

Human Health Focus Group

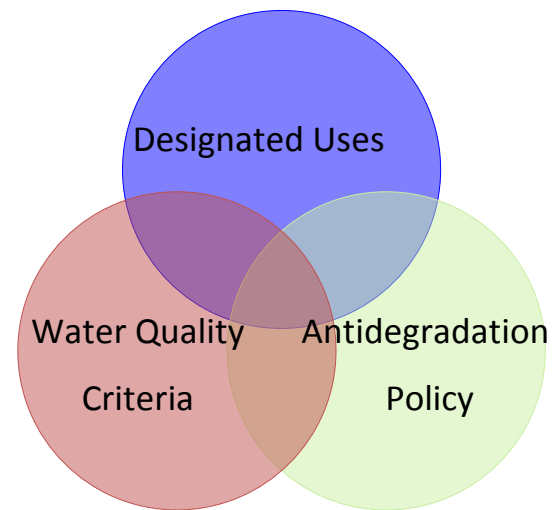
This presentation represents the work of the Human Health Focus Group members:

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- Joan Rothelien, PhD- Oregon Health and Science University
- Sue MacMillan- URS Corporation
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What are Water Quality Standards (WQS)?

- WQS are the foundation of state/tribal water quality-based pollution control programs under the Clean Water Act.
- WQS are to protect public health or welfare, enhance the quality of the water and serve the purposes of the Clean Water Act.

WQS are composed of:



How is Risk Assessment used to develop Water Quality Criteria

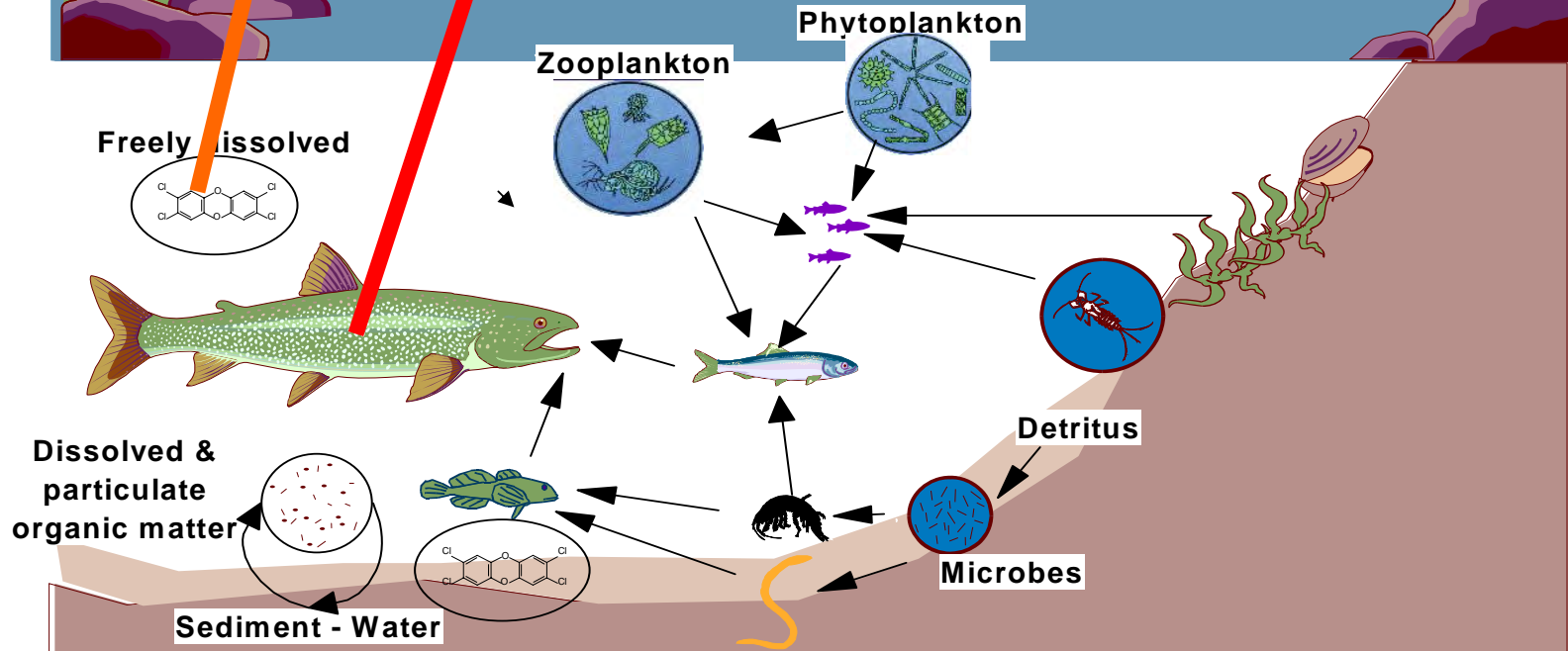
- EPA publishes guidance values for two types of numeric criteria:
 - Criteria to protect aquatic life; and
 - Criteria to protect human health.
- Human health criterion: the highest concentration of a pollutant in water that is not expected to pose a significant risk to human health.
- EPA publishes two types of human health guidance values:
 - Those to protect individuals consuming fish and water; and
 - Those to protect individuals consuming fish only.



Drinking Water

Eating Fish

Human health water quality criteria for ingestion of water, fish and shellfish



Prospective Risk Assessment

Predicting the likelihood of injury, disease, or death due to exposure to chemicals released into the waters of the US.



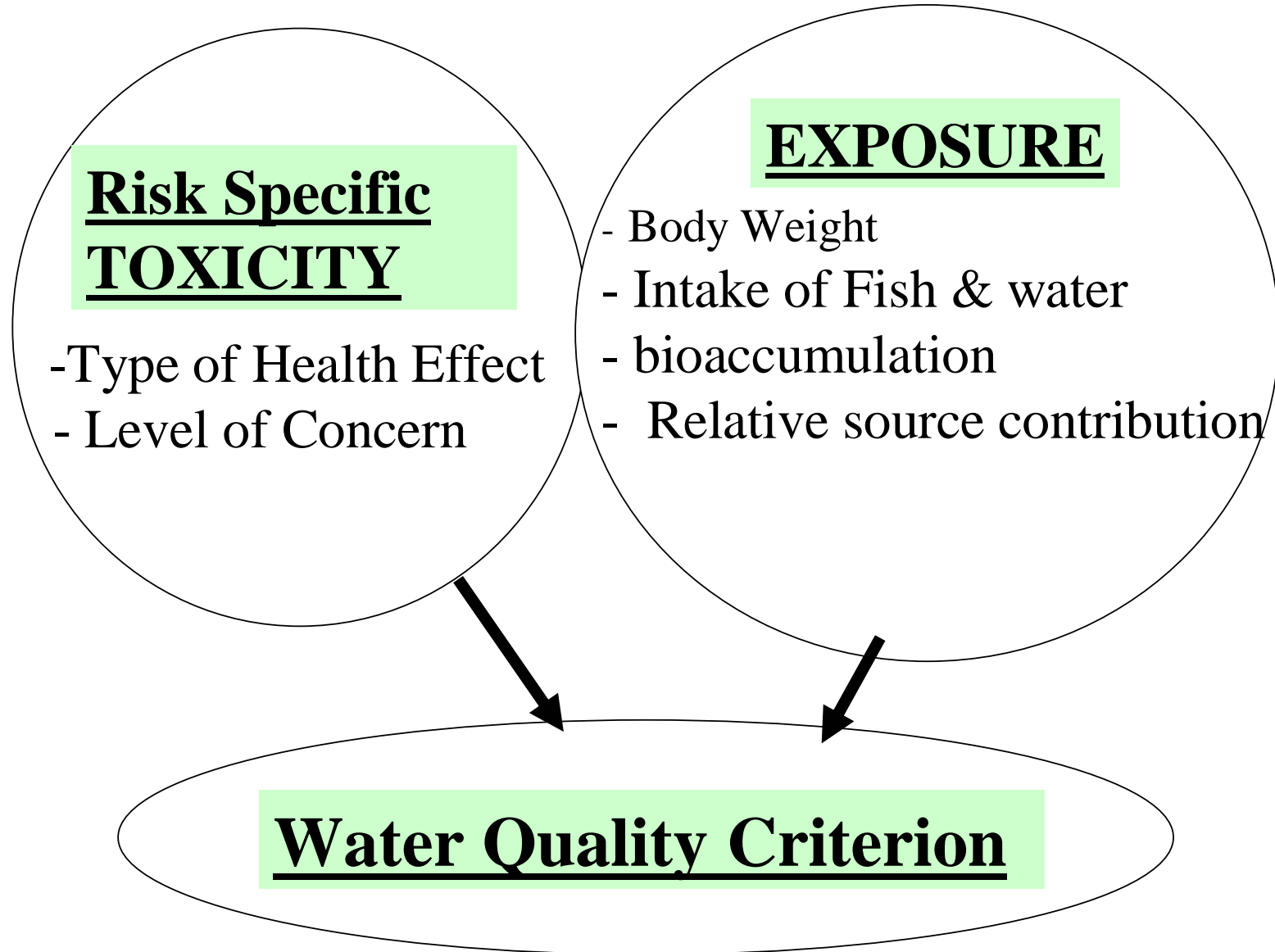
General Equation for Deriving **Human Health Criteria**



*Water Quality Criterion =
Risk Specific Toxicity x Exposure*



Risk Assessment to Derive Water Quality Criteria



Risk Assessment to Derive Water Quality Criteria

Risk Specific Toxicity

-Type of Health Effect

Cancer and Non-Cancer

- Level of Concern

Target cancer risk level

Non-Cancer reference dose

EXPOSURE

Water Quality Criterion

Human Health Criteria: What do we need to know about Toxicity

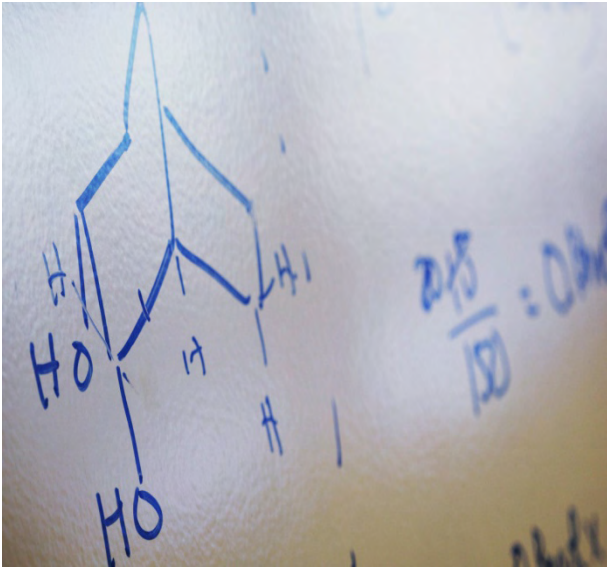
CARCINOGENS:

- $q1^*$, the cancer slope factor
- The target risk level

ODEQ recommends a target risk level of no more than 1 in a million chance of cancer

NONCARCINOGENS:

- Reference Dose (RfD*)- Estimate of exposure that is likely to be without an appreciable risk of deleterious effects during a lifetime.



* Risk values and complete toxicological assessments may be found on EPA's Integrated Risk Information System (IRIS) at www.epa.gov/iris

What do we
need to know
About
Exposure?

EXPOSURE

- Body weight
- Intake of Fish & Water
- bioaccumulation
- Relative source contribution

**Risk Specific
TOXICITY**

Ambient Water Quality Criterion

What do we need to know about exposure?

USEPA exposure recommendations for people:

-BW = Human Body Weight (kg)

Average adult body weight
70 kg (150 pounds)

-DI = Drinking Water

(L/day)

2 liters per day for the 90th
percentile of the US Adult
population; about 8 glasses
1 liter = about 32 ounces

-FI = Fish Intake (kg/day)

17.5 grams per day for
90th percentile of US adult
population

(Consumers & nonconsumers)

4 ounces per week

Fresh water and estuarine
fish

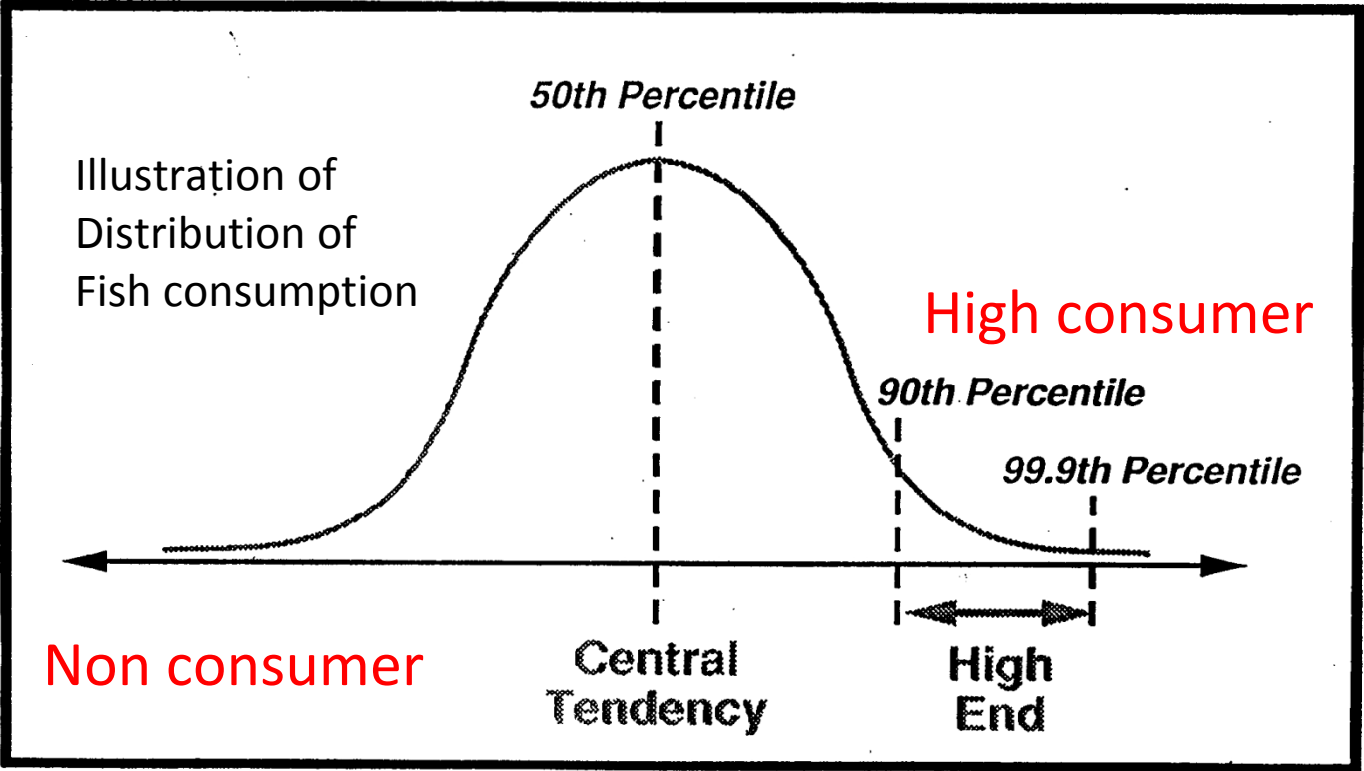


National Health and Nutrition Examination Survey, as reported in the Exposure Factors Handbook (USEPA, 1997).

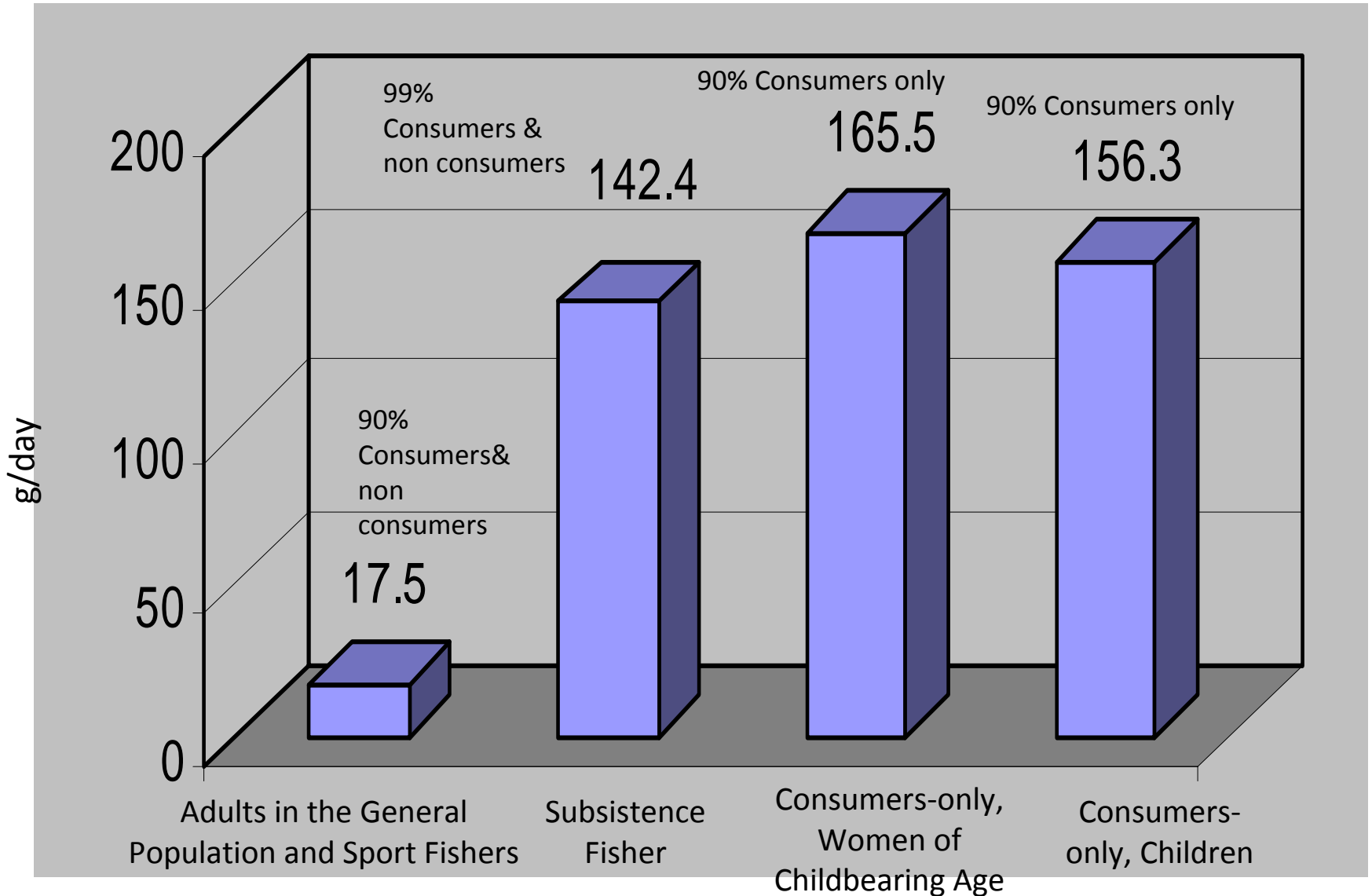


Drinking water and food ingestion from
US Dept of Agriculture National Food Survey 1977-1978,
1994-1996, 1998 as reported by USEPA 1997, 2000, 2002

POPULATION DISTRIBUTION



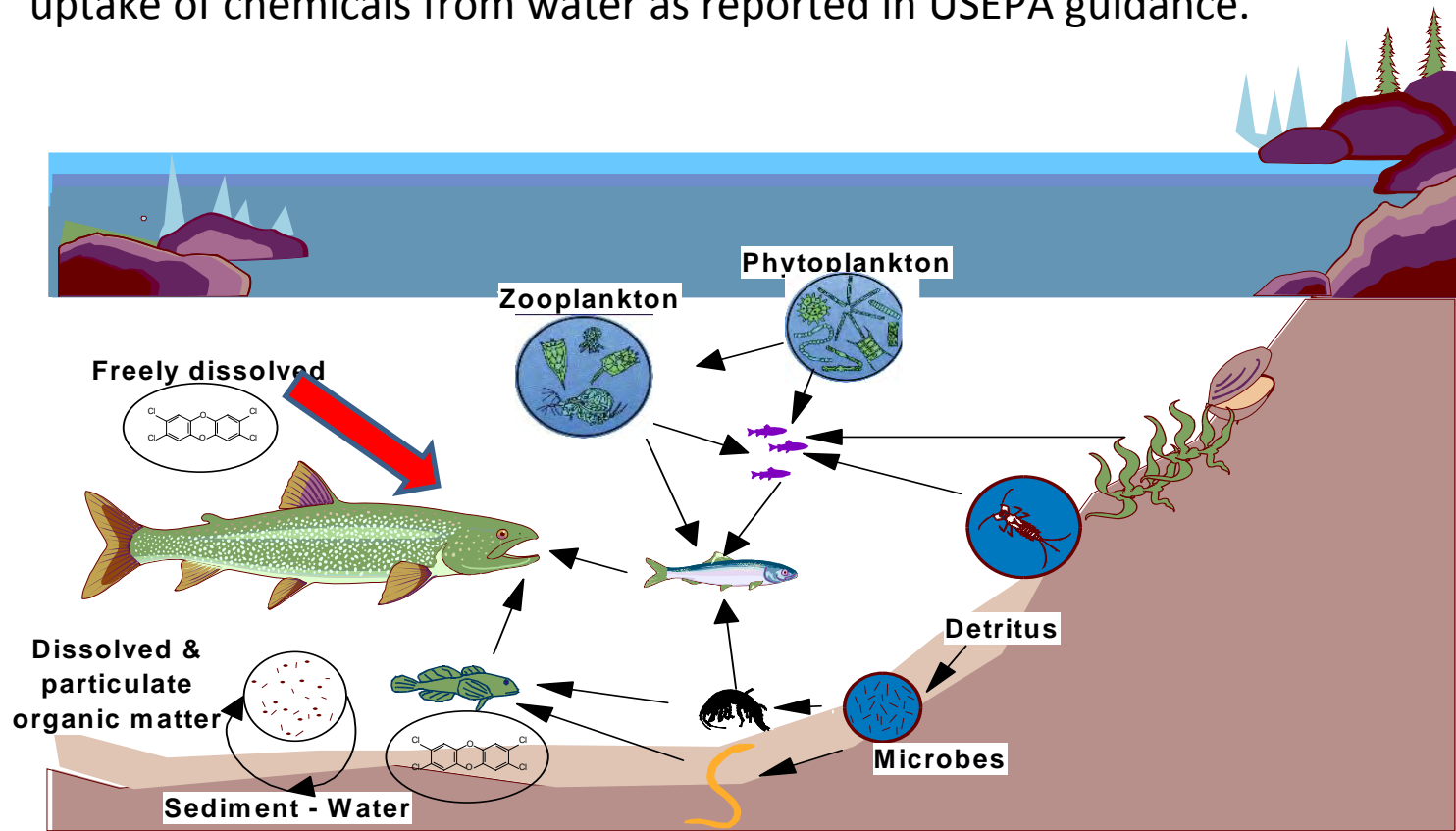
EPA National Default Values for Consumption of Freshwater and Estuarine Fish and Shellfish (EPA 2000)



What do we need to know about exposure?

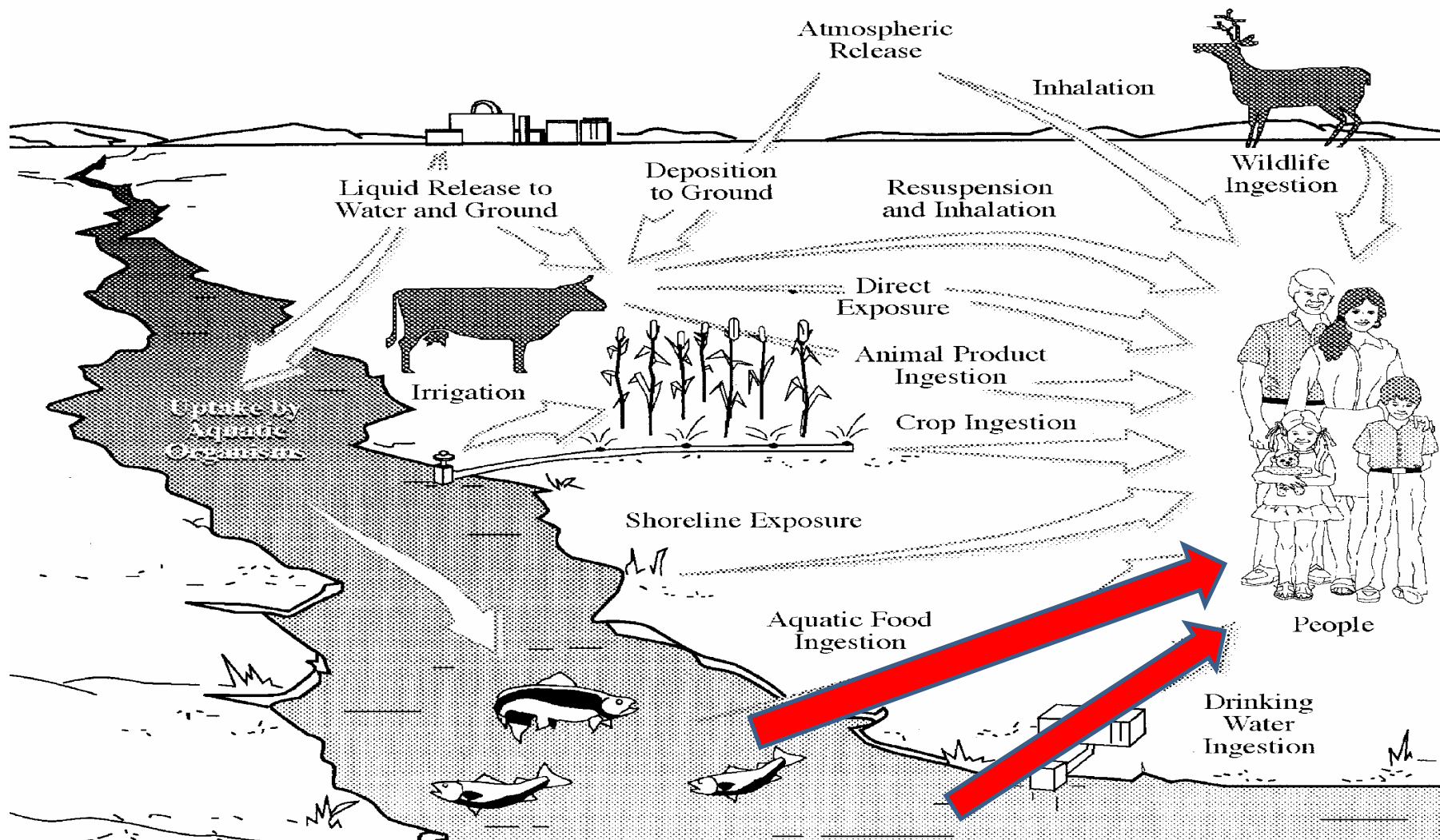
How much chemical is taken up by fish through their gills?

USEPA exposure recommendations for bioconcentration factors for uptake of chemicals from water as reported in USEPA guidance.



What do we need to know about exposure?

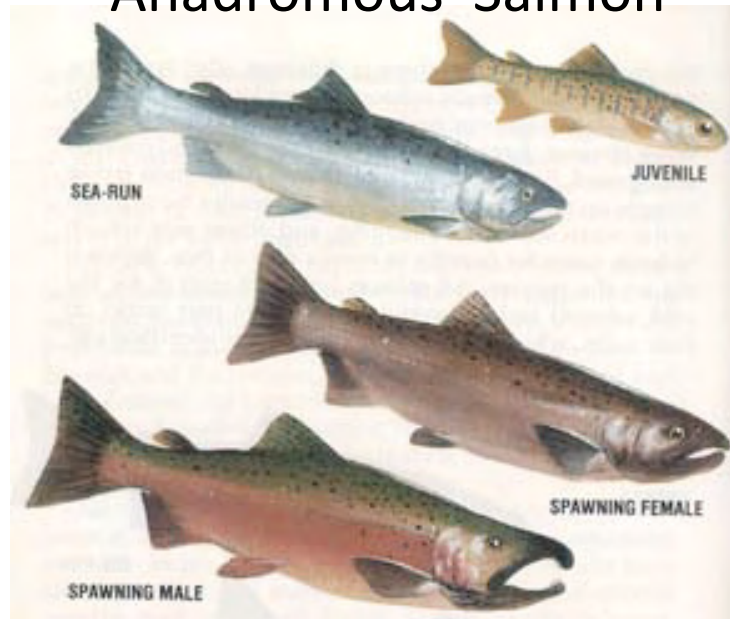
Relative Source Contribution How much of a particular chemical may come from sources other than drinking water and fish and shellfish.



What do we need to know about exposure?

Relative Source Contribution How much of a particular chemical may come from sources other than fresh water and estuarine fish and shellfish.

Anadromous Salmon



Freshwater Trout

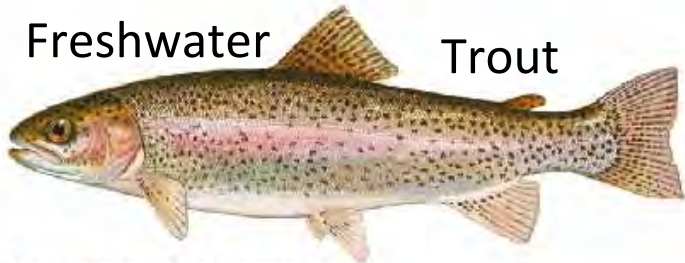


Photo courtesy USFWS/Duane Raver

Marine Pacific Halibut



Pacific Halibut
Hippoglossus stenolepis

Example of Water quality criterion for PCBs

PCB Toxicity

PCBs can harm the immune system, cause neurobehavioral deficits, and reduced birth weight.

PCBs are probable human carcinogens

Cancer Slope Factor = 2 per mg/kg-day

Source of information US EPA: EPA's Integrated Risk Information System at www.epa.gov/iris

PCB Exposure *Source of information US EPA*

<http://www.epa.gov/waterscience/criteria/nrwqe-2006.pdf>

Body weight = 70 kg, Drinking water intake = 2 liters per day, Fish ingestion rate = 17.5 g/day, Bioconcentration factor = 31200 liters/kg

General Equation For Linear Cancer Effects

Water Quality Criterion = Risk Specific Toxicity X Exposure

$$\text{Water Quality Criterion} = \text{RSD} \times \left(\frac{BW}{DI + (FI \times BCF)} \right)$$

Risk Specific Toxicity

RSD = Risk Specific Dose

Target Risk Level divided by Cancer Slope

Exposure

-BW = Human Body Weight

-DI = Drinking Water Intake

-FI = Fish Intake

-BCF = Bioconcentration Factor

General Equation For Linear Cancer Effects

Example: PCBs

Water Quality Criterion = Risk Specific Toxicity X Exposure

$$0.00006 \text{ ug/l} = \frac{1 \text{ in a million}}{2} \times \left(\frac{70}{2 + (17.5 \times 31200)} \right)$$

Risk Specific Toxicity

RSD = Risk Specific Dose

Target Risk Level = ODEQ Target risk level = 1 in 1 million
divided by PCB Cancer Slope = 2

Exposure

- BW = Human Body Weight (70 kg, average US adult)
- DI = Drinking Water Intake (2 L/day, 90% of us adults)
- FI = Fish Intake (17.5 kg/day, 90% of US adults)
- BCF = Bioconcentration Factor (31200 L/kg) example

Example of Water quality criterion for Endrin

Central nervous system (brain and spinal cord)injury

Reference Dose = 0.0003 mg/kg-day

*Source of information US EPA: EPA's Integrated Risk Information System at
www.epa.gov/iris*

Body weight = 70 kg, Drinking water intake = 2 liters per day, Fish
ingestion rate = 17.5 g/day, Bioconcentration factor = 130
liters/kg, Relative source contribution = 20% (default)

Exposure *Source of information US EPA*

<http://www.epa.gov/waterscience/criteria/nrwqe-2006.pdf>

General Equation For Non-Cancer Effects

Water Quality = Toxicity X Exposure
Criterion

$$\text{Water Quality Criterion} = RfD \times RSC \times \left(\frac{BW}{DI + (FI \cdot BCF)} \right)$$

Toxicity

-RfD = Reference Dose (mg/kg-day)

Exposure

- RSC = Relative Source Contribution

-BW = Human Body Weight (kg)

-DI = Drinking Water Intake (L/day)

-FI = Fish Intake (kg/day)

-BCF = Bioconcentration Factor (L/kg)

-RSC = Relative Source Contribution (percent)

General Equation For Non-Cancer Effects

Pesticide: Endrin

Water Quality Criterion = Risk Specific Toxicity X Exposure

$$0.059 \text{ ug/l} = 0.0003 \times 0.2 \left(\frac{70}{2 + (17.5 \times 130)} \right)$$

Toxicity

-RfD = Reference Dose (0.0003 mg/kg-day) Example

Exposure

-RSC = Relative Source Contribution (20 percent)

-BW = Human Body Weight (70 kg)

-DI = Drinking Water Intake (2 L/day)

-FI = Fish Intake (17.5 kg/day)

-BCF = Bioconcentration Factor (130 L/kg)

Fish Tissue Criteria

- Criteria can be expressed as a fish tissue concentration by dropping the Drinking Water Intake and BAF terms
 - Useful for pollutants where BAF is highly variable due to site-specific factors (e.g., Methylmercury) SEE:
<http://www.epa.gov/waterscience/criteria/methylmercury/>
 - Allows direct measurement of fish tissue for assessment purposes