Assessing Risk of EPA Authorized Pesticide Uses to ESA Listed Pacific Salmonids

General approach and use of California DPR data

CDPR
February 27, 2012

National Marine Fisheries Service Office of Protected Resources Pesticide Team

Thom Hooper, Tony Hawkes, Scott Hecht
Lacey, WA

Sunny Snyder, Paige Doelling, Kira Goetschius
Silver Spring, MD

<u>Ecotoxicology Program- NW Fisheries Science Center</u>
Nat Scholz, David Baldwin, Julann Spromberg,
Kate MacNeale, Cathy Laetz
Seattle, WA

Background

- Jan 2001- Lawsuit filed against EPA to consult on Effects of 54 active ingredients on listed Pacific Salmonids
- 2002 through 2004- EPA transmitted biological evaluations on 54 active ingredients with determinations of “may affect” on 37 active ingredients.
- Nov 2007 – Legal complaint filed against NMFS for unreasonable delay in completing consultations.
- July 2008- Settlement Agreement to complete consultation on 37 active ingredients

Settlement Agreement to complete consultation on 37 active ingredients

- Batch 1: chlorpyrifos, malathion, diazinon (Nov 2008)
- Batch 2: carbofuran, carbaryl, methomyl (April 2009)
- Batch 3: azinphos methyl, dimethoate, phorate, methidathion, naled methyl parathion, disulfoton, fenamiphos, methamidophos, phosmet, ethoprop, bensulide (August 2010)
- Batch 4: 2,4-D, triclopyr BEE, diuron, linuron, captan, chlorothalonil (June 2011)
- Batch 5: oryzalin, trifluralin, and pendimathalin (May 2012)
- Batch 6: molinate and thiobencarb (June 2012)
- Remaining: (June 2013): propargite, fenbutatin-oxide, diflubenzuron, 1,3-D, lindane, racemic metolachlor, bromoxynil, and prometryn.

Goals of this trip

- Learn more about thiobencarb use and existing programs in California that influence risk to salmonids
  - CDPR
  - California Rice Commission
  - U.C. Davis
  - California Department of Fish and Game
  - USGS

Purpose of ESA Section 7 Consultation

Each federal agency shall insure that any action authorized, funded, or carried out is not likely to:

- Jeopardize T/E species
- Result in destruction or adverse modification of designated critical habitat

Entities Involved in ESA Consultations on FIFRA Actions

Action Agency: U.S. EPA/ Office of Pesticide Programs

Consulting Agency: NOAA/ NMFS/Office of Protected Resources/ Endangered Species Division

Applicants: Designated by EPA- Pesticide companies

e.g. Valent- Registrant of Bolero® products

How Does NMFS Reach Conclusions in a Biological Opinion?

- Our process is outlined in the USFWS/NMFS Consultation Handbook (1998)
- Major sections of a Biological Opinion:
  - Federal Action / Action Area
  - Status of the Species
  - Environmental Baseline
  - Effects of the Action
  - Cumulative Effects
  - Integration and Synthesis

Federal Action

"Any action authorized, carried out, or funded"

"Authorization for use or uses described in labeling of a pesticide."

Definition reached at NMFS-USFWS-USEPA meeting 12/12/2007

TOUCHDOWN PRO

Herbicide

Nonselective Foliar Systemic Herbicide for Weed Control

Active Ingredient:
*Glyphosate:
N-(phosphonomethyl) glycine 28.3%

Inert Ingredients: 71.7%

Total: 100.0%

*Contains 3 pounds of glyphosate acid in each gallon, in the diammonium salt form.

See directions for use in attached booklet.

AGRICULTURAL USE REQUIREMENTS

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR part 170. Refer to supplemental labeling under "Agricultural Use Requirements" in the Directions for Use section for information about this standard.

EPA Reg. No. 100-1121
EPA Est. 100-LA-001 [SG]
EPA Est. 100-NE-001 [MHA]
Superscript identifies manufacturing site

Touchdown® and the Syngenta logo are trademarks of a Syngenta Group Company
U.S. Patent No. 5,468,718

©2001 Syngenta

Syngenta Crop Protection, Inc.
Greensboro, North Carolina 27409
www.syngenta-us.com
SCP 1121A-L1 0601

KEEP OUT OF REACH OF CHILDREN.
CAUTION

FIRST AID

If in eyes	• Flush eyes with plenty of water. Call a physician if irritation persists.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment.

HOT LINE NUMBER
For 24 Hour Medical Emergency Assistance (Human or Animal) or Chemical Emergency Assistance (Spill, Leak, Fire, or Accident), Call
1-800-888-8372

Precautionary Statements

Hazards to Humans and Domestic Animals

Causes moderate eye irritation. Avoid contact with eyes or clothing. Wash thoroughly with soap and water after handling.

Environmental Hazards

Do not apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not contaminate water when cleaning equipment or disposing of equipment wash water.

Storage and Disposal

Container Disposal

Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill or by incineration, or, if allowed by State and local authorities, by burning. If burned, stay out of smoke.

CONTAINER IS NOT SAFE FOR FOOD, FEED, OR DRINKING WATER!

2.5 gallons
U.S. Standard Measure

syngenta

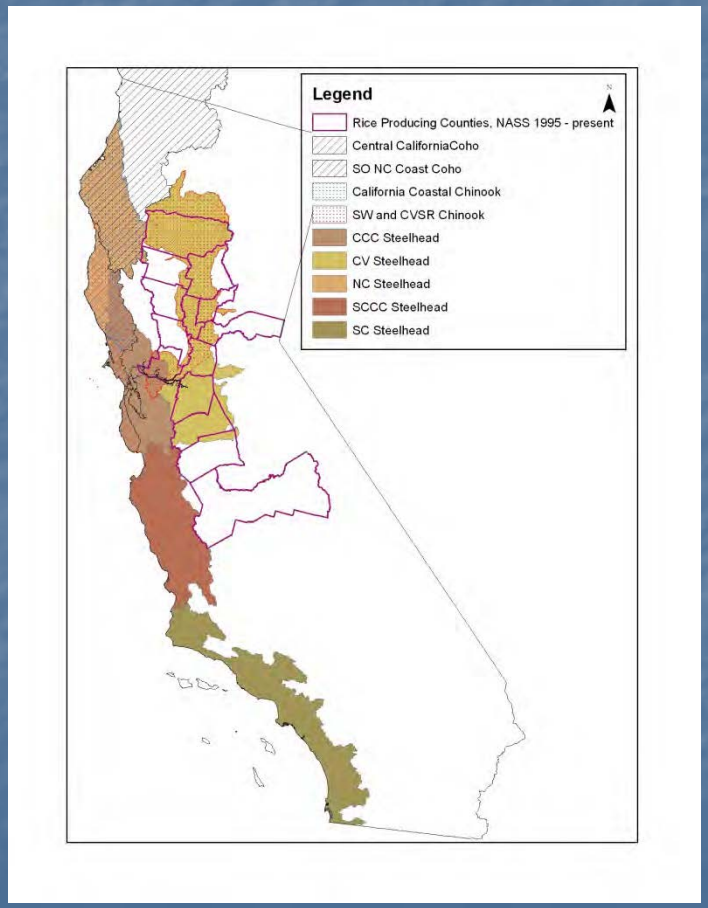
Description of the Action

- Information reviewed
  - Labels
    - Where it can be applied (Ag commodities, residential, etc.,)
    - Methods of application, rates, existing restrictions that reduce risk
    - Ingredients
    - Tank mixtures
- Duration: 15 years- consistent with EPA registration review cycle

Label authorized uses

Pesticide (products)	States	Land Use Category	Examples
Thiobencarb (7)	CA	Cropland	Rice only
Molinate (0)	-	-	Canceled
Malathion (100+)	CA, ID, OR, and WA	Cropland, non-crop ag, Rangeland, Forested areas, Residential, industrial, Flooded areas	~100 crops, pasture and rangeland, Mosquito and fly control for public health, ...

Distribution of rice and listed salmonids in CA



ESA listed salmon in California's Central Valley

-

  Sacramento River winter-run Chinook

  (Threatened 1990, status changed to Endangered 1994)

  Critical Habitat designated 1993

-

  Central Valley spring-run Chinook

  (Threatened 1999)

  Critical Habitat designated 2005

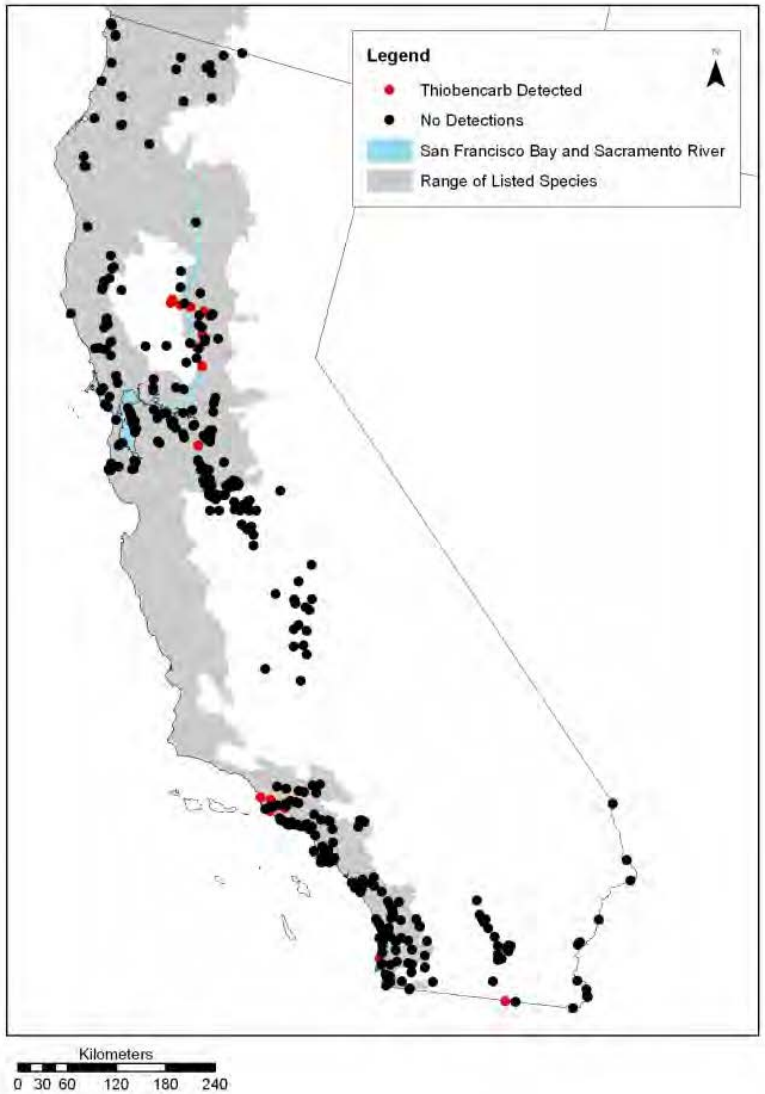
-

  Central Valley Steelhead

  (Threatened 1998)

  Critical Habitat designated 2005

Monitoring for thiobencarb



How Does NMFS Reach Conclusions in a Biological Opinion?

- Our process is outlined in the USFWS/NMFS Consultation Handbook (1998)
- Major sections of a Biological Opinion:
  - Federal Action / Action Area
  - Status of the Species
  - Environmental Baseline
  - Effects of the Action
  - Cumulative Effects
  - Integration and Synthesis

Status of the Species

- Species life history description
- Status and distribution
  - Reasons for listing
  - Trends
  - Threats
- Population Viability Elements
  - Genetic diversity
  - Abundance
  - Productivity
  - Distribution

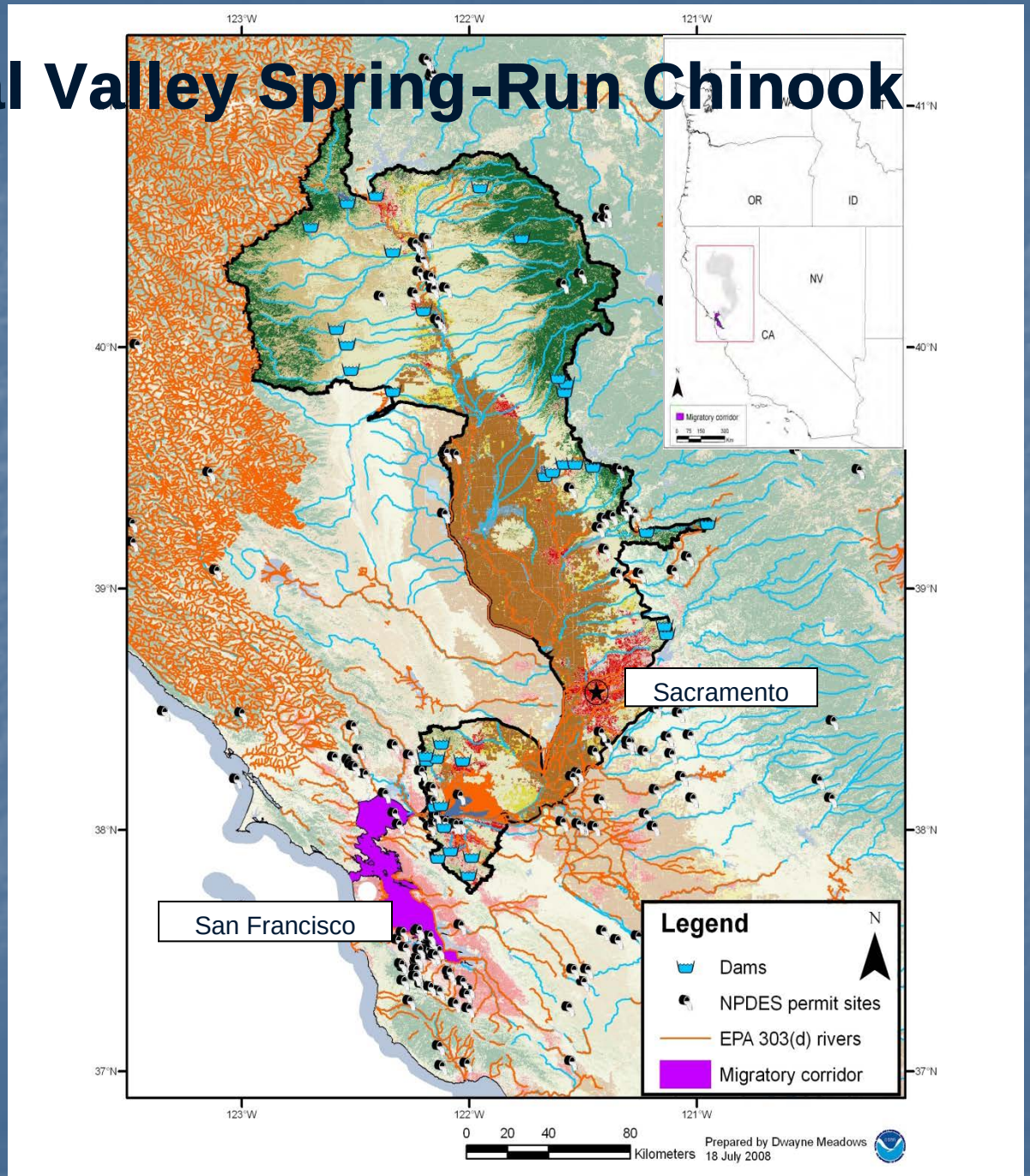
How Does NMFS Reach Conclusions in a Biological Opinion?

- Our process is outlined in the USFWS/NMFS Consultation Handbook (1998)
- Major sections of a Biological Opinion:
  - Federal Action / Action Area
  - Status of the Species
  - Environmental Baseline
  - Effects of the Action
  - Cumulative Effects
  - Integration and Synthesis

Environmental Baseline

By regulation, environmental baselines for biological opinions include the past and present impact of all state, Federal or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR §402.02).

Central Valley Spring-Run Chinook



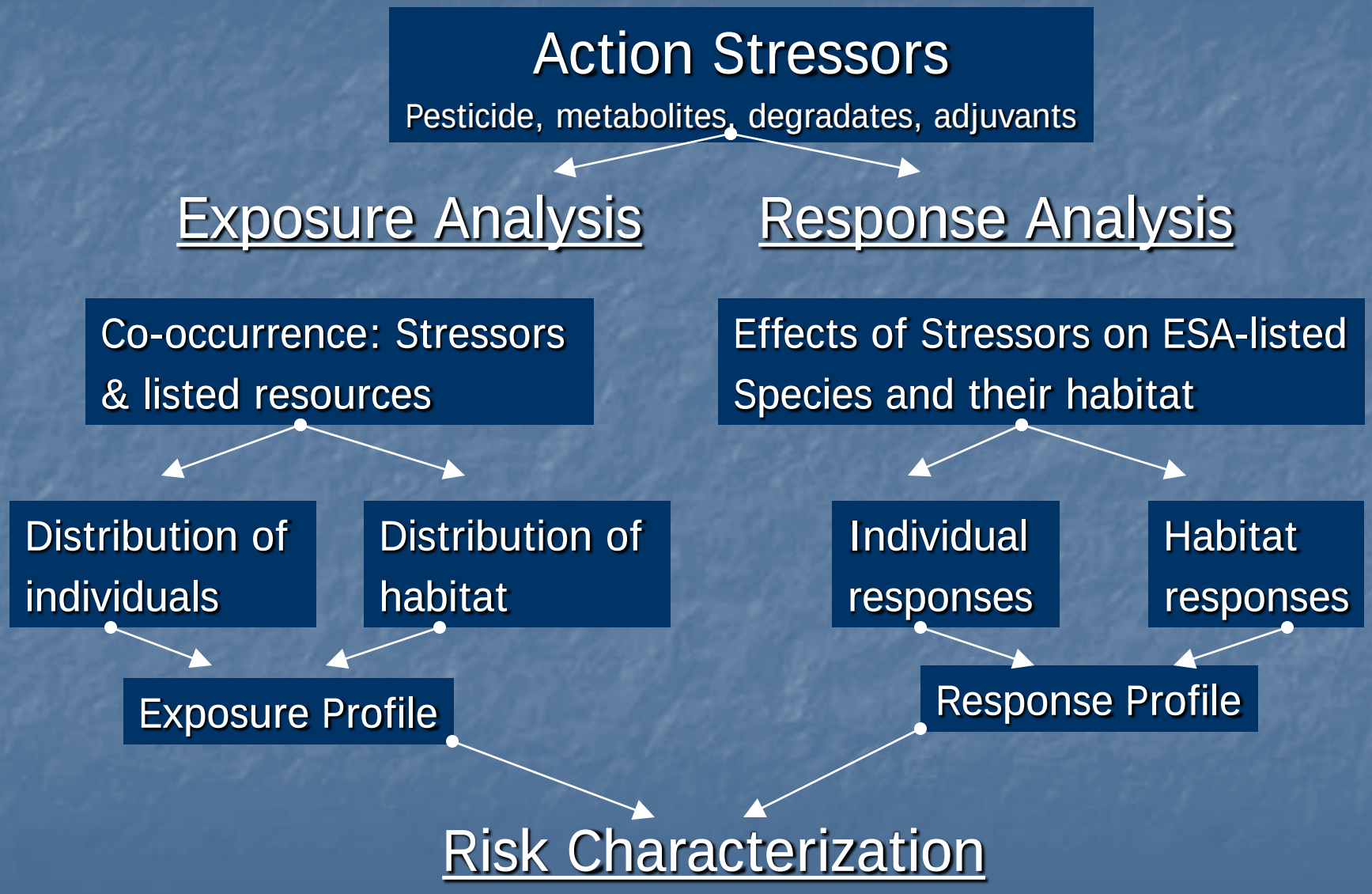
What are some of the existing baseline activities within the action area that influence risk?

- Holding requirements for pesticide-treated water on rice fields
- Buffer requirements to aquatic habitats

How Does NMFS Reach Conclusions in a Biological Opinion?

- Our process is outlined in the USFWS/NMFS Consultation Handbook (1998)
- Major sections of a Biological Opinion:
  - Federal Action / Action Area
  - Status of the Species
  - Environmental Baseline
  - Effects of the Action
  - Cumulative Effects
  - Integration and Synthesis

Risk Framework



Risk Characterization

Effects on individuals

Effects on populations

Effects on species (ESU or DPS)

Does EPA insure the actions are not likely to jeopardize the continued existence of the species?

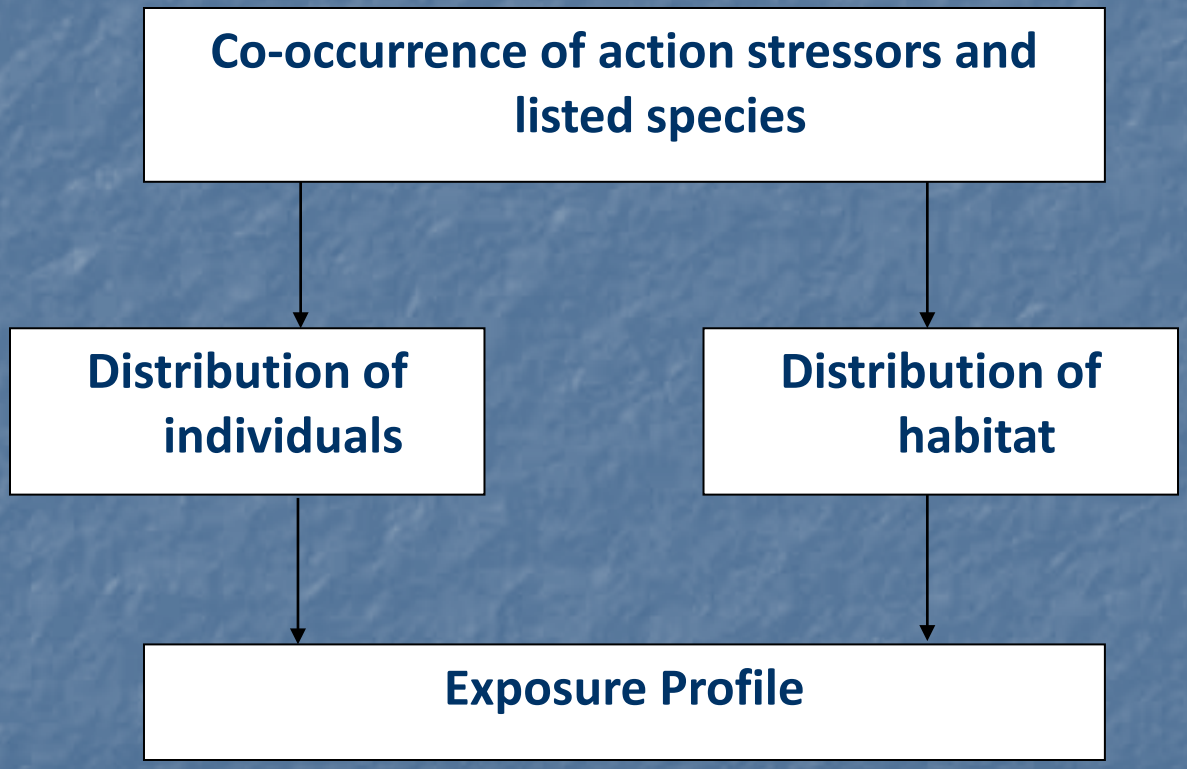
Effects of habitat

Effects on primary constituent elements

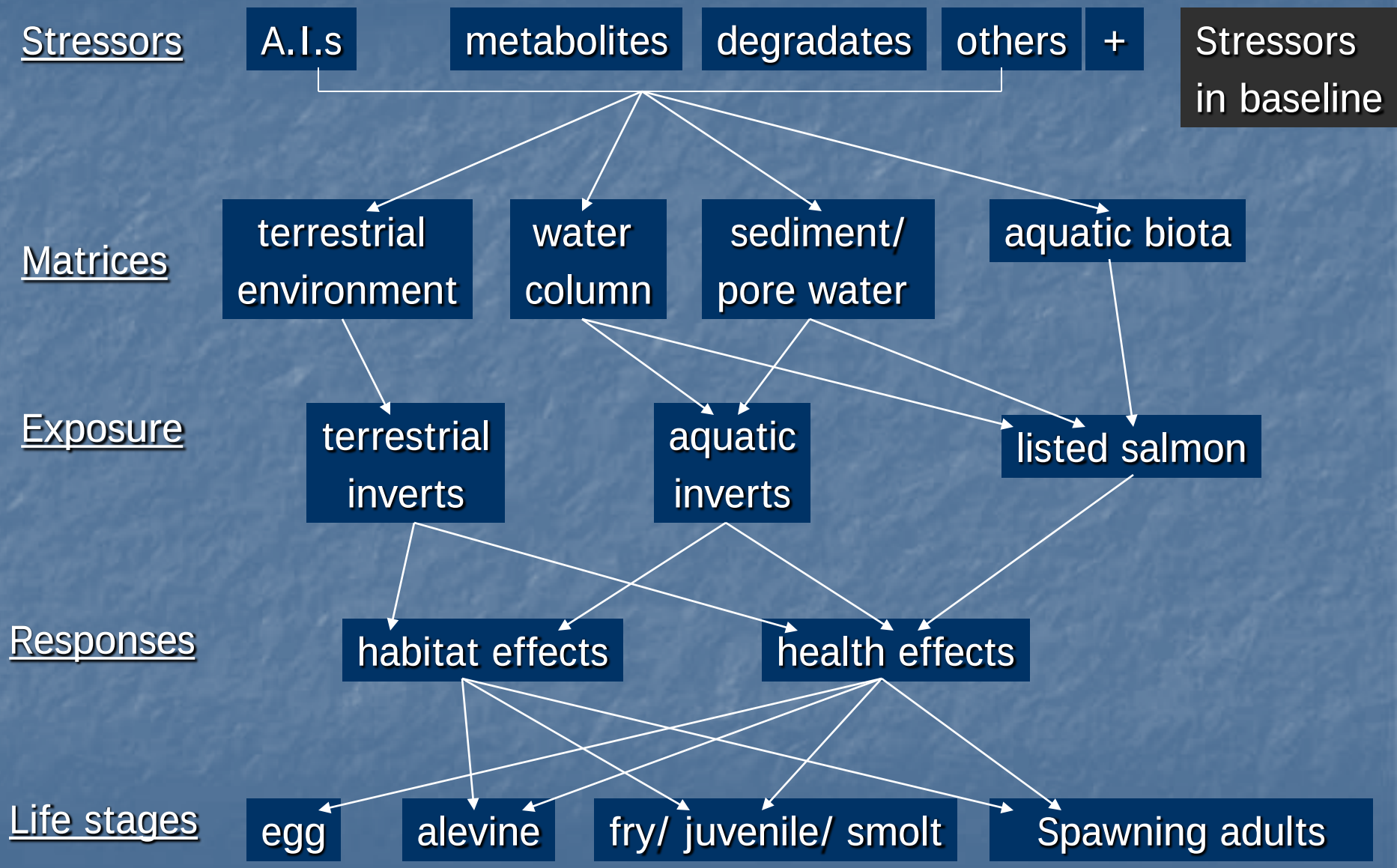
Effects on conservation value of designated critical habitat

Does EPA insure the actions are not likely to adversely modify or destroy designated critical habitat?

Exposure Analysis

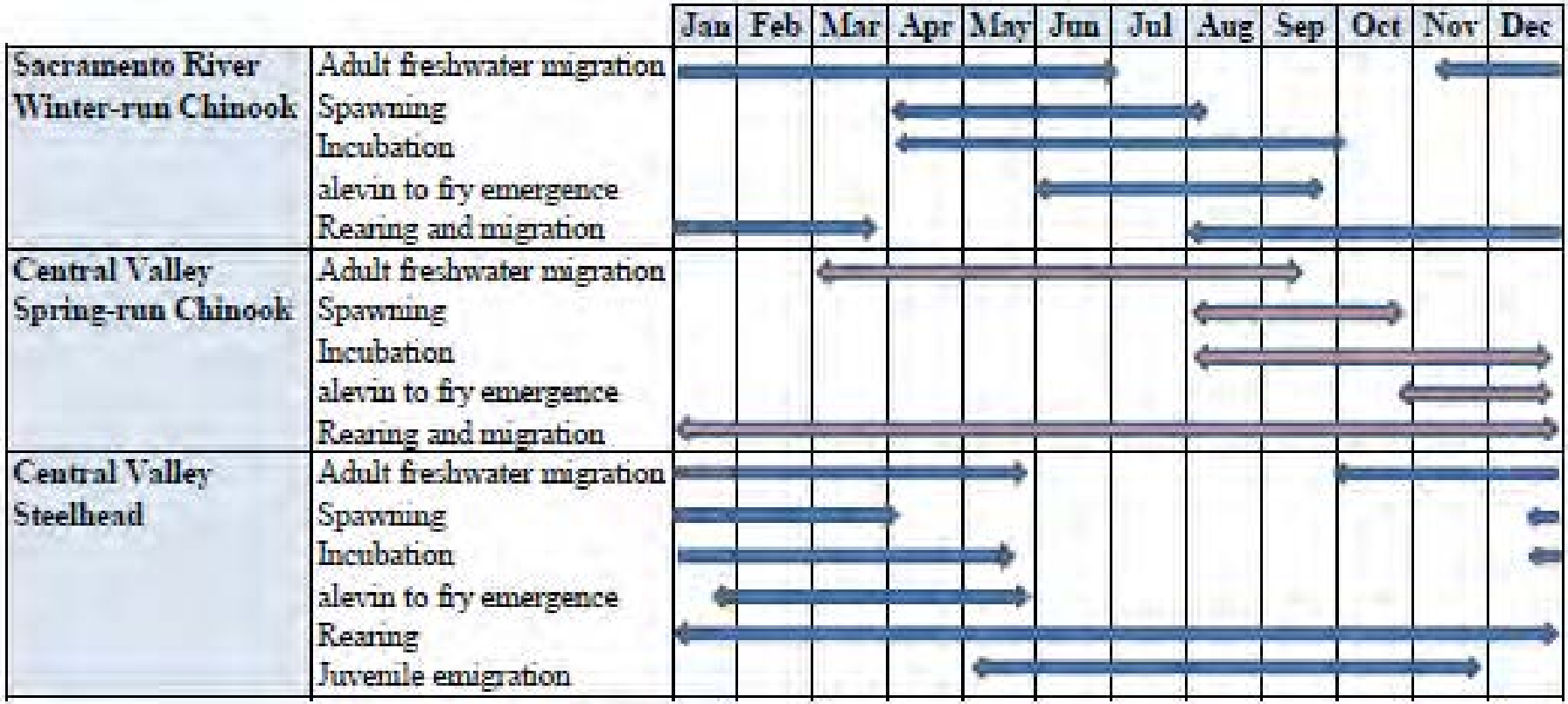


Distribution of Stressors



Central Valley ESA Listed Salmonids

Generalized Run-timing Information by Life Stage

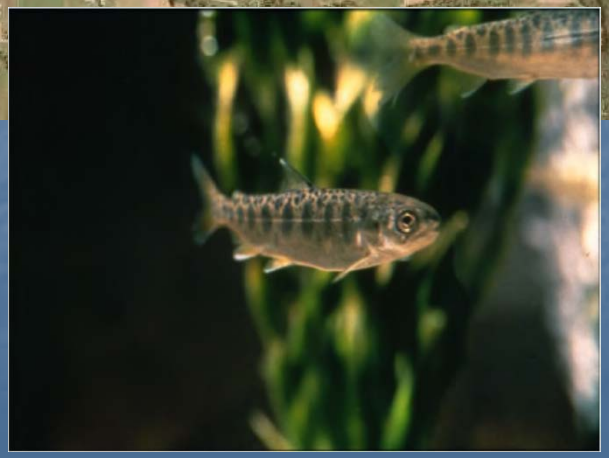


Exposure Information Evaluated

- Pesticide Transport Modeling
  - EPA RICE Model
  - AgDrift Model
- Monitoring data
  - Ambient surface water data
  - Targeted surface water monitoring
- Spatial relationships
  - thiobencarb use sites, surface water monitoring, and the distribution of listed salmonids

Floodplains and Small Streams

- Habitat for rearing, spawning
- Essential habitat for small fry/juveniles to rear and seek protection from high velocity flows
- Spatially and temporally variable in occurrence, flow, and size
- Restoration focus



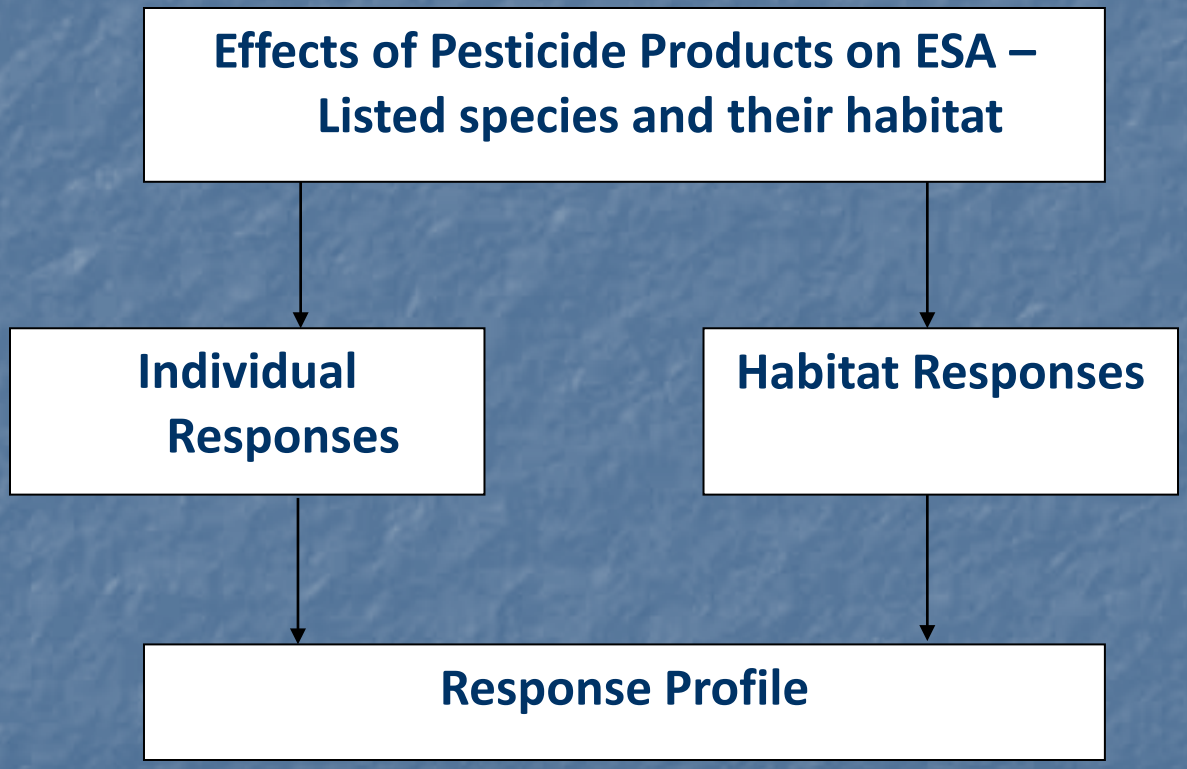
Pesticide Mixtures

- Two or more pesticides are detected in agricultural, urban, and mixed use watersheds more than 90% of the time*
- Monitoring in urban streams across U.S.**
  - Two or more herbicides in 85% samples
  - Two or more insecticides in 54% samples
  - Four or more herbicides were detected in 61% of the water samples.
- CDPR Pesticide Use Reports indicating co-application of thiobencarb with other products

Source:

*Gilliom et al. 2006. Pesticides in the nations streams and groundwater, 1991-2001. NAWQA Program Circular 1291. Unites States Geological Service. **Hoffman et al. 2000. Environmental Toxicology and Chemistry 19:2249-2258.

Response Analysis



Examples of Salmonid Health Assessment Endpoints

Assessment Endpoints	Assessment Measures
Juvenile growth	Foraging behavior Growth rate Condition index
Reproduction	Courtship behavior Number of eggs produced Fertilization success
Early development	Gastrulation Organogenesis Hatching success
Smoltification	ion exchange (*i.e.* gill Na^+/K^+ ATPase activity) Blood hormone (*i.e.* thyroxin) Salinity tolerance
Disease-induced mortality	Immunocompetence Pathogen prevalence in tissues Histopathology
Migration or distribution	Use of juvenile rearing habitats Adult homing behavior Selection of spawning sites

Examples of Habitat Assessment Endpoints

Assessment Endpoints	Assessment Measures
Prey availability	Acute and chronic toxicity (LC_{50}) Species abundance (aquatic and terrestrial) Indices of biological integrity (IBIs)
Primary productivity	Macro-algal cover Chlorophyll concentration Dissolved oxygen production
Habitat structure	Sediment grain size (embeddedness) Shelter availability Large woody debris
Riparian function	Plant community composition Allochthonous inputs of organic matter Riparian buffer width
Water quality	Temperature Dissolved oxygen concentration Sediment load

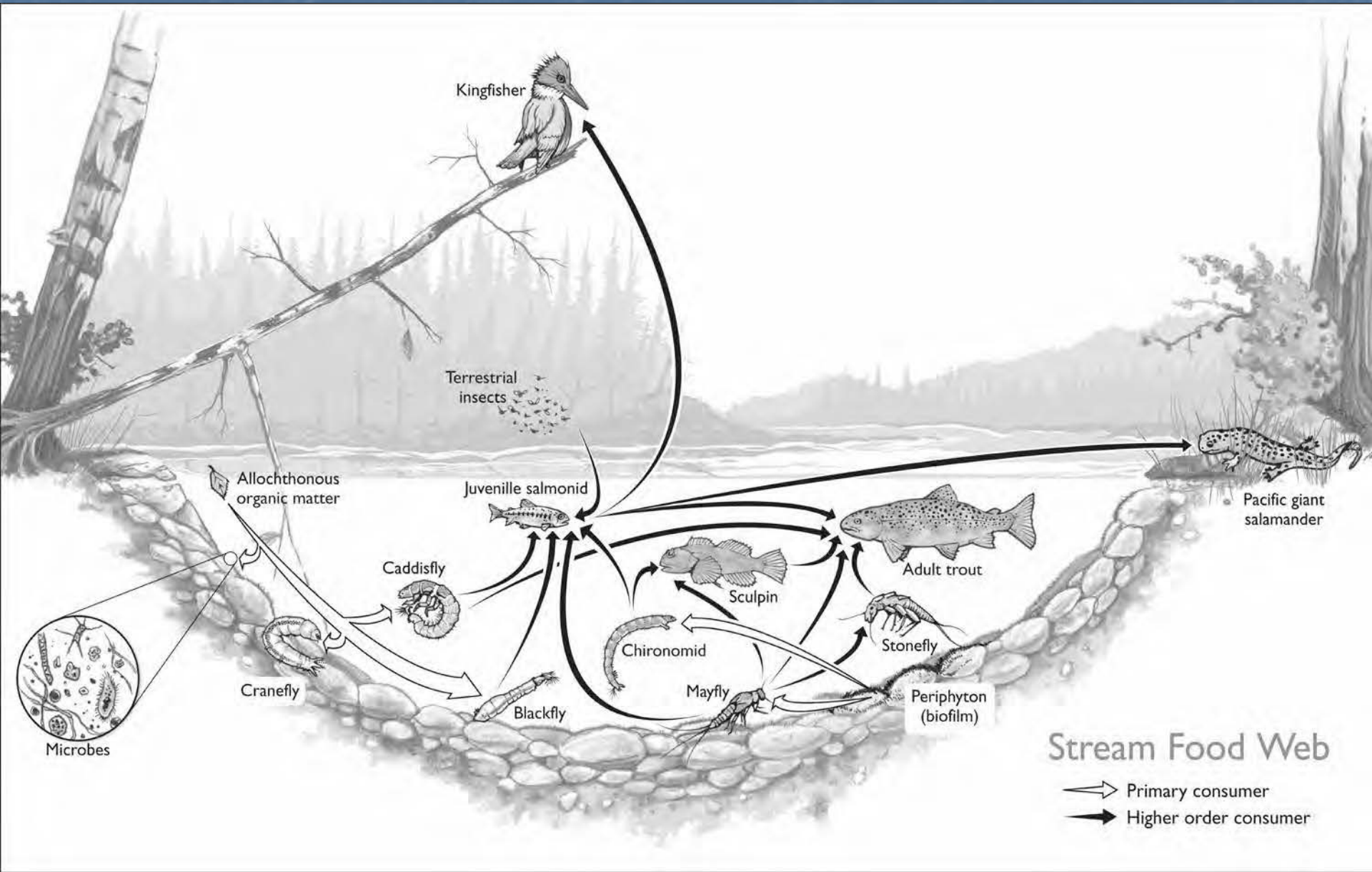
Summarize Effects Data

- Summarize effects data from EPA's biological evaluations and open literature.
- Discuss the relevancy of the effect to our assessment endpoints (growth, survival, etc.)
- Score the degree of confidence we have in the observed effect -
  - Direct measurement of assessment endpoint
  - Appropriate surrogate for listed species
  - Well-conducted study

Develop Risk Hypotheses Based on Toxicity Information

- Salmonid lethality from acute exposure
- Salmonid behavioral impacts (swimming, migration, spawning, predator avoidance)
- Reduction of salmonid prey
- Impacts on salmonid growth and reproduction
- Mixtures cause additive and synergistic responses
- Other action stressors cause adverse effects
- Baseline stressors contribute to increased responses (temperature, other OPs/CBs)

Freshwater rearing of juvenile salmonids



Summary of Assessment Methods

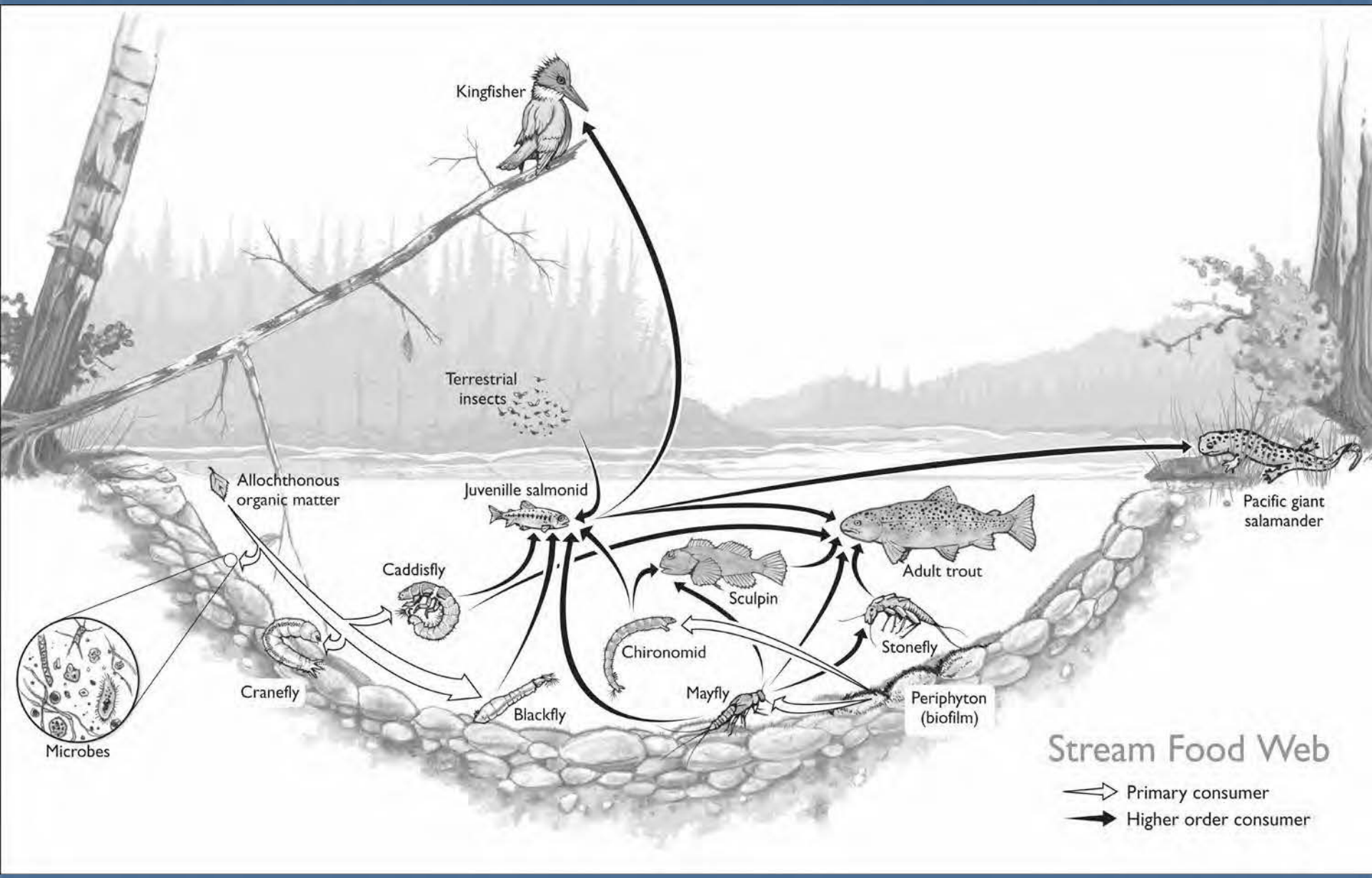
- Identify stressors that may have direct and indirect effects on environment;
- Characterize exposure to individuals and designated critical habitat;
- Identify risk at the individual level;
- Evaluate risk to species and habitat (considering effects of action, condition of environmental baseline, status of the species, and cumulative effects)

Use of California Information

- Surface water monitoring Data
- CDPR Use Reports
  - Acreage treated
  - Formulations used
  - Application rates
  - Tank Mixtures

Information Needs

- CA restrictions for thiobencarb
  - Buffers
  - Holding times
- Rice cultivation practices (e.g. water management, when granular versus liquid formulations used)
- Spatial relationships between use of thiobencarb, monitoring sites, and salmonid-bearing systems


Kingfisher
Terrestrial insects
Allochthonous organic matter
Juvenille salmonid
Pacific giant salamander
Adult trout
Caddisfly
Sculpin
Stonefly
Chironomid
Cranefly
Mayfly
Blackfly
Periphyton (biofilm)
Microbes
Stream Food Web
Primary consumer
Higher order consumer

EXTRA SLIDES

California Central Valley Salmon Species and Population Annual Growth Rates

ESU	Population	λ - H=0	95% CI -lower	95% CI - upper
Central Valley Spring-run Chinook	Butte Creek	1.300	1.060	1.600
	Deer Creek	1.170	1.040	1.350
	Mill Creek	1.190	1.000	1.470
Sacramento River Winter-run Chinook	Sacramento River	0.970	0.870	1.090
California Central Valley Steelhead	Sacramento River	0.950	0.900	1.020

Handling Uncertainty

Type 1 Error	Type 2 Error
Reject true null hypothesis - Claim an effect when none exists	Accept false null hypothesis- Claim no effect when one exists
Protect Species more than necessary	Protect species less than necessary, even lose species
Lose scientific credibility	Lose practical and scientific credibility
Increase socioeconomic costs more than necessary	Permit activities that should not have been approved

Table adapted from: Science and the Endangered Species Act. Committee on Scientific Issues in the Endangered Species Act. National Research Council. 1995.

EPA RICE Model

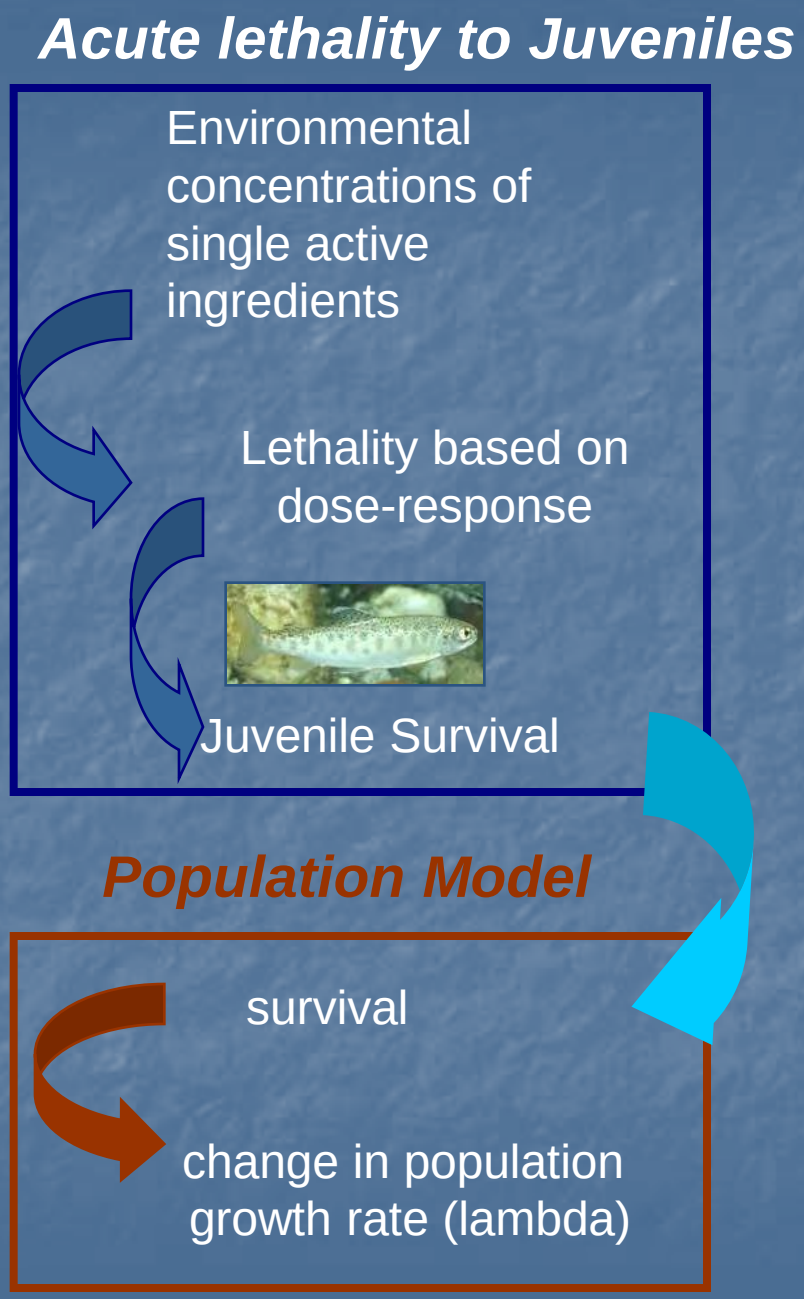
- 0.1 meter deep
- Instantaneous partitioning assumed to calculate peak concentration
- 1st order degradation assumed to calculate concentrations at different dates post-application
- Label require 14-d holding period
- Additional requirements in CA

Linking the available Information:

- Acute lethality (LC50)
- Slope
- Juvenile survival
- Population growth rate

Not Incorporated:

- Sublethal responses
- Indirect effects
- Mixture toxicity
- Other ingredients
- Baseline stressors



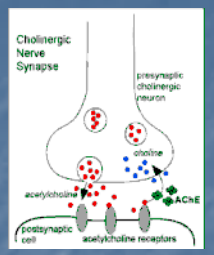
Linking the available Information:

- Reduced prey
- Enzymatic inhibition
- Reduced foraging
- Reduced size
- Juvenile survival
- Population growth rate

Not incorporated:

- Lethality to fish
- Mixture toxicity
- Other ingredients
- Baseline stressors

Somatic Growth Model



Inhibition of Acetyl-cholinesterase

Reduced ration

growth

Population Model

survival

change in population growth rate (lambda)

Slide: D. Baldwin

Integration and Synthesis

- Considers *Effect of the Action* in the context of *Status of the Species*, *Environmental Baseline*, and *Cumulative Effects*
- Each ESU/DPS and a.i. combination evaluated separately for species and critical habitat
- Factors considered
  - Intensity and distribution of use sites across ESU/DPS
  - Co-occurrence of use sites and salmon habitat
  - Salmon life history
  - Likelihood of individual and population level effects from use of pesticides
  - Exposure to additional stressors not related to action
  - Population trends and relative importance of populations within ESUs/DPSs

Endangered Species Act definitions

ESA Consultation Handbook

- Not likely to adversely affect (NLAA) – effects on listed species are expected to be *discountable*, or *insignificant*, or *completely beneficial*.
- Discountable – Extremely unlikely to occur… can't measure or detect
- Insignificant – should never reach the scale where *take* occurs.

Endangered Species Act definitions

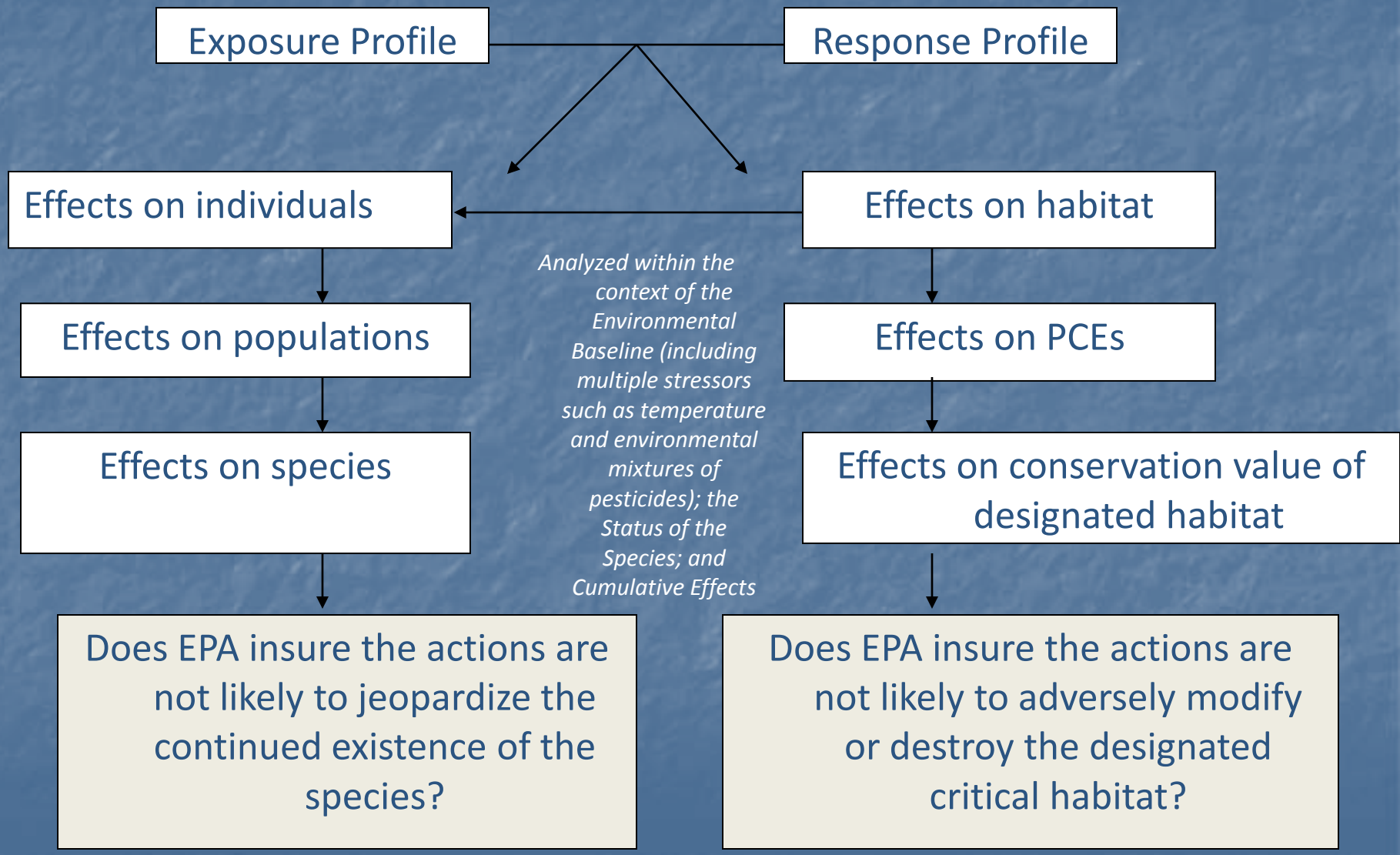
ESA Consultation Handbook

- Take- "to *harass*, *harm*, pursue..."
- Harm – "any significant habitat modification or degradation that results in death or injury... significantly impairing behavioral patterns such as breeding, feeding, or sheltering"
- Harass – "...to significantly disrupt normal behavior patterns which include but are not limited to, breeding, feeding or sheltering"

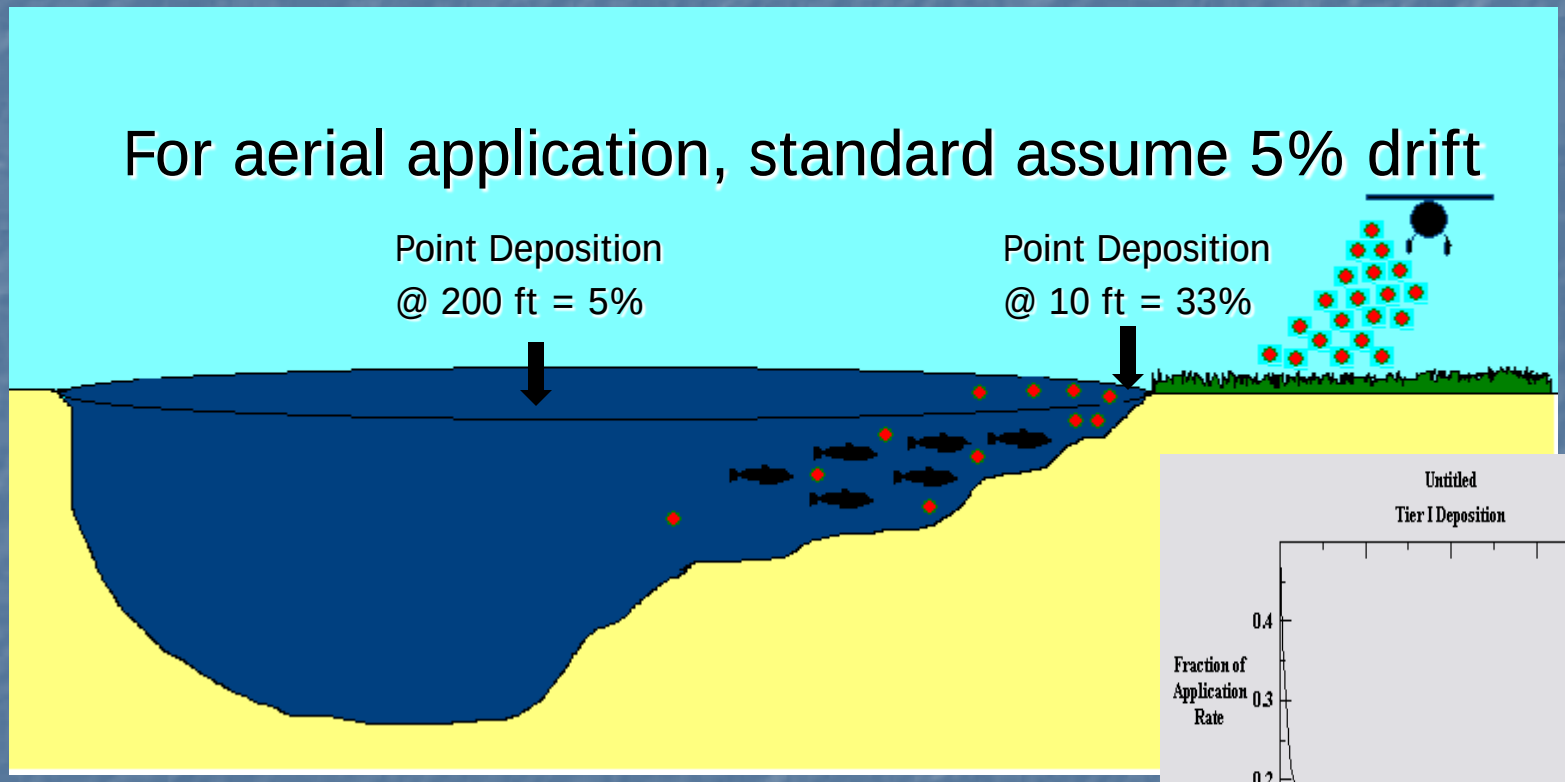
Developed Critical Habitat Risk Hypotheses to Evaluate Effects to Primary Constituent Elements (PCEs)

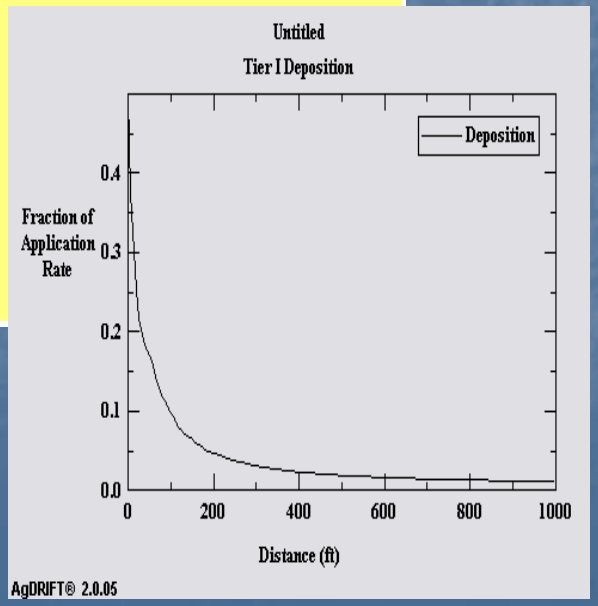
- PCEs
  - Freshwater spawning sites
  - Freshwater rearing sites
  - Freshwater migration corridors
  - Estuarine and nearshore marine
- Attributes of PCEs
  - Water quality
  - Substrate
  - Natural cover
  - Prey availability

Integration and Synthesis



Distribution of Chemicals and Fish





Evaluate Support for Each Risk Hypothesis

- If exposure and response information support a risk hypothesis then we evaluate if population level effects likely.
- If exposure and response information do not support a risk hypothesis then we do not evaluate population level effects.
- Data uncertainties discussed for each risk hypothesis.