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Central Valley
Regional Water Quality Control Board

Water Quality Criteria Method Development

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Previous Regional Board Efforts

- Diazinon/chlorpyrifos had been identified as significant water quality problems
- Basin Plan Amendments adopted for:
  - Sacramento/Feather Rivers (Revision Pending)
  - Sacramento urban creeks
  - San Joaquin River
  - Delta

Past Public Comments

- Potential impacts of alternative pesticides should be evaluated
- Additive or synergistic impacts should be considered
- Numeric water quality objectives should be established
- Consider alternatives to US EPA's method for deriving water quality criteria

Supports Basin Planning Effort

- Technical Reports in Development
  - Water Quality Risk Evaluation of Pesticides based on extent of use and toxicity
  - Aquatic Life Beneficial Use Evaluation
  - Water Quality Criteria derivation
- Basin Plan Amendment to
  - Address >500 natural waterways in Sacramento and San Joaquin River watersheds
  - Establish water quality objectives/TMDLs for 3-5 pesticides

Potential Uses of Criteria

- Establishment of Water Quality Objectives
- Interpretation of Narrative Objective
  - 303(d) List
  - NPDES & Irrigated Lands Waiver Programs
- DPR during registration / re-evaluation?

Background

- Past water quality criteria have been based on the 1985 EPA Guideline for Derivation of Numeric Water Quality Criteria
- Current EPA Method has been used successfully for many years
- Newer methods have become available and merit review
- Regional Board is looking for a method that can handle limited data sets

Research Study Overview

- Researchers from UC Davis are under contract to assist with the review of Water Quality Objectives
- Purpose: Identify/develop a method(s) for deriving numerical water quality criteria that are protective of aquatic life and could be used as the basis for pesticide water quality objectives in the Central Valley

Research Study Objectives

- Ensure that criteria are scientifically defensible
- Incorporate current scientific thinking
- Include methodology for establishing numeric criteria for pesticides w/varying toxicity data sets
- Provide for comprehensive review of multiple pesticides
  - Diazinon and chlorpyrifos to begin with
  - At least 3 additional pesticides this year
  - Possibly additional pesticides next year

Disclaimer

- Project Researcher recently left UC Davis to work with US EPA
- A new researcher has been tentatively identified but has not yet begun to work on the project
- During the transition, Central Valley Water Board Staff will present the method.
- Please bear with us, we’re learning this too.

Summary of Method Elements

- Guidance on collection and evaluation of raw data
- Alternatives for various sizes of datasets
- Ability to address acute and chronic exposures
- Ability to adjust criteria based on environmental factors

Collection of Raw Data

- Requires Data includes Physical-Chemical, Ecotoxicity, Human Health data
- Includes a table of recommended print and electronic data sources
- Provides means to fill chronic data gaps with estimation techniques
- Provides guidance on how to consider nontraditional endpoints and data from multi-species studies

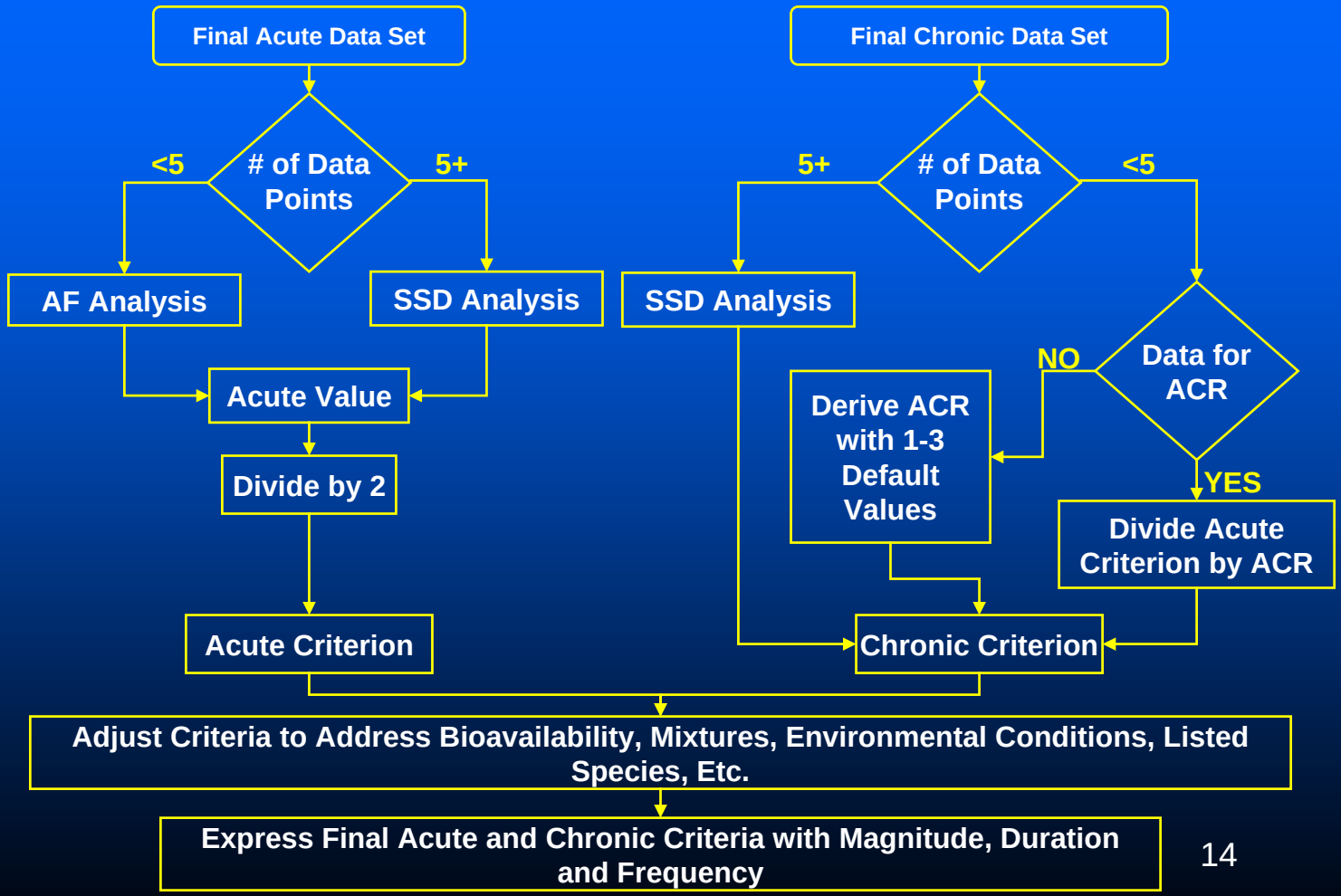
Evaluation of Data

- Only toxicity studies with acceptable relevance and reliability scores can be used
  - Relevance – The extent to which a test is appropriate for a particular hazard
  - Reliability – inherent quality of a test relating to test methodology and the way that the performance and results of the test are described.

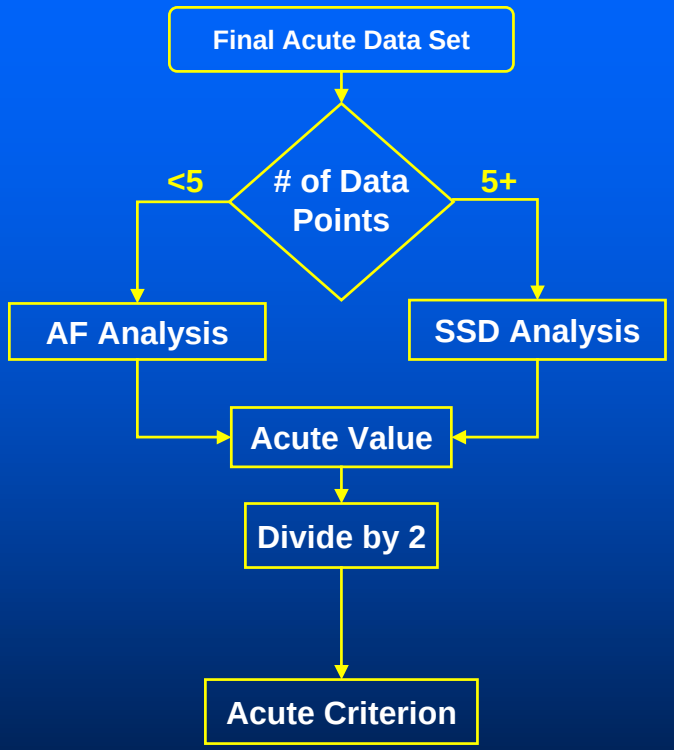
Data Reduction

- Data are reduced such that each species has one representative data point in the final data set.
  - SMAV – Species (geometric) Mean Acute Value – Based on LC_{50}
  - SMCV – Species (geometric) Mean Chronic Value – Based on Maximum Allowable Toxicant Concentration (MATC)
  - Use most sensitive life stage and endpoint for each species
  - Additional directions for more nuanced data issues
- Final data set is collection of SMAV/SMCV

Criteria Derivation Flow Chart



Criteria Derivation Flow Chart



Size of Final Data Set

- To use the Species Sensitivity Distribution procedure (SSD), the final data sets must include at least 5 SMAV with representatives of all of the following:
  - The family Salmonidae
  - A warm water fish
  - A planktonic crustacean, of which must be in family Daphniida in the genus *Ceriodaphnia*, *Daphnia*, or *Simpocephalus*
  - A Benthic Crustacean
  - An insect (for non-herbicide), or alga or vascular plant (for herbicides)
- Assessment Factor Method is used for other datasets

SSD Analysis

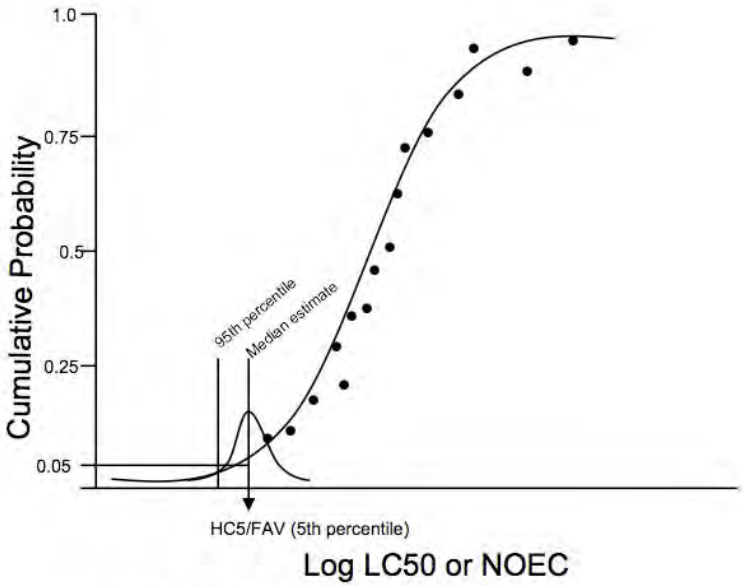


Figure 1. Generic illustration of SSD technique

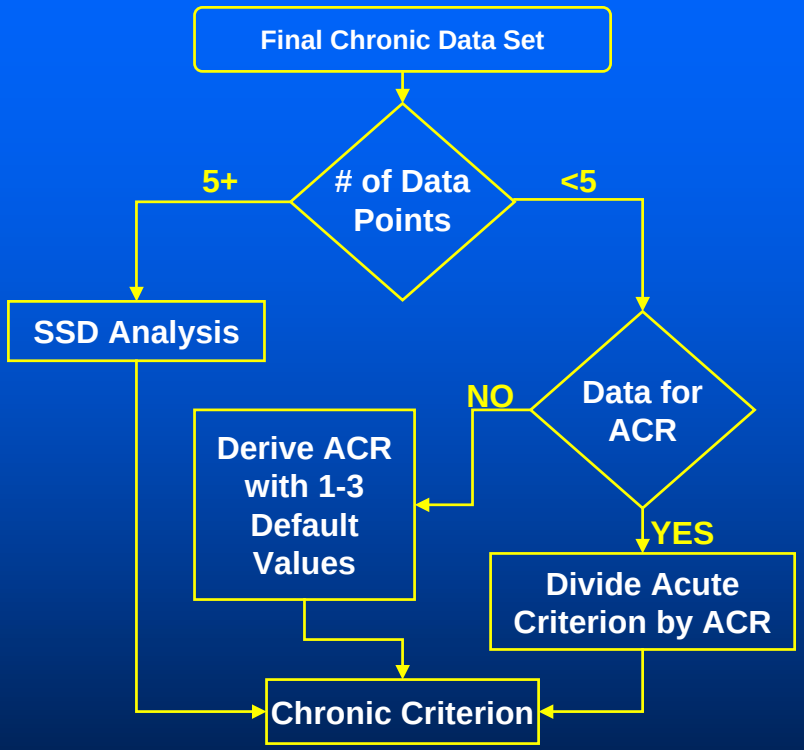
Source: Tenbrook & Tjeerdema 2006

Assessment Factors

$$\text{Acute Value} = \frac{\text{Lowest Value In Data Set}}{\text{Assessment Factor}}$$

- Used where data requirements for SSD cannot be met.
- Size of the Assessment Factor is dependent on the number of SMAV available
  - Ranges from 5.1 (4 SMAV) to 570 (1 SMAV)
  - DPR Requires at least 3 Toxicity Tests, so AF based on 1 or 2 data points should not occur in practice

Criteria Derivation Flow Chart



Size of Final Data Set

- SSD is used for data sets with 5 or more SMCV
- Procedure is equivalent to Acute SSD, except:
  - SMCV are used
  - SMCV are based on NOEL
  - No Safety Factor is applied to convert the Chronic Value to a Chronic Criterion
- Assessment Factor Method is used for other datasets

Acute to Chronic Ratio

$$\text{Chronic Criterion} = \frac{\text{Acute Value}}{\text{ACR}}$$

- Used with data sets having fewer than 5 SMCV
- ACR is the ratio of the acute values to available chronic values
- Default ACR's can be used if there is not enough data to calculate a single-chemical ACR
  - The Default ACR is based on the 80th percentile of all pesticide ACRs
  - Default ACR's are intended to be updated as new data becomes available

Final Criteria

- Expressed in the same manner as U.S. EPA criteria
  - Magnitude – final calculated criterion
  - Duration – 4-day average for chronic criterion and 1-hour average for acute criterion
  - Frequency – no more than 1 exceedance every 3 years on the average

Chlorpyrifos Criteria

New Method

- Chronic – 10.5 ng/L
- Acute - 11.5 ng/L

U.S. EPA Method for same data set (calculated by Karkoski)

- Chronic – 15 ng/L
- Acute – 17 ng/L

Questions?

For more information on the criteria derivation method, please see: http://www.waterboards.ca.gov/centralvalley/programs/tmdl/pest-basinplan-amend/index.html#Criteria.