“ECEM”

Ecological Contaminant Exposure Model

A Food-Wed Based Ecological Exposure Assessment Tool

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Developed by
Pacific Northwest National Laboratory
for the U. S. Department of Energy

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What is ECEM?

- An ecological risk assessment modeling tool
- Estimates exposures
  - from metals, organics, and/or radionuclides
  - in terrestrial and/or aquatic environments
- Based on a food-web architecture
- Helps environmental managers assess impacts as part of a regulatory or decision-making process

How does ECEM work?

- User inputs
  - contaminants of interest
  - species of interest and species in food web
  - environmental data (e.g., contaminant concentrations in air, water and soil)
- Results of the model are
  - body burden or dose rate
  - compared to environmental benchmarks to calculate the environmental hazard quotient, or
  - used as input into human health assessments

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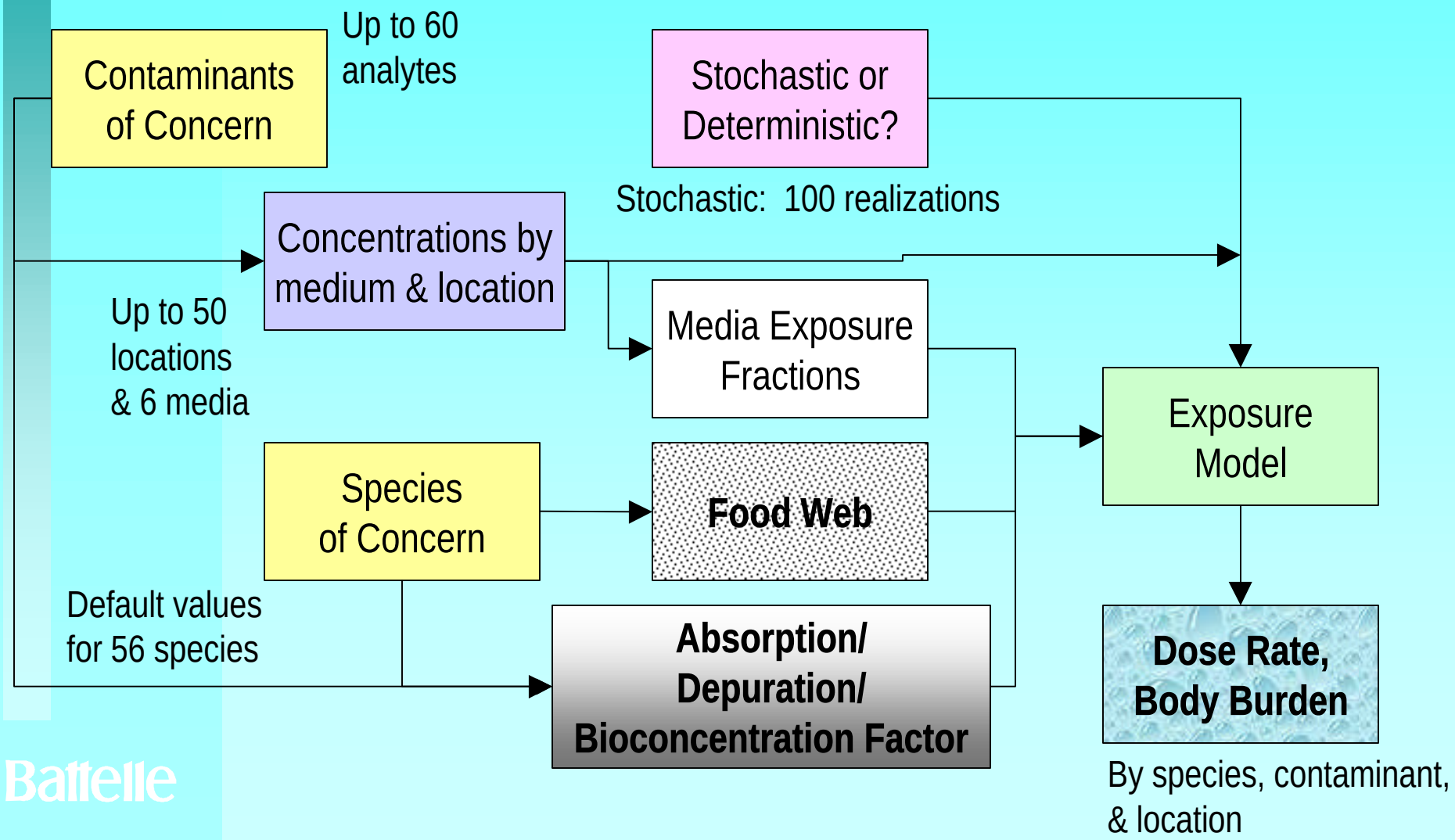
Structure of ECEM



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Let's go through an example… … ..

What is the problem to be assessed?

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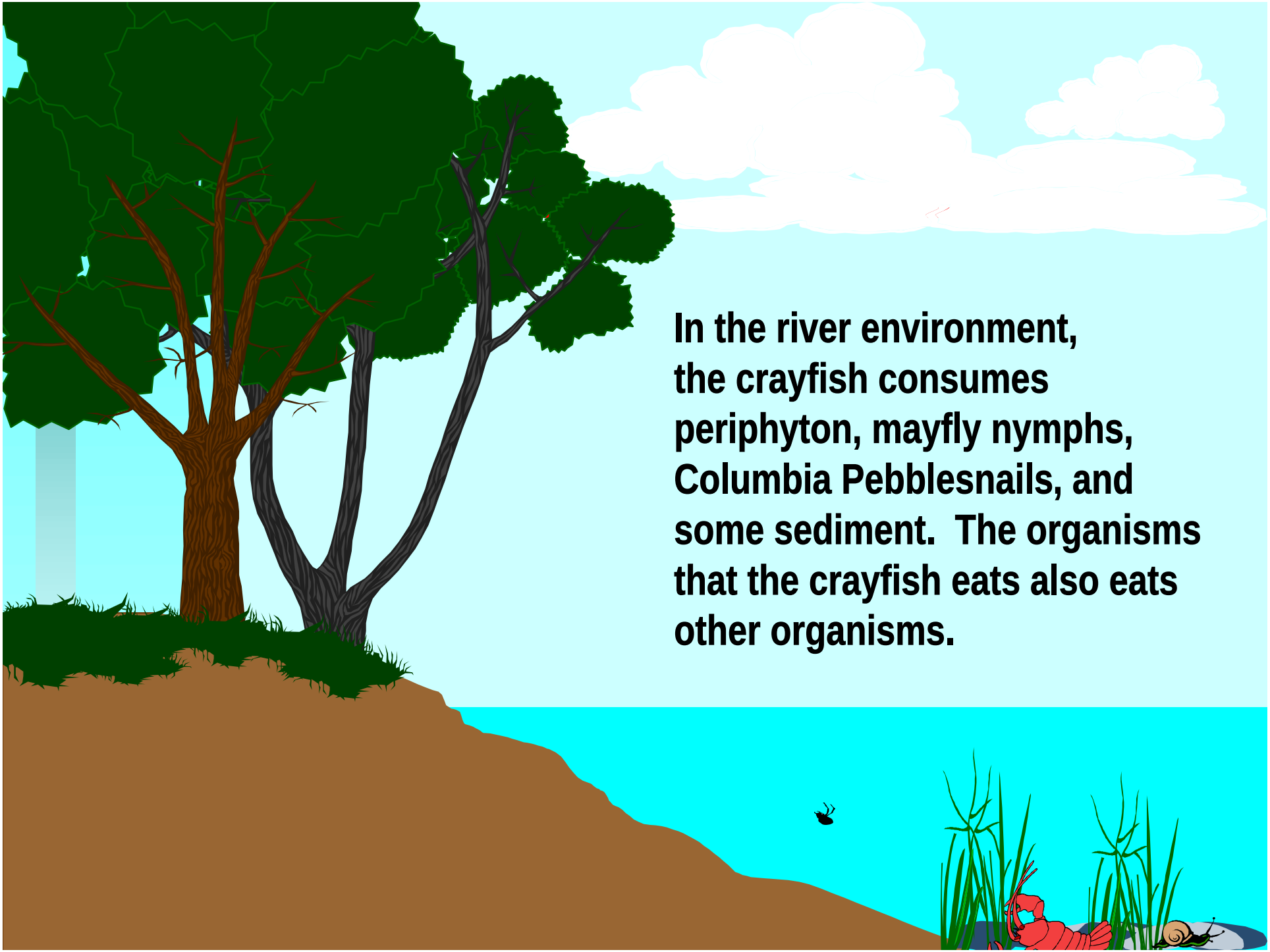
A waste site is in the vicinity a riparian zone and a river.

The environment is contaminated with Strontium-90, chromium, and zinc.

The species of concern for the ecological risk assessment are a beaver and a crayfish.

In the riparian environment, the beaver consumes
black cottonwood trees and mulberry trees.


In the river environment, the crayfish consumes periphyton, mayfly nymphs, Columbia Pebblesnails, and some sediment. The organisms that the crayfish eats also eats other organisms.

That is, the food web definitions are:

- Crayfish Consumption
  - 30% Sediment
  - 50% Periphyton
  - 10% Mayfly
    - 10% Sediment
    - 30% Phytoplankton
    - 40% Periphyton
    - 12% Water Millfoil
    - 4% Hyallela
    - 4% Daphnia Magna
  - 10% Columbia Pebblesnail
    - 10% Sediment
    - 80% Periphyton
    - 10% Water Millfoil
- Beaver Consumption
  - 50% Black Cottonwood
  - 50% Mulberry

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The environmental data for this example:

- Media Data
  - Pore Water
  - Surface Water
  - Sediment
  - Soil
- Internally-Calculated Concentrations
  - Air Vapor
  - Air Particulate

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Now that we have the basic problem defined,

Let's start the model… … …

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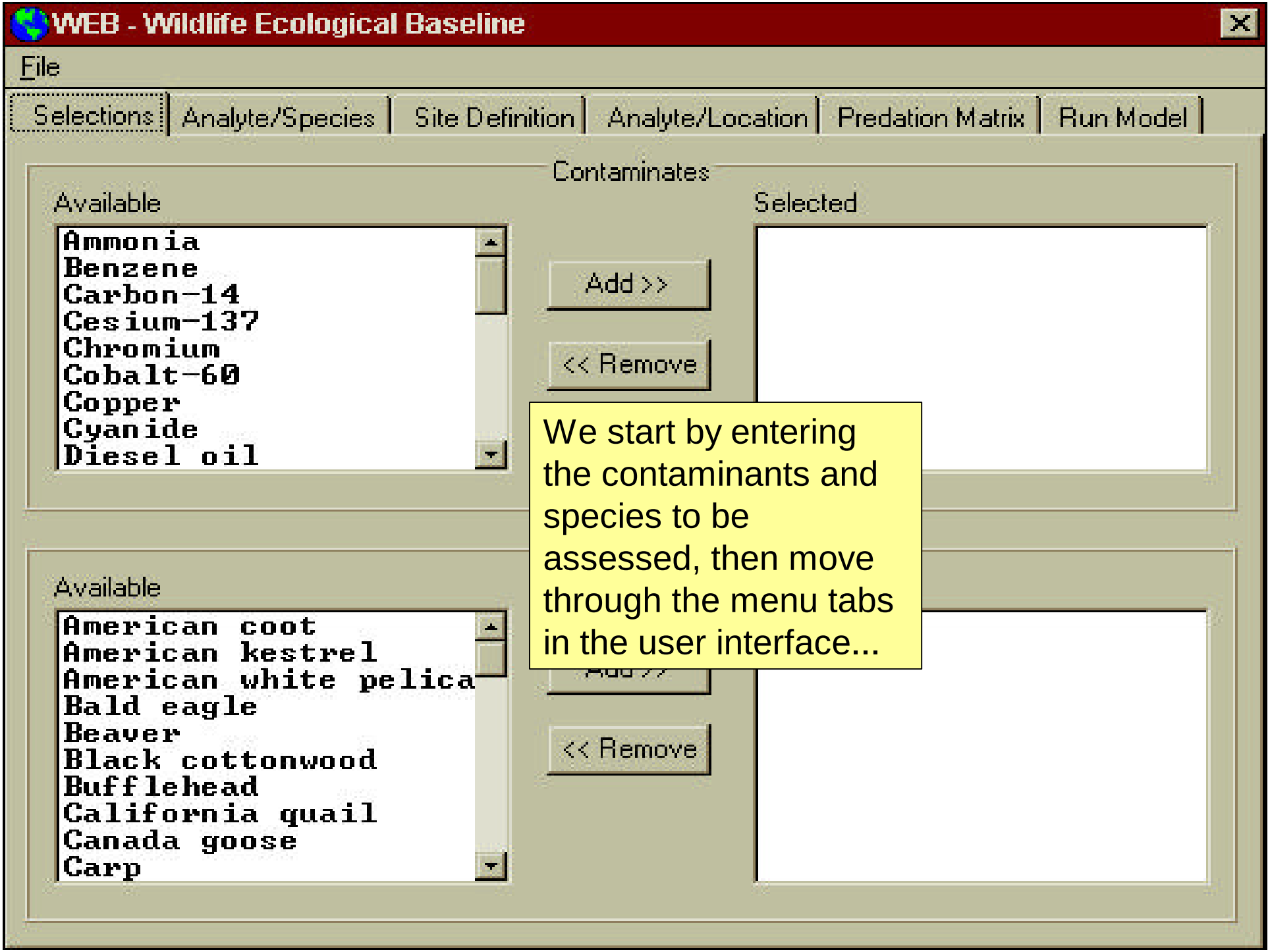


We start by entering the contaminants and species to be assessed, then move through the menu tabs in the user interface...

WEB - Wildlife Ecological Baseline

File

Selections | Analyte/Species | Site Definition | Analyte/Location | Predation Matrix | Run Model

Contaminates

Available

Phosphate
Strontium-90
Sulfate
Technetium-99
Tritium
Uranium-234
Uranium-238
Xylene
Zinc

Add >>

<< Remove

Selected

Chromium
Zinc
Strontium-90

We have now selected the contaminants of concern and all the species in the food web

Species

Available

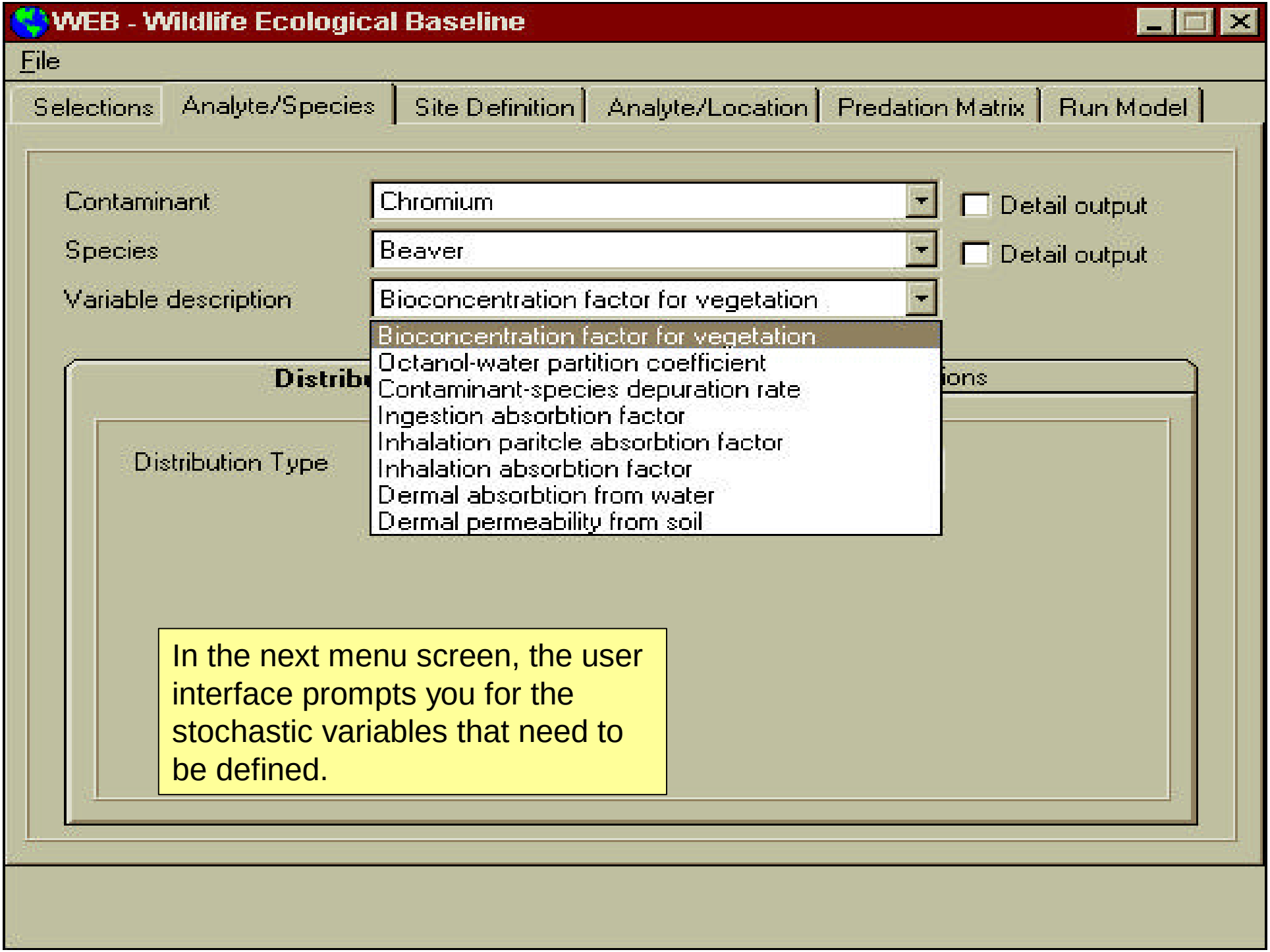
Clams
Cliff swallow
Columbia pebblesnail
Columbia yellowcress
Common snipe
Coyote
Crayfish
Daphnia magna
Dense sedge
Fern

Add >>

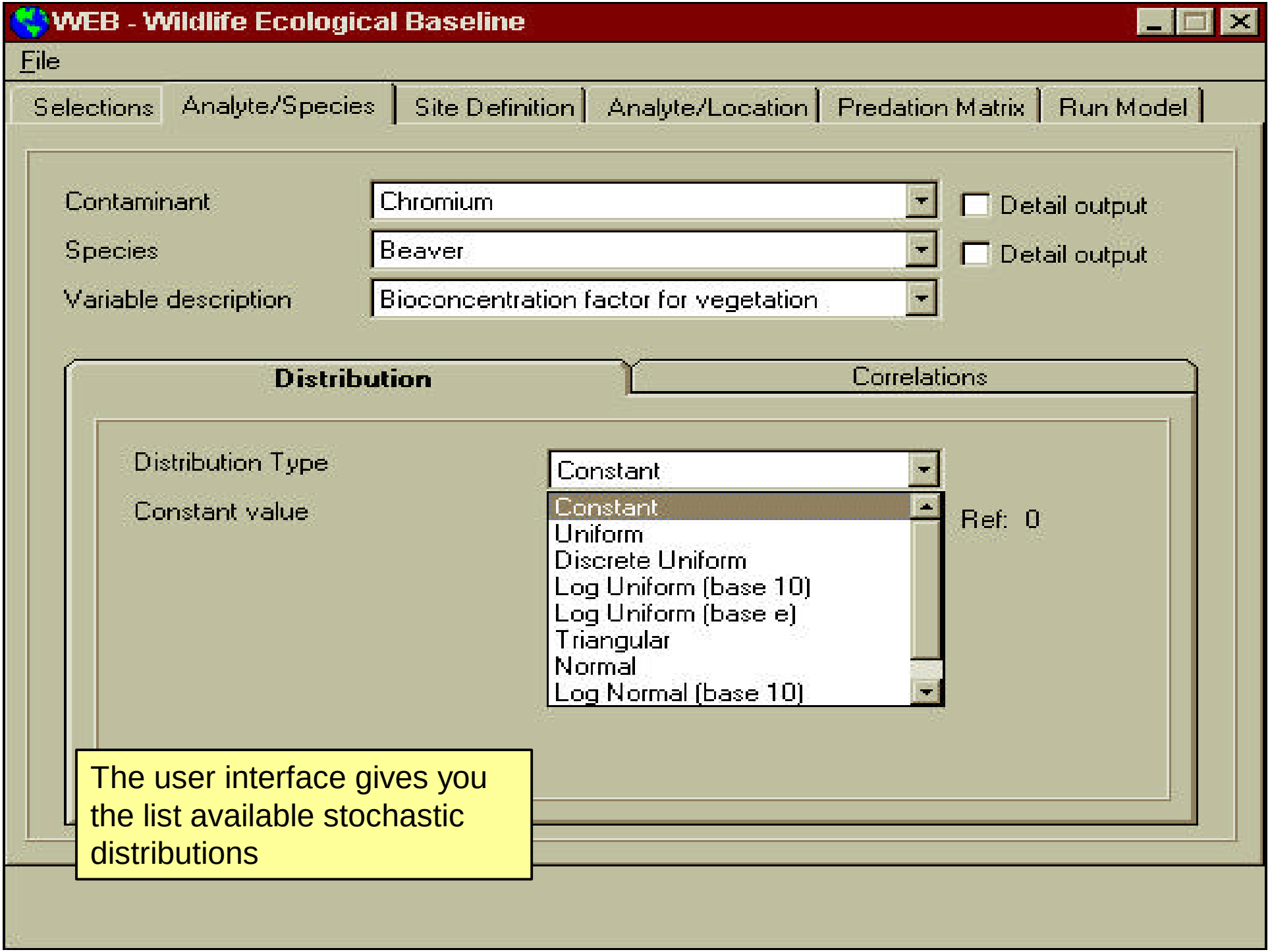
<< Remove

Selected

Beaver
Black cottonwood
Mulberry
Crayfish
Periphyton
Mayfly
Columbia pebblesnail
Phytoplankton
Water millfoil
Hyallela



In the next menu screen, the user interface prompts you for the stochastic variables that need to be defined.



The user interface gives you the list available stochastic distributions

WEB - Wildlife Ecological Baseline

File

Selections | Analyte/Species | Site Definition | Analyte/Location | Predation Matrix | Run Model

Contaminant: Chromium — Detail output

Species: Beaver — Detail output

Variable description: Bioconcentration factor for vegetation

Distribution | Correlations

Distribution Type: Constant

Constant value: 0.0 — Ref: 0

Once you select a distribution, you will see the appropriate parameters to define the distribution. In this case, we've selected the constant distribution.

WEB - Wildlife Ecological Baseline

File

Selections | Analyte/Species | Site Definition | Analyte/Location | Predation Matrix | Run Model

Locations

Location ID: ND-010

Add

Change

Delete

Edit Attributes

Import

ND-001
ND-002
ND-003
ND-004
ND-005
ND-006
ND-007
ND-008
ND-009
ND-010

We proceed by selecting all the location-specific parameters. The parameters that are not node-specific are set on this screen.

General

Cowherd function	0.0		Ref: 0
Exposure interval	0.0	sec	Ref: 0
Universal gas constant	0.0	Pa-m^3/m	Ref: 0
Respirable fraction	0.0	g/m^2-hr	Ref: 0
Area of contamination	0.0	cm^2	Ref: 0
Length of side of contamination	0.0	m	Ref: 0
Uptake fraction of tritium in plants	0.0	fraction	Ref: 0

WEB - Editing location ND-010

Description: Definition line for node ND-010

Done

Node-specific parameters are set on this screen.

Northing coordin	9.1	m	Ref: 0
Easting coordina	9.2	m	Ref: 0
Agregate particale size	0.0	mm	Ref: 0
Oxygen concentration in the surface water	6.9	mg/l	Ref: 0
Soil porosity	0.39	percent	Ref: 0
Fraction of soil organic carbon content	0.1	fraction	Ref: 0
Fraction of vegitative cover	0.59	fraction	Ref: 0
Nonerodible elements correction factor	0.89		Ref: 0
Soil density	2.19	g/cm^3	Ref: 0
Surface roughness height	7.9	m	Ref: 0
Mean temperature	279.0	K	Ref: 0
Mean annual wind speed	3.9	m/s	Ref: 0
Mixing zone wind speed	0.0	m/s	Ref: 0

WEB - Wildlife Ecological Baseline

File

Selections | Analyte/Species | Site Definition | Analyte/Location | Predation Matrix | Run Model

Contaminant: Chromium — Detail output

Location: ND-001 — Detail output

Variable description:

DistributionType

- Soil-Water partition coefficient
- Pore water concentration
- Sediment concentration
- Soil concentration
- Springs concentration
- Surface water concentration

We set analyte and analyte/location dependent parameters on this screen.

WEB - Wildlife Ecological Baseline

File

Selections | Analyte/Species | Site Definition | Analyte/Location | Predation Matrix | Run Model

	Columbia pebblesnail	Hyallela	Daphnia magna	Sediment	Tot
Black cottonwood				0.0000	0.00
Mulberry				0.0000	0.00
Beaver				0.0000	1.00
Phytoplankton				0.0000	0.00
Periphyton				0.0000	0.00
Water milfoil				0.0000	0.00
Crayfish	0.1000			0.3000	1.00
Mayfly		0.0400	0.0400	0.1000	1.00
Columbia pebblesnail				0.1000	1.00
Hyallela				0.5000	1.00
Daphnia magna				0.0000	1.00

The predation matrix for the selected species in the food web is set here. The final column is a row sum that must total either 0 or 1.

WEB - Wildlife Ecological Baseline

File

Selections | Analyte/Species | Site Definition | Analyte/Location | Predation Matrix | Run Model

Controls

Title of run: Demo Deterministic case for the ECORISK Code

Name of user: Terri B. Miley

Random seed value: 445544 Ref: 0

Number of realizations: 1 Ref: 0

Run WEB

File Locations

Analyte library	h:\ecorisk\ANALYTES.PRN
Species library	h:\ecorisk\SPECIES.LIB
Species radius libray	h:\ecorisk\RADIUS.PRN
Node library	h:\ecorisk\NODES.LIB
Media data	h:\ecocon\Dettst.cnh
Output report	Dettst.rpt
Body burden report	Dettst.bur
Stats summary	Dettst.sta

Debug

- [ ] Nodes
- [ ] Species
- [ ] Constant
- [ ] Concentrations
- [ ] Generate
- [ ] Loop
- [ ] Analytes
- [x] Equations
- [ ] Correlations
- [ ] Statistical Report
- [ ] Print stochastic def.
- [ ] Check input only

We name the input library files and output files on this screen.

WEB - Wildlife Ecological Baseline

File

Selections | Analyte/Species | Site Definition | Analyte/Location | Predation Matrix | Run Model

Controls

Title of run: Demo Deterministic case for the ECORISK Code

Name of user: Terri B. Miley

Random seed value: 445544 Ref: 0

Number of realizations: 1 Ref: 0

Run WEB

We are now all set to run the code by pressing

Fil

Analyte library: h:\e

Species library: h:\ecorisk\SPECIES.LIB

Species radius libray: h:\ecorisk\RADIUS.PRN

Node library: h:\ecorisk\NODES.LIB

Media data: h:\ecocon\Dettst.cnh

Output report: Dettst.rpt

Body burden report: Dettst.bur

Stats summary: Dettst.sta

Debug

- [ ] Nodes
- [ ] Species
- [ ] Constant
- [ ] Concentrations
- [ ] Generate
- [ ] Loop
- [ ] Analytes
- [x] Equations
- [ ] Correlations
- [ ] Statistical Report
- [ ] Print stochastic def.
- [ ] Check input only

What kind of results do you get from ECEM?

- Results

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System Requirements for ECEM

- Software
  - Windows Application
  - Visual Basic User Interface
  - Fortran 90 Code
- Hardware
  - PC running Windows 95
  - 40 MB RAM
  - 150 MB Disk Space

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