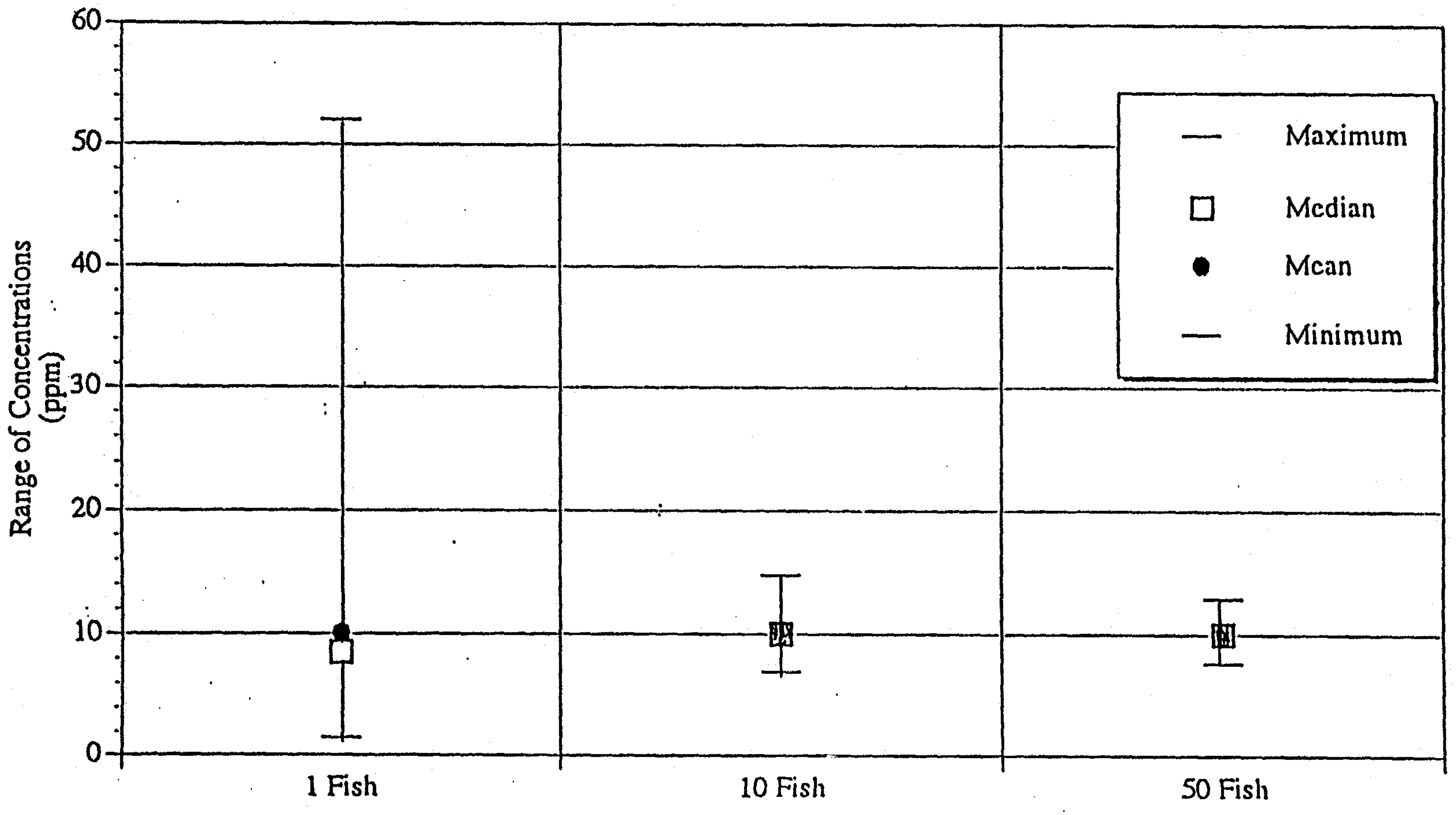
10.3667

Information on Variation in Exposure Factors May Not Be Appropriate for Calculating a Distribution of Long-Term Doses

- ❑ Consumption data
  - Based on short-term surveys
  - Age-dependent behavior
- ❑ Duration is age-dependent
- ❑ Variation in concentration of PCBs in fish

10.3668

The Variation in Environmental Concentration (Fish Concentration) Varies with the Number of Fish Consumed

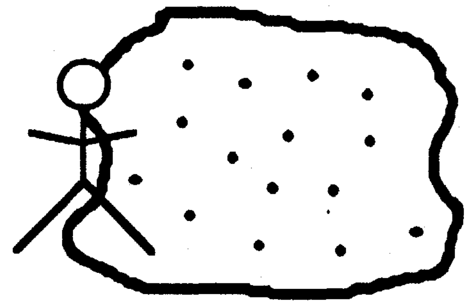


10.3669

Exposure Scenarios Should Model:

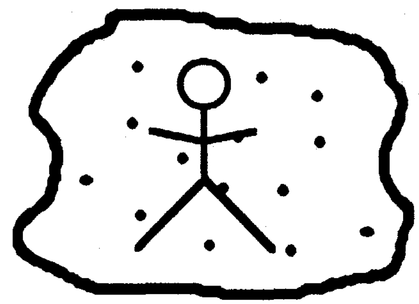
When Exposure Begins

- Age of the individual
- Date of the exposure



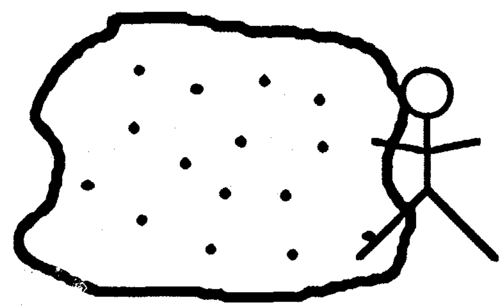
How Intensity Varies During Exposure

- Age-specific behaviors
- Date-specific information on the intensity of the source of the exposure



When Exposure Ends

- Age of the individual
- Date of the exposure



Microexposure Event Modeling

- ❑ Considers an individual's exposure as a series of separate exposure events
- ❑ Models each event separately
- ❑ Defines each exposure event in terms of
  - Age of the individual
  - Distribution of possible environmental concentrations (random variation)
  - Predicted environmental concentrations (long-term trends)

10.3671

Microexposure Modeling

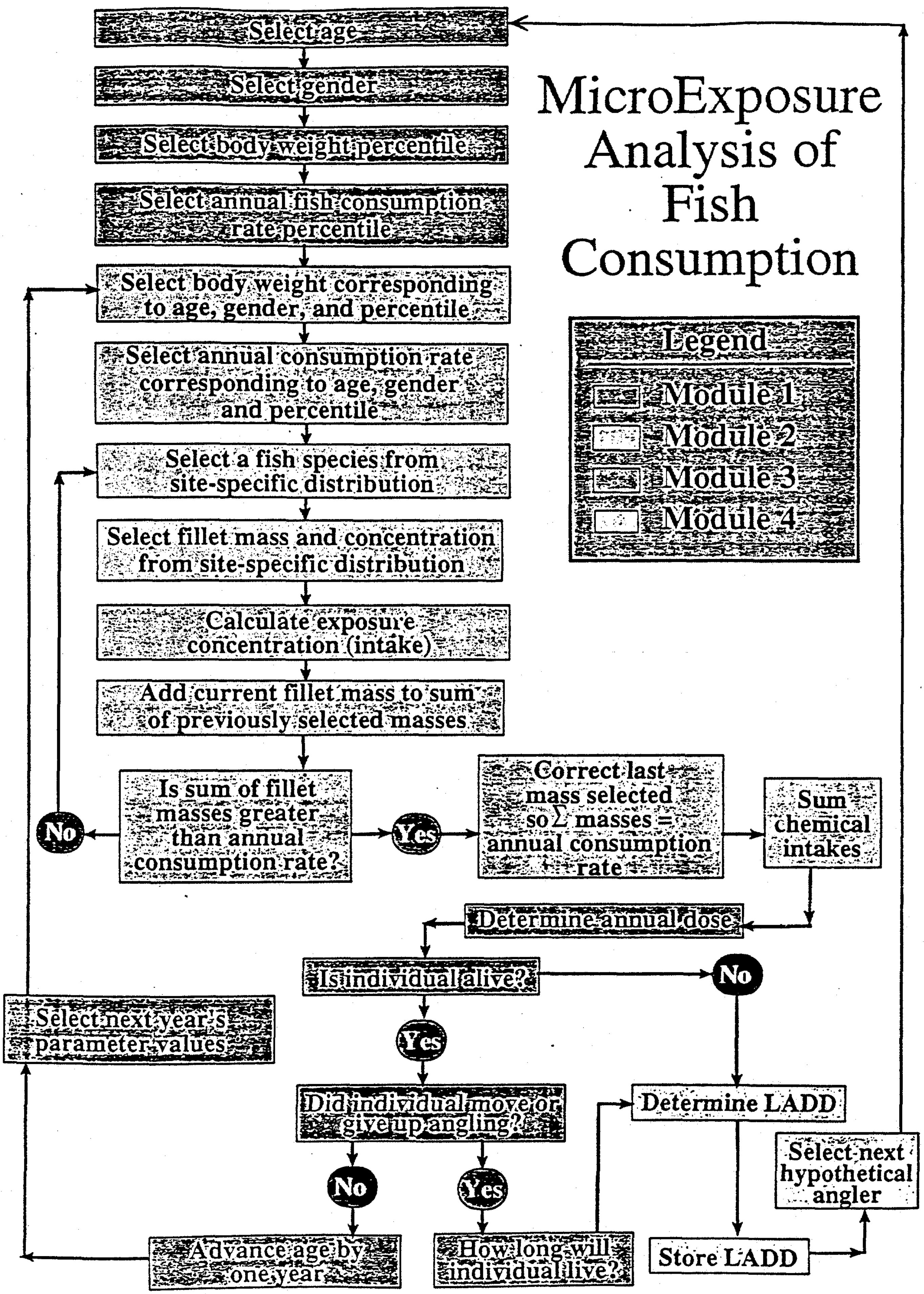
$$\text{Dose Rate} = \frac{\text{Duration} \times \text{Intake Rate} \times \text{Environmental Concentrations}}{\text{Lifetime} \times \text{Body Weight}}$$

$$\text{Dose} = \frac{1}{\text{Averaging Time}} \sum^{\text{Duration (in years)}} \frac{1}{\text{Body Weight}} \sum^{\text{Annual Number of Events}} \text{Individual Dose Event}$$

$$\text{LADD} = \frac{1}{70\ \text{years}} \sum^{\text{Angling Duration}} \frac{1}{\text{Body Weight}} \sum^{\text{Fish Consumed}} \text{Fish Concentration on a Lipid Basis} \times \text{Percent Lipids} \times \text{Fish Size} \times (1 - \text{Cooking Loss})$$

Proposed Approach

- Model the dose received from each fish consumed and sum the doses to determine the long-term dose rates for each angler, taking into account:
  - the proper use of the distribution of PCB concentrations in fish
  - species preference
  - cooking losses
  - temporal changes in PCB concentrations
  - exposure duration
  - timing of remedial alternatives


MicroExposure Analysis of Fish Consumption
Legend
Module 1
Module 2
Module 3
Module 4
Select age
Select gender
Select body weight percentile
Select annual fish consumption rate percentile
Select body weight corresponding to age, gender, and percentile
Select annual consumption rate corresponding to age, gender and percentile
Select a fish species from site-specific distribution
Select fillet mass and concentration from site-specific distribution
Calculate exposure concentration (intake)
Add current fillet mass to sum of previously selected masses
Is sum of fillet masses greater than annual consumption rate?
No
Yes
Correct last mass selected so Σ masses = annual consumption rate
Sum chemical intakes
Determine annual dose
Is individual alive?
No
Yes
Select next year's parameter values
Did individual move or give up angling?
No
Yes
Advance age by one year
How long will individual live?
Determine LADD
Store LADD
Select next hypothetical angler

Fish Consumption Analysis - Module 1

Select Age

↓

Select Gender

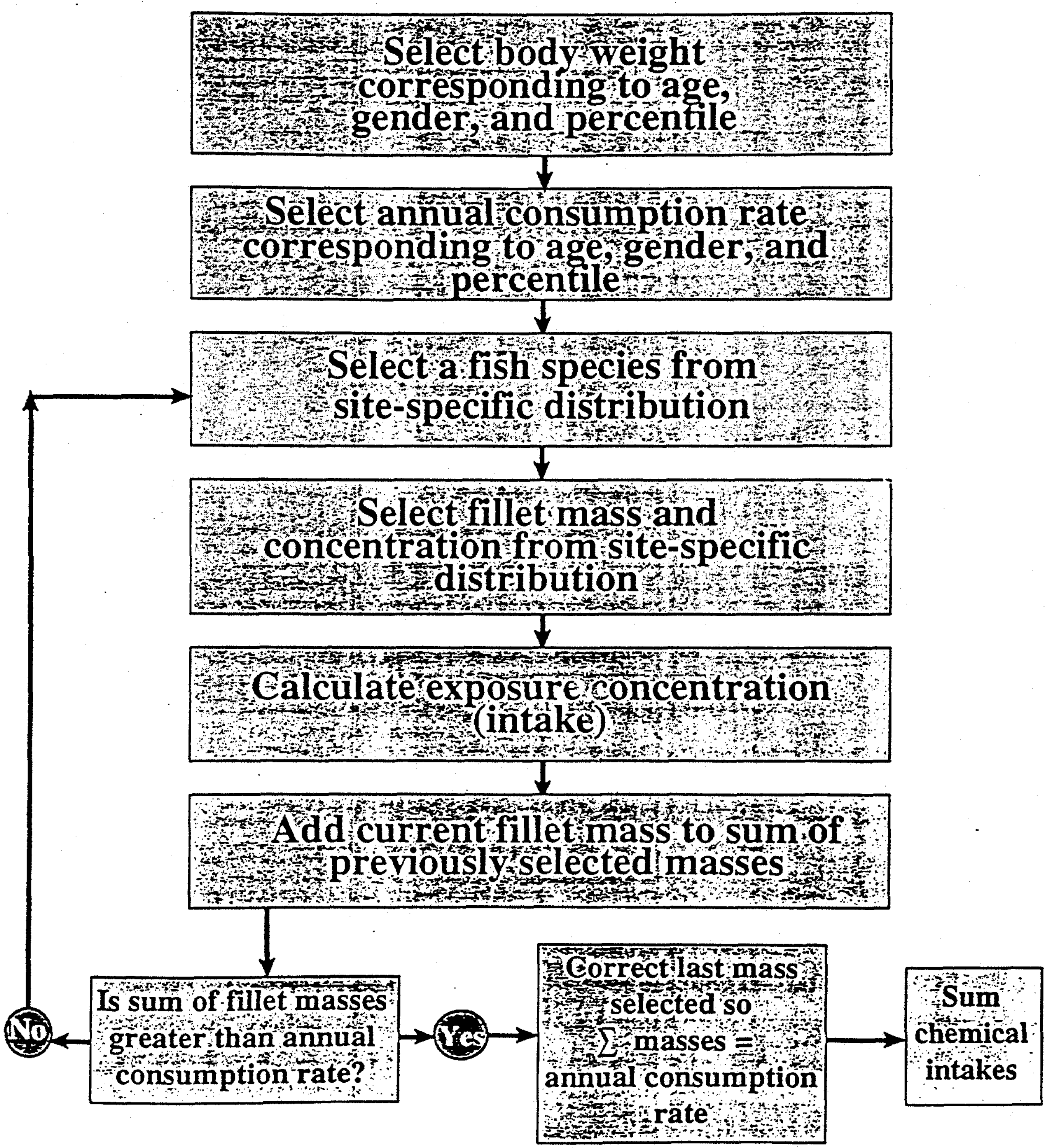
↓

Select Body Weight Percentile

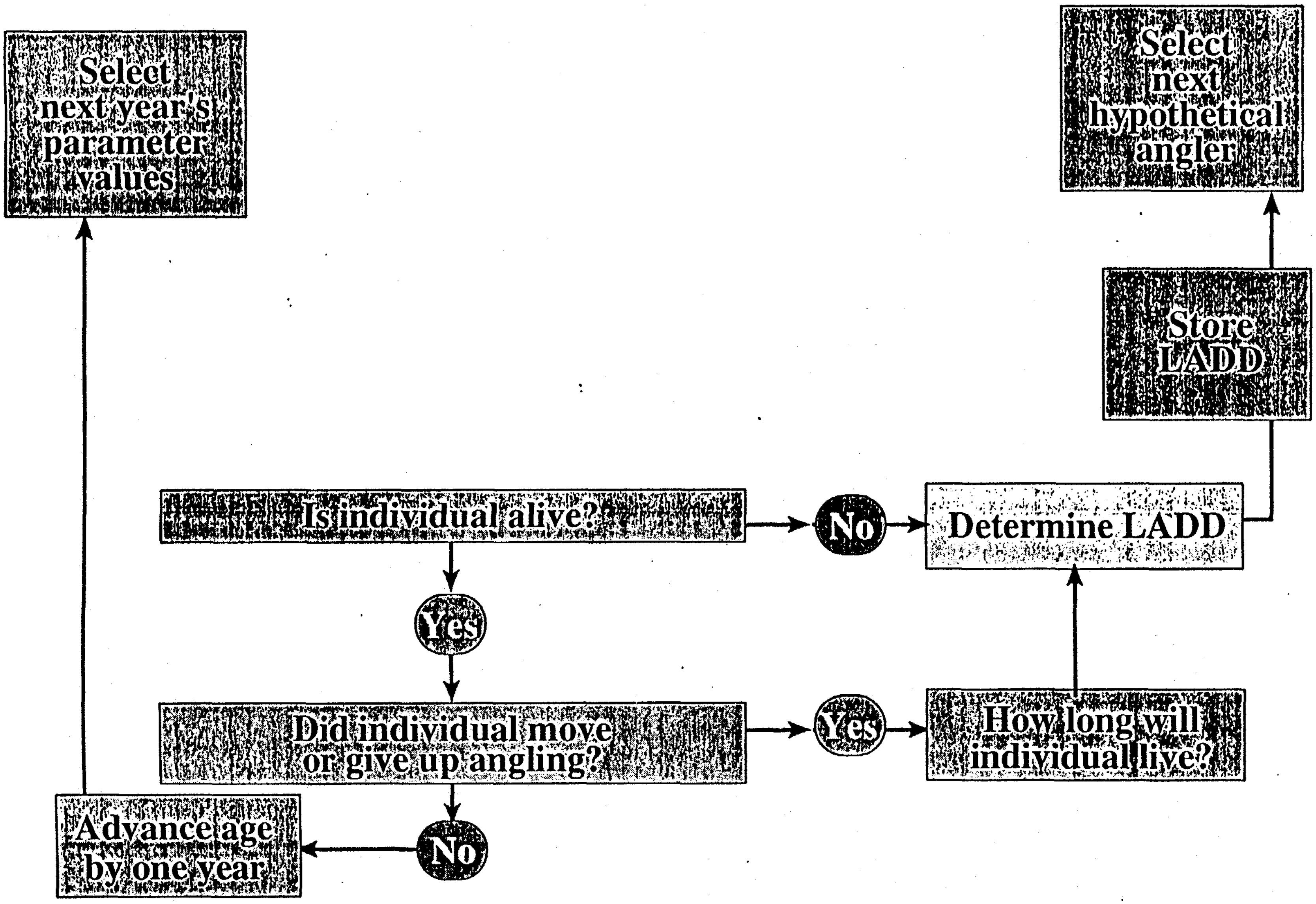
↓

Select Annual Fish Consumption Rate Percentile

Fish Consumption Analysis
Module 2



Fish Consumption Analysis
Module 3 & Module 4



10.3678

What are the Goals of Exposure Assessment for the Hudson River

- Develop distributions of interpersonal variation of dose
- Toxicologically relevant dose rates
- Reflect changes in source terms associated with different remedial actions

Interpersonal Variation in Dose

- Define dose rates for the "high-end" individual
- Define dose rates for the "typical" individual
- Define the dose distribution and the average dose rate for deriving estimates of population risks
- Evaluate dose rates to subpopulations

10.3680

Toxicologically Relevant Dose Rates

- For Carcinogenic Risk Assessment:
  - Lifetime Average Daily Dose Rate (LADD)
- For Noncarcinogenic Risks:
  - Chronic Average Daily Dose Rate

10.3681

Incorporation of Impacts of Remediation

- Remediation will not occur for some time
- Initial impact may be an increase in fish concentrations
- Reductions in fish concentration may not occur until some time after remediation
- Control of specific sources may have different effects for different portions of the river

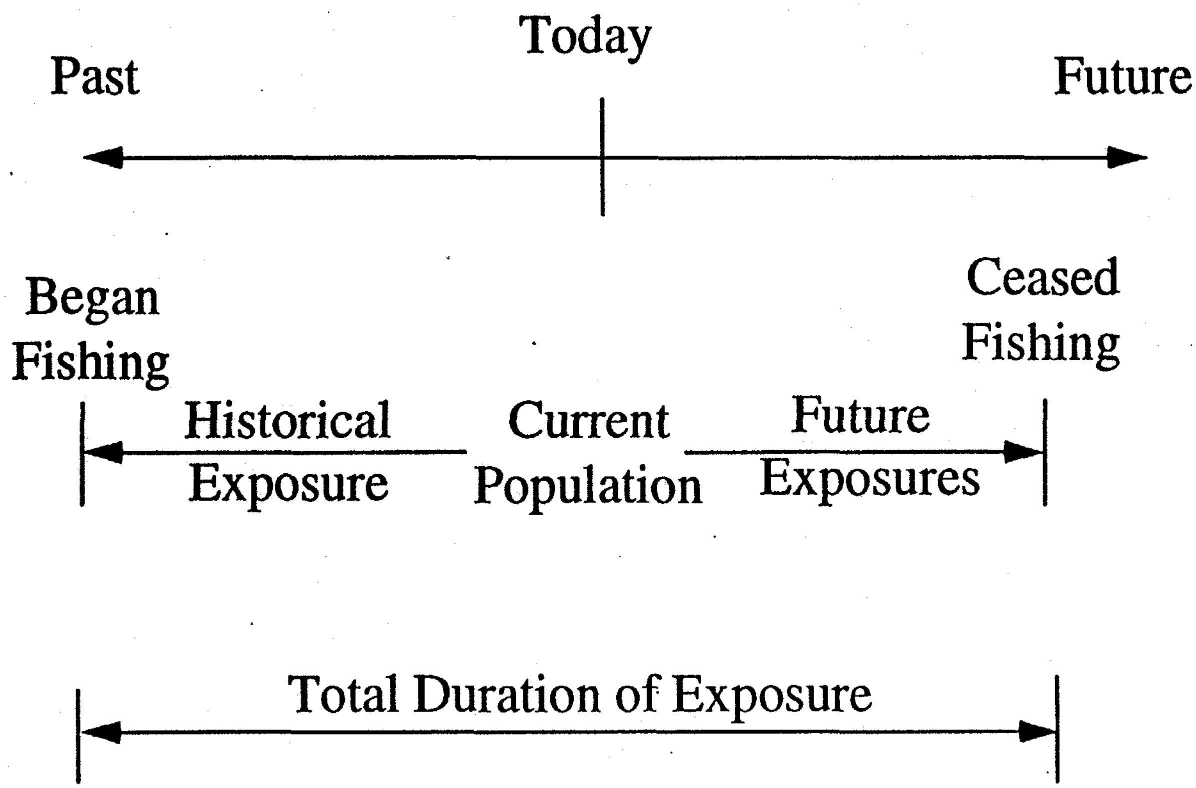
10.3682

Dose Rate Determination

- LADD Estimate:
  - The sum of all doses (on a body weight basis) divided by an averaging time of 70 years
- Chronic Exposure Estimate:
  - RfD is intended to be protective for chronic exposures: averaging time is defined as seven years or duration of exposure, whichever is larger.

10.3683

Duration and the Definition of the Exposed Population



Definition of the Exposed Population

- Past exposures are not the focus of the risk assessment
  - existence of the ban on fishing
  - remedial actions can only change future exposures
- Because of the potential for natural remediation and the remedial activities at Baker Falls, future exposures are expected to decline
- Therefore, the population with the highest risks is the current population

Duration of Exposure

- Not defined as a distribution in the model input
- Based on mobility, angling cessation, and lifespan

10.3686

Temporal Changes in Angler Behavior

- Fish consumption rates
  - stability of annual estimates
  - age-related changes in intake
- Age-related mobility of anglers
- Age-related changes in body weight

10.3687

Temporal Changes in Fish Concentration

- The current program uses a simple exponential decline model to predict future concentrations of lipids
  - Could be replaced with more complex temporal models (see journal article)
- Assume that percent lipid is constant over time
  - could be replaced with a variable term to account for year-to-year variation in percent lipid

10.3688

Fish Concentrations

- Model currently treats concentration of PCBs in fish on a lipid normalized basis
  - allows a comparison of data from different years
  - consistent with certain modeling approaches (see Phase I document)
- Model uses a single lookup table to locate linked data on PCB concentration and fish mass

10.3689

Determining the Future Concentration of a Specific Fish

- Modeling will indicate trends in the mean concentration of PCBs in fish
- We propose that the distribution of fish concentration at a specific reach be adjusted for a future year based on the change in the mean concentration

$$\begin{array}{c}\text{Concentration}\\ \text{in a Randomly}\\ \text{Selected}\\ \text{Fish in Year X}\end{array} = \begin{array}{c}\text{Concentration}\\ \text{in a Randomly}\\ \text{Selected}\\ \text{Fish in Year Y}\end{array} * \frac{\text{Mean Concentration in Year X}}{\text{Mean Concentration in Year Y}}$$

Estimating the Dose Received by Consumption of One Fish

- Species selection based on species preference
- Selection of a concentration is random event within a species
- Cooking loss defined as the fraction of PCB remaining after cooking based on the frequency of use of specific cooking methods

$$\text{Dose} = \frac{\text{PCB concentration}}{\text{(lipid basis)}} * \%\ \text{lipids} * \text{fish mean} * (1\text{-cooking loss})$$

10.3691

Uncertainty and Variability

- Uncertainty is the imprecision that occurs due to a lack of knowledge about the true value
- Variability is imprecision that occurs due to the heterogeneity of the true values

10.3692

The Proposed Approach

- Focuses on interindividual variation in dose rate
- Uncertainty should be dealt with by adoption of conservative assumptions in the selection of distributions for input and by sensitivity analysis of the impact of alternative assumptions

Conservative Assumptions

- Selection of angler consumption rates from multiple streams
- Proposed cooking loss underestimates the true loss
- Rate of cessation of angling in underestimated
- No consideration of "temporary" cessation of angling or intermittent practice of catch and release

10.3694

Exposure to Specific Age Groups

- The model can investigate distribution of doses for specific age groups
- Fish consumption data not available for ages under 18
- We conservatively estimate intake rates for 10- to 18-year olds
- Because of higher mobility, LADDs for children may be smaller than the general population

10.3695

Software Issues

Presentation to USEPA Region II
Cynthia Curry
November 6, 1995
New York, NY

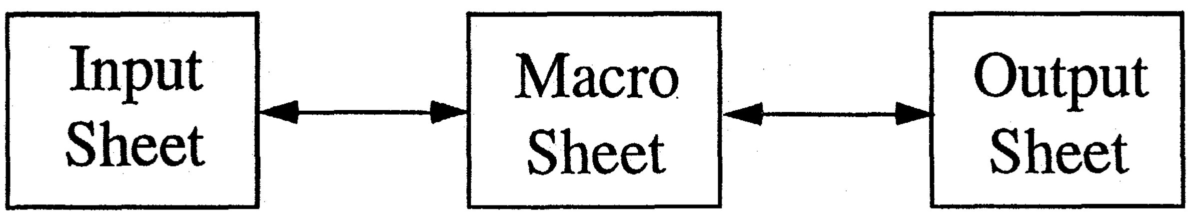
ChemRisk®
A Division of McLaren/Hart Environmental Engineering

Software Used to Develop Microexposure Model

- Microsoft Excel Spreadsheet with Business Graphic and Database: Version 4.0, Microsoft Corporation, 1992
- @Risk: Risk Analysis and Simulation Add-In for Microsoft Excel: Version 3.0, Palisade Corporation, 1994

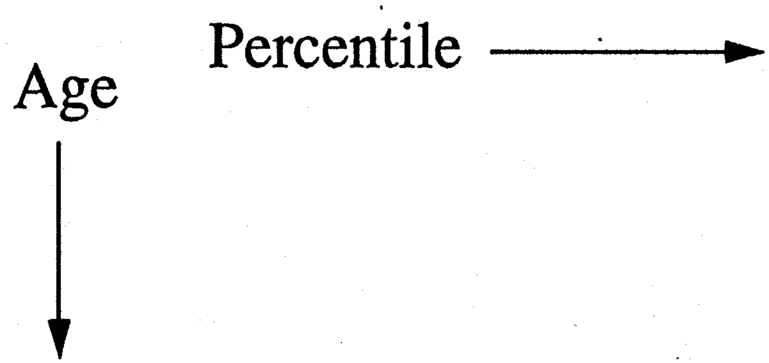
Model Description

- Written as a series of Excel macros, or series of commands
- Contains three linked spreadsheets:



Input Sheet

- Contains input distributions of data, e.g., body weight by age and gender



- Program uses a LOOKUP function to locate appropriate data

Macro Sheet

- An Excel document can be a worksheet, macro sheet or chart
- In a worksheet, formulas are solved for an active cell
- In a macro sheet, specialized calculations are performed by a series of commands (macros)
- Many macros can be created on one macro sheet
- One macro can call one or more additional macros

Macro Sheet (cont'd)

Type of macros used to program Microexposure model are <u>command</u> macros:

	Column A	
Row 1	Macro name	
Row 2	= command line 1	beginning
Row 3	= command line 2	↓
Row 4	= command line 3	↓
Row n	= command line n	↓
Row n+1	= RETURN()	end

Macro Sheet (cont'd)

- Macro commands commonly do the following:
  - select a value from a data set and set a variable name equal to that value
  - select a value according to defined conditions:

    [IF TRUE] [IF FALSE]

    = IF (value 1 = a, set value 2 = b, set value 2 = c)
  - call other macros
  - solve an equation and set a variable equal to the solution
  - control the location of an active cell in a worksheet
  - end a macro

Macro Sheet (cont'd)

- By using macros to run a Monte Carlo Model, individual exposure events (consumption of individual fish) can be modeled independently for each person: "Microexposure" modeling

Output Sheet

- Receives output from simulation
- Designed by modeler
- Summary statistics can be computed on a range of cells in the Output Sheet at the end of the specified iterations

Note:

Output Sheet takes the place of the summation and reporting components of @Risk.

LOOKUP Function

- Used in Macro Sheet to locate data from Input Sheet
- Data in Input Sheet needs to be entered as arrays or vectors
- Horizontal (HLOOKUP) or Vertical (VLOOKUP) functions

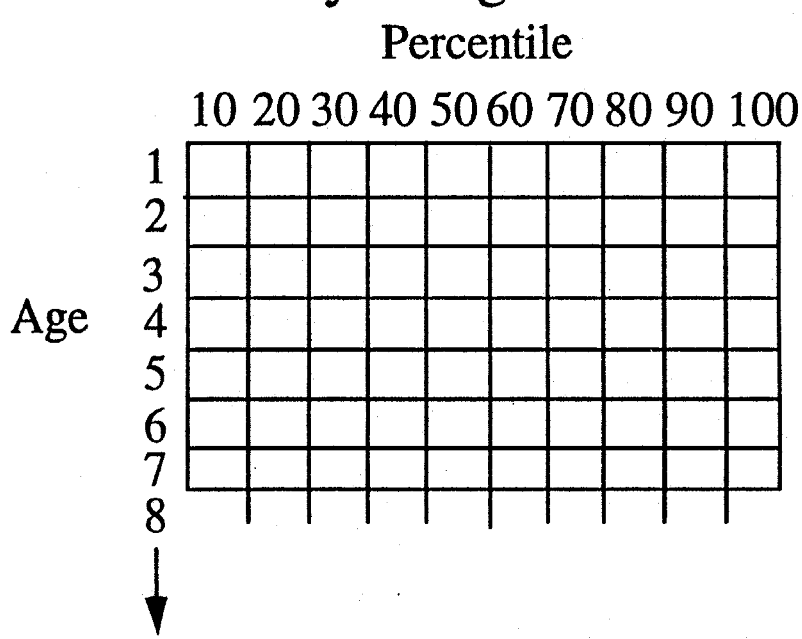
LOOKUP Function (cont'd)

- HLOOKUP searches the top row of an array for a particular value, and returns the value in the indicated cell:

[VALUE] [ARRAY] [ROW]

= HLOOKUP (lobwperc, bwrange, A)

Body Weight Data



LOOKUP Function (cont'd)

- VLOOKUP searches the leftmost column of an array for a particular value, and returns the value in the indicated cell:

  [VALUE] [ARRAY] [COLUMN]

  = VLOOKUP (ID, FishData, 3)

Fish Data

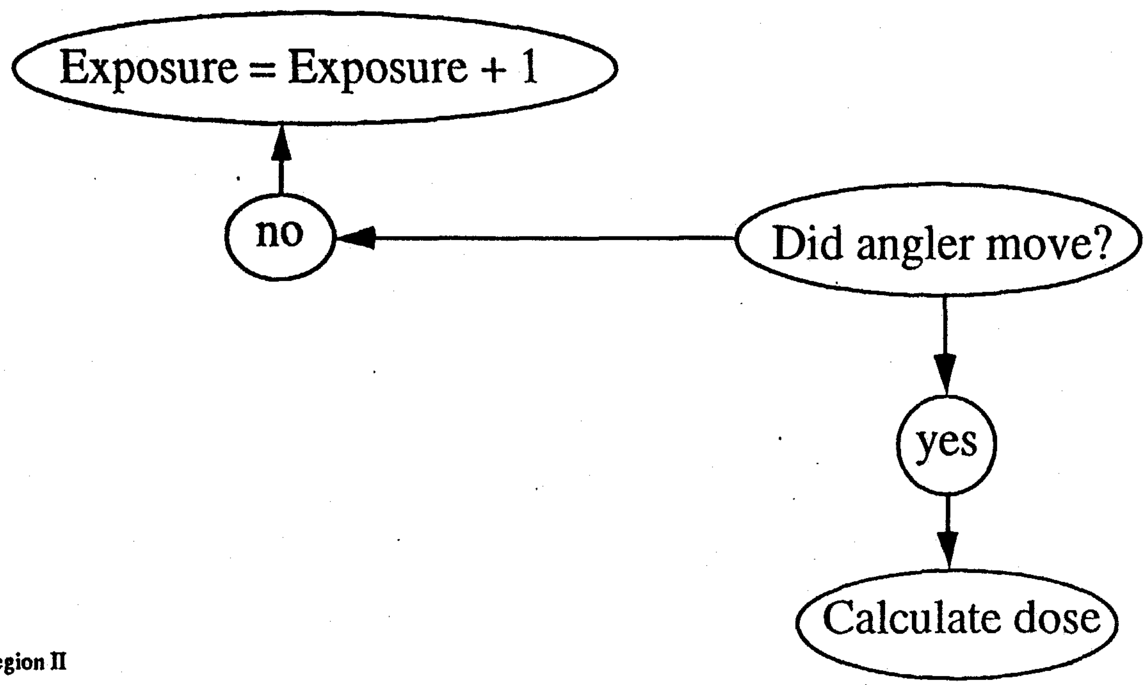
ID	PCB Conc.	Mass

IF Functions

- Used to create binary decision commands

[CONDITION] [IF TRUE] [IF FALSE]

= IF (angler moved, calculate dose, go to next exposure year)



WHILE Loops

- ☐ Used to carry out a series of macro commands while a certain condition remains TRUE:

  EXPOSURELOOP

  = WHILE (A<90)

    Determine anglers body weight

    Determine angler's fish consumption rate

    Determine intake of PCBs

    Calculate dose of PCBs

    Determine if angler is exposed next year

  = NEXT ()

- ☐ Always end with NEXT ()

Most Common @Risk Functions

- Discrete
- DUniform
- LogNorm
- Normal
- TLogNorm
- TNormal
- Triang
- Uniform
- Cumul

10.3711

RiskUniform

- Simulation vehicle for uniform distribution
- Distribution used for a quantity that varies uniformly between two values, or when only a range of values is known.

= RiskUniform (minimum, maximum)

where,

minimum = least possible value

maximum = greatest possible value

RiskTriang

- Simulation vehicle for triangular distribution
- Distribution often used as a conservative estimate of a lognormal distribution when data are limited

= RiskTriang (minimum, mode, maximum)

where,

minimum = least possible value

mode = most likely value

maximum = greatest possible value

RiskTNormal

- Simulation vehicle for truncated normal distribution
- Distribution of characteristics of a population (e.g., height, weight) constrained by truncation values

= RiskTNormal (μ, σ, minimum, maximum)

where,

μ = mean

σ = standard deviation

minimum = least possible value

maximum = greatest possible value

RiskTLogNorm

- Simulation vehicle for truncated lognormal distribution
- Represents quantities that are the product of a large number of other quantities - constrained by truncation values

= RiskTLogNorm (μ, σ, minimum, maximum)

where,

μ = mean

σ = standard deviation

minimum = least possible value

maximum = greatest possible value

RiskNormal

- Simulation vehicle for normal distribution
- Distribution of characteristics of a population expected to vary symmetrically and smoothly about a mean (e.g., height, weight).

$$= \text{RiskNormal}\ (\mu, \sigma)$$

where,

μ = mean

σ = standard deviation

RiskLogNorm

- Simulation vehicle for lognormal distribution
- Represents quantities that are the product of a large number of other quantities, e.g. distribution of physical quantities in nature

$$= \text{RiskLogNorm}\ (\mu, \sigma)$$

where,

μ = mean (arithmetic)

σ = standard deviation (arithmetic)

RiskDUniform

- Simulation vehicle for discrete uniform distribution
- For situations with a few possible outcomes, each with equal probability of occurrence

$$= \text{RiskDUniform}\ (\{\chi_1, \chi_2, \ldots, \chi_n\})$$

where,

$\chi_1, \ldots, \chi_n$ = possible values

10.3718

RiskDiscrete

- Simulation vehicle for an empirical discrete distribution
- For situations with a small number of possible outcomes with variable probability of occurring

$$= \text{RiskDiscrete}\ (\{\chi_1, \chi_2, \ldots, \chi_n\}, \{p_1, p_2, \ldots, p_n\})$$

where,

$\chi_1,\ldots,\chi_n$ = possible values

$p_1,\ldots,p_n$ = corresponding probabilities of occurrence

10.3719

RiskCumul

- Simulation vehicle for a continuous empirical distribution
- Specifies a cumulative distribution with n points, set by a minimum and maximum

= Risk Cumul (minimum, maximum, ($\{\chi_1, \chi_2, \ldots, \chi_n\}$, $\{p_1, p_2, \ldots, p_n\}$)

where,

minimum = least possible value

maximum = greatest possible value

$\chi_1, \ldots, \chi_n$ = breakpoint values within range

$p_1, \ldots, p_n$ = corresponding cumulative probabilities

10.3720

Monte Carlo Modeling of Time-Dependent Exposures Using a MicroExposure Event Approach

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ABSTRACT

Over the last 10 years a number of researchers have used Monte Carlo analysis to investigate the variation in long-term average dose rates in exposed populations and the uncertainty in estimates of long-term average dose rates for specific individuals. In general, these researchers have modeled long-term exposures using simple dose rate equations which assume that individuals are exposed to a single environmental concentration at a constant rate over a specified exposure duration. This paper presents an alternative approach for modeling long-term average exposures called microexposure event modeling which addresses a number of shortcomings in traditional dose rate equations. The paper discusses the limitations of the traditional dose rate equation, presents a description of the methodology, and illustrates advantages of the approach with a case study.

KEY WORDS

Monte Carlo, modeling, variability, exposure, methodology, MicroExposure

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Risk Analysis
An International Journal

1. INTRODUCTION

Traditionally, risk assessors have estimated the dose rates received from potential exposure to environmental contaminants using simple algebraic equations. These equations combine information on the concentration of contaminants in environmental media, the behavior of individuals exposed, and the rate at which the contaminants enter the body[1]. While the precise equation and the number of exposure parameters vary, the dose rate equation generally follows the form:

$$\text{Dose Rate} = \frac{\text{Environmental Concentration} * \text{Intake Rate} * \text{Duration}}{\text{Body Weight} * \text{Averaging Time}} \quad \text{[Eq. 1]}$$

[1,2].

If averaging time is defined as the individual's life span (75 years), then Equation 1 provides an estimate of the Lifetime Average Daily Dose Rate (LADD). This equation has been often used to make conservative estimates of the dose rates received by exposed individuals[1]. Such estimates are developed by using conservative estimates for the values of most or all of the parameters in the equation[1,2].

A number of researchers have investigated the use of Monte Carlo analysis to characterize the uncertainty and interindividual variability in dose rates in exposed populations[3,4,5,6,7]. The models used by the researchers are based on Equation 1, where each parameter is assigned a distribution that reflects either the interindividual variability in the parameters' value in the exposed population, the uncertainty in the value of the parameter or some combination of uncertainty and variation. This approach provides insight regarding the uncertainty in the dose rate of an individual randomly selected from the exposed population[3,8].

In this paper, we identify a number of limitations with the use of Equation 1 for modeling the variation in long-term dose rates in exposed populations and describe how these limitations can be addressed by modeling long-term exposures as a series of individual exposure events. Under this approach, each event is modeled separately and then summed to yield estimates of long-term dose rates. We demonstrate that such an approach provides several useful capabilities including: one, the ability to incorporate information on time-dependent changes in the values of exposure parameters; two, the ability to investigate the effect of short-term variations in parameter values on the distribution of long-term dose rates in exposed populations; and three, to provide measures of interindividual variability in average dose rates for different averaging times.

2. LIMITATIONS OF THE EXISTING DOSE RATE EQUATION FOR PREDICTING DISTRIBUTIONS OF LONG-TERM DOSE RATES

The use of Equation 1 to calculate the distribution of long-term average daily dose rates in an exposed population suffers from two major limitations. First, information on the interindividual variability in many of the equation's parameters is difficult to derive from existing data. Second, the equation cannot easily address time-dependent changes in the parameters.

In order to characterize interindividual variability, Monte Carlo models require information on how the values for each parameter vary across the members of the exposed population. In the case of the parameter "environmental concentration" the model requires information on the time-weighted average of all the "environmental concentrations" each individual interacts with throughout the duration of his or her life. This interpersonal variation in the "environmental concentration" is related to, but not the same as, the temporal or spatial variation in exposure concentrations revealed by monitoring surveys.

One difficulty in characterizing the variation in long-term average concentrations is illustrated by the determination of the "exposure concentration" in a fish consumption pathway. The distribution of concentrations in individual fish is not the same as the distribution of the average contaminant concentration in the fish that an individual angler consumes over his or her lifetime. If an angler consumes a large number of fish, the lifetime average concentration of fish consumed will be approximated by the arithmetic mean concentration in the survey of fish. All anglers who consume large amounts of fish will have similar "average concentrations". In contrast, anglers who consume only a few fish will have a much greater variation in their "average concentration" parameter.

The "intake rate" parameter in the exposure equation also poses problems for models of long-term variation. Measurements of interpersonal variation are affected by the time period over which they are collected[8,9]. In general, measurements of interpersonal variation from short-term surveys will overestimate the long-term variation in the same populations, because of the presence of short-term components of variation that are averaged out over longer periods of time[9]. Intake rates are available for various media[10] but the period of time over which the intakes are measured is typically much smaller than the length of time of interest to the risk assessor. For example, soil consumption rates in children are typically based upon surveys conducted over a few days or weeks[11,12,13], and the best available data on water consumption are based on a three-day survey[14].

A second issue is the age dependencies in parameter values. Intake rates for many routes of exposure vary over an individual's lifetime. Strong age dependencies in tapwater consumption, soil ingestion, and inhalation rate are well known[10,12,14]. Variation in exposure duration is also known to be dependent on the age of the exposed individual[4,5]. Finally, body weight and body surface areas are also age dependent[2].

Time-dependent changes can also occur in environmental concentrations, such that exposures to environmental contaminants may vary over time. For example, movement of groundwater can result in long-term trends in the concentration of constituents in drinking water wells[16]. In addition, dose reconstruction projects that focus on characterizing historical exposures often evaluate cohorts, where exposure rates varied widely over different time periods[17].

3. DESCRIPTION OF THE PROPOSED APPROACH

An approach that addresses these problems is to evaluate an individual's long-term dose rate as the sum of doses received from separate exposure events. We refer to this approach as microexposure event modeling. Under this approach, the assessor separately specifies the values of the exposure parameters for each exposure event. This concept has been used to evaluate exposure to dioxin via fish consumption[18,19], exposures to VOCs in tapwater[16], and exposure to lead among children[21]. In addition, the methodology has been used to evaluate exposure duration[15,20]; however, it has not been formally presented in the literature.

Under the microexposure event model, Equation 1 is replaced with:

$$\text{Dose Rate} = \frac{1}{\text{Averaging Time}} \sum_{j=1}^{\text{Duration}} \frac{1}{\text{Body Weight}_j} \sum_{i=1}^{\text{Events}_j} \text{Environmental Concentration}_{ij} * \text{Intake}_{ij} \qquad \text{[Eq. 2]}$$

where, Environmental Concentration$_{ij}$ is the concentration of the contaminant in the environmental media to which the individual is exposed during the ith exposure event in the jth year of his or her life; Intake$_{ij}$ is the amount of contaminated media entering the individual during the ith exposure event in the jth year of his or her life; Events$_j$ is the number of exposure events that occur during the jth year of the individual's life; Body Weight$_j$ is the average weight of the individual during the jth year of the individual's life; Duration is the number of years between the individual's first and last exposure event. Averaging time is defined by the toxicity endpoint being evaluated. The averaging time for carcinogenic effects is defined as the average human lifespan of 75 years. For noncarcinogenic effects, the averaging time is defined as Duration or some shorter period of time[2]. Where the intake rate is expressed as a mass per unit of time an additional parameter, Event Duration$_{ij}$, may be added to the second summation. This parameter is the duration of the ith exposure event in the jth year. In this paper, the application of the model is specific to risk assessments of those environmental contaminants which are evaluated according to the promise that risk of an adverse effect is a function of dose rate and not accumulated dose or body burden.

The approach defines an exposure event as a period of exposure in which a dose model based on single values for concentration, intake rate, body weight and other relevant exposure factors provides a reasonable characterization of the dose received. For example, when evaluating exposures that occur as a result of the consumption of contaminated food, a single meal can be considered an exposure event. In other instances where the level of contamination and the intake rate may remain constant over longer periods of time, the exposure event can be defined as consumption occurring over months or years.

The parameter values used in the estimate of the dose rate for each event can be based on temporal- and age-specific information. In this fashion, the approach can provide estimates of the distribution of long-term average dose rates, consistent with temporal trends.

The number of exposure events in an individual's life is based on the initiation and cessation of behaviors that result in exposures. For example, living in a contaminated residence, working near a point source of emissions, or fishing from a contaminated body of water are all examples of such behavior. A binary decision model is used to determine whether an individual who has completed an exposure event will continue his or her exposure. This probability can be based on age-specific information on the probability of initiating or ceasing the behavior that causes the activity. The model can also handle intermittent exposures by allowing for periods of time where intake is low or nonexistent but where there is still some finite probability of intake.

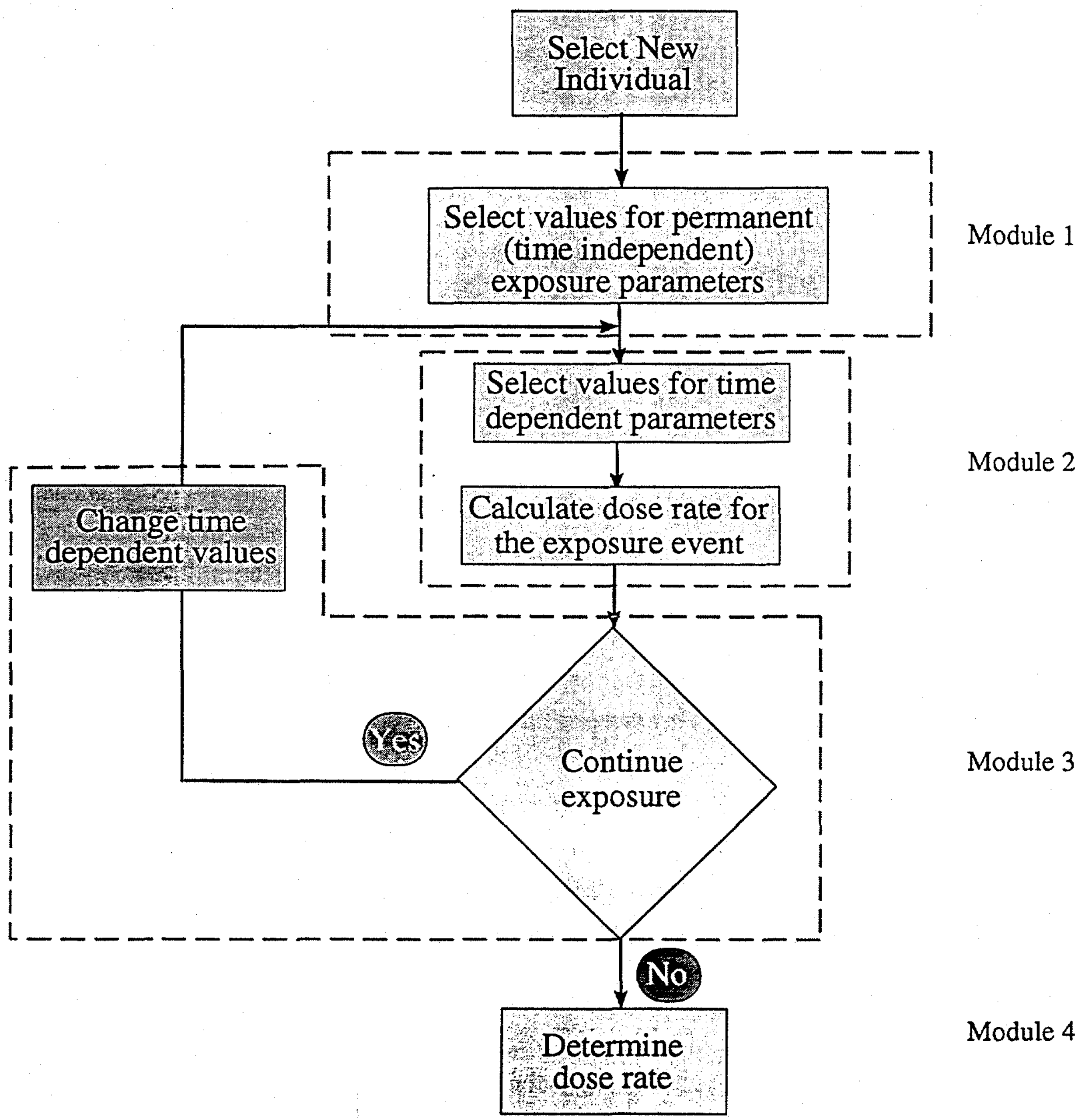
An example of a microexposure event model for a population of individuals exposed to a residence-related source of contamination can be illustrated as follows. The model begins by assuming that an individual is exposed for one exposure event (e.g., he or she lived in the contaminated residence for some period of time). The model then uses the age-specific probability of that individual changing residences to determine if a second exposure event will occur. This process is repeated until the model determines that the individual moved and no further exposure event will occur. This approach results in a characterization of the future dose rates in a population currently exposed to a source of contamination.

A benefit of the microexposure event approach is in that it tracks an individual dose rate during different portions of his or her life. For example, if it is suspected that a contaminant may cause an effect as a result of a one year exposure, the model can track the annual average dose rates for each year of an individual's exposure and identify the highest annual exposure. When a contaminant requires several years of exposure to cause an effect, the model can track an individual's highest multi-year average dose rate.

Monte Carlo models based on Equation 1 are relatively simple to run using existing software (e.g., @Risk©[22] and Excel[23] with minimal programming requirements. Microexposure event models are more complex and require programming features such as nested loops and binary branching. Using nested loops, an outer loop can provide a simulation of one individual's exposures, while a series of inner loops models the dose rates for the individual exposure events. As described above, binary decisions are used to model the number of exposure events.

Figure 1 presents a generic microexposure model of long-term dose rates, consisting of four basic modules. In the first module, an individual from the exposed population is selected and assigned

Figure 1. Components of a MicroExposure Event Monte Carlo



an initial age and any other permanent (time independent) exposure characterizations (e.g., gender or location of residence). The second module assigns the values to time-dependent parameters, (such as the environmental concentration, intake rate, and body weight) for the exposure event. Then the second module generates an estimate of the dose received during the initial exposure event. The third module stores the estimated dose and then determines, based on mobility, mortality, or other relevant demographic information whether the exposure continues. If the individual continues to be exposed, the model returns to module two, adjusts the time-dependent variables to reflect the increased age of the individual and temporal changes in environmental concentrations, and calculates a second dose. Once the exposures are determined to have ceased, the fourth module calculates the individual's lifetime average daily dose rate (or other long-term dose rate) and returns to the first module to simulate the dose rate for the next individual.

4. CASE STUDY: MODELING LONG-TERM EXPOSURES TO LIPOPHILIC CONTAMINANTS IN FISH

In this case study, the results of an microexposure event model of interindividual variability are compared to a Monte Carlo model based on Equation 1. In addition, we demonstrate the ability of our approach to incorporate information on temporal changes in exposure parameters and to provide toxicologically relevant estimates of dose rate distributions.

To simplify the presentation, we assume that the only exposure pathway of interest is the intake of a persistent lipophilic compound from the consumption of contaminated fish. Historical releases of the chemical have resulted in its occurrence in fish. Because discharges of the contaminant have ceased, fish tissue concentrations are declining over time.

In this case study, we used our approach in four ways. First, we performed a traditional Monte Carlo and a microexposure event (MEE) model of the interindividual variability in the lifetime average daily dose rates (LADDs) that occur as the result of future exposures to the contaminant. Second, we used the MEE model to investigate the impact of making alternative assumptions concerning the use of annual fish consumption rates to model LADDs. Third, we investigated the impact of alternative assumptions on future levels of fish contamination on the estimate of LADD distributions. Finally, we used the MEE model to estimate the distribution of maximum annual average dose rates and maximum seven year average dose rates in the exposed population.

4.1. Description of the Model

Figure 2 presents a flowchart for the model. The model evaluated each fish consumed as a separate exposure event. The number of exposure events (fish eaten) in a given year of the angler's life was determined from the angler's intake for a given year and a size distribution for the fish consumed. The individual angler's annual exposure was modeled based on the sum of the separate doses received from the individual fish consumed each year. The model assumed that exposures occurred until the angler moved away from the area. At the end of each year, the model determined if the angler stopped fishing the affected body of water either because the angler left the area or because of mortality as predicted by longevity tables. The LADD for the angler was determined by summing the annual dose rates and dividing by the average human life span of 75 years.

The equation used to calculate the LADD for an individual angler (and reflected in Figure 2) is:

$$\text{LADD} = \frac{1}{75\ \text{years}} \sum_{j=1}^{\text{Angling Duration}} \frac{1}{\text{Body Weight}_j} \sum_{i=1}^{\text{Fish Consumed}_j} \text{Fish Concentration}_{ij} * \text{Fish mass}_{ij} \qquad \text{[Eq. 3]}$$

where, Angling Duration is the number of years an angler consumes fish from the affected water; Fish Consumed_j is the amount of fish consumed in the jth year of the angler's exposure; Body Weight_j is the body weight of the angler in the jth year; Fish $\text{Concentration}_{ij}$ is the concentration in the ith fish caught in the jth year; Fish Mass_{ij} is the mass of the fillet from the ith fish caught in the jth year. Table 1 gives descriptions of the distributions used for the exposure parameters.

4.2. Traditional Monte Carlo Model

The traditional Monte Carlo model for the scenario was performed using the following equation.

Figure 2. MEE Model of Fish Consumption Case Study

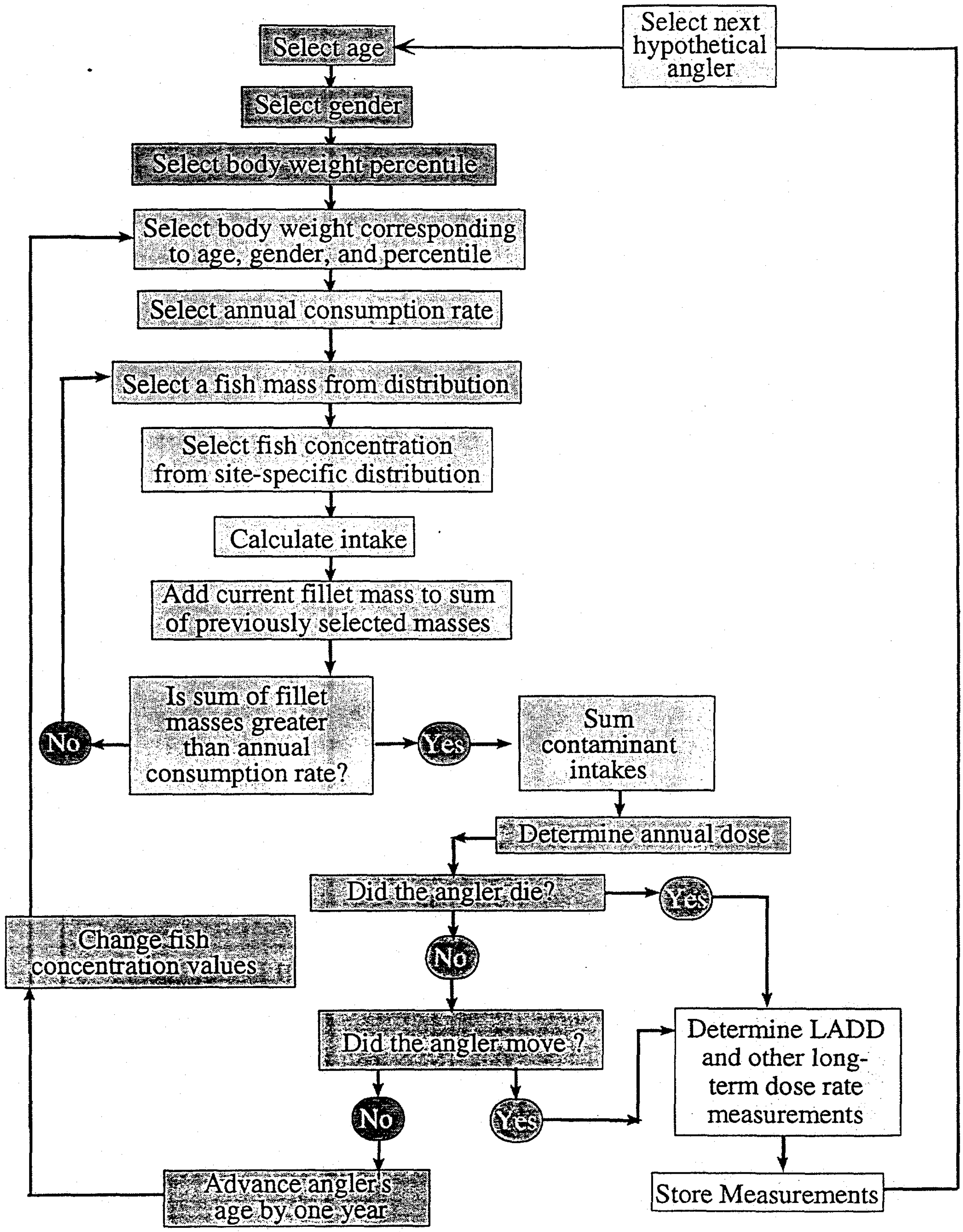


Table 1. Distributions Used in Monte Carlo Models

Parameter	Description[1]	Reference
<u>Traditional Monte Carlo</u>		
Body Weight (kg)	Risk T Normal (71,15.9,45,119)	Finley et al., (10)
Exposure Duration (yrs)	Risk Cumul (1,87{2,2,4,9,16,26,33}, {0.05,0.1,0.25,0.5,0.75,0.9,0.95})	EPA, (15)
Consumption Rate (g/day)	Risk Cumul (0.001,118,{0.11,0.17,0.23,0.28,0.25,0.46, 0.59,0.71,0.83,0.99,1.2,1.4,1.7,2.1,2.5,3.2,4.3 6.1,12.4},{0.05,0.10,0.15,0.20,0.25,0.30,0.35, 0.40,0.45,0.5,0.55,0.60,0.65,0.70,0.75,0.80,0.85 0.90,0.95})	Ebert et al., (24)
Fish Concentration (ppm)	Risk T lognorm (10,6,0.5,100)	Assumed
<u>MicroExposure Monte Carlo</u>		
Body Weight (kg)	Risk D Uniform, age-and gender-specific[2]	EPA, (2)
Exposure Duration (yrs)	Modeled[3]	EPA, (2)
Fish Mass (g)	Risk T lognorm (500,400,100,1200)	Assumed
Fish Concentration (ppm)	Same[4]	Assumed
Fish Consumption Rate (g/day)	Same[4]	Ebert et al., (24)[2]

1. Distributions are described using the @Risk distribution format (22).
2. Distribution is substantially the same as the distribution in the traditional Monte Carlo.
3. Duration is modeled based on the same mobility and mortality assumptions used in EPA, (15).
4. Same as Traditional Monte Carlo.

$$\text{LADD} = \frac{\text{Fish Concentration} * \text{Consumption Rate} * \text{Angling Duration}}{\text{Body Weight} * \text{75 years}} \quad \text{[Eq. 4]}$$

The distributions used for the parameters in this equation are also given in Table 1. Wherever possible, the same distributions used in the MEE model were used in this analysis.

4.3. Investigation of Alternative Fish Consumption Rate Assumptions

Annual fish consumption rates among recreational anglers fishing rivers and streams were used in this analysis. While annual data are typically considered to be a good measure of long-term intake, they are not the same as lifetime intake rates. If the distribution of the long-term intake rates is the same as the results of an annual survey, then each angler's behavior must be constant from year to year. However, an assumption that an angler's intake will never vary from year to year is unlikely, since an angler's fish intake will be influenced by year-to-year variations due to weather, fishing regulations, personal or family obligations, health and physical condition considerations, and differences in species availability or waterbody productivity.

The impact of using a distribution of annual intakes in a model of LADDs can be investigated by making two alternative assumptions that bound the relationship between distributions of annual and lifetime averages. The first assumption is that the intake of an angler remains constant for each year he or she fishes from the contaminated body of water (fixed perennial fish consumption rate). The second assumption is that in any given year an angler will base an equal probability of having any of the intake rates reported in the recreational angler survey[24] (randomly selected fish consumption rates).

4.4. Investigation of Alternative Assumptions on Future Concentrations in Fish

The concentration of the contaminant in fish would be expected to decline over time since the contaminant is no longer being released. The declining concentrations may be a simple function of time or may follow a more irregular pattern. For example, if the sediments contaminated are being covered by clean sediments then the bioavailability of the compound will decline and future fish concentrations may follow some monotonicly decreasing function. A more complex scenario can be generated by assuming that a future storm event brings buried sediments to the surface and an increase in fish concentrations. In this case, the decline in fish concentrations will be interrupted by an elevation in concentration and then a subsequent decline.

In this study, we investigated the dose rates resulting from three scenarios of the future concentrations in fish. In the first scenario, concentrations remain constant over time. In the second, concentrations decline at a rate of 20 percent per year. In the third, concentrations decline at 20 percent per year but during the fifth year a storm event resuspended contaminated sediment and the fish levels returned to a level equal to 80 percent of the initial level. Following the storm event, the levels declined at 20 percent per year.

4.5. Alternative Measures of Long-term Dose Rates

The MEE model was used to investigate interindividual variability in three separate measures of the long-term dose rates: the maximum annual average dose rate, the maximum seven-year average dose rate, and the chronic dose rate. The maximum annual average dose rate for an angler is determined by selecting the highest annual dose rate among all the annual averages for each individual during the course of his or her exposure. The maximum seven-year average for each angler is determined by keeping a running seven-year average of the annual dose rates and selecting the highest seven-year average dose rate that occurs in each individual's exposures. The chronic dose rate is calculated using Equation 3 where 75 years is replaced by the duration of exposure.

4.6. Model Specifications

The model was written in Excel macro language[22] using @Risk[23] as a source of "formulas" for generating distributions. The model was run on a Pentium based PC with a 60 mhz clock speed. All of the Monte Carlo model runs simulated the intake rates for 5,000 individuals. Previous runs of the model demonstrated that 5,000 individuals provided stable estimates for the median, 95th, and 99th percentiles. It took approximately 25 hours of computer time to develop estimates for 5,000 individuals. The traditional Monte Carlo model was run on the same machine and took less than one hour to model dose rates for 5,000 individuals.

5. RESULTS AND DISCUSSION

Figure 3 presents the results of the MEE and traditional Monte Carlo models. In general, the MEE model resulted in lower estimates of LADDs than the traditional Monte Carlo model. This difference was most pronounced for the upper end of the distribution where the dose rates were 3 to 4 times lower. The differences in the median intakes differed by a factor of 1.5.

The reasons for the differences between the models are two-fold. First, the traditional model assumes that all the variation in fish contaminant concentrations are directly reflected in the interpersonal variation in dose rate. The MEE model, by summing multiple fish, has the net effect of incorporating a smaller portion of the variation in fish contaminant concentrations in the distribution of dose rates. The fraction of the inter-fish variation decreases with the number of fish consumed resulting in an increased divergence between the two models at higher dose rates. The second reason for the difference is that the MEE model defines the duration of exposure in a different fashion than the traditional Monte Carlo model. The MEE model evaluates only the future exposures of the current population, as a result, the duration is defined as the period of time from the initial date the model is run until the year the individual moves away from the area, or is no longer living. The distribution of durations used in the Monte Carlo model includes the years an individual has already been exposed[15]. By incorrectly incorporating this historical component the traditional model produces a distribution of durations that is larger than the distribution of future residential durations produced by the MEE model.

Figure 4 presents the three different scenarios for future concentrations of contamination in fish. As the figure indicates, the 20 percent decline scenario resulted in approximately a three-fold decrease in the estimate of the dose rate for the 95th percentile as compared to the no decline scenario. In contrast, inclusion of a storm event had a smaller impact on the estimates of dose rates, raising the dose rates for the 95th percentile angler approximately 30 percent.

Figure 5 presents the results of the two model runs for the fixed perennial and randomly selected fish consumption rates. As the figure indicates, random variation in annual fish consumption rates raises the estimates of LADDs for the vast majority of anglers, but lowers the estimates in the top 5 percent of the population. The impact is greatest at the 99th percentile where the assumption of randomly varying intakes lowered the dose rate estimate by a factor of 2.5. This finding implies that the use of the results from annual surveys of fish consumption rates as models of lifetime

Figure 3. Lifetime Average Daily Dose Rates Predicted by the MEE and Traditional Model

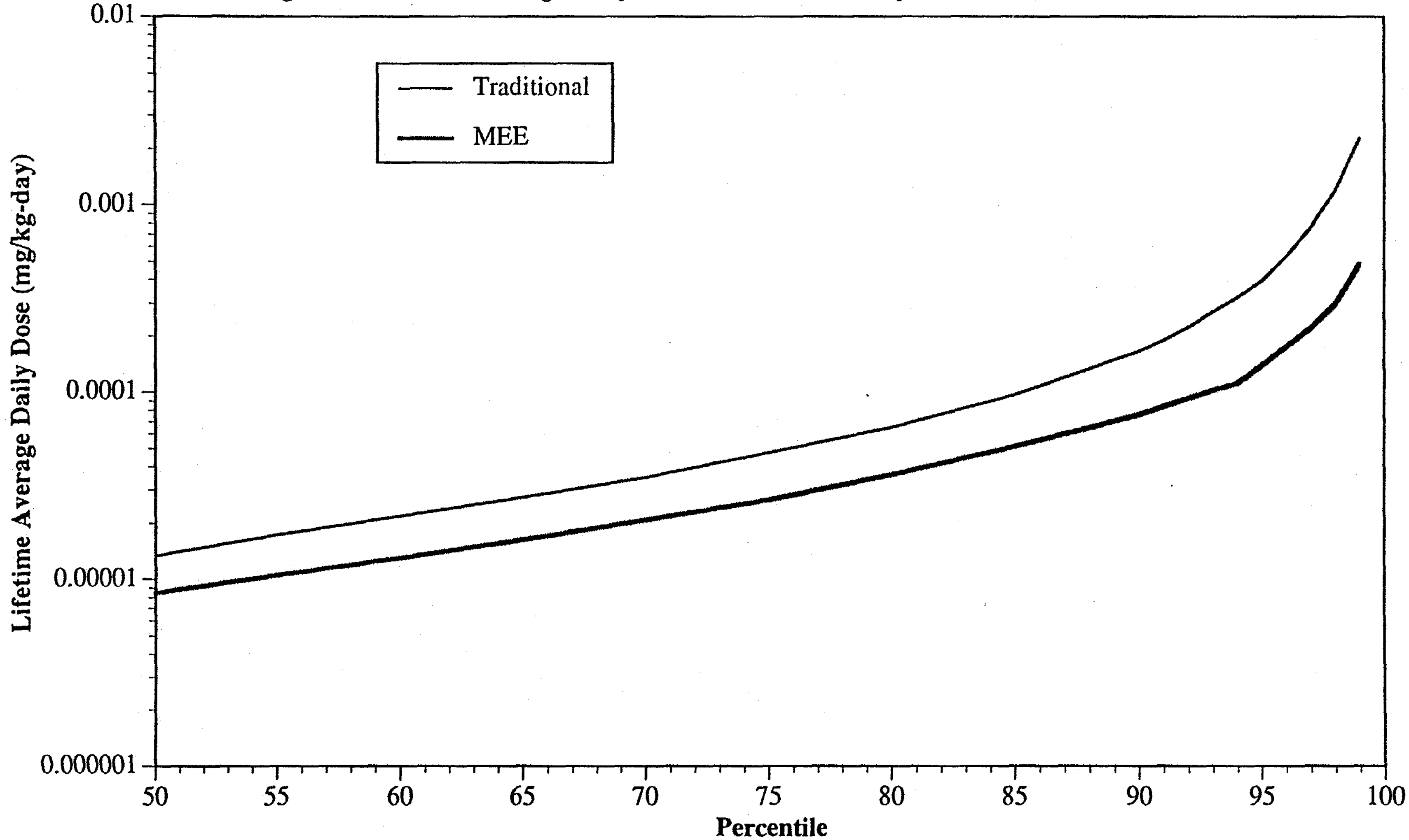


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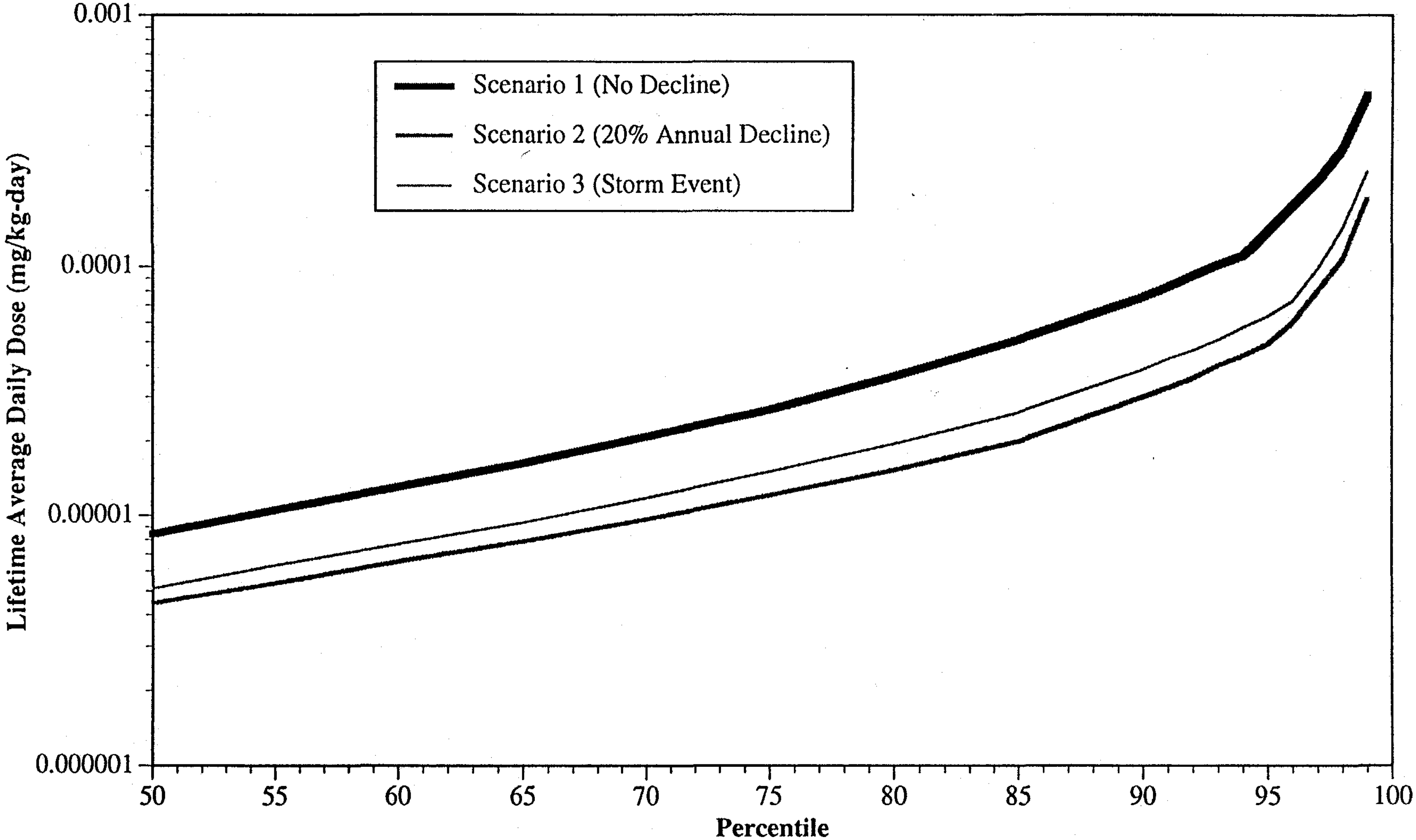
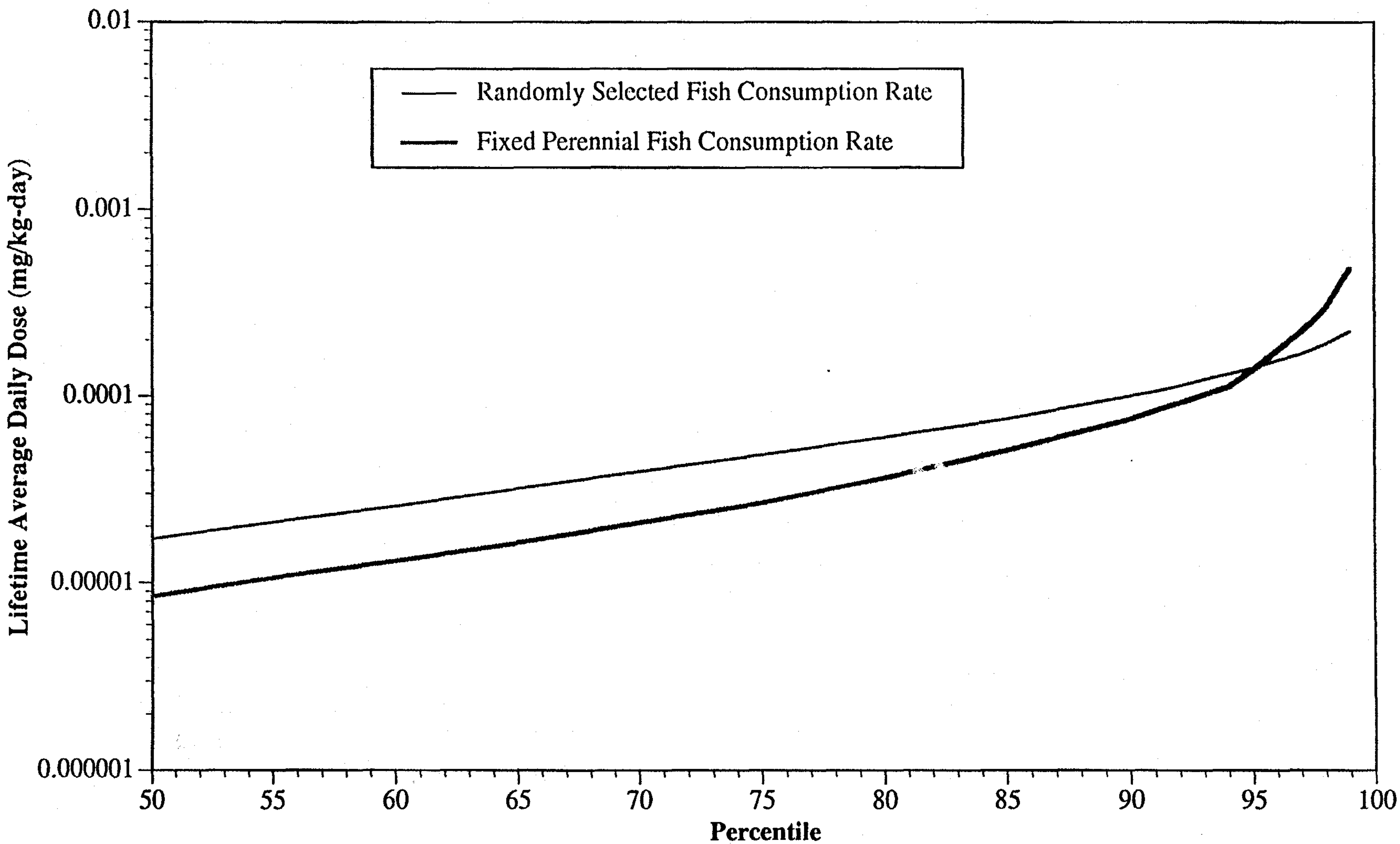
Figure 4. Impact of Alternative Assumptions of Future Levels of Contamination in Fish on Lifetime Average Daily Dose Rates



10.3736

Figure 5. Impact of Alternative Angler Consumption Rates Assumptions on Lifetime Average Daily Dose Rates



10.3737

consumption rates will result in an underestimation of dose rates for the majority of anglers but overestimate consumption for the high-end anglers.

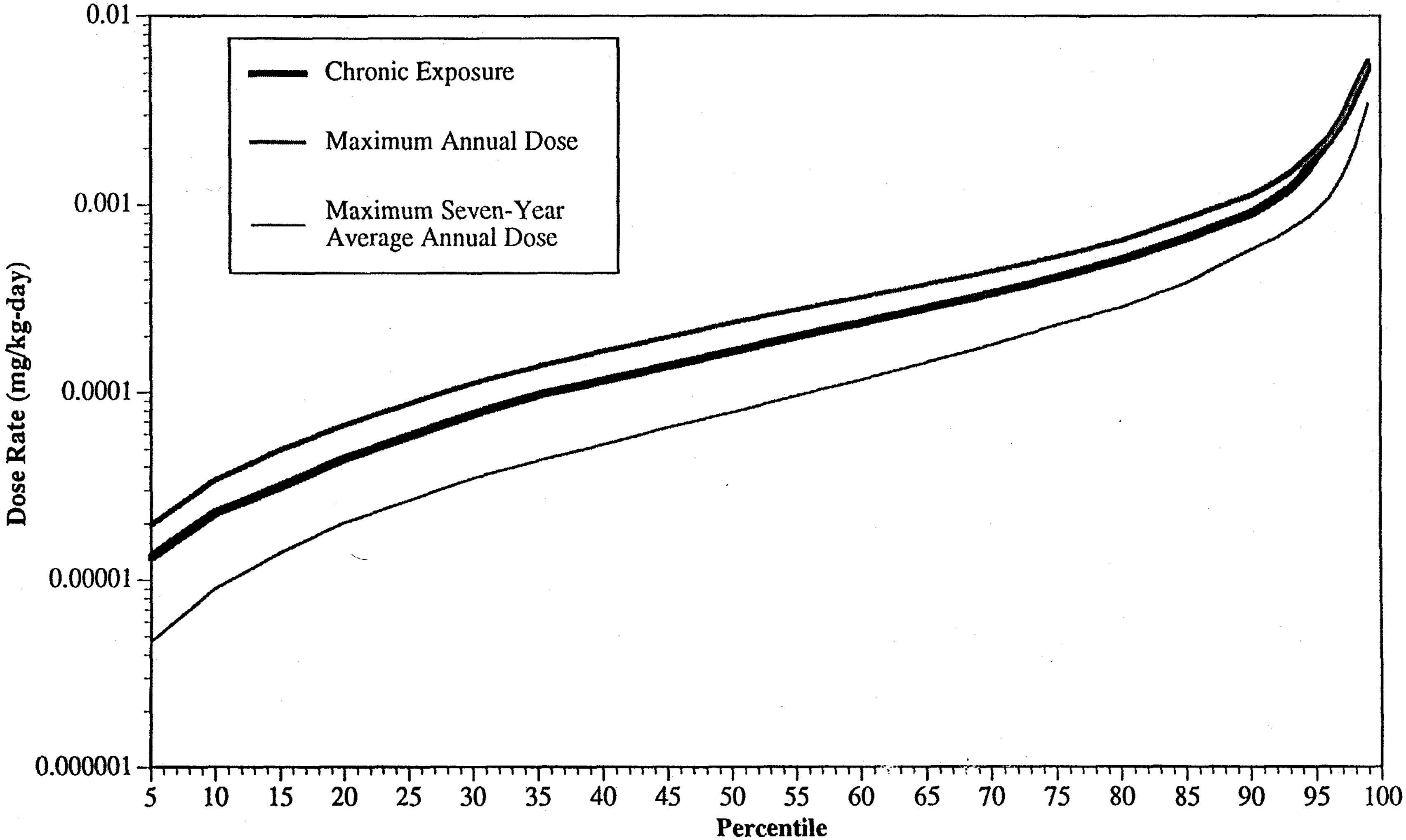
Figure 6 presents the results of the three different measures of long-term dose rates in the exposed population: the maximum annual average dose rate, the maximum seven-year annual average dose rate, and the chronic dose rate. The maximum annual dose rate was 40 percent higher than the chronic dose rate for the median angler but only 18 percent higher for the high-end angler. Because of random variation in contaminant levels in the individual fish an angler consumes, it stands to reason that the maximum annual dose rate will always be higher than the average intake the individual receives over the entire duration of his or her exposure. The reason for the smaller differences in the anglers who consumed large numbers of fish, i.e., the high-end angler, is that the probability of only eating fish with above average concentrations decreases with the number of fish consumed.

The distribution of the maximum seven-year annual average is lower than the distribution of the maximum annual average. Because the maximum seven-year annual average reflects the intake over a number of years, much of the year-to-year variation in intake is averaged out. As a result, the maximum seven-year average annual dose rates tend to have less interindividual variability than the maximum annual average dose rate. The maximum seven-year average dose rates are also lower than the chronic dose rates. Because the duration of exposure is less than seven years for some anglers, the seven-year average includes years with zero exposure.

6. DISCUSSION AND CONCLUSIONS

The microexposure event approach allows the investigation of a number of issues of interest to exposure assessors such as the effect of age on long-term exposures, use of information on short-term variation in characterizing long-term variations in dose rates, determination of the distributions of toxicologically relevant measures of long-term dose rates, and incorporation of temporal changes in exposure parameters. As demonstrated, these factors can have significant impacts in characterizing the distributions of long-term exposures, particularly for the high-end exposed individuals. For example, the estimate of the dose rate for the 99th percentile, assuming a fixed intake rate, was 3 to 4 times lower than the traditional Monte Carlo model results. If an assumption of random variation in intake is made, the estimate is an order of magnitude lower.

Figure 6. Alternative Definitions of Chronic Exposure: Maximum Annual Dose Rates, Maximum Seven Year Dose Rates, and Chronic Dose Rates



10.3739

This paper focuses on the use of Monte Carlo modeling as a technique to evaluate interindividual variability in dose rates received by individuals in an exposed population. However, the approach can be incorporated into more complex models of uncertainty and variation, such as nested loop models of uncertainty and variation[25,26,27].

In summary, MEE models provide a number of resources to exposure assessors. When an exposure pathway involves varying levels of contaminants, MEE models can incorporate information on the temporal changes in the estimates of long-term intake. In addition, analysts using Monte Carlo models based on Equation 1 may wish to use MEE models to investigate the potential for overestimating dose rates for the high-end exposed individual.

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