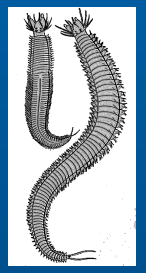
California Sediment Quality Objectives For Human Health

Ben Greenfield, Aroon Melwani
San Francisco Estuary Institute

Steve Bay
Southern California Coastal Water Research Project

California Sediment Quality Objectives

- State Water Board mandated to develop Sediment Quality Objectives for enclosed bays and estuaries
  - Narrative Objectives supported by indicators and thresholds
- Science team provides technical guidance on approaches
  - Direct effects to aquatic life: benthic community
    - Steve Bay – This session 5:00 PM
  - Indirect effects to humans
    - Aroon Melwani – This session 3:10 PM



Sediment Quality Objective for Human Health – What will it be used for?

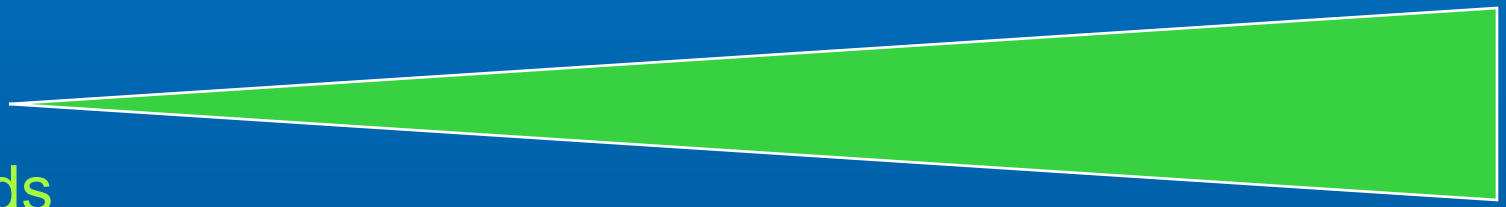
- Does a site meet narrative objective?
  - "Pollutants shall not be present in sediments at levels that will bioaccumulate in aquatic life to levels that are harmful to human health"
- Legal policy that may be used for multiple purposes
  - Identify impaired water bodies
  - Determine compliance with permit conditions
  - Prioritize sites for management actions
- Should be
  - Scalable to user and program needs
  - Consistent and standardized

Environmental decision making – Is more complex better?

-Generic
-Simple

-Site specific data
-Complex

Realism
Effort/$$
Data needs



Thresholds

Risk assessments

Tiered Approaches

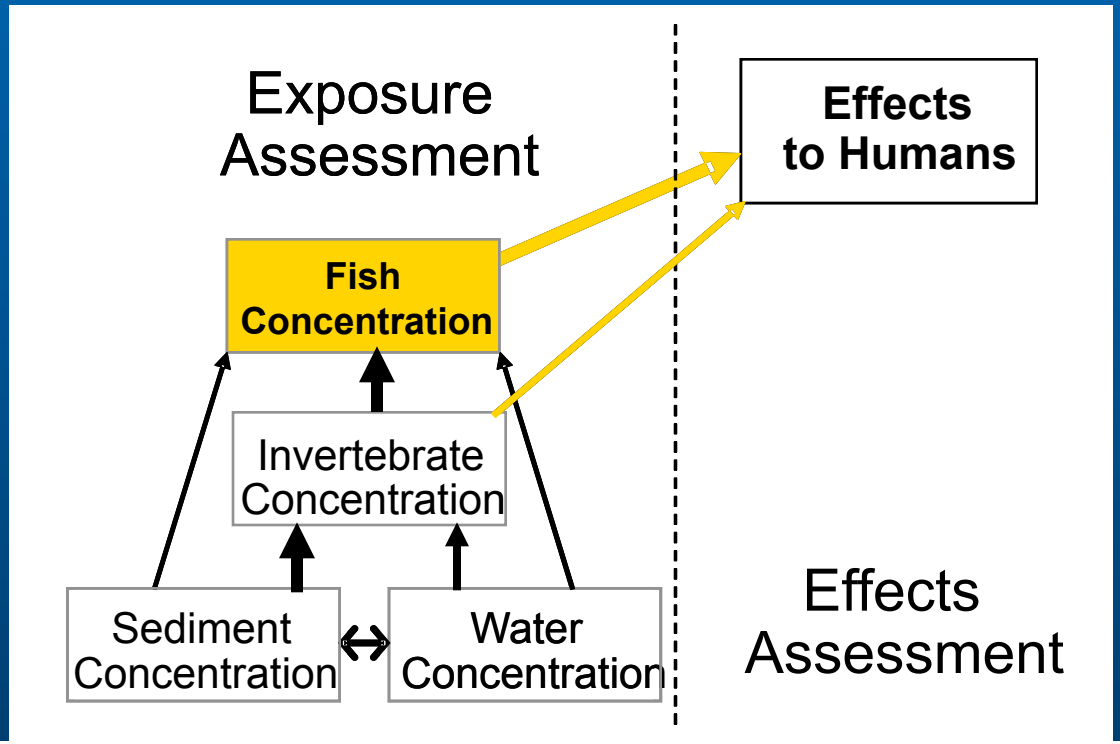
Dredged Materials Testing
Tiered Risk Assessments

Key Assessment Framework Elements

- Conducted at the site scale
  - An area characterized by multiple sampling locations
- Two indicators address two assessment questions
- Tiered framework used to guide assessment
  - Scalable degree of complexity
  - Moves from a hazard assessment towards a risk assessment
- Outcome - five categories of impact
- Tools applicable to PCBs and chlorinated pesticides

Two assessment questions

1. Do pollutant concentrations in seafood (fish and shellfish) pose unacceptable health risks to human consumers? (seafood consumption risk)
2. Is sediment contamination at a site a significant contributor to the seafood contamination? (sediment contribution)



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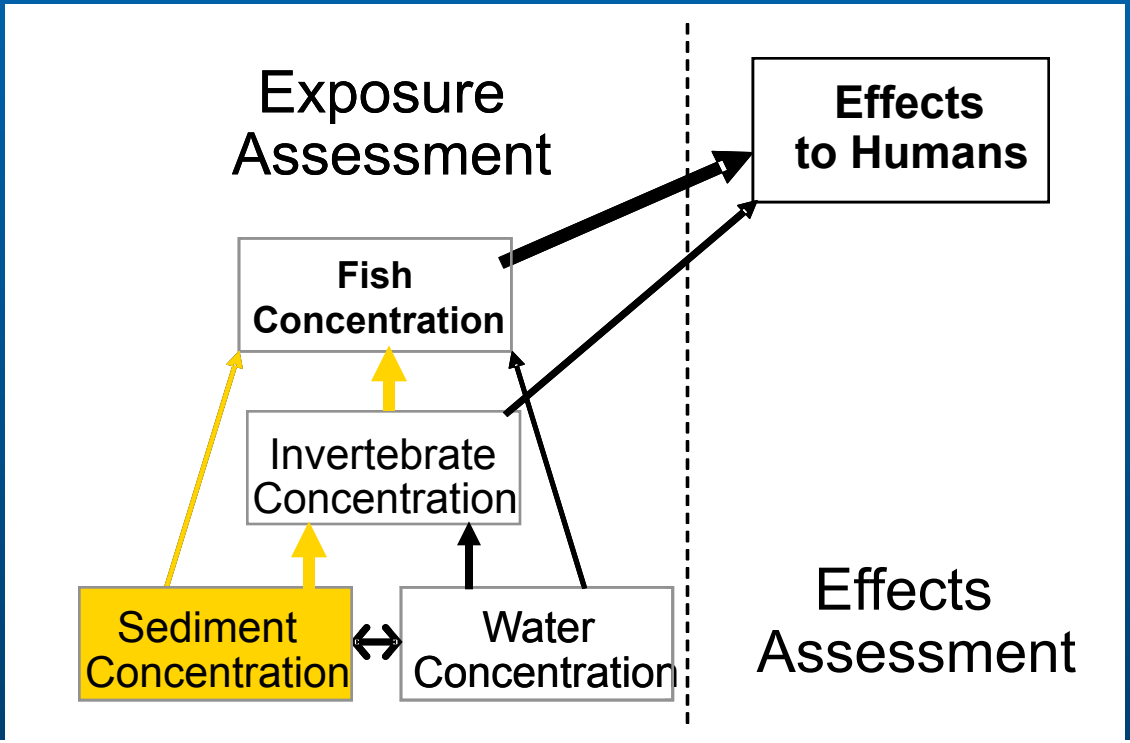
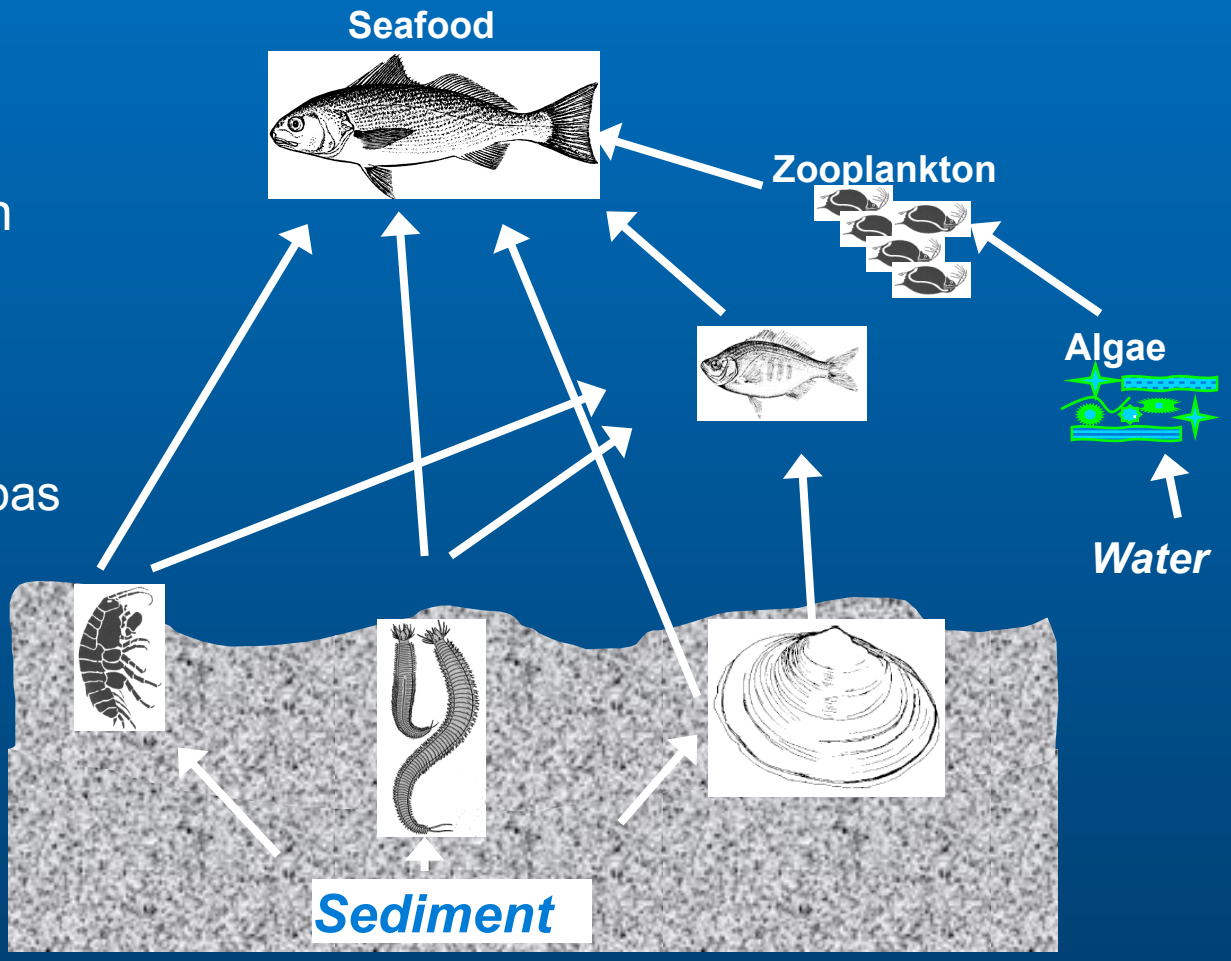


Consumption Risk

- Collection and analysis of seafood from site
- Cancer risk and noncancer hazard calculated using standard equations
- Integrates all sources and factors affecting bioaccumulation at the site

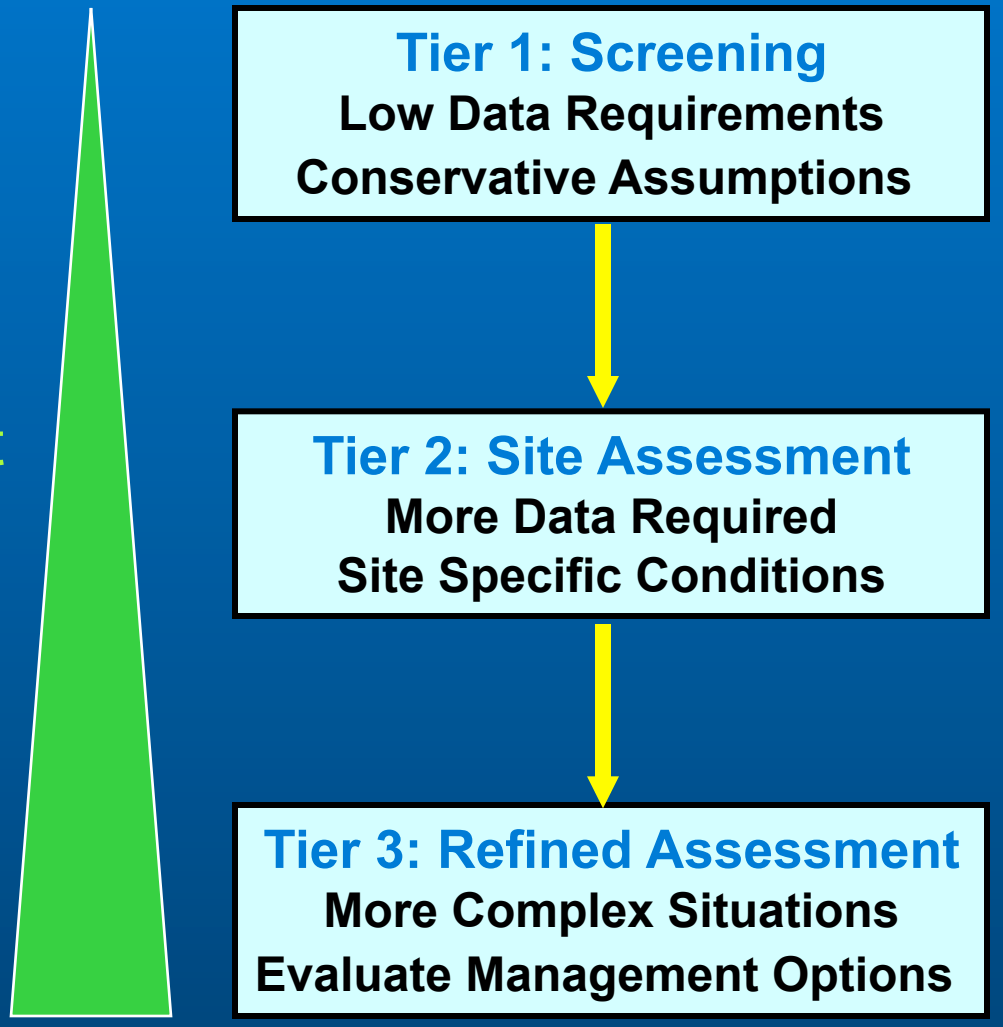
Sediment Contribution

- Analyze site sediments
- Estimate contribution of site sediment to measured tissue contamination
- Uses bioaccumulation models and assumptions – calculating food web uptake
  - Uses Arnot and Gobas model



Tiered Assessment Framework

- Three tiers
  - Data requirements and complexity relate to situation
  - Reduced effort/cost for sites of low concern



What is Tier I?

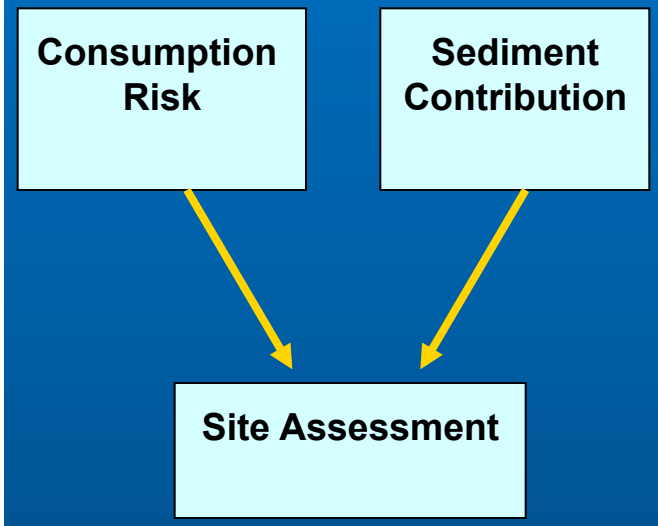
- Purpose: Optional screening step to benefit the user
- Evaluate either tissue or sediment data (or both if available)
- Conservative assumptions
- Use of single thresholds
- Can pass or move to next Tier
- Efficiently identify sites clearly of low concern
  - Reduce evaluation costs for clean sites

Tier I

What is Tier II?

- Purpose: Site assessment to determine if SQO met
  - Increased site specificity and accuracy of assessment relative to Tier I (increased data requirements)
  - Incorporates aspects of uncertainty and variability
- Process: Evaluate both tissue and sediment data
  1. Calculate seafood consumption risk category using site tissue data
  2. Calculate sediment contribution category using site sediment data
  3. Compare risk and contribution indicators to determine site assessment category
  4. Probabilistic methods for uncertainty and variability

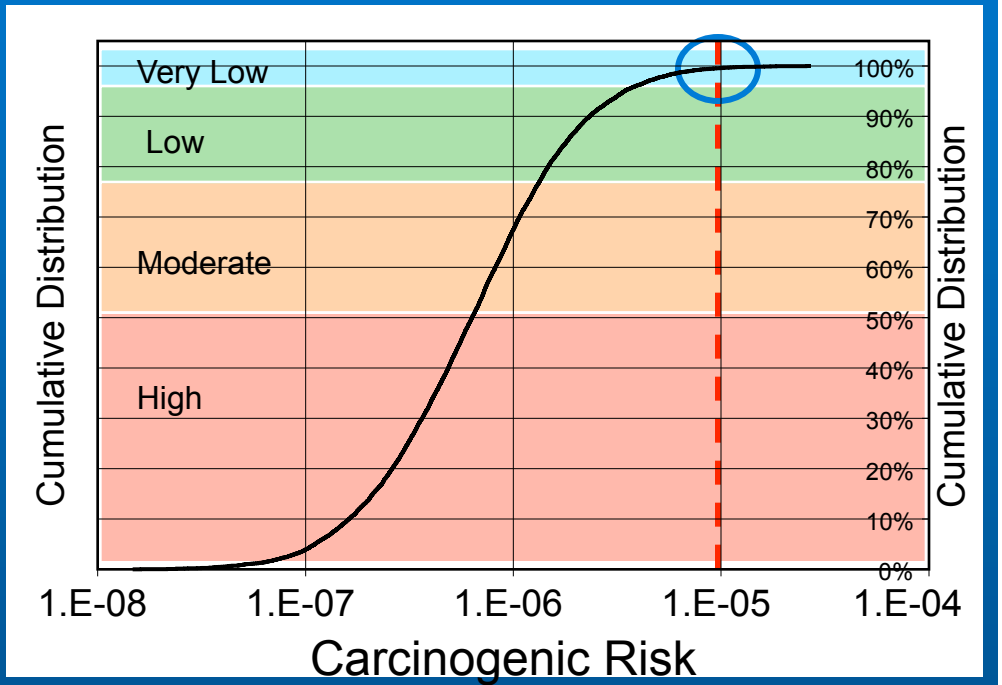
Tier II



Consumption Risk	Sediment Contribution	Site Assessment
1. Very Low	1. Very Low	1
1. Very Low	2. Low	1
1. Very Low	3. Moderate	1
1. Very Low	4. High	1
2. Low	1. Very Low	1
2. Low	2. Low	1
2. Low	3. Moderate	2
2. Low	4. High	2
3. Moderate	1. Very Low	2
3. Moderate	2. Low	3
3. Moderate	3. Moderate	4
3. Moderate	4. High	5
4. High	1. Very Low	2
4. High	2. Low	3
4. High	3. Moderate	4
4. High	4. High	5

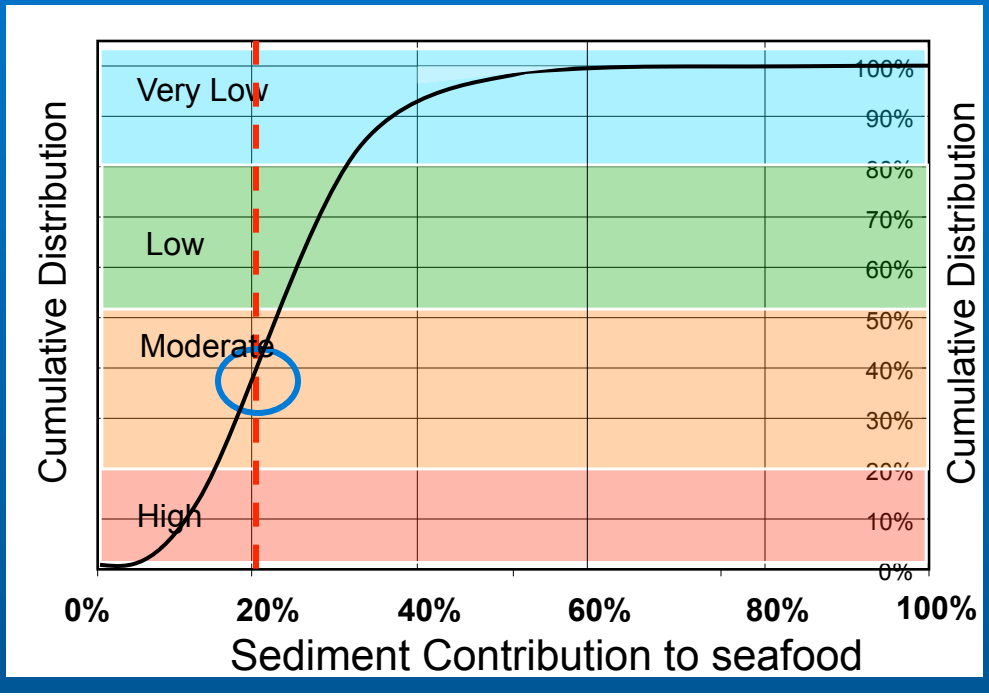
Tier II Cumulative Distribution of Risk

- **Consumption risk indicator expressed as degree of risk to human health**
  - **Cancer risk probability**
  - **Noncancer hazard quotient**
- **Multiple categories**
  - **Categories provide mechanism to communicate results**



Consumer Group	Cumulative % of risk or hazard distribution	Carcinogenic Risk			Noncancer Hazard	
		Threshold	Outcome		Threshold	Outcome
Virtually All	96-100%	10^{-5}	1. Very Low		1	1. Very Low
Most Consumers	76-95%	10^{-5}	2. Low		1	2. Low
Upper End Consumer	51-75%%	10^{-5}	3. Moderate		1	3. Moderate
Average Consumer	0-50%	10^{-5}	4. High		1	4. High

Tier II Cumulative Distribution of Sediment Contribution



Sediment contribution	Cumulative % below threshold	Contribution threshold	Outcome
Mostly below threshold	80-100%	20%	1. Very Low
Median below	50-80%	20%	2. Low
Median above	20-50%	20%	3. Moderate
Mostly above	<20%	20%	4. High

Example Results: Integration and Assessment

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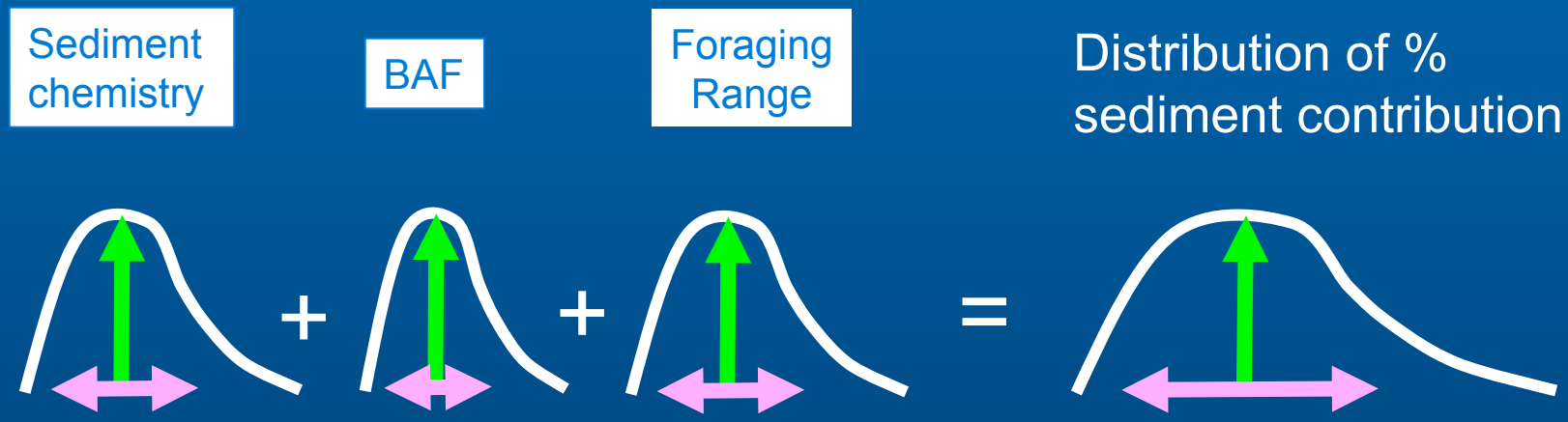
What is Tier III?

- Optional additional data collection and modeling
- Approach not prescribed
- Can move towards assessment of management actions
- Reaching risk assessment paradigm

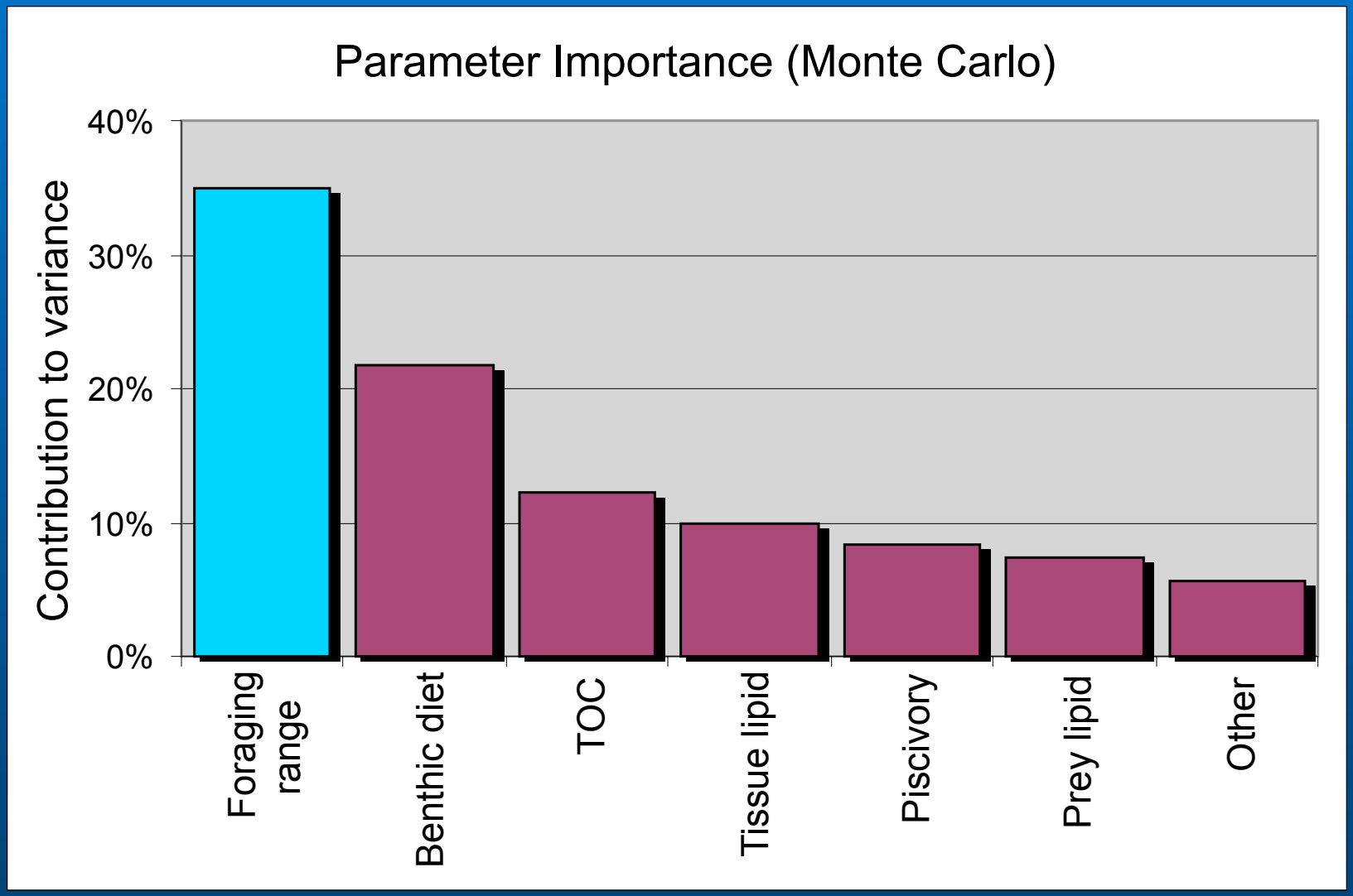
Technical methods

How are Tier II distributions generated?

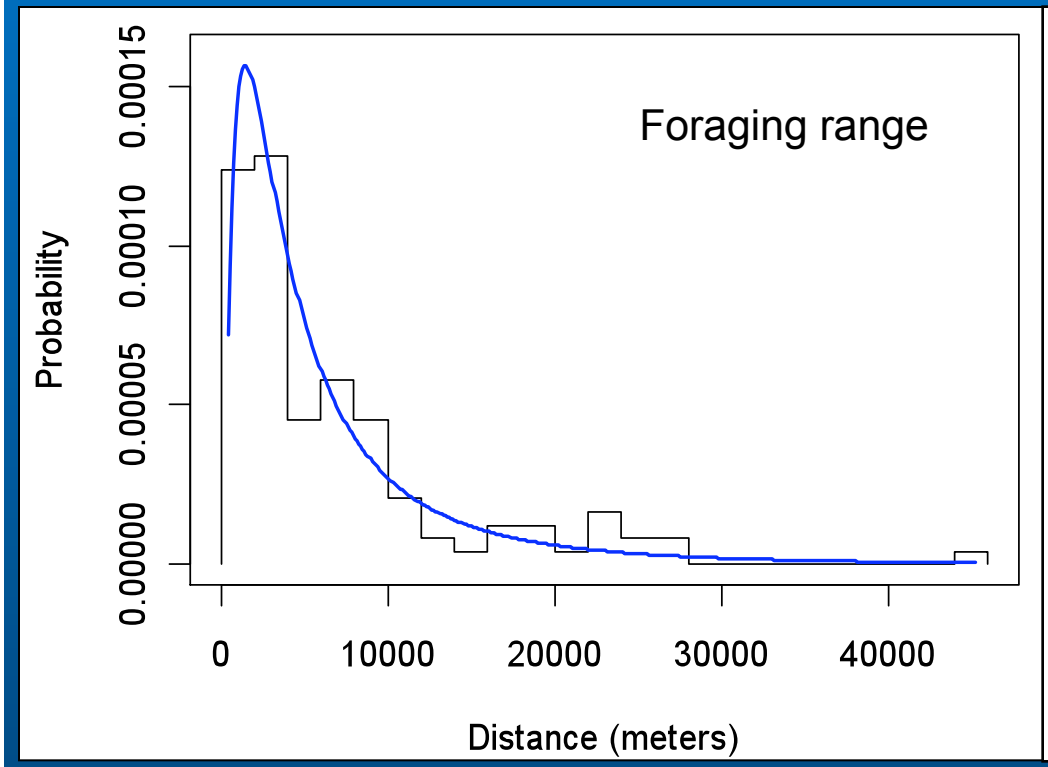
- **Monte Carlo simulations using uncertainty of influential parameters**

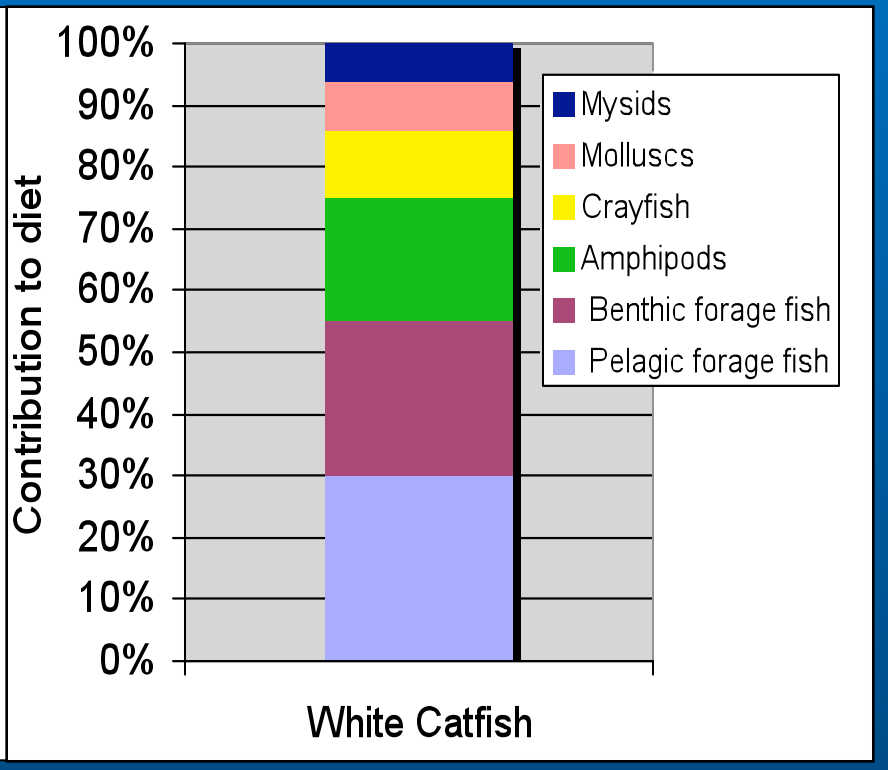


Influential parameters identified using sensitivity analysis



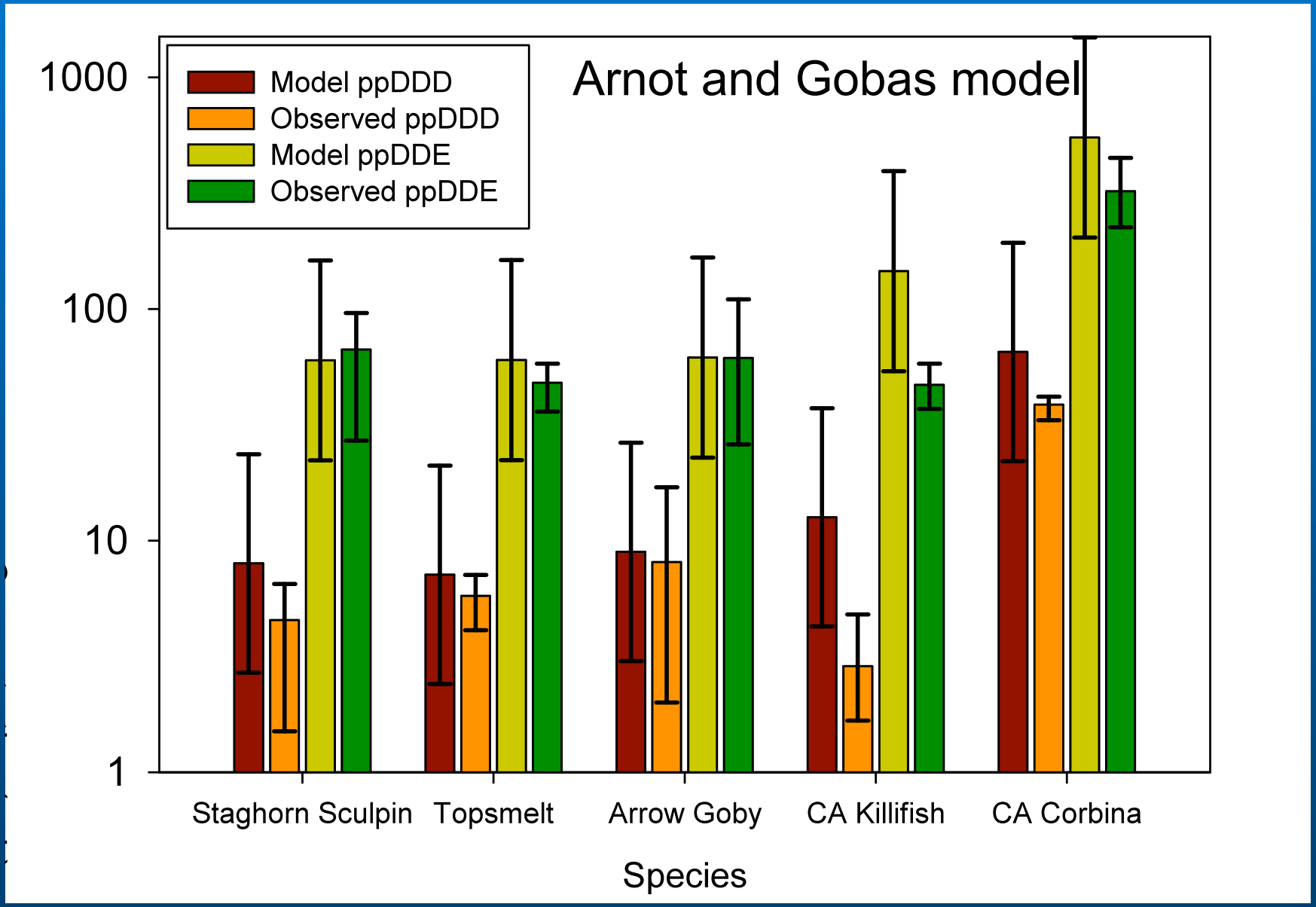
Statewide estimates for influential parameters





- Provided for indicator fish species for dietary guilds
- Option to use local information

Sediment contribution calculated using validated bioaccumulation model



Summary

- Statewide assessment program
  - Human health (this talk, Aroon Melwani)
  - Direct effects to benthic communities (Steve Bay)
- Seafood measurements – consumption risk
- Sediment measurements – sediment contribution
- Tiered approach – scalable complexity
  - Tiers II and III generating cumulative distribution
  - Tier II focus on most influential parameter measurements

Further information and reports

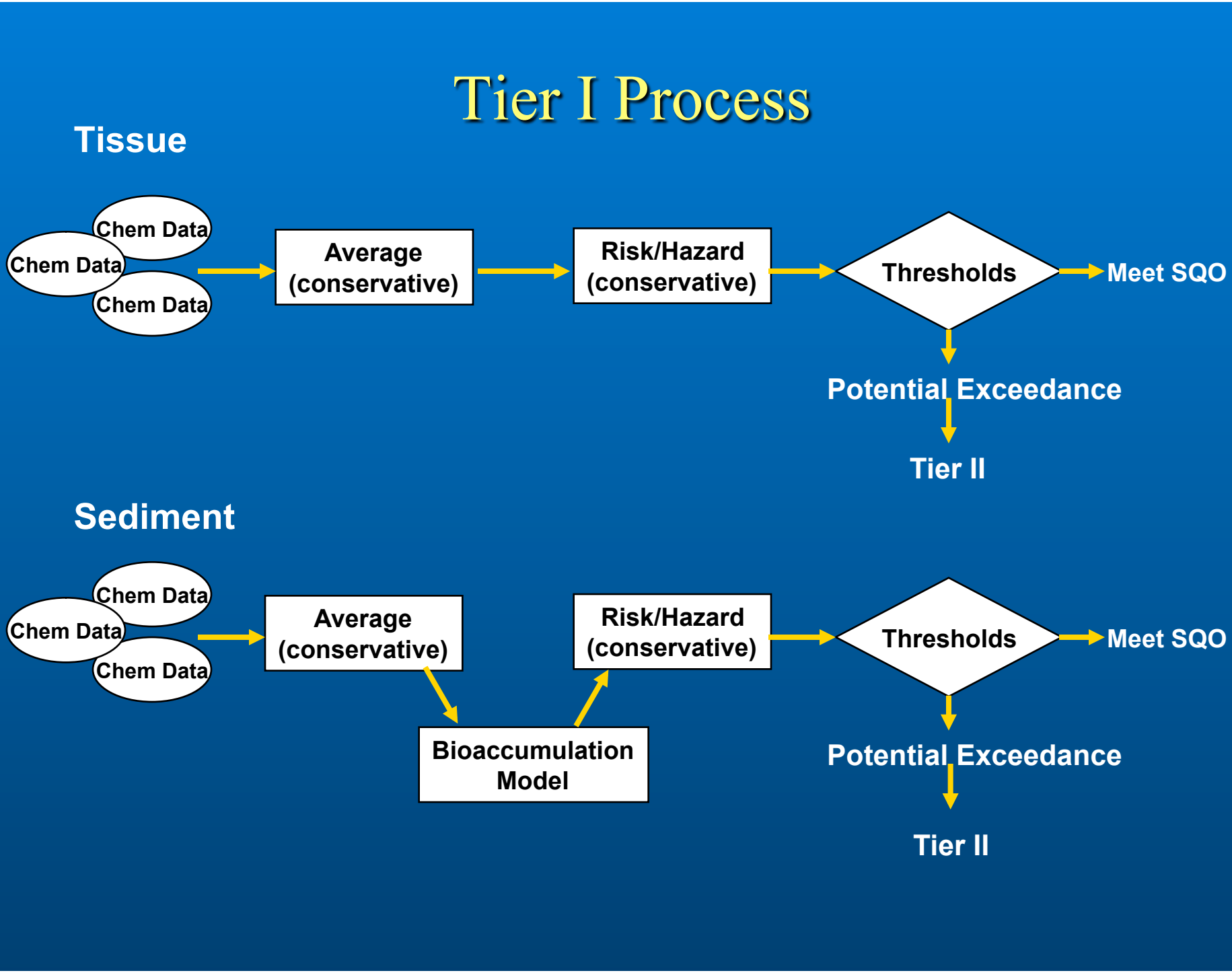
- **Other talks this session:**
  - Estimating biota exposure range for calculation of bioaccumulation parameters. ***3:10 PM***
  - Progress in improving the scientific foundation for sediment quality assessment and management. ***5:00 PM***
- Ben Greenfield – **ben@sfei.org**
- Steve Bay **steveb@sccwrp.org**

END OF TALK

Current Practices for Human Health Assessment in CA

- No standardized assessment approach
  - Agency developed fish consumption advisories
  - Site specific risk assessments
  - 303d listing/TMDL Evaluations – practices vary by region
- Sediment contribution to risk not always considered
  - Inconsistent technical methods for assessment of sediment contribution
- Opportunity to improve quality of future assessments
  - Greater transparency and consistency
  - Improved linkage with sediment
  - Best scientific tools

Tier I Process



Tier II