# Bioassessment and Biocriteria

## for Natural Resource Managers and Citizen Monitoring Groups

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# Introductions

- Dave Gibson - CA. Reg. Water Quality Control Board
- Neal Biggart - San Diego Stream Team Coordinator
- Deborah Lelevier - The Escondido Creek Conservancy Coordinator

# Logistics

## Today

- Agenda
- Facilities
- Lunch
- Sign up for Sampling/Processing Teams

## Saturday

- Meet at Visitor Center Parking Lot.
- Wear Field Clothes
- Bring Water, Lunch, Hat
- Bring Forms & Equipment

# Why Bioassessment?

*"The objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters"*

Clean Water Act (section 101a)

# Workshop Premises No. 1

- Assessment of Physical and Biological Conditions of Our Waters is the First Step Toward Improving Water Quality and Protecting Beneficial Uses
  - Mission of the State and Regional Boards
  - State Water Resources Control Board Strategic Plan Goal No. 6

# Workshop Premise No. 2

- Standardized Techniques to Measure Physical and Biological Conditions Are Necessary
  - Ensure Statewide Comparability of Data
  - Provide Opportunity for Efficient Use of Limited Funds

# Workshop Premise No. 3

- Concerned Citizens are an Essential Component of Water Quality Monitoring and Protection.
  - Citizens Rely Upon These Water Resources
  - Citizens Fund Protection, Clean Up and Restoration Activities
  - Most Concerned Stakeholders
  - Strategic Plan Goal No. 5

# Aquatic Resources Are Still Declining

- Loss of Commercial Fisheries
  - 95% Reduction in Freshwater Harvests
  - Fish Advisories Increased 73% between 1993-1996 (Karr and Chu 1999)
- More Aquatic Organisms Are Classified Rare to Extinct than Terrestrial Organisms
  - 34% of Fish
  - 75% of Unionid Mussels
  - 65% of Crayfish (Master 1990)

# Condition of Water Resources

- Riparian Corridors Have Been Decimated (Swift 1984)
- >33% of River Miles Do Not Support Beneficial Uses
- More than 50% of Assessed Lakes, 98% of Great Lakes Shore Miles, and 44% of Estuary Areas Do Not Fully Support Beneficial Uses
- (US EPA 1992, 1995)

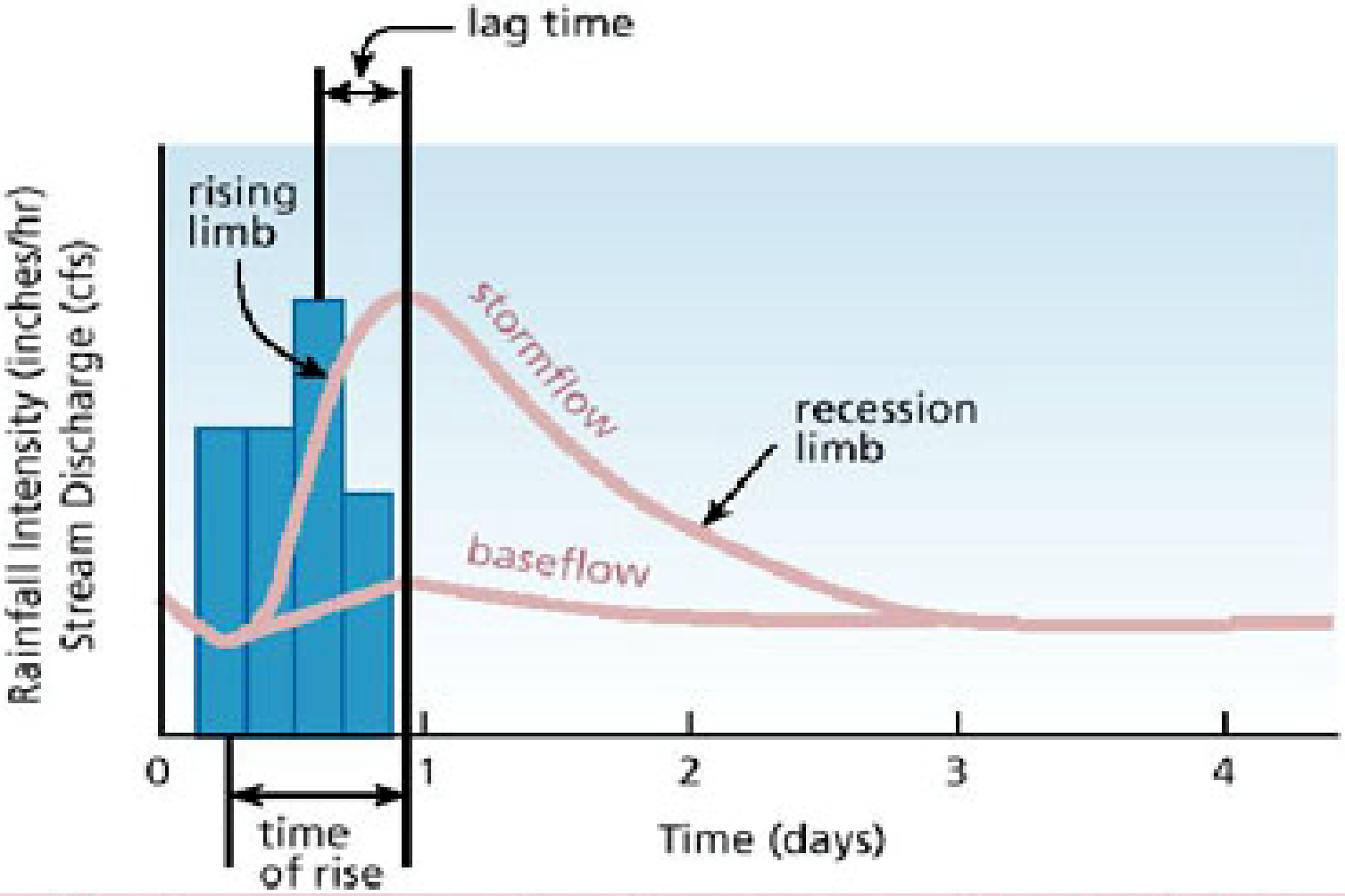
# Current Assessment Techniques Underestimate Impacts

- Chemical Criteria Underestimate Impacts
- Interactions and Synergistic Effects
- Degradation Is Not Limited to Water Chemistry
- Maxted (1997) Demonstrated a 25% Increase in Impairment Levels Over Chemical Criteria Alone When Biological Criteria Were Included.

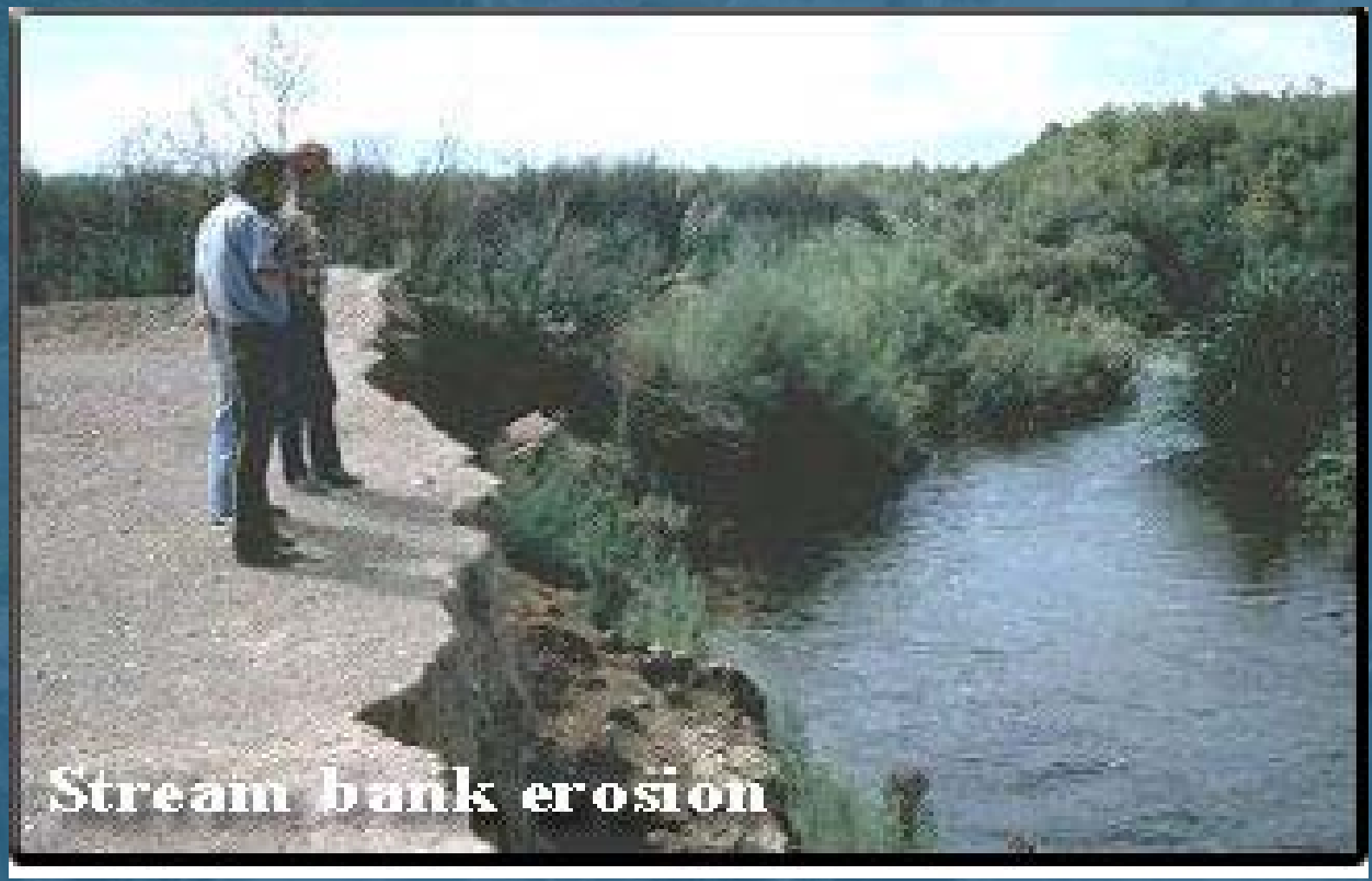
# Sources Of Impacts

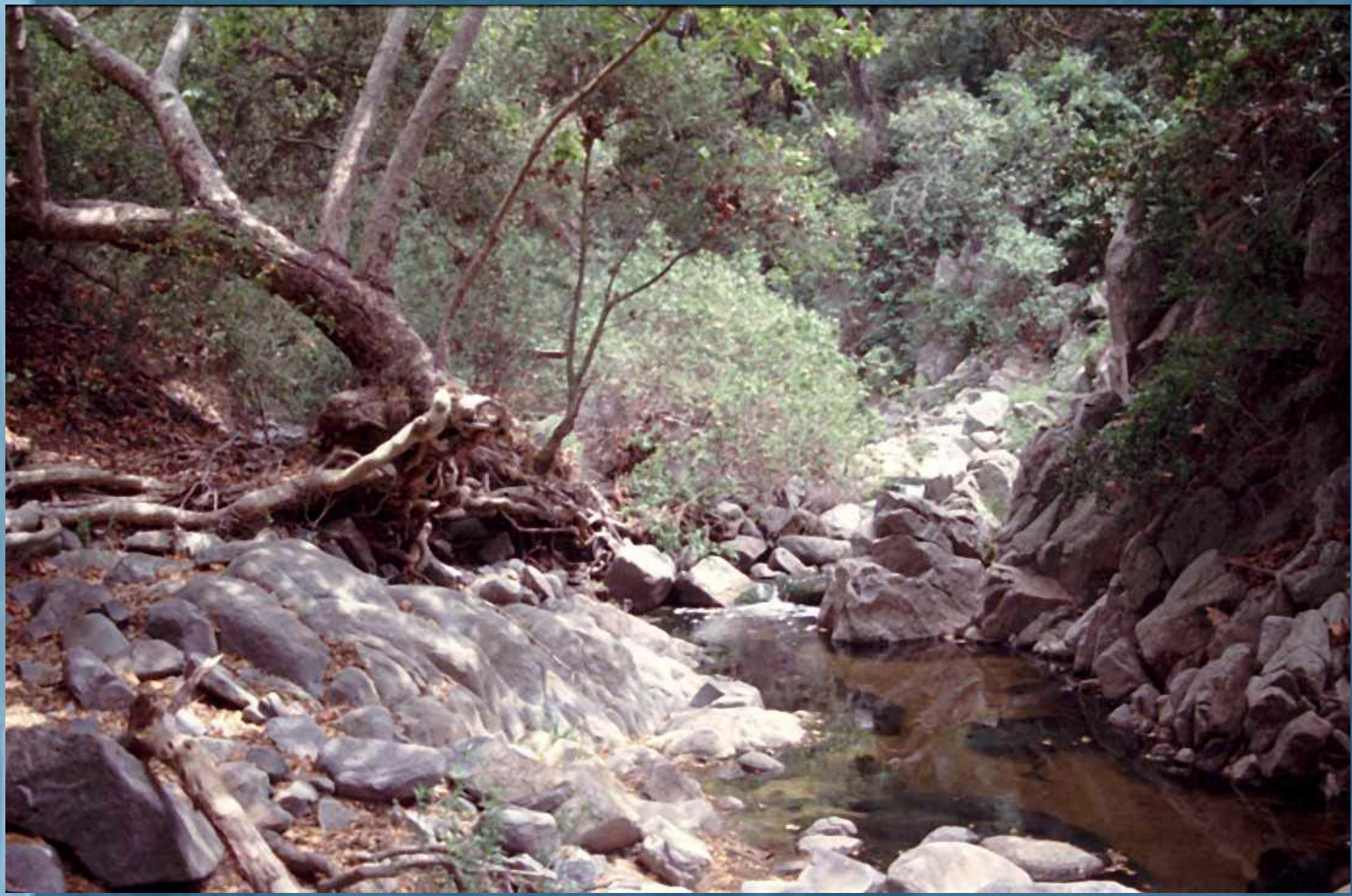
- Point Source
  - Largely Addressed by the NPDES Program
- Non Point Source
  - Largest Water Quality Problem
  - Multiple Stressors and Pathways
  - Leading Sources
    - Agriculture
    - Urban Runoff
    - Habitat Conversation/Loss

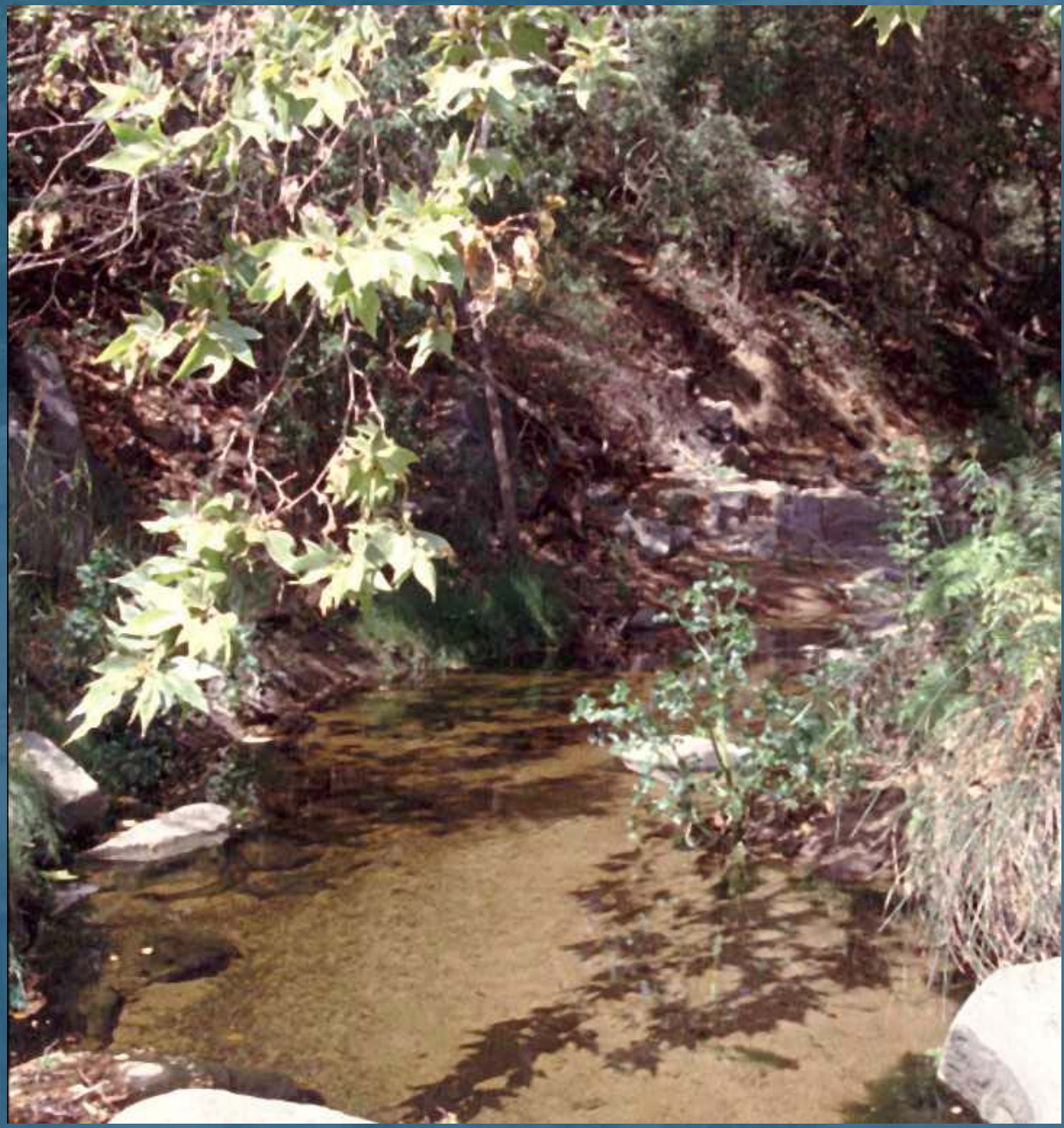

TUESDAY MORNING
Miracle-Ear
TOYOTA




A hydrograph shows how long a stream takes to rise from baseflow to maximum discharge and then return. Blue bars indicate rainfall amount and timing relative to flow changes.


Stream bank erosion






SED
OIL
PRIVATE PROPERTY
NO
TRESPASSING

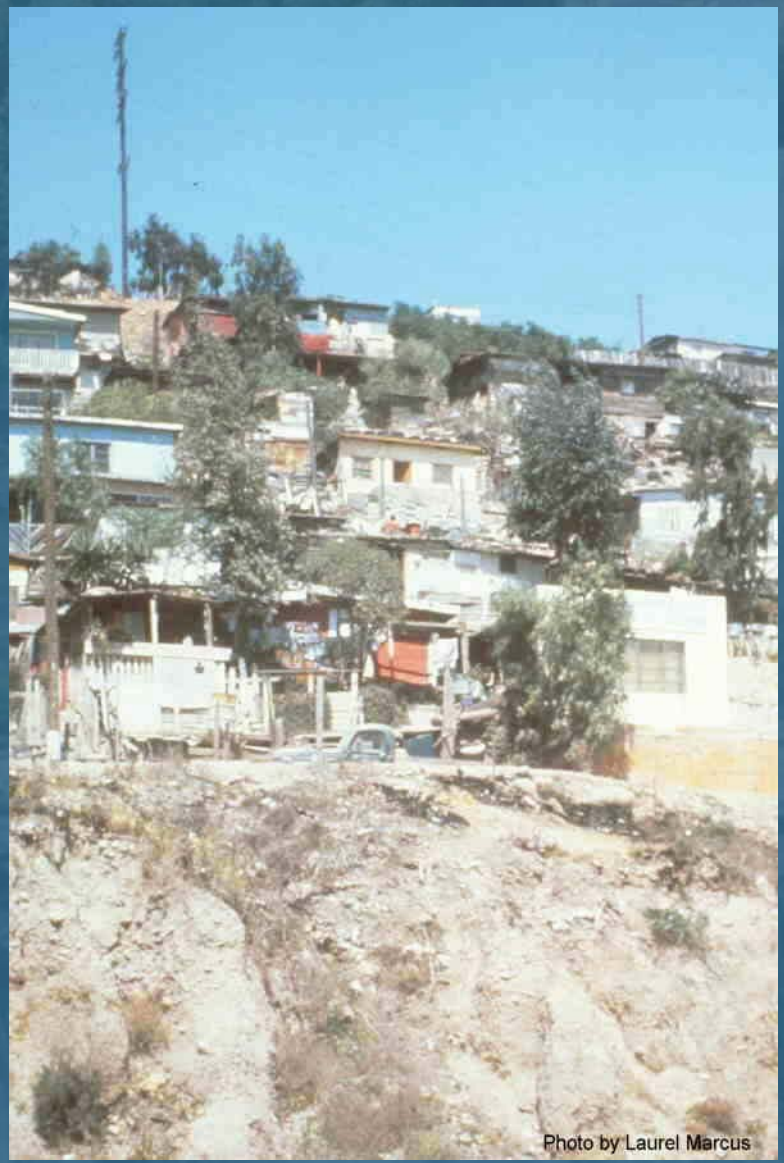
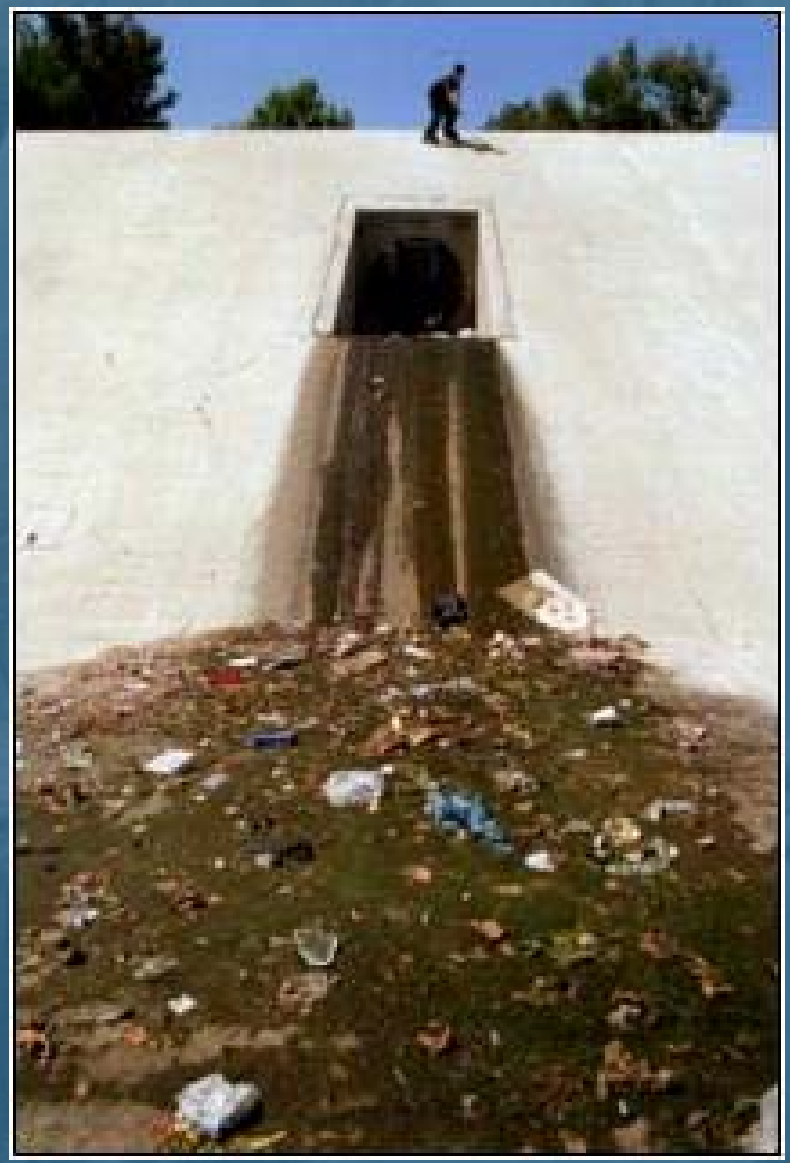
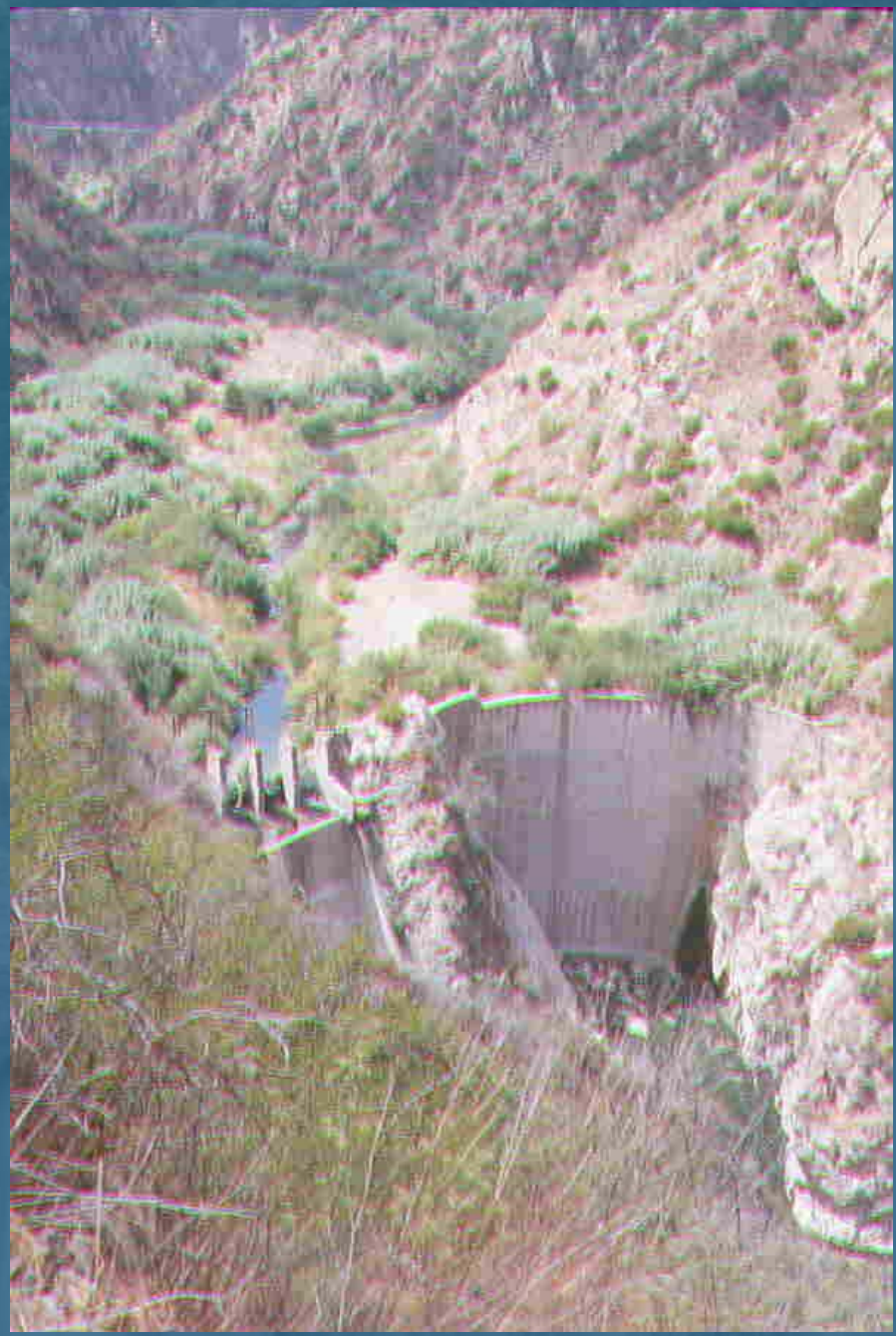
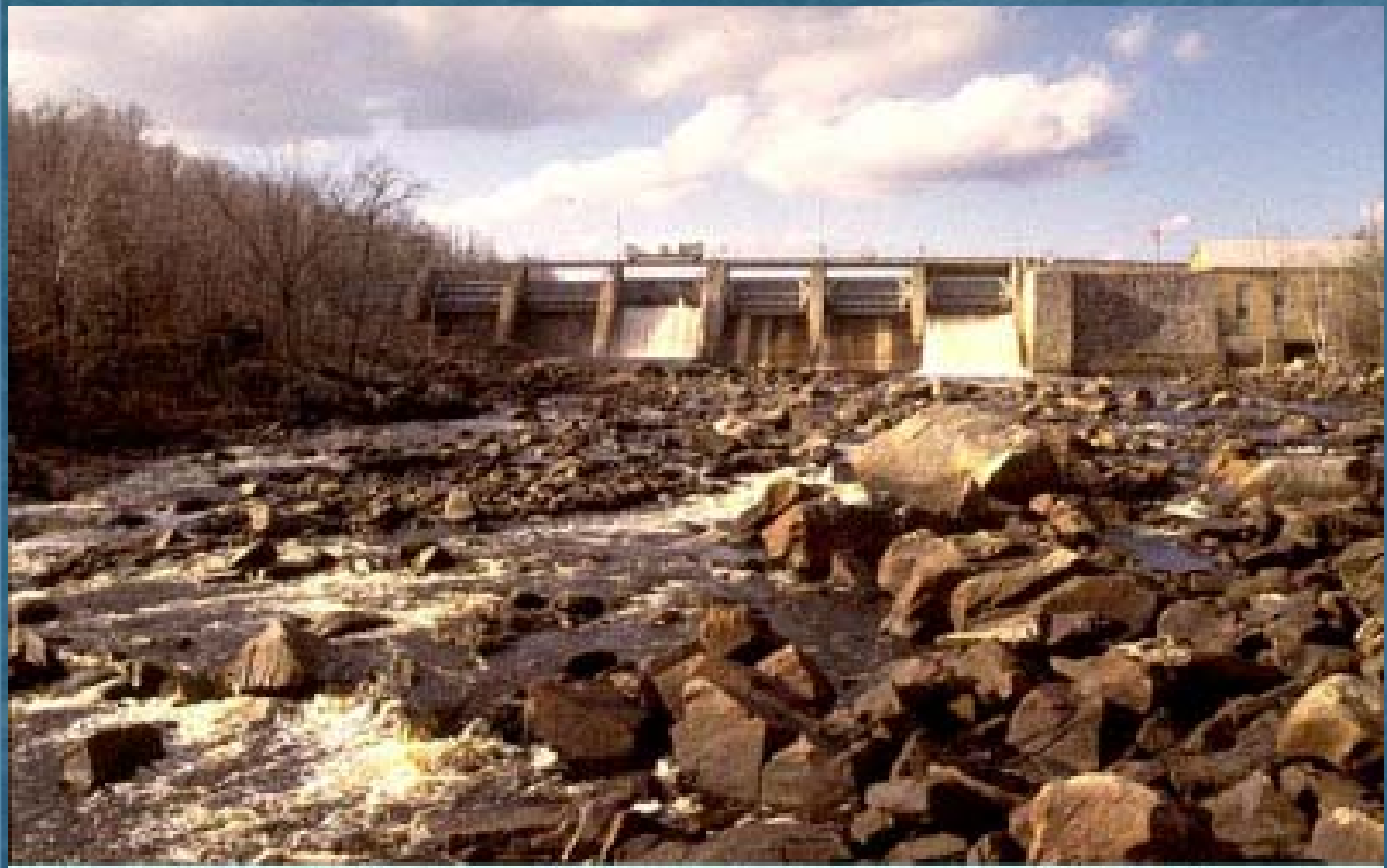


Photo by Laurel Marcus

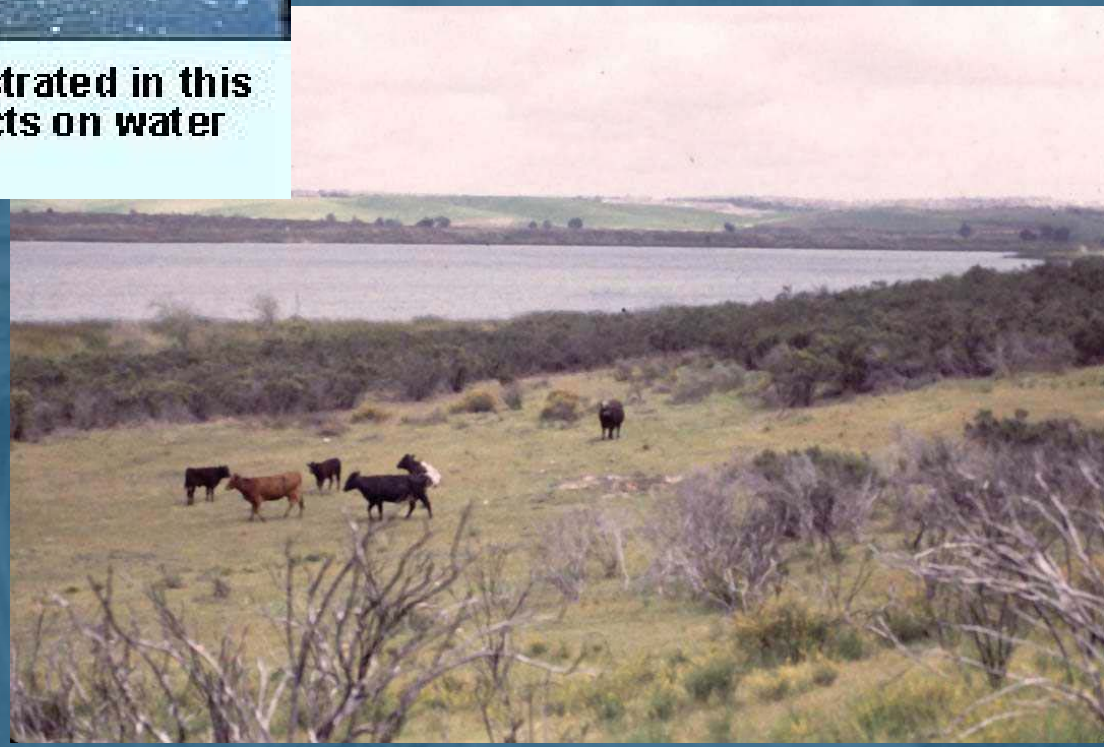


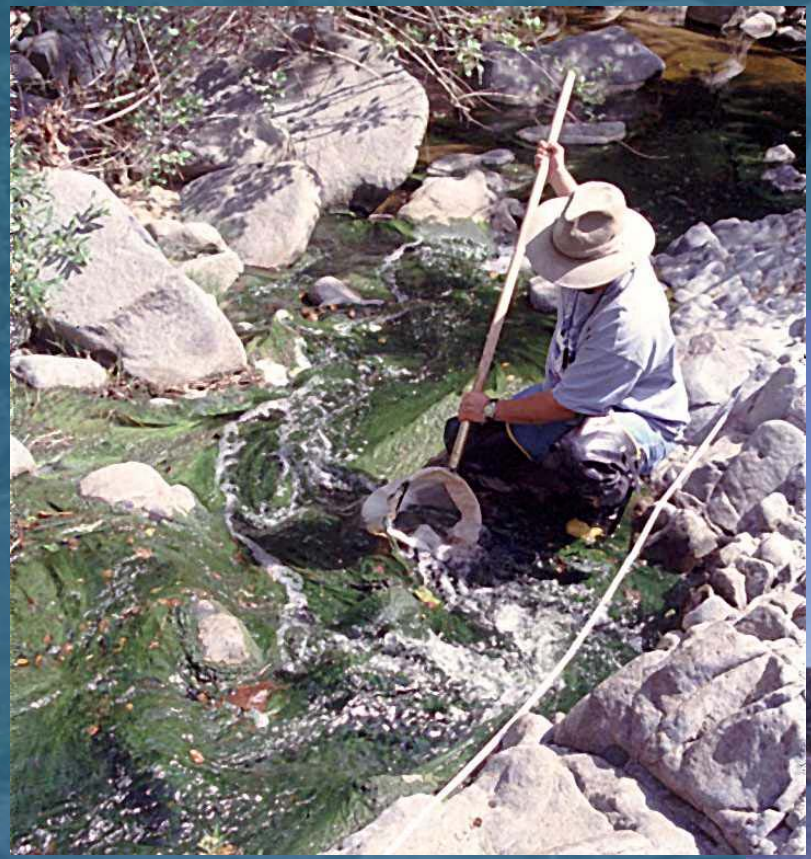




Grandfather Falls Dam, Wisconsin has had a visible effect on reducing flow volume and changing sediment characteristics downstream, with resultant changes in aquatic habitat quality.

Poor grazing management, as illustrated in this photo, can have devastating impacts on water quality and overall stream health.





# Bioassessment

- Focuses on Organisms Whose Very Existence Depends on Water and Habitat Quality
- Integrates Effects of Totality of Conditions Over Time
- Representative Of Watershed Scale Impacts
- Pulse or Press Impacts

# Bioassessment

- Relies Upon Organisms That at are Risk
  - Direct Measurement of Beneficial Use Attainment
  - Reflects Effects of Multiple Stressors
- Organisms are Ubiquitous and Representative of the Region
- Low Impact Monitoring

# Bioassessment

- Cost Effective
  - 2-4 Times per Year
  - Low Capital Investment
- Results are Robust, yet Sensitive
- Results are Readily Understood and Accepted by the Public
  - Stream Health is a Familiar Expression
  - Preferred over Thick, Indigestible Reports

# History of Biological Assessment

- 1922 Isaac Walton League
- 1969 Save Our Streams
- 1972 Clean Water Act
- 1980's Ohio and North Carolina Programs
- 1989 US EPA Guidance issued
- 1991-93 Santa Margarita River Assessment
- 1994 Hot Creek Hatchery Assessment

# History

- 1994 Cal. Aquatic Bioassessment Workgroup formed.
- 1997-1998 San Diego River Bioassessment Project
- 1997-2002 RWQCB Ambient Bioassessment Monitoring Program
- 1998 San Diego Stream Team Founded.
- 1999 Second USEPA Guidance Released

# Regional Board Approach

- Incorporate into NPDES Permits
- Core Assessment Tool in Surface Water Ambient Monitoring Program (SWAMP)
- Focus of Select Special Studies
  - Priority for 205j Grant Program
  - Ambient Bioassessment Program Follow-up
  - Periphyton
- Support Initiation of Biocriteria Development

# Ambient Bioassessment Monitoring Program

- 1997-1998 Planning
- 1998 - Sampled May, Sept.  and Nov.
- 1999 - 2000 Sampled May and November
- 2000 First Report
- 2001 Sampled May, Focused on Reference Conditions
- 2001 Second Report
- 2002 Todays Report and Prelimnary IBI

# Metrics Used
# Taxa Richness and Composition
## Table 2

- Taxonomic Richness
- Cumulative Taxa
- Cumulative EPT Taxa
- Ephemeroptera Taxa
- Plecoptera Taxa
- Trichoptera Taxa
- Dipteran Taxa
- Non Insect Taxa
- EPT Taxa
- EPT Index (%)
- Sensitive EPT (%)
- Chironomidae (%)
- Hydropsychidae (%)
- Baetidae (%)

# Metrics
# Tolerants and Intolerants

- Hilsenhoff Biotic Index (Tolerance Value)
- Percent Intolerant Taxa (TV = 0-2)
- Percent Tolerant Raxa (TV = 8-10)

# Metrics Used
# Community Attributes

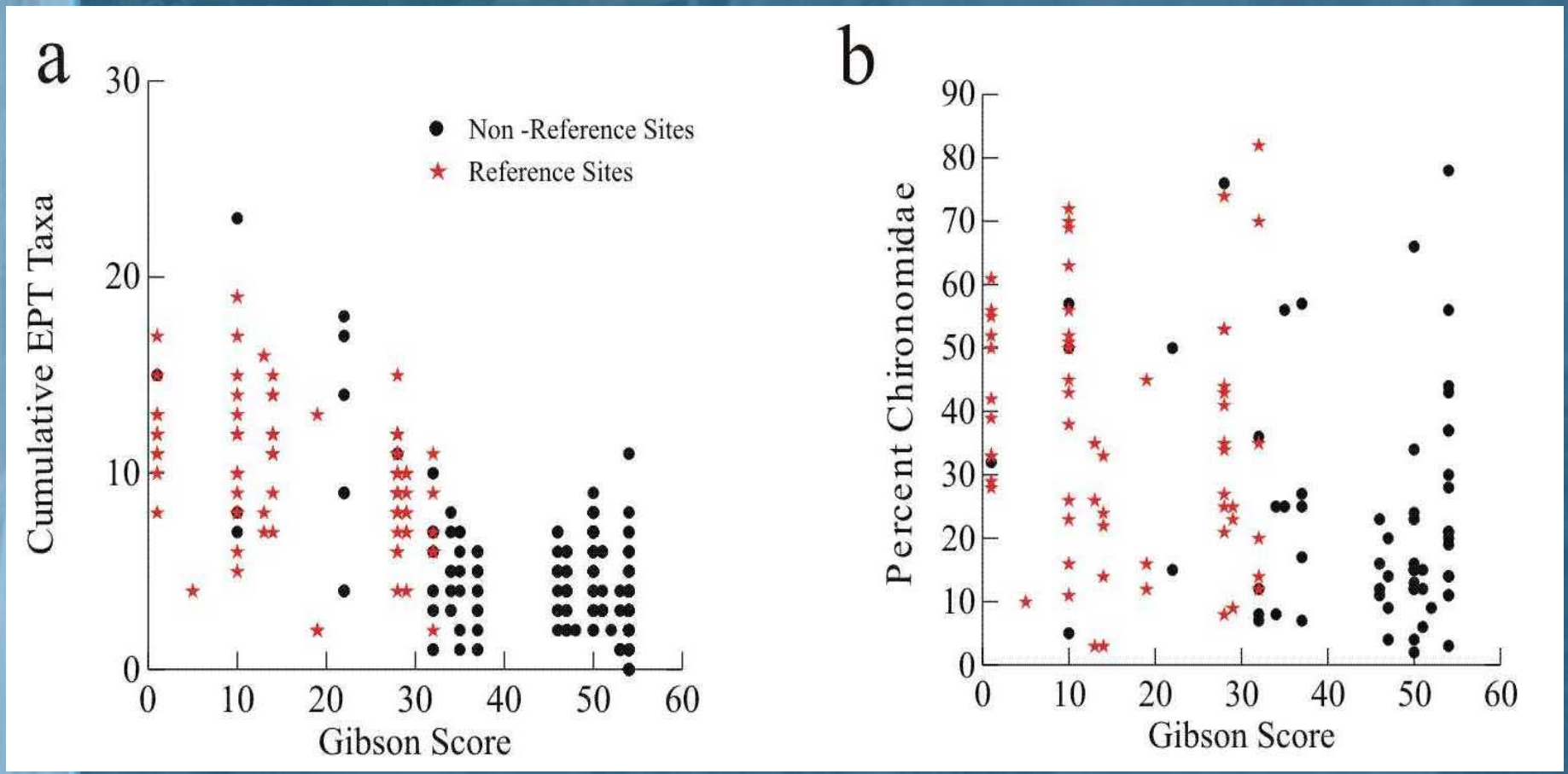
- Shannon Diversity Index
- Percent Dominant Taxon
- Abundance
- Collectors (%)
- Filterers (%)
- Grazers (%)
- Predators (%)
- Shredders (%)

# Metrics Selected for IBI

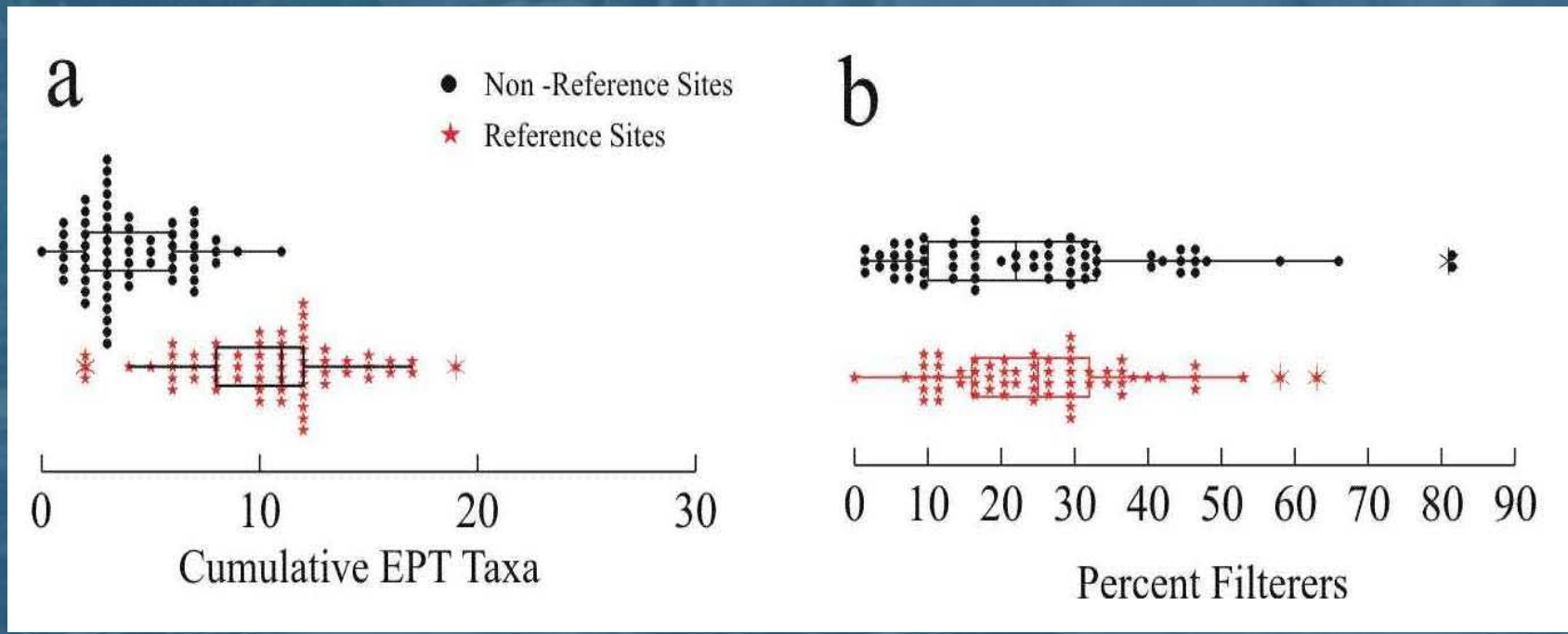
## Table 4

- Cumulative Taxa
- Dominant Taxon
- Sensitive EPT Index
- EPT Index
- Shannon Diversity
- Percent Intolerant Taxa
- Percent Grazers

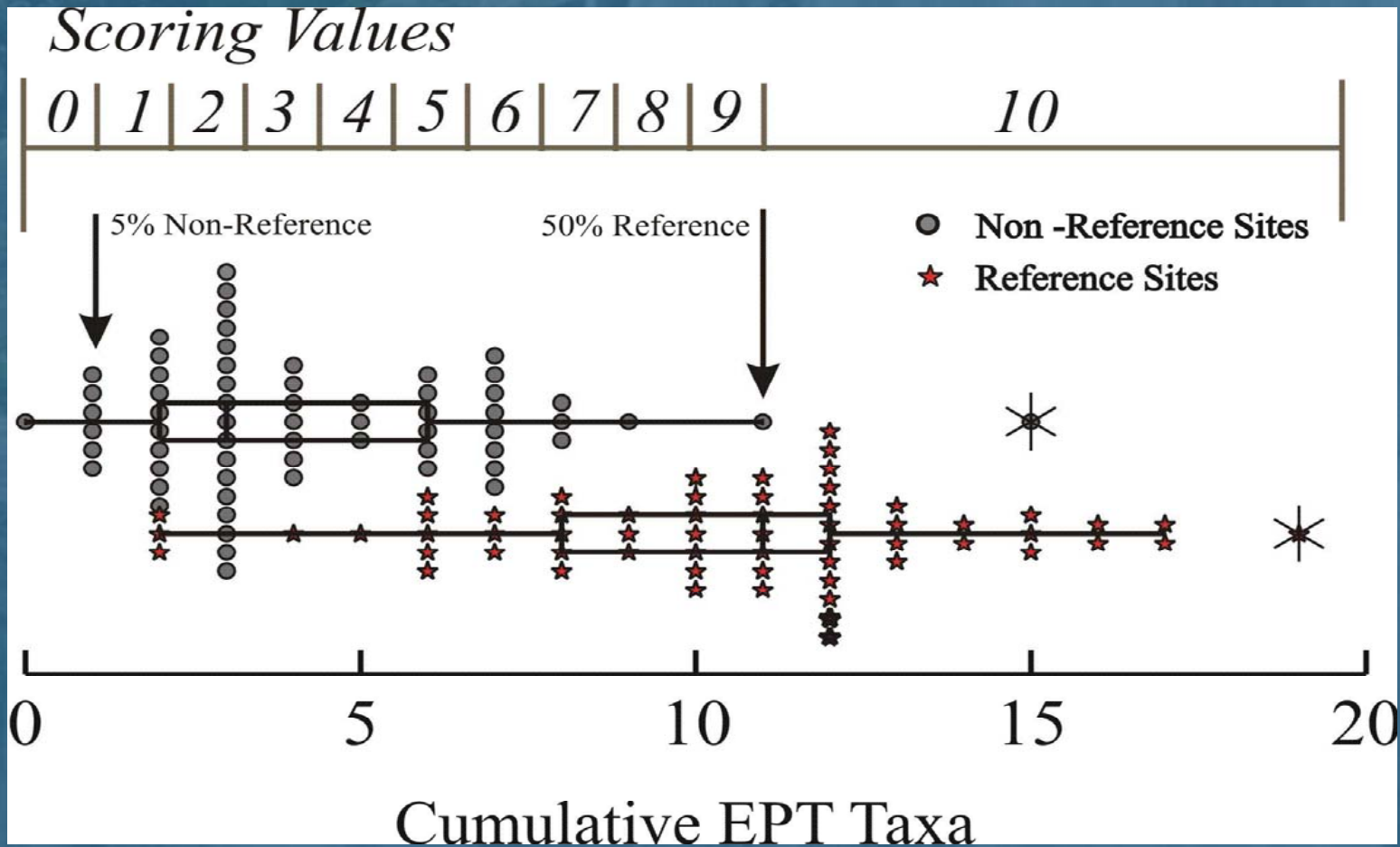
# Dose Response Curve



# Metrics Distinguish Reference Conditions



# IBI Scoring


Scoring Values
0 1 2 3 4 5 6 7 8 9 10
5% Non-Reference
50% Reference
Non -Reference Sites
Reference Sites
0
5
10
15
20
Cumulative EPT Taxa

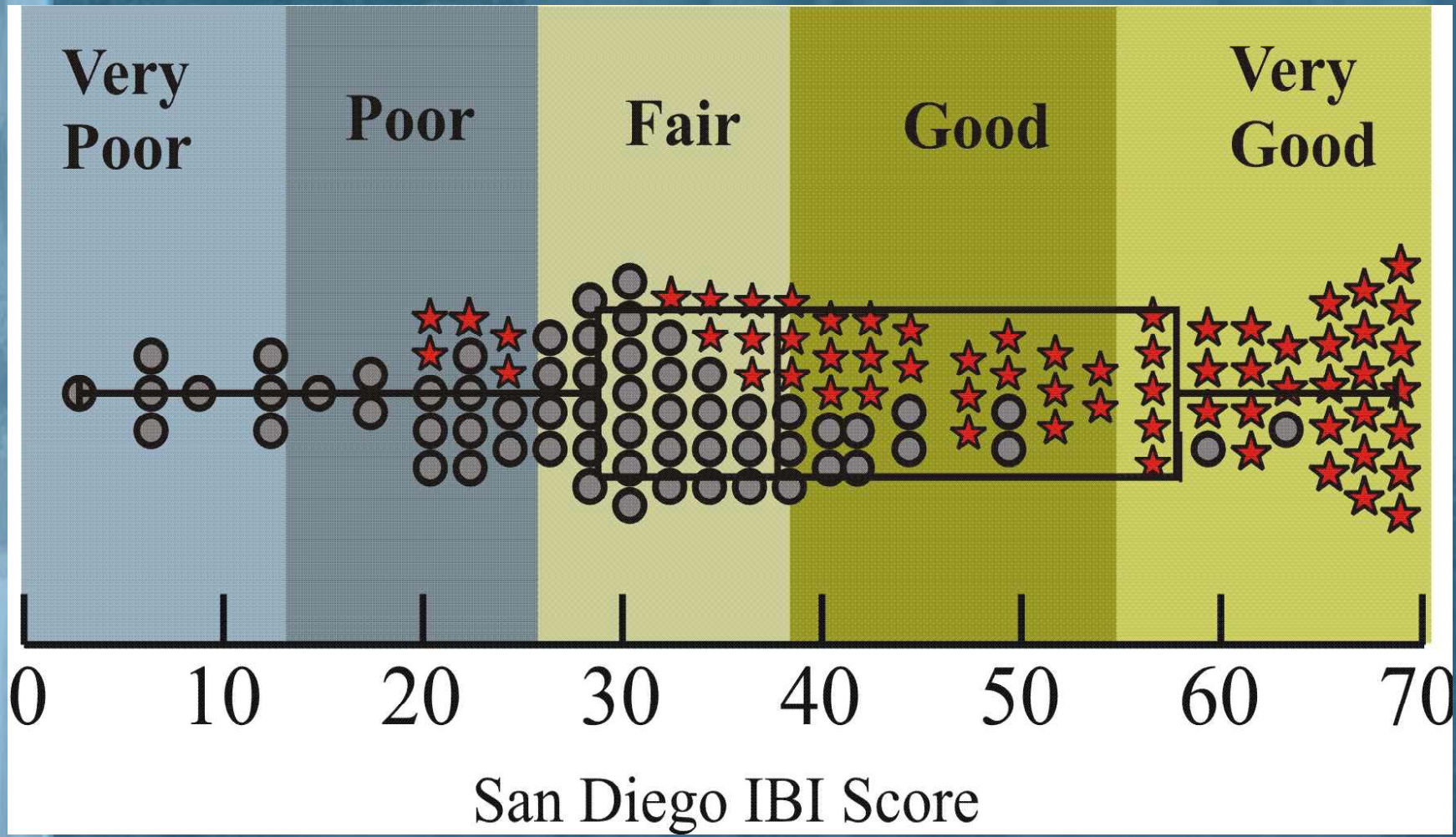
# IBI Table

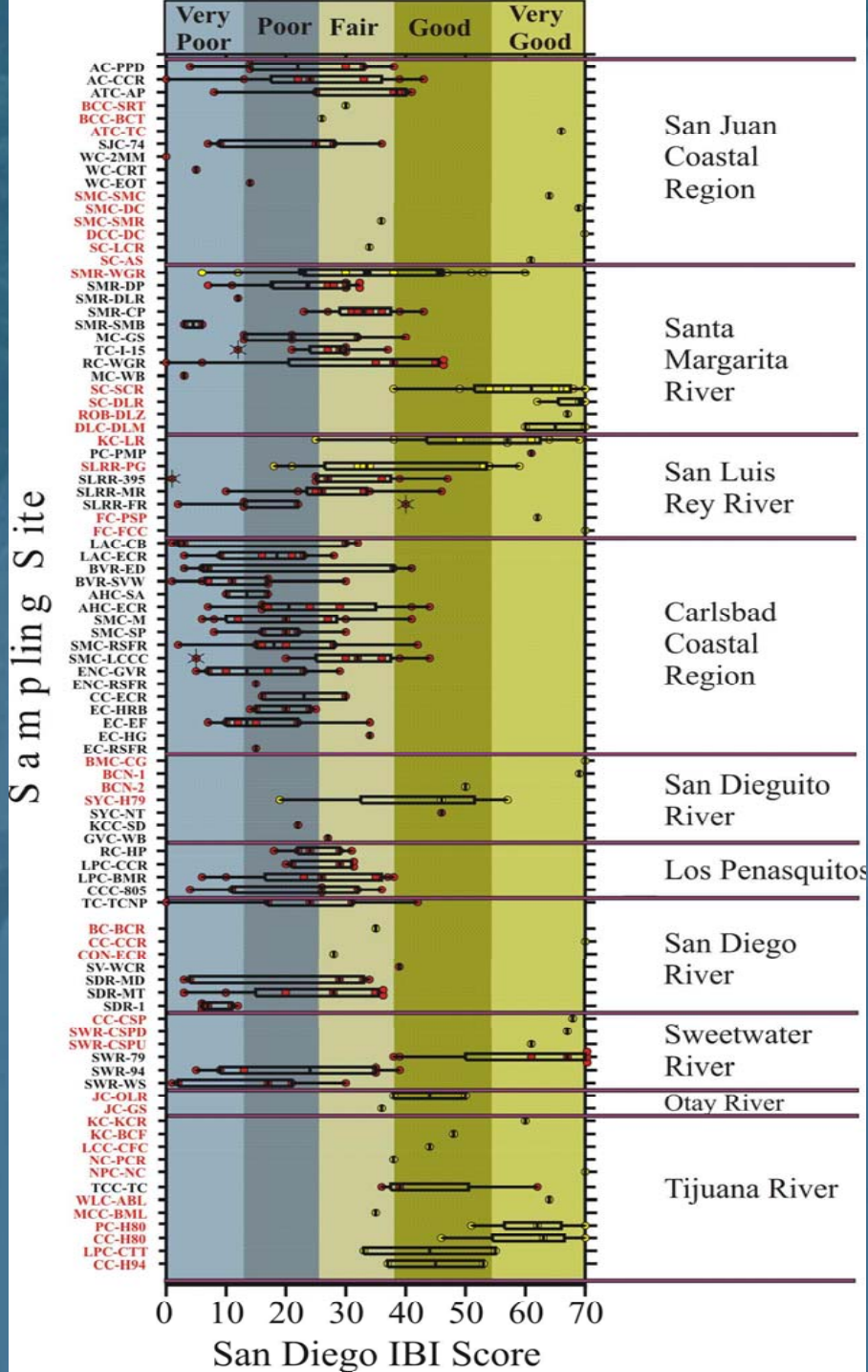
## Table 4

| | Metric Scoring Ranges for San Diego IBI | | | | | | |
|---|---|---|---|---|---|---|---|
| **Score** | **Cumulative Taxa** | **Dominant Taxon** | **Sensitive EPT Index** | **Cumulative EPT Taxa** | **Shannon Diversity** | **Intolerant Taxa** | **Percent Grazers** |
| **0** | 0-16 | >56 | 0-0.6 | 0-1 | 0-1.31 | 0-.5 | 0-0.6 |
| **1** | 17-19 | 54-56 | 0.7-1.3 | 2 | 1.31-1.4 | 0.6-1.0 | 0.7-1.3 |
| **2** | 20-21 | 51-53 | 1.4-2.0 | 3 | 1.41-1.49 | 1.1-1.6 | 1.4-2.0 |
| **3** | 22-23 | 49-50 | 2.1-2.7 | 4 | 1.5-1.58 | 1.7-2.1 | 2.1-2.7 |
| **4** | 24-25 | 47-48 | 2.8-3.3 | 5 | 1.59-1.67 | 2.2-2.7 | 2.8-3.4 |
| **5** | 26-27 | 45-46 | 3.4-4 | 6 | 1.68-1.76 | 2.8-3.2 | 3.5-4.1 |
| **6** | 28-29 | 42-44 | 4.1-4.6 | 7 | 1.77-1.84 | 3.3-3.8 | 4.2-4.8 |
| **7** | 30-31 | 40-41 | 4.7-5.3 | 8 | 1.85-1.93 | 3.9-4.3 | 4.9-5.5 |
| **8** | 32-33 | 37-39 | 5.4-6 | 9 | 1.94-2.02 | 4.4-4.9 | 5.6-6.2 |
| **9** | 34-35 | 34-36 | 6.1-6.9 | 10 | 2.03-2.11 | 5.0-5.4 | 6.3-7 |
| **10** | >35 | 0-33 | >6.9 | 11 | >2.11 | >5.4 | >7 |

| **BI Scores** | **Very Poor** | **Poor** | **Fair** | **Good** | **Very Good** |
|---|---|---|---|---|---|
| | **0-12** | **13-25** | **26-37** | **38-54** | **55-70** |

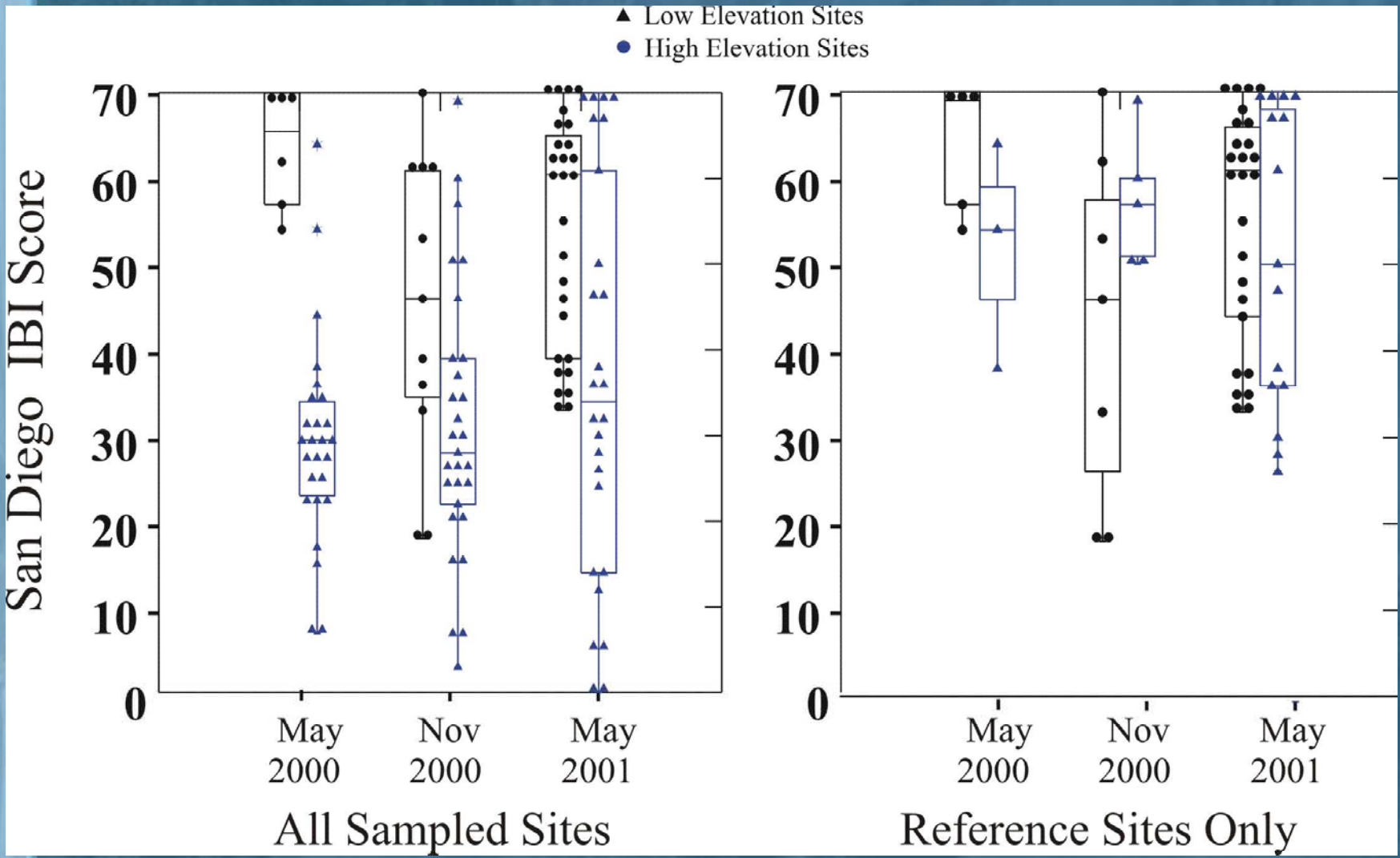
# San Diego IBI Distribution

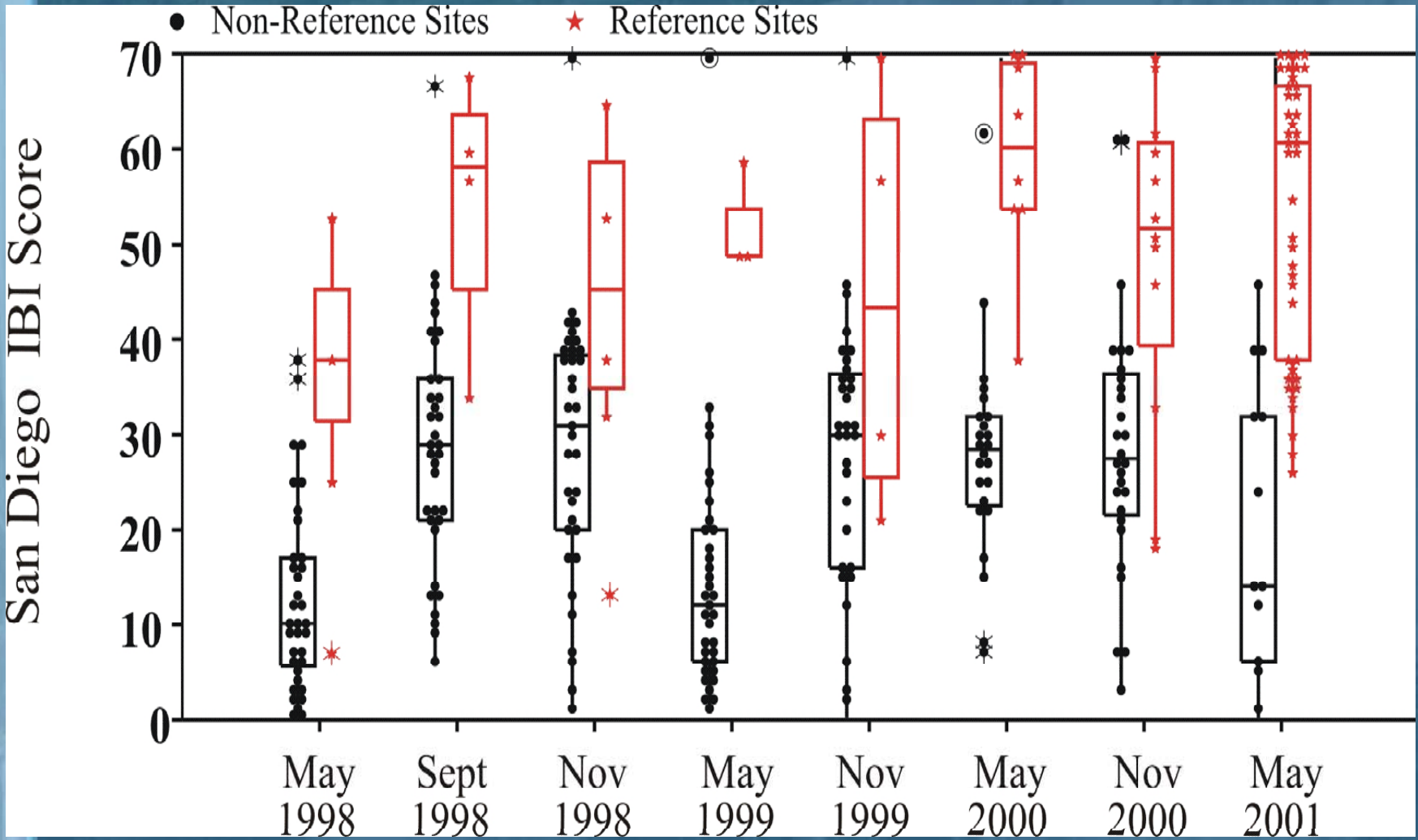


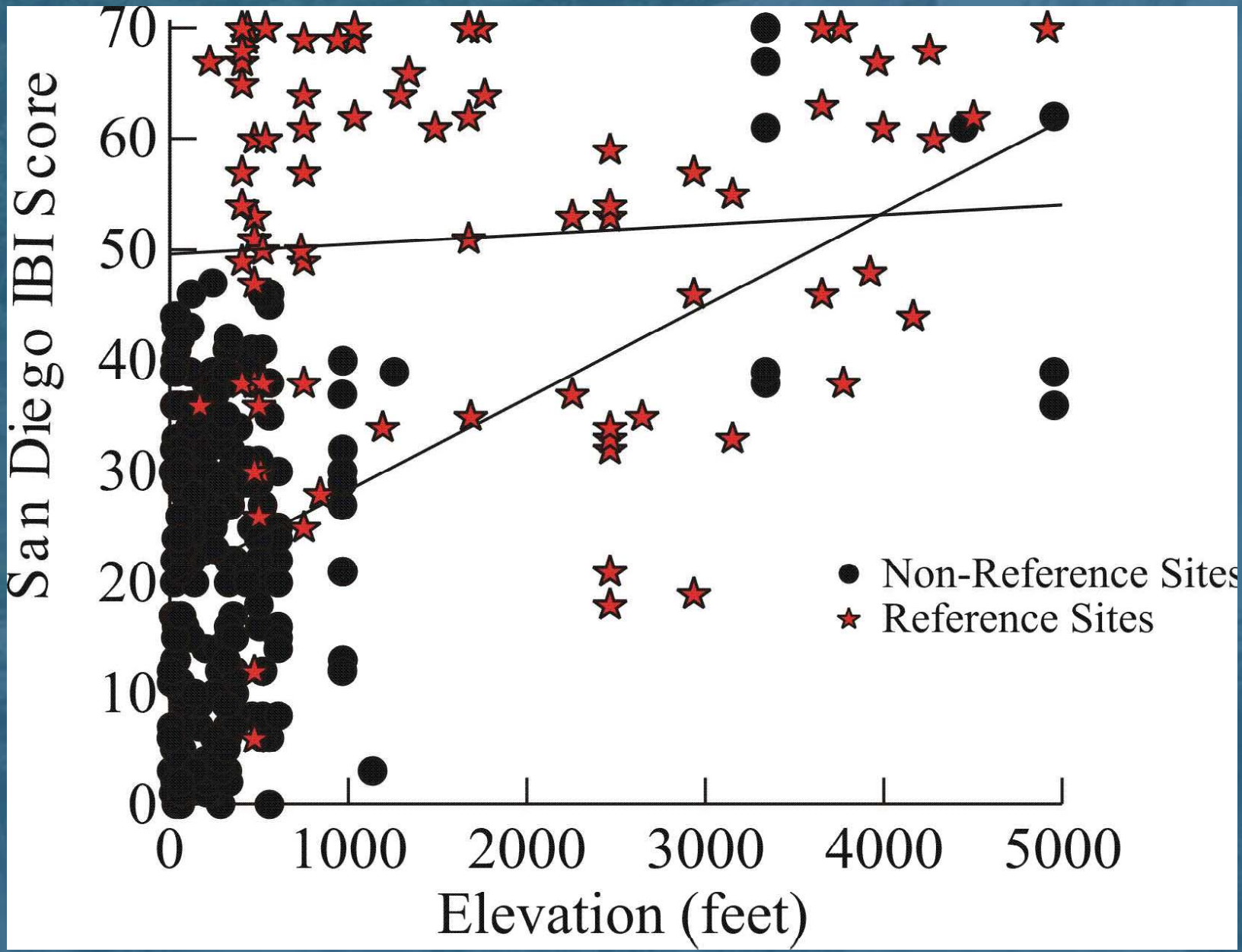

Very Poor
Poor
Fair
Good
Very Good
AC-PPD
AC-CCR
ATC-AP
BCC-SRT
BCC-BCT
ATC-TC
SJC-74
WC-2MM
WC-CRT
WC-EOT
SMC-SMC
SMC-DC
SMC-SMR
DCC-DC
SC-LCR
SC-AS
SMR-WGR
SMR-DP
SMR-DLR
SMR-CP
SMR-SMB
MC-GS
TC-I-15
RC-WGR
MC-WB
SC-SCR
SC-DLR
ROB-DLZ
DLC-DLM
KC-LR
PC-PMP
SLRR-PG
SLRR-395
SLRR-MR
SLRR-FR
FC-PSP
FC-FCC
LAC-CB
LAC-ECR
BVR-ED
BVR-SVW
AHC-SA
AHC-ECR
SMC-M
SMC-SP
SMC-RSFR
SMC-LCCC
ENC-GVR
ENC-RSFR
CC-ECR
EC-HRB
EC-EF
EC-HG
EC-RSFR
BMC-CG
BCN-1
BCN-2
SYC-H79
SYC-NT
KCC-SD
GVC-WB
RC-HP
LPC-CCR
LPC-BMR
CCC-805
TC-TCNP
BC-BCR
CC-CCR
CON-ECR
SV-WCR
SDR-MD
SDR-MT
SDR-1
CC-CSP
SWR-CSPD
SWR-CSPU
SWR-79
SWR-94
SWR-WS
JC-OLR
JC-GS
KC-KCR
KC-BCF
LCC-CFC
NC-PCR
NPC-NC
TCC-TC
WLC-ABL
MCC-BML
PC-H80
CC-H80
LPC-CTT
CC-H94
Sampling Site
San Juan Coastal Region
Santa Margarita River
San Luis Rey River
Carlsbad Coastal Region
San Dieguito River
Los Penasquitos
San Diego River
Sweetwater River
Otay River
Tijuana River
0
10
20
30
40
50
60
70
San Diego IBI Score

# Key Findings

- Seasonal Differences in Community Composition
- No Significant Seasonal Difference in Metrics
- No Significant Difference Between Sites Based on Elevation
- Significantly More Impacted Sites in Urban Areas


Low Elevation Sites
High Elevation Sites
San Diego IBI Score
70
60
50
40
30
20
10
0
May 2000
Nov 2000
May 2001
All Sampled Sites
Reference Sites Only


Non-Reference Sites
Reference Sites
San Diego IBI Score
70
60
50
40
30
20
10
0
May 1998
Sept 1998
Nov 1998
May 1999
Nov 1999
May 2000
Nov 2000
May 2001


San Diego IBI Score
70
60
50
40
30
20
10
0
0
1000
2000
3000
4000
5000
Elevation (feet)
Non-Reference Sites
Reference Sites

# Summary and Recommendations

- No Need for Separate Seasonal IBIs
- No Need for Separate IBIs Based on Elevation
- Sites Should Be Evaluated at More Than One Sampling Event

# Recommendations

- IBI Should Be Refined
  - Quantatitive Physical and Chemical Monitoring at all Bioassessment Sites
  - Evaluate Seasonality
  - Quantification of IBI Performance
  - Identify Additional Reference Sites, Use DFG/SNARL Procedure

# Additional Recommendations

- Integrate Data Collection Between Monitoring Programs
  - Municipal Copermittee Monitoring Program
  - SDRWQCB Monitoring (SWAMP)
  - Continuing Evaluation of Reference Sites
  - Maintain QA/QC Program
- Initiate Development of Biocriteria (3-5 yrs)