



Interagency Ecological Program

COOPERATIVE ECOLOGICAL
INVESTIGATIONS SINCE 1970

Dr. Anke Mueller-Solger
IEP Lead Scientist
CALFED Science Program
July 27, 2009



Interagency Ecological Program

COOPERATIVE ECOLOGICAL
INVESTIGATIONS SINCE 1970

What is
the IEP?
(History)

What is IEP
Science?
(What we do now)

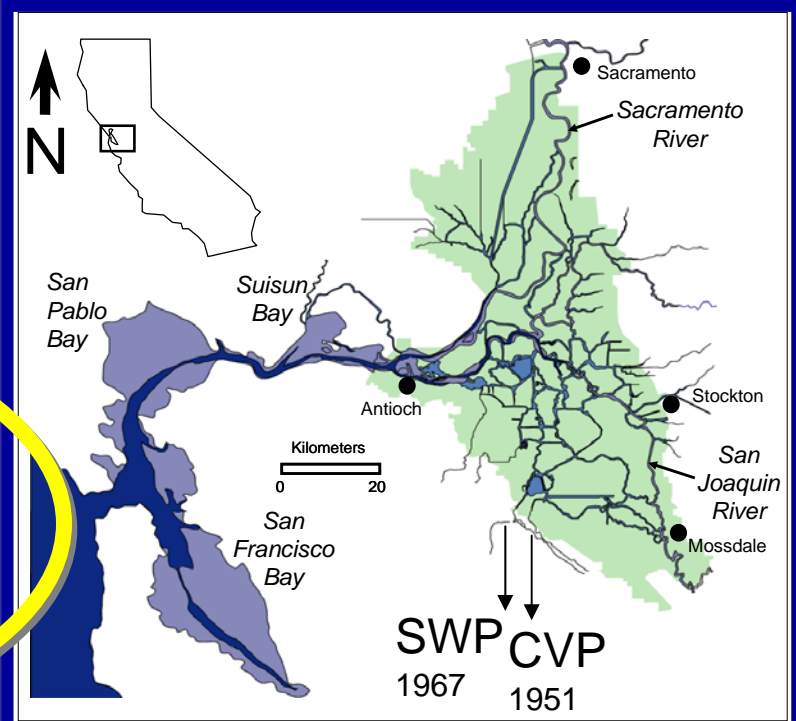
How does IEP
"feed into"
other efforts?



Interagency Ecological Program

COOPERATIVE ECOLOGICAL INVESTIGATIONS SINCE 1970

What is the IEP? (History)



Testimony at 1969-70 SWRCB Water Rights Hearings:

- "Fish and wildlife problems" in the estuary
- SWP & CVP may contribute

Need studies to

- Understand fish and wildlife resource requirements
- Find ways to minimize SWP & CVP impacts

1970 MOA

USBR

IN WITNESS WHEREOF, the parties hereto have executed this Memorandum
of Agreement on July 13, 1970.

U. S. BUREAU OF RECLAMATION
Region 2

By *R. J. Pfefferly*

CALIF. DEPARTMENT OF WATER RESOURCES

By *W. L. Guendell*

Approved as to legal form
and expediency:

R. J. Tomlin

DWR

U. S. BUREAU OF SPORT FISHERIES
AND WILDLIFE, Region 1

By *John D. Findley*
JOHN D. FINDLEY
Regional Director

CALIF. DEPARTMENT OF FISH & GAME

By *[Signature]*

I hereby certify that all conditions for exemption set
forth in State Administrative Manual Section 1701.13 have
been complied with and this document is exempt from
review by the Department of Finance.

By *[Signature]*

USFWS

DFG

1970 MOA

The intent of this Memorandum of Agreement is to provide for the performance of studies necessary to obtain a thorough understanding of the requirements of fish and wildlife resources.

Interagency Ecological STUDIES Program (IESP)

1970-1982: Focused studies to allow "full" water project development (with Peripheral Canal)

1982-90s: Monitoring and studies to meet regulatory requirements & evaluate effects of project operations, fish facilities, barriers

1993: Program review - reorganization, IEP

2000s: Pelagic Organism Decline (POD) **study** focus

Future? Integrated Environmental Assessments (*Socio-Ecological Science*) - System shifts, B.O.s, BDCP (P.C.!)



Interagency Ecological Program

COOPERATIVE ECOLOGICAL
INVESTIGATIONS SINCE 1970

What is
the IEP?

Current Program:
2000 MOU;
6 Federal & 3
State Agencies
+ SFEI, CALFED,
CVRWQCB;
~ \$30 M



Interagency Ecological Program

COOPERATIVE ECOLOGICAL
INVESTIGATIONS SINCE 1970

What is
IEP Science?
(What we do now)



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What is IEP Science? (What we do now)

IEP Mission: Provide information on the factors that affect ecological resources in the Sacramento - San Joaquin Estuary, that allow for more efficient management of the estuary.

No "Science"



What is
IEP Science?
(What we do now)

Interagency
Ecological Program

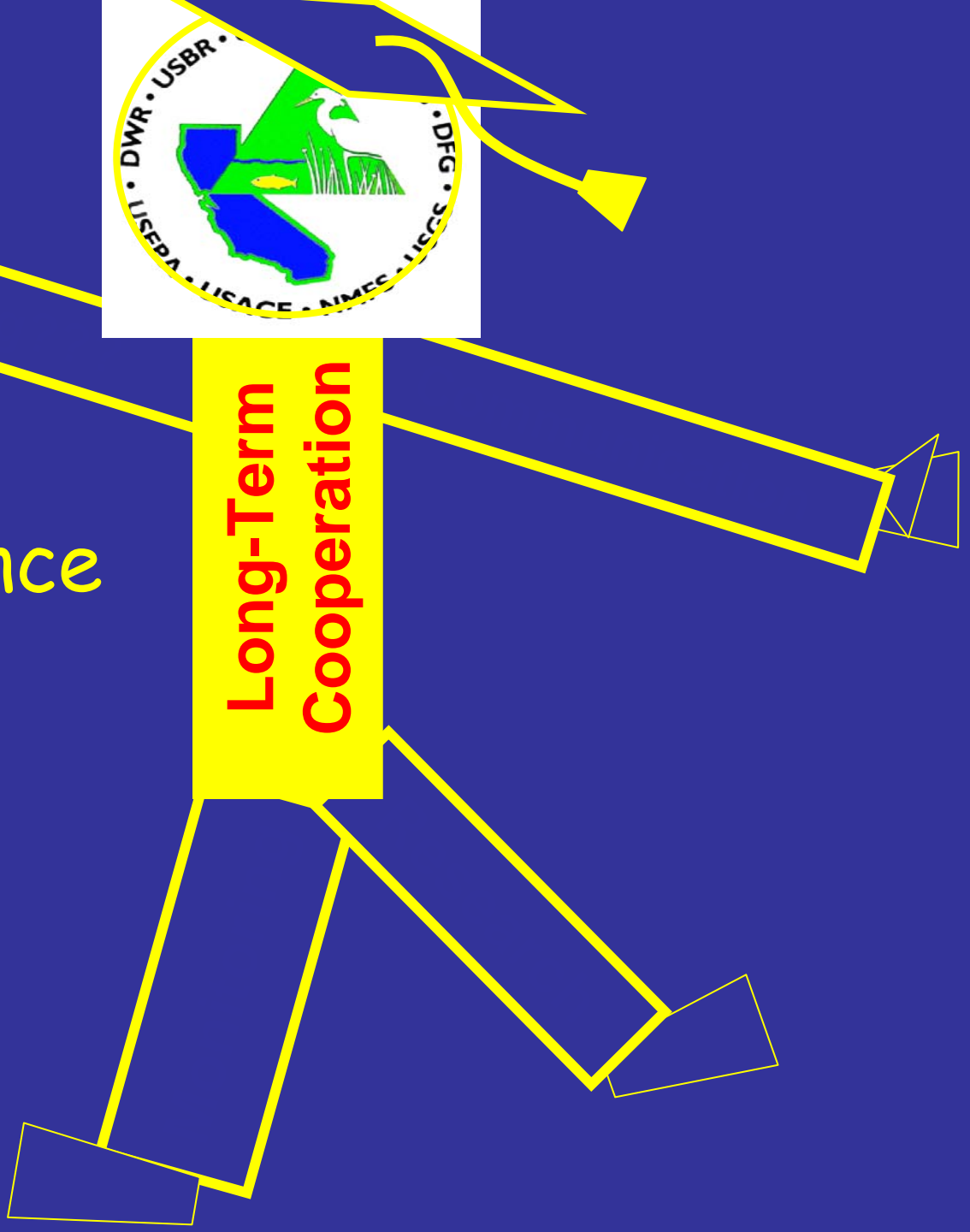
COOPERATIVE ECOLOGICAL
INVESTIGATIONS SINCE 1970

Long-Term
Cooperation



Meet
Dr. *IEP-Science*

**Long-Term
Cooperation**



Dr. IEP-Science
does science!



**Long-Term
Cooperation**

Analysis
Synthesis
Review

Modeling

Communication

Long-Term
Cooperation

Monitoring

Research

Dr. IEP-Science
does science!

Analysis
Synthesis
Review

Modeling

Communication

Long-Term
Cooperation

Research

Monitoring

Dr. IEP-Science
does science!

-- MONITORING
& MODELING

Analysis
Synthesis
Review

Modeling

IEP Monitoring:

- Long-term
- Cooperative
- Consistent
- Mostly Mandated

"News
journalism"

Communication

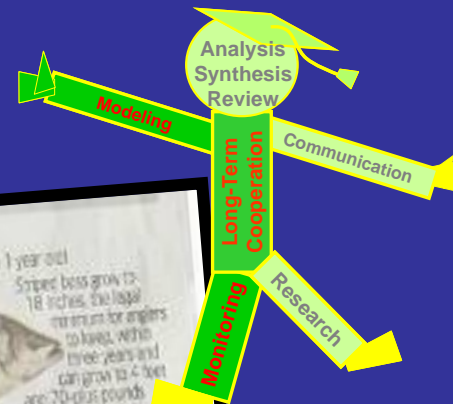
Long-Term
Cooperation

Research

Monitoring



2005: Pelagic Organism Decline (POD)



Fish survey

Each year, scientists survey dozens of locations along the Delta using a trawl net to capture a sampling of fish. The numbers at right are calculations of population density based on the average number of fish caught in a speeded volume of water.

Copepods

Pseudodiaptomus (fishes' fall aged)
A type of zooplankton, copepods are usually 1 to 1.5 mm long and help form the bottom of the food chain in the Delta.

Delta smelt

(all ages)
Typically being just one year, Delta smelt grow to about 4 inches.

Juvenile striped bass

Two to 1-year old
Striped bass grow to 18 inches, the legal minimum for anglers to keep. Within three years and can grow to 4 feet and 70-plus pounds.

DELTA DANGER

A decline in fish species and their food source is a reminder of a recurring worry in the West: A broad ecosystem collapse

By Matt Weiser
STAFF WRITER

An unprecedented research effort is to make sense of an alarming plunge in Delta fish species, but some observers believe it's "too little, too late."

The \$2 million research plan was put in just five months by state and federal fisheries surveys in fall 2004 to

Fortunes of a key Delta fish keep sinking

Members of Congress Seek Answers on Delta Fish Decline

by Dan Bacher Thursday, May 12, 2005 at 11:23 PM
danielbacher@hotmail.com

Decline In Delta Forage Species Alarms Scientists

May 25, 2005
By Dan Bacher

Officials challenged over Delta smelt deaths

By Matt Weiser
STAFF WRITER

It also could be shown that the Department of Water Resources has been acting on

Delta smelt threatened

Delta smelt continue to decline with the latest numbers from a fish survey. The numbers also suggest of abundant habitat to water return for the species' population. The lower numbers over records for the Delta fish coincide with near-record periods of Delta near in three of the past five years.

A massive restoration program may have nothing left to save

By Matt Weiser

The San Francisco Examiner

Opinion

Delta fish decline hints at water crisis

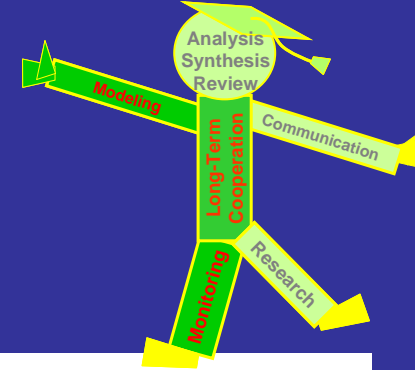
Viewpoint

By Los Angeles Times
Published: Wednesday, August 24, 2005 11:54 PM PDT

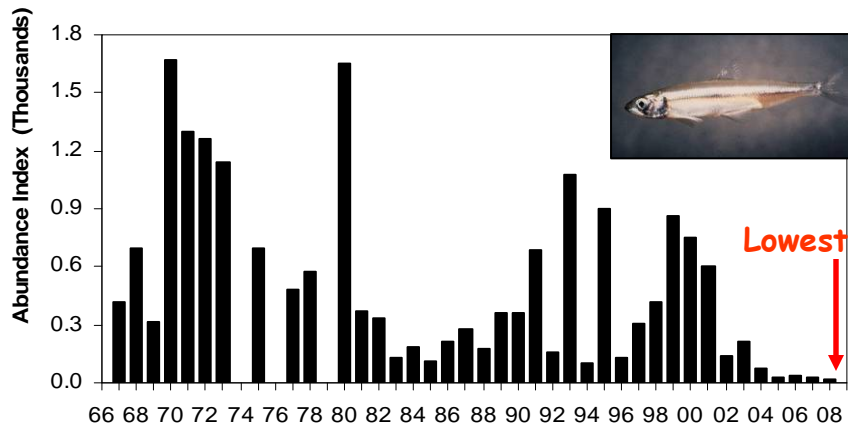
Food chain collapsing in the California Delta

2008: POD fish continue to decline

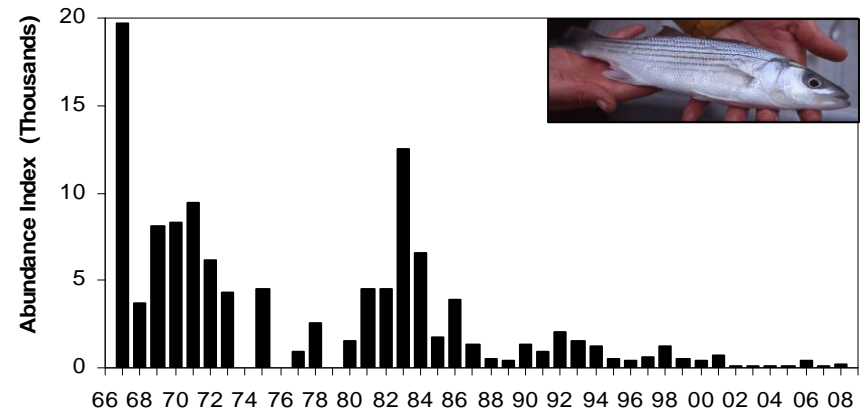
Source DFG long-term Fall MW Trawl monitoring
No sampling 1974 and 1979



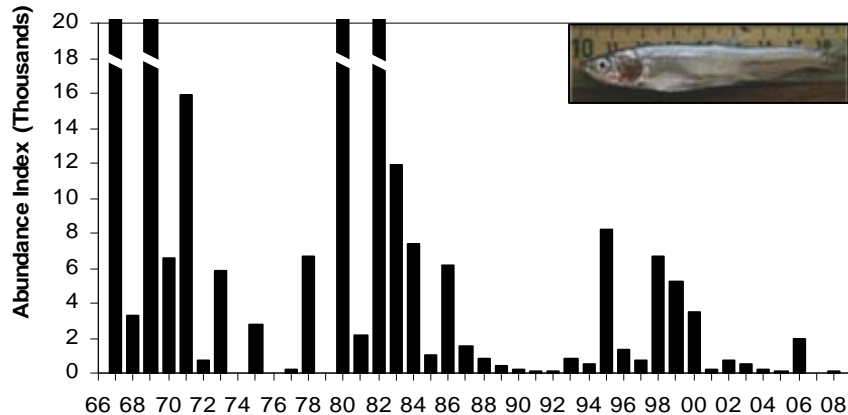
Delta Smelt



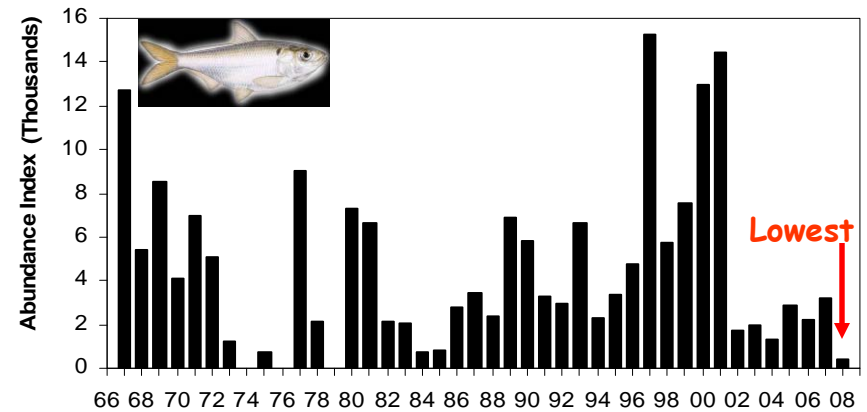
Striped Bass



Longfin Smelt



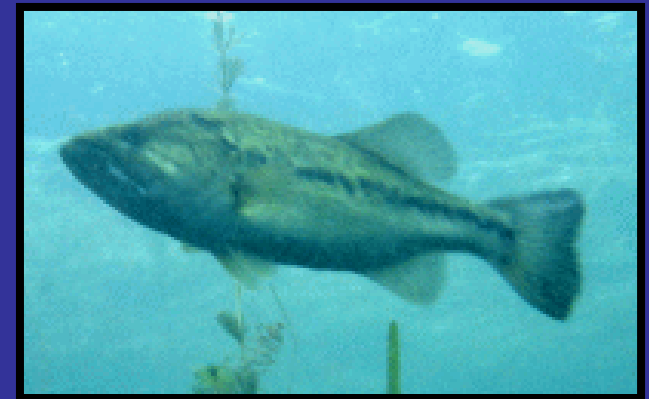
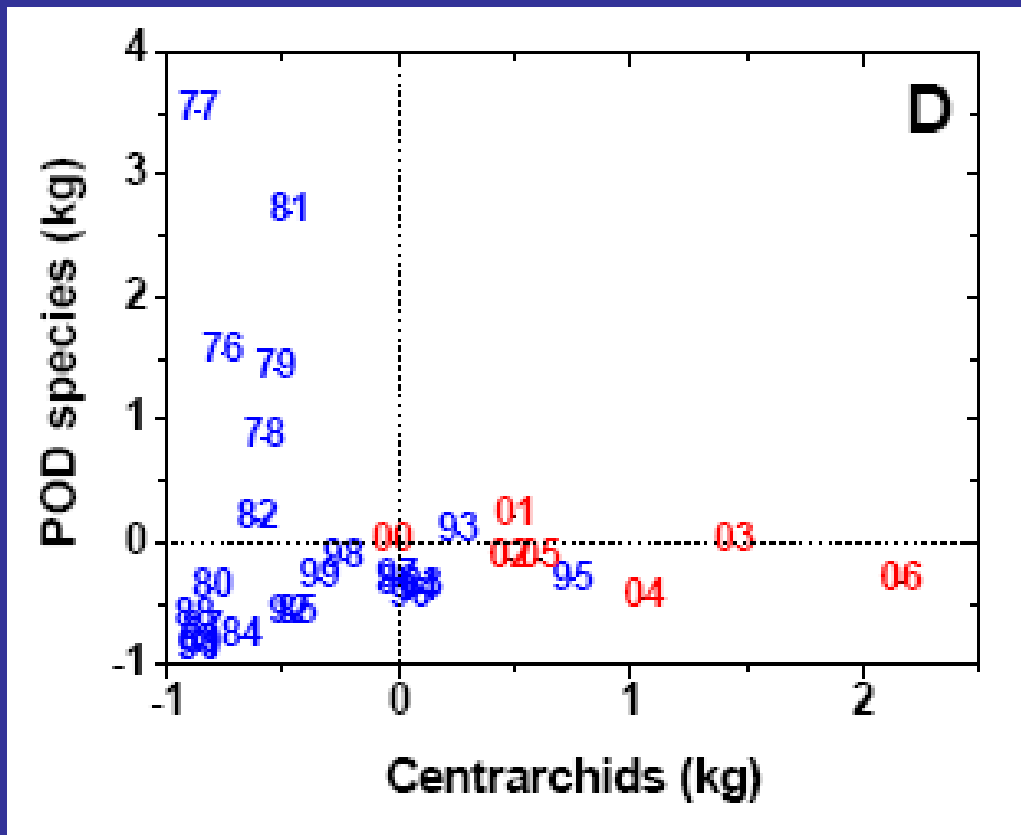
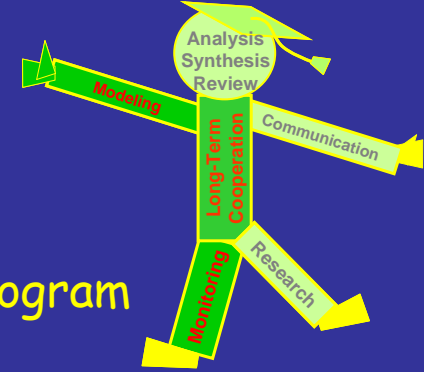
Threadfin Shad



Introduced species dominate

e.g. Centrarchids

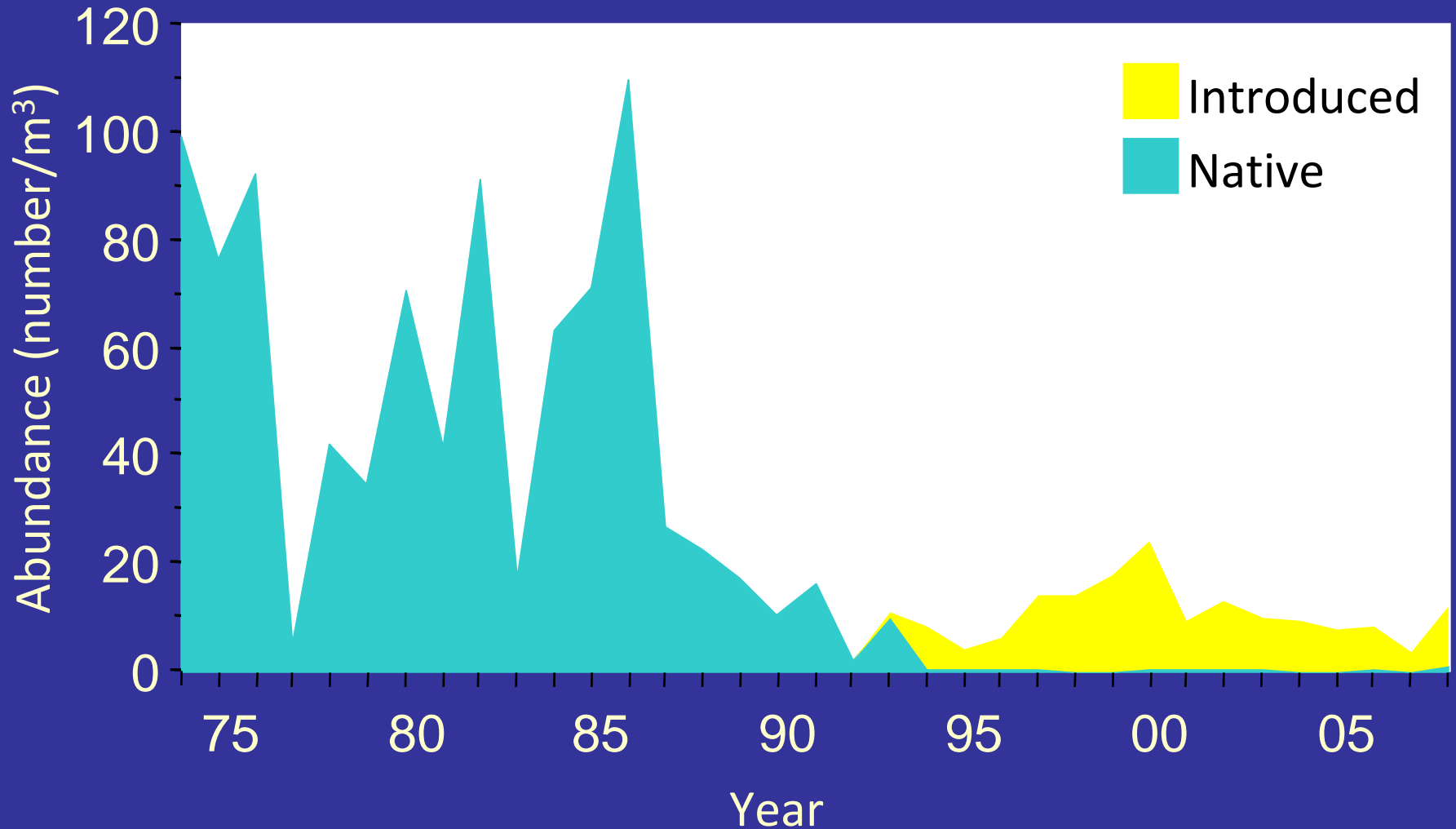
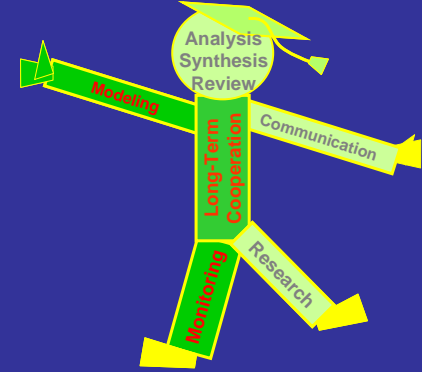
Data Source: USFWS long-term Juvenile Fish Monitoring Program
Published in Moyle and Bennett, PPIC 2008 (Fig. 2D)



Introduced species dominate

e.g. Introduced mysids

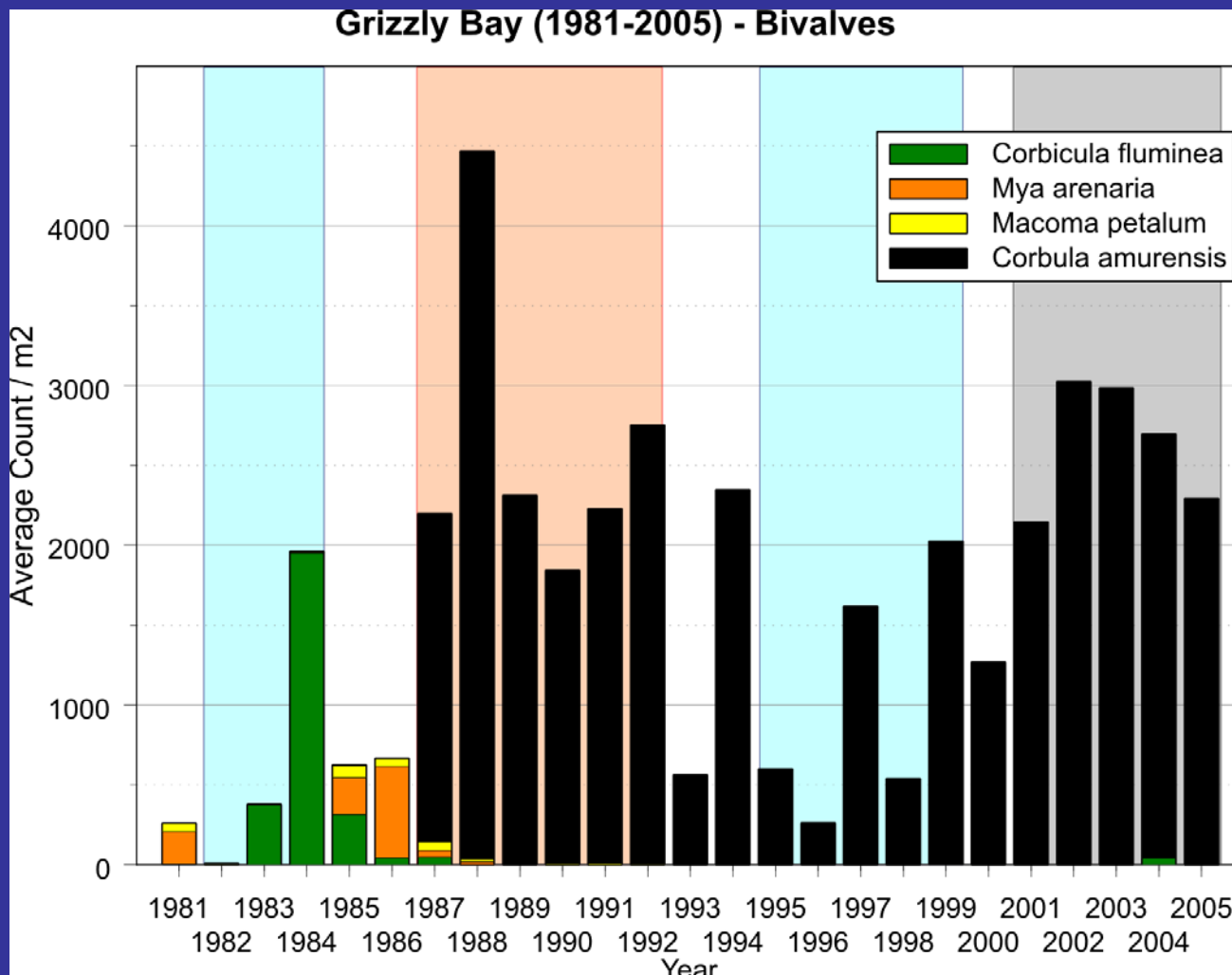
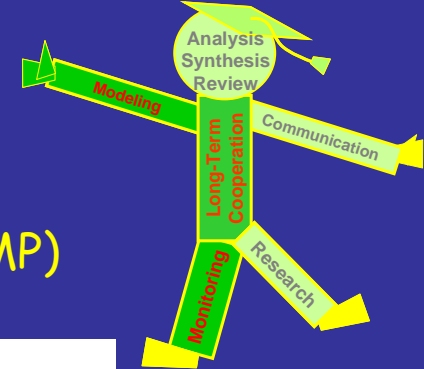
Data Source: DFG long-term zooplankton monitoring (EMP)



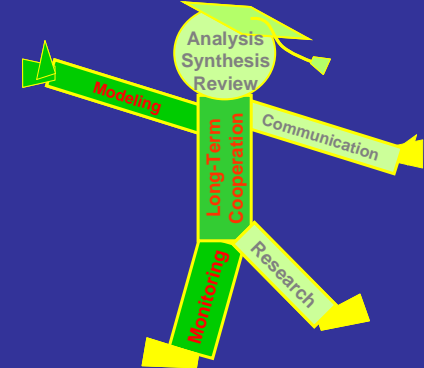
Introduced species dominate

e.g. *Corbula*, Grizzly Bay

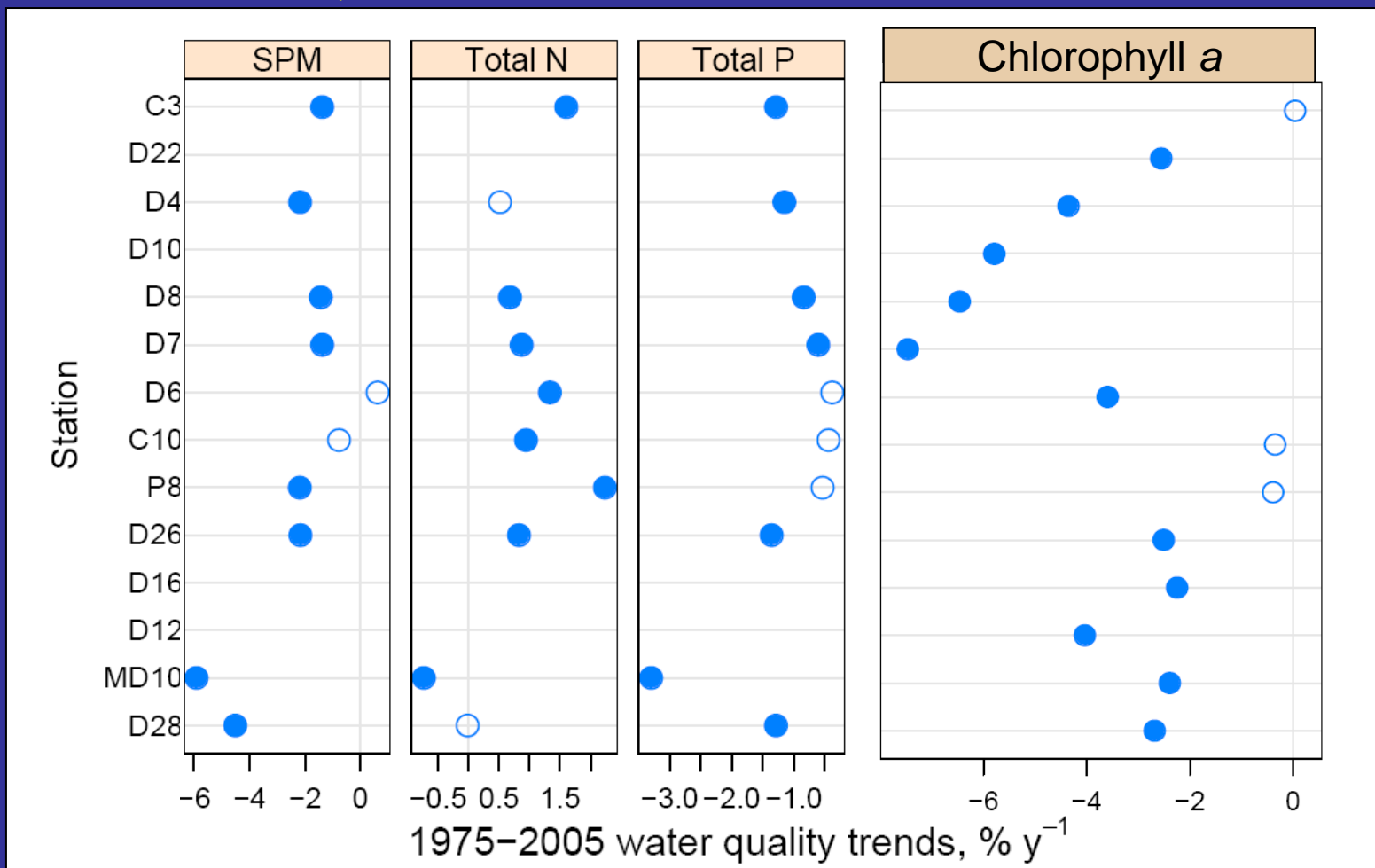
Data Source: DWR-USBR long-term benthos monitoring (EMP)



Nitrogen increased, SPM, TP, & Chl a decreased



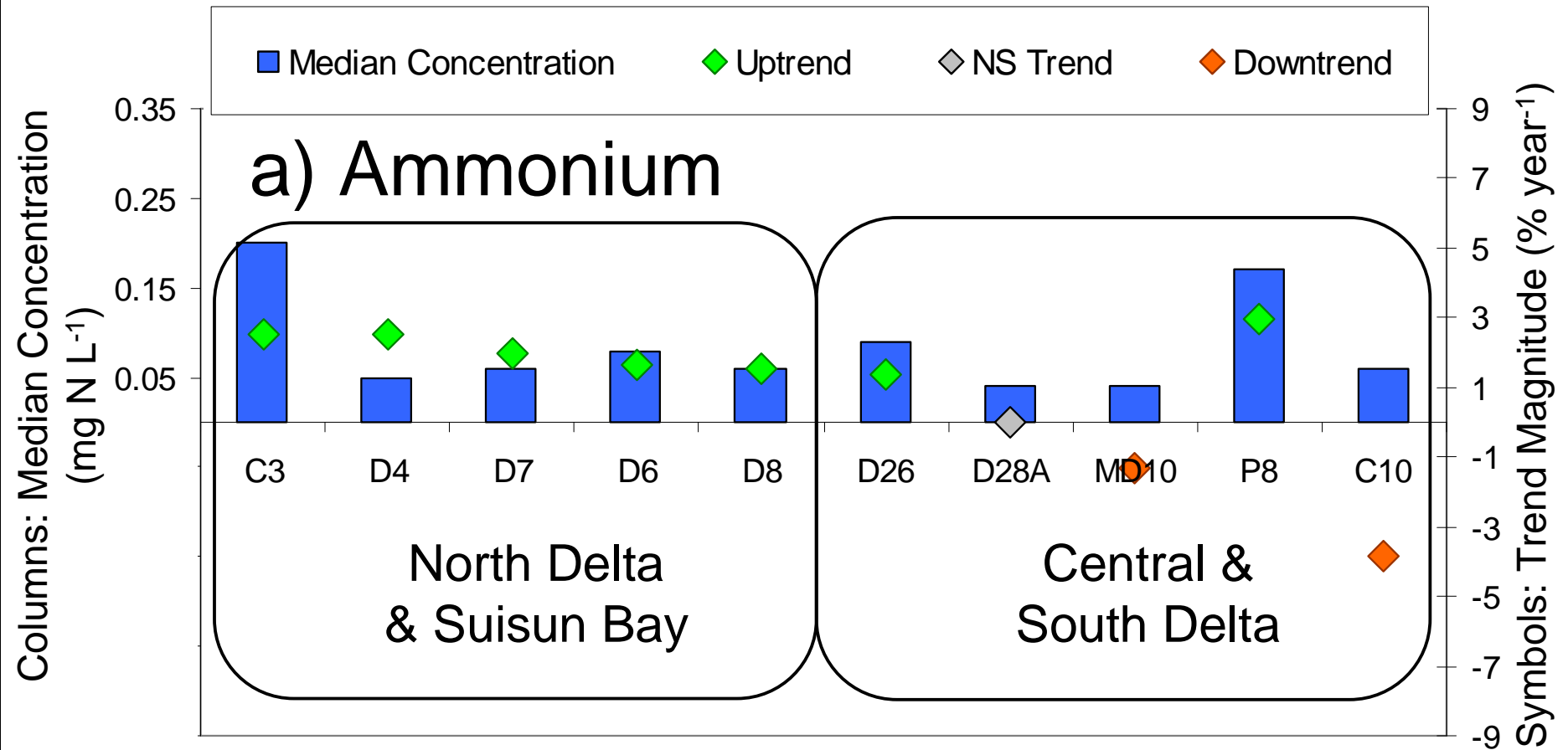
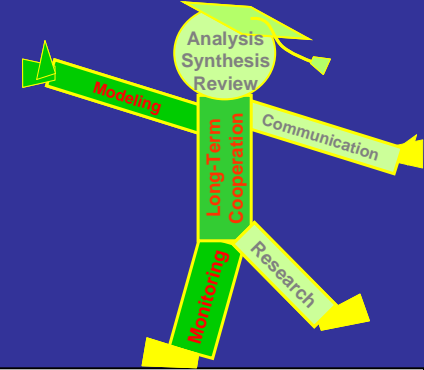
Data Source: DWR-USBR long-term WQ monitoring (EMP)
Published in Jassby, SFEWS 2009



Ammonium-N increased

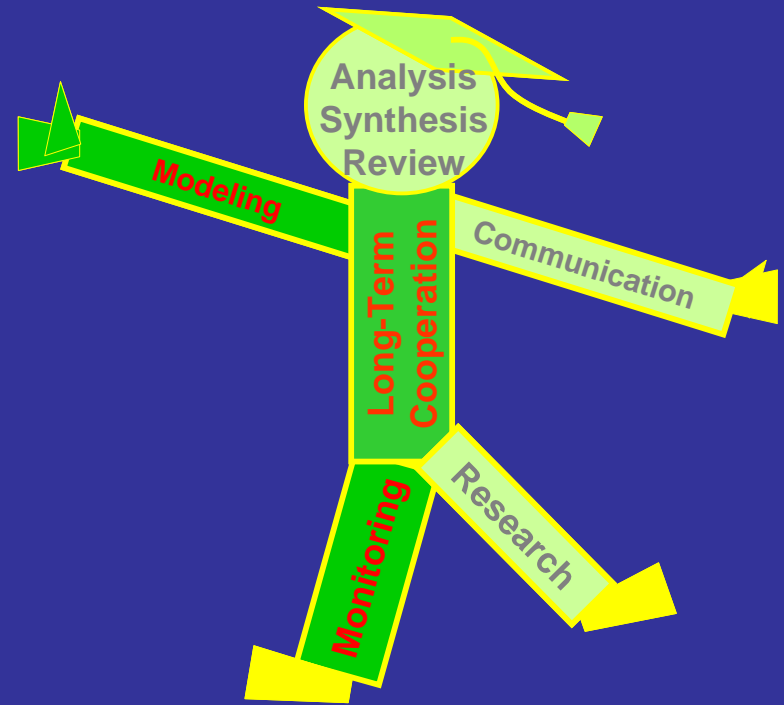
e.g. Ammonium-N concentrations

Data Source DWR-USBR long-term WQ monitoring (EMP)



IEP Monitoring:

- Long-term
- Cooperative
- Consistent
- Mostly Mandated
 - SFE, Delta & Suisun focus
 - Mostly channels & bays
 - Continuous to semi-annually
 - *Variables:*
 - Fish
 - Jellyfish
 - Zooplankton
 - Benthos
 - Phytoplankton
 - Nutrients, D.O., pH, Turbidity
 - Salinity/EC, Temperature
 - Flow



NOT:

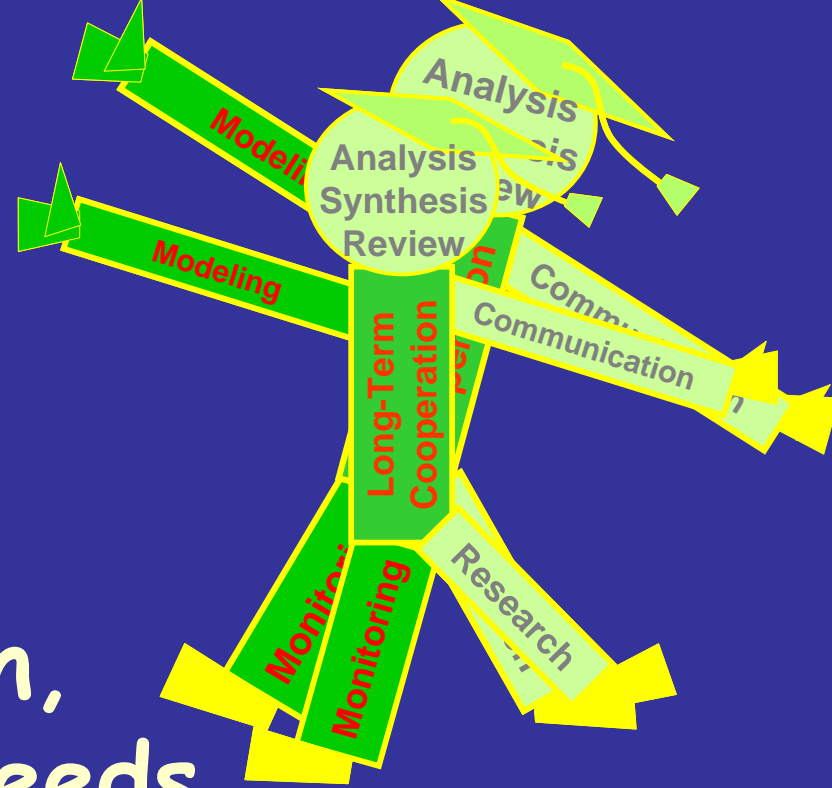
- Microbes*
- Toxicity & Contaminants*
- Wetlands
- Plants*
- Vegetated Edges/Shore*
- Fish Condition*

* Pilots with POD

IEP Monitoring:

- Long-term
- Cooperative
- Consistent
- Mostly Mandated
- ... but also evolving:

→ Better information,
Responsive to new needs



IEP Monitoring:

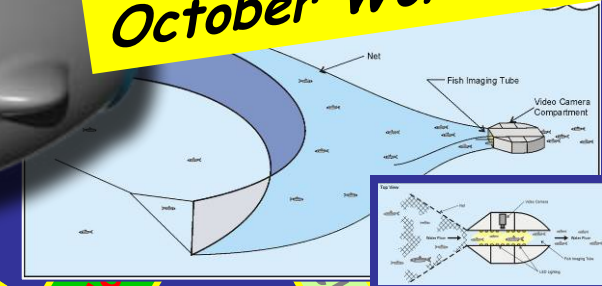
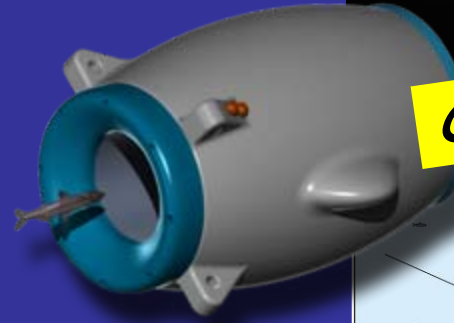
- Long-term
- Cooperative
- Consistent
- Mostly Mandated
- ... but also evolving:

→ Better information,
Responsive to new needs

- New survey designs
- New analyses & modeling
- New variables
- New tools
- New vessels
- New people



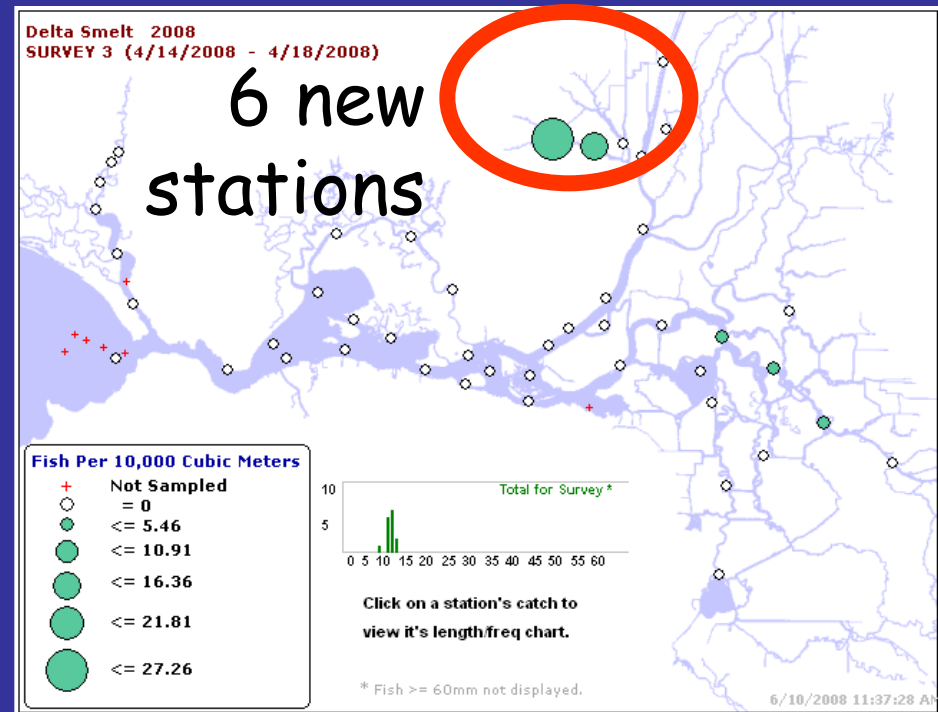
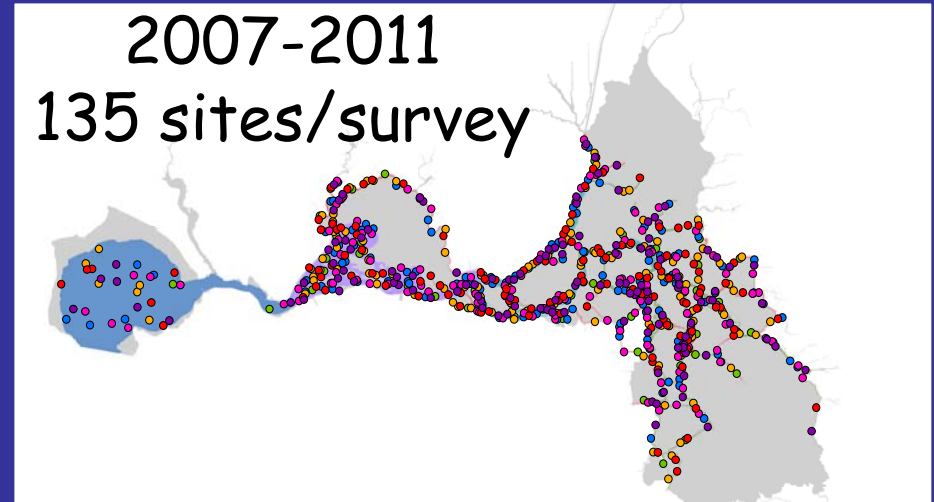
October Workshop!



New survey designs

Benthic semiannual
"distributed" surveys
(GRTS design)

Fish surveys: north
Delta, larval smelt



New variables

Water Toxicity

- *Hyalella azteca*
- Striped bass
- Delta smelt

Contaminants

- Pyrethroids
- Ammonia

Toxic Algae



Aquatic Toxicology Laboratory
School of Veterinary Medicine
University of California
Davis, California

*Pelagic Organism Decline (POD):
Acute and Chronic Invertebrate and Fish Toxicity
Testing in the Sacramento-San Joaquin Delta
2006-2007*

Final Report

30 April, 2008

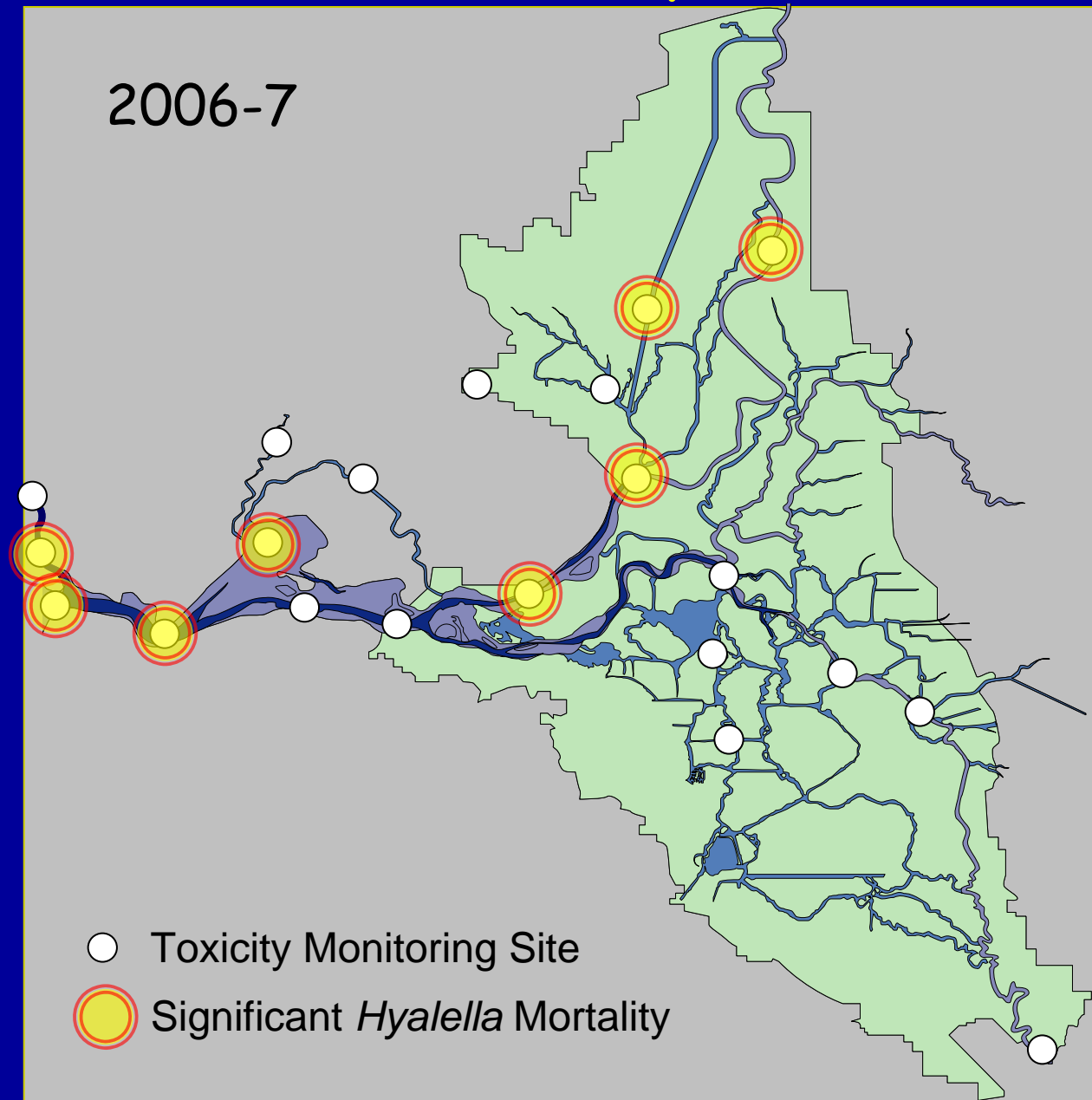
Inge Werner, Linda Deanovic, Dan Markiewicz, Marie
Stillway, Nathan Offer, Richard Connon, Susanne Brander

Pyrethroid Pesticides in the Sacramento-
San Joaquin Delta:
Sources and impacts on Delta waters

Donald Weston, University of California, Berkeley
Michael Lydy, Southern Illinois University
Contact: dweston@berkeley.edu

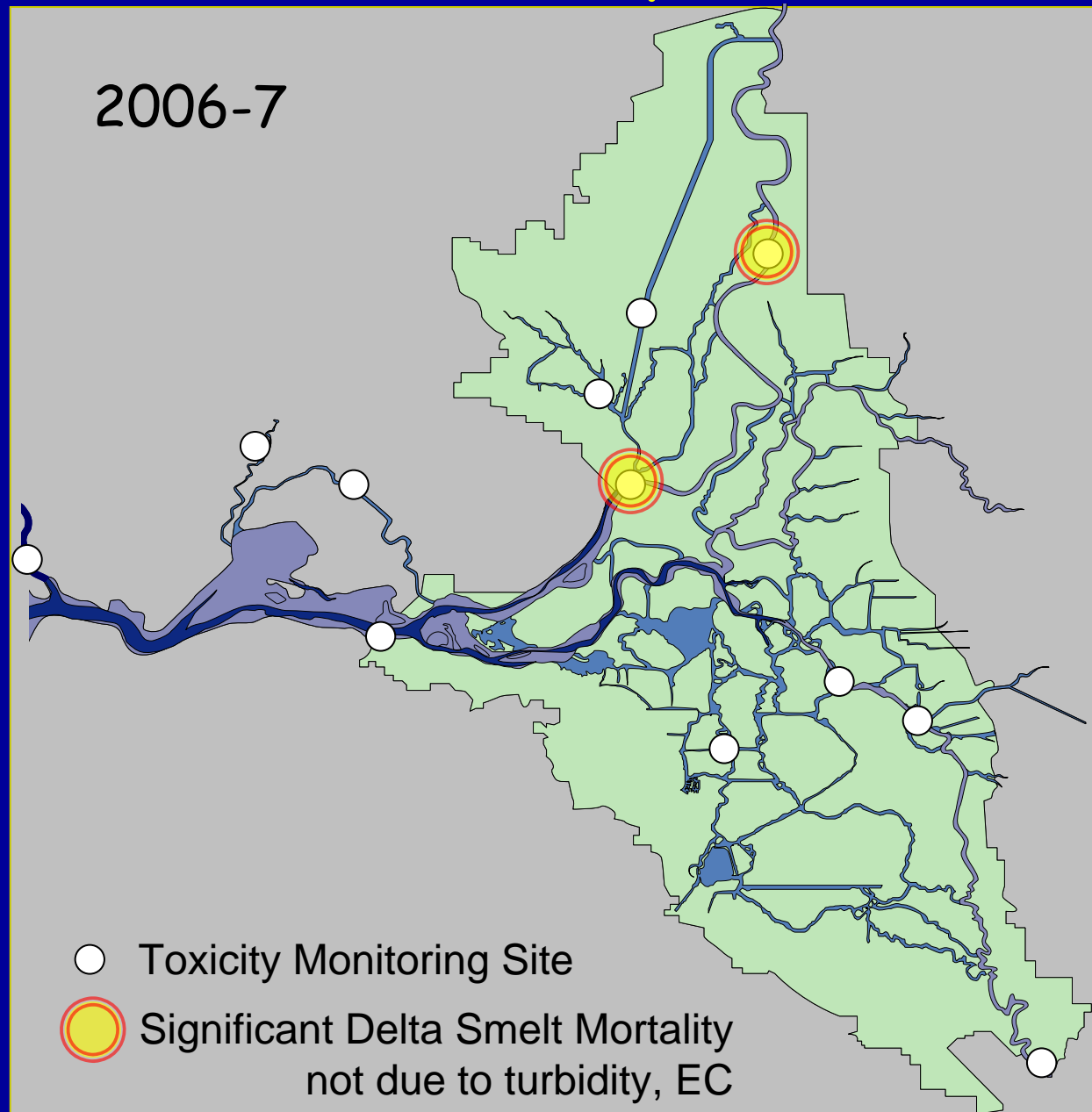
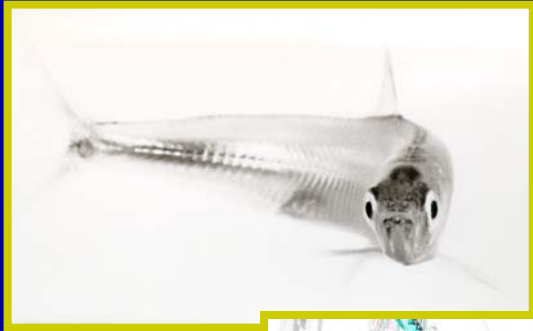
Mortality in 15 of 693 water samples (2.2%)

Hyalella azteca



Mortality in 2 of 71 water samples (3%)

Delta smelt



Summer *Microcystis* blooms in the Delta

Toxic blooms:

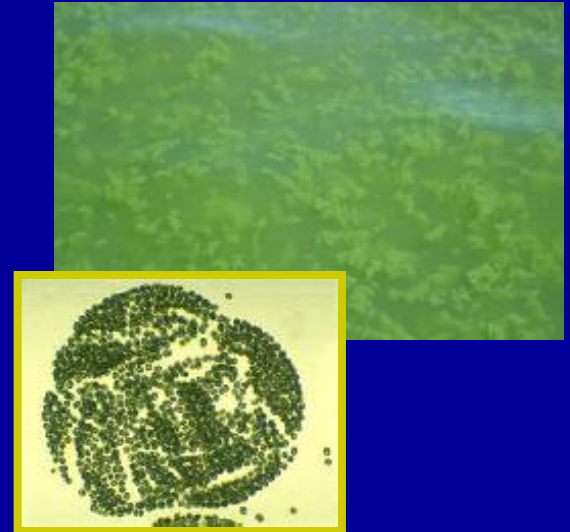
- Low streamflow
 - High water temperature (25°C+)
 - Stable conditions
 - Nutrients?
- 2007&08 were worst bloom years on record

Hydrobiologia (2008) 600:187–204
DOI 10.1007/s10750-007-9231-x

PRIMARY RESEARCH PAPER

The influence of environmental conditions on the seasonal variation of *Microcystis* cell density and microcystins concentration in San Francisco Estuary

P. W. Lehman · G. Boyer · M. Satchwell ·
S. Waller



New analyses & modeling

Delta smelt & longfin smelt abundance estimates


POD-NCEAS groups
*September 8-9
Workshop!*

OCTOBER 2008

SAN FRANCISCO SCIENCE ESTUARY & WATERSHED
Published by the California Bay-Delta Authority Science Program and the John Muir Institute of the Environment

Sample Design-based Methodology for Estimating Delta Smelt Abundance

Ken B. Newman, U.S. Fish and Wildlife Survey
Ken_Newman@fws.gov



National Center for Ecological Analysis and Synthesis

$$\frac{\partial}{\partial t} (\nabla^2 \phi) = \frac{\partial \psi}{\partial z} \frac{\partial}{\partial x} (\nabla^2 \psi) - \frac{\partial \psi}{\partial x} \frac{\partial}{\partial z} (\nabla^2 \psi) + \nu \nabla^2 (\nabla^2 \psi) + \dots$$

CALFED Science Program - POD Work Team page

http://www.science.calwater.ca.gov/pod/pod_work.html

NCEAS IEP POD Work Teams

- IEP Lead: Larry Brown, USGS
- NCEAS Lead: Erica Fleishman, Fleishman@nceas.ucsb.edu
- POD Steering Committee
- Systems Ecology
- Contaminants
- Ocean Interactions

New analyses & modeling

2009 IEP PUBLIC WORKSHOP SERIES

[2009 IEP Workshop Series Overview](#)

[Agenda for 2009 Workshop 1:](#)

Physical Modeling and Fish Management

May 26-27, 2009

CALFED Delta Room, 650 Capitol Mall, Sacramento, CA.

For additional workshop materials, please see http://www.science.calwater.ca.gov/events/IEP_SAG.html

May Workshop!

May 26 & 27, 2009, CALFED Delta Room, Sacramento:

Public IEP Workshop featuring

the latest models combining
physics and fish

and a panel of
IEP Science Advisors

[Click here to read more...](#)

Interagency Ecological Program
for the San Francisco Estuary

PROGRAM REVIEWS

Analysis
Synthesis
Review

Modeling

Communication

Long-Term
Cooperation

Monitoring

Research

"Special Studies"

Dr. IEP-Science
does science!

-- **RESEARCH**

"Investigative
journalism"



**Analysis
Synthesis
Review**

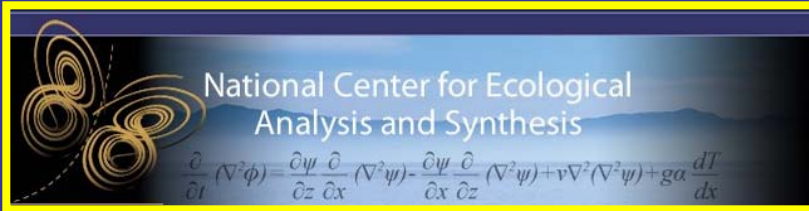
Modeling

Communication

**Long-Term
Cooperation**

Monitoring

Research

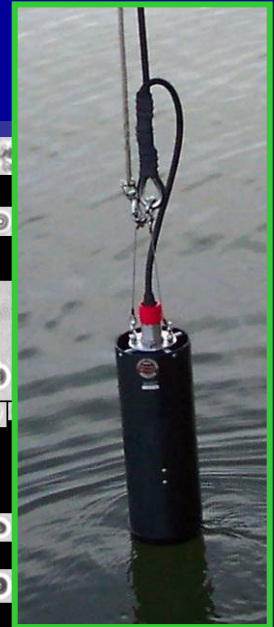
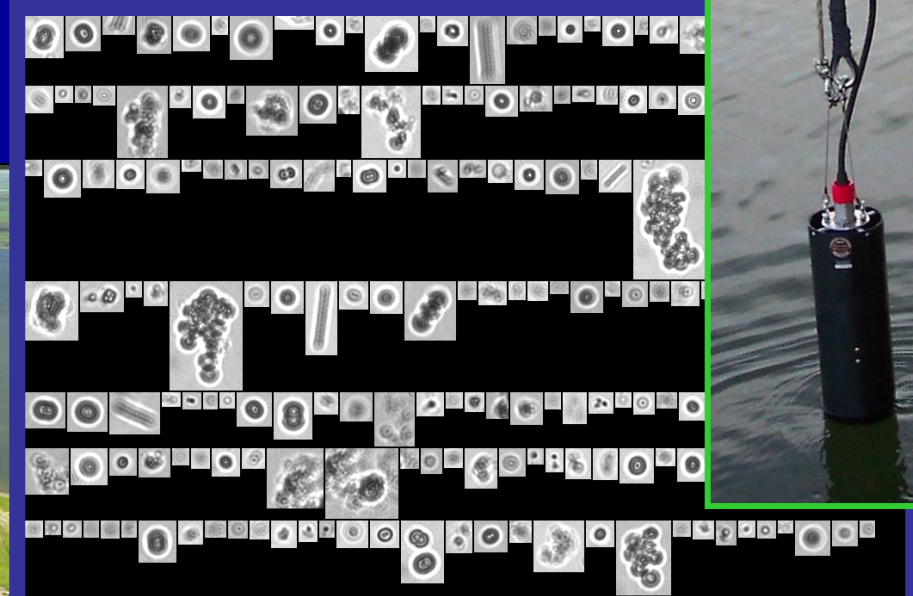
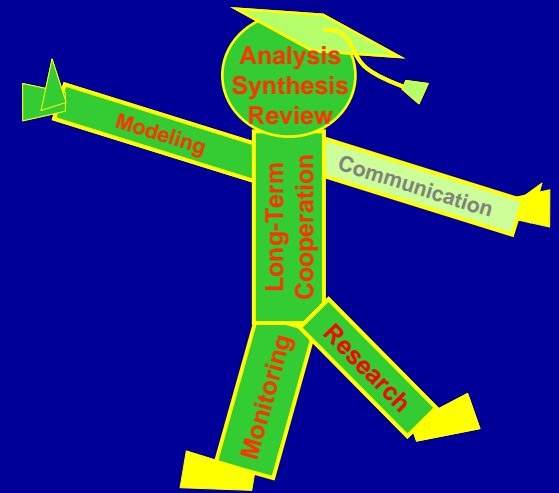


September Workshop

IEP Science Advisory Group

CALFED Science Reviews

- Fish Facilities
- Monitoring Technologies



IEP POD Investigations

Since 2005

What, why, how?



CALFED Science Program - POD page - Windows Internet Explorer

http://www.science.calwater.ca.gov/pod/pod_index.html

File Edit View Favorites Tools Help

Google

CALFED Science Program - ...

Delta Smelt
Distribution
Comparing smelts

Longfin Smelt

Striped Bass
DFG Striped Bass Program

Threadfin Shad

IEP POD SYNTHESIS REPORTS

- 2008 Synthesis of Results - Pending Release
- Summary of Ammonia Results, March 2009 prepared for the CALFED workshop on
- Ammonia/Ammonium
- 2007 Synthesis of Results
- 2005 Synthesis of Results
- 2005 CALFED Review

IEP POD WORKPLANS

- 2009 Addendum to 2008 Workplan
- 2008 Workplan
- 2006-2007 Workplan
- 2005 Workplan

Interagency Ecological Program
COOPERATIVE ECOLOGICAL INVESTIGATIONS SINCE 1970



2009 POD Workplan:

54 studies,

> 100 scientists,

~ \$12 million

Problems: bond freezes,
furloughs, contracting

IEP POD Investigations POD Conceptual Model



CALFED Science Program - POD page - Windows Internet Explorer

http://www.science.calwater.ca.gov/pod/pod_index.html

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CALFED Science Program - ...

Delta Smelt
Distribution
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Threadfin Shad

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IEP POD WORKPLANS

- 2009 Addendum to 2008 Workplan
- 2008 Workplan
- 2006-2007 Workplan
- 2005 Workplan

IEP POD LINKS

- POD Home
- POD Management Team
- POD Work Teams
- Final Study Reports
- Publications
- IEP Calendar

IEP NEWSLETTER

The IEP Newsletter is now available online.

Science News

News from the CALFED Science Program

The CALFED Science Program's Science News is now available online.

SAN FRANCISCO ESTUARY & WATERSHED

The San Francisco Estuary and Watershed Science is now available online

Conceptual Model Diagram:

```
graph TD
    subgraph TOP_DOWN [TOP-DOWN]
        Water[Water Operations]
        Predator[Predation]
    end
    subgraph BOTTOM_UP [BOTTOM-UP]
        FoodAvail[Food Availability]
        FoodQual[Food Quality]
    end
    Water --> FishAbund[FISH ABUNDANCE]
    Predator --> FishAbund
    FoodAvail --> FishAbund
    FoodQual --> FishAbund
    FishAbund --> Prefer[Prefer Fish Abundance]
```

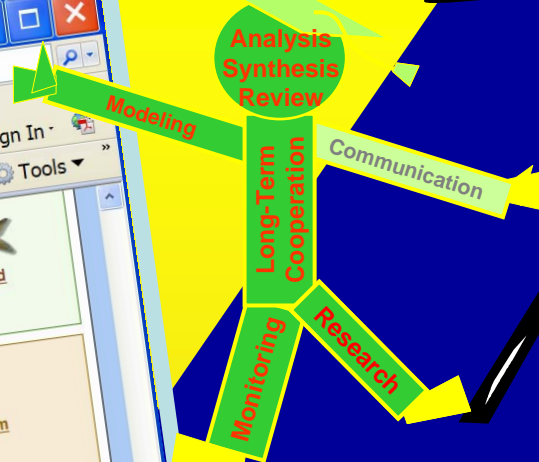
PHYSICAL & CHEMICAL FISH HABITAT

- Salinity
- Temperature
- Turbidity
- Contaminants
- Disease
- Toxic Algae

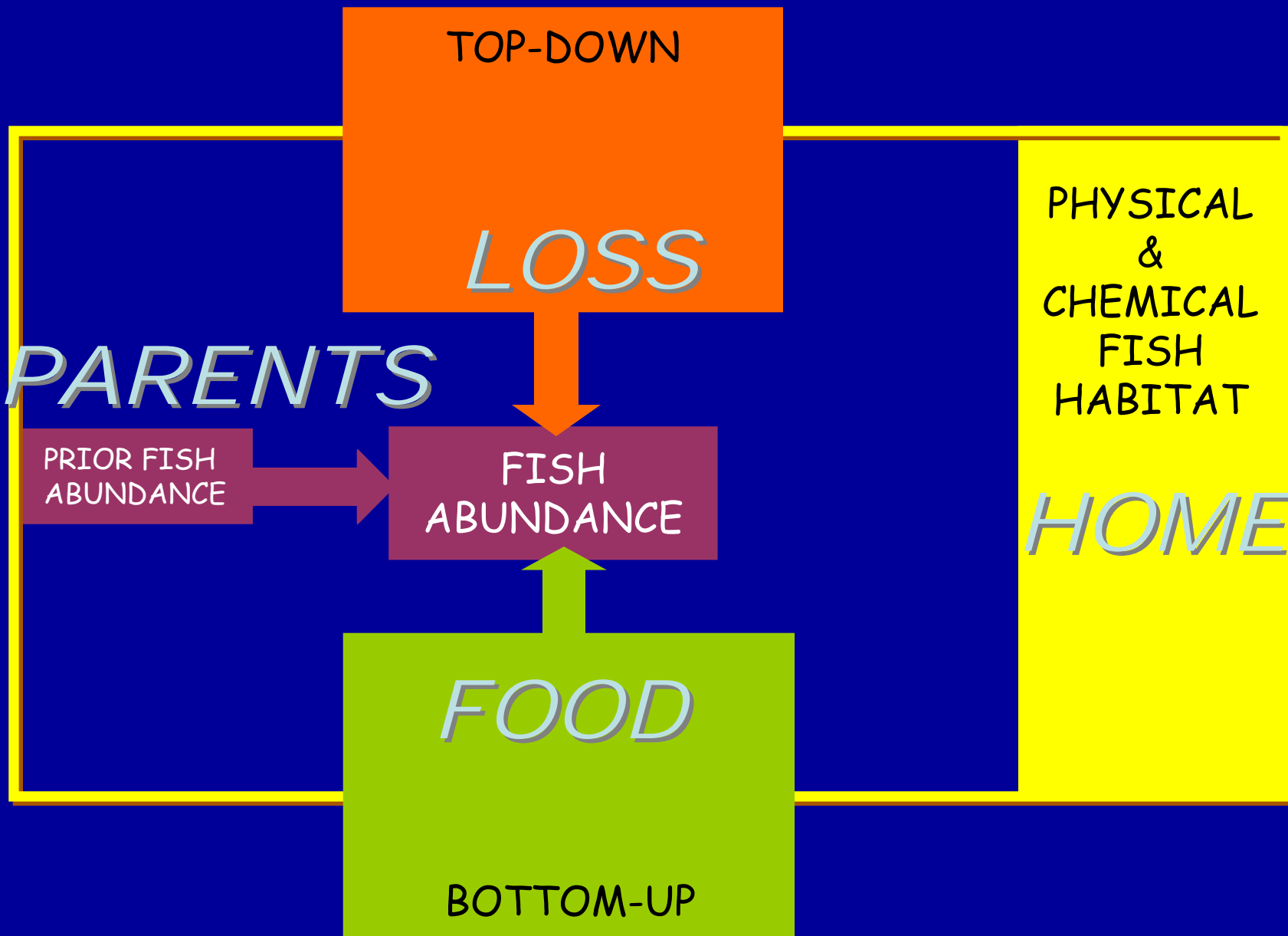
Intergovernmental Ecological Program

COOPERATIVE ECOLOGICAL INVESTIGATIONS SINCE 1970

USBR • USFWS • SWRCB • DFG • NMFS • USEPA • USFWS



Sommer et al,
Fisheries 2007



TOP-DOWN

LOSS

PARENTS

PRIOR FISH
ABUNDANCE

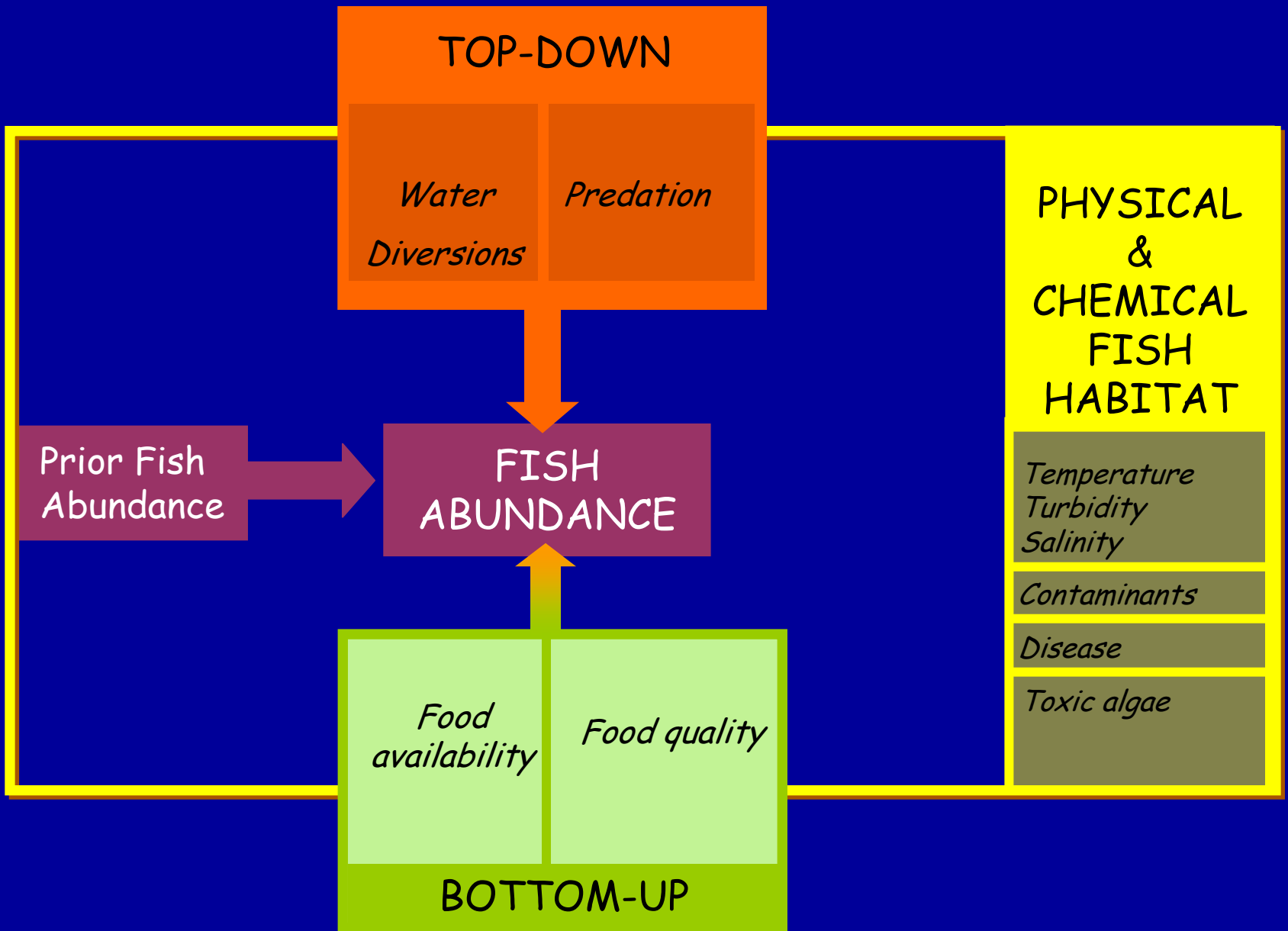
FISH
ABUNDANCE

FOOD

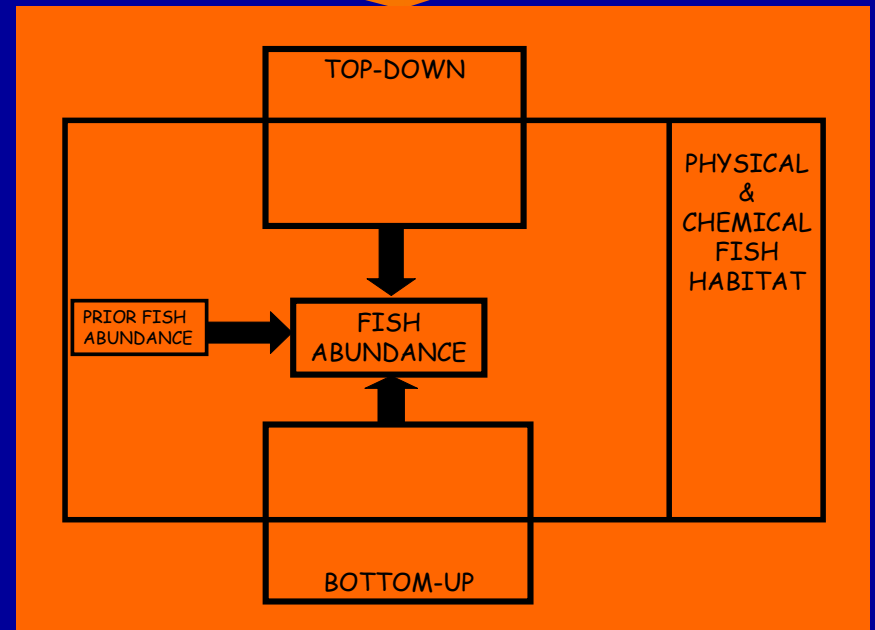
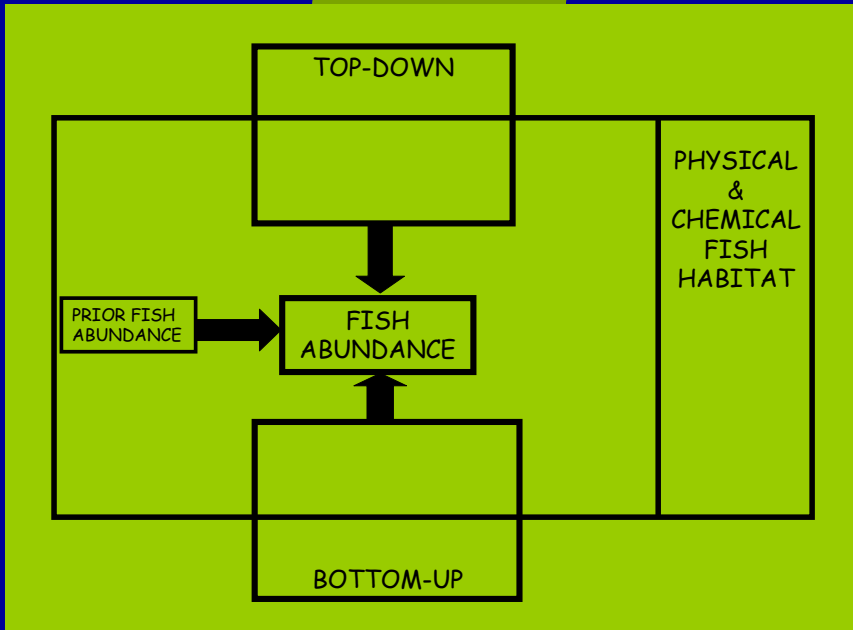
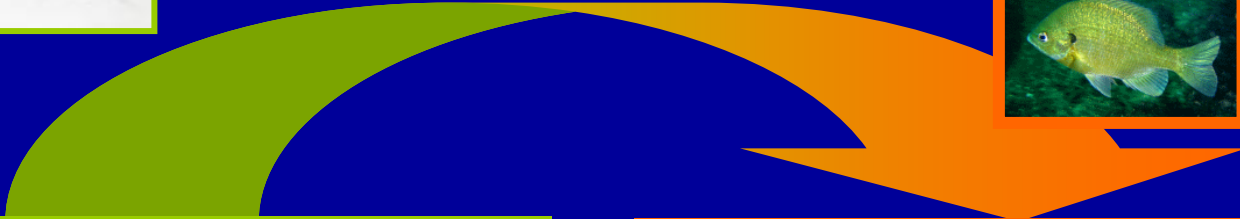
BOTTOM-UP

PHYSICAL
&
CHEMICAL
FISH
HABITAT

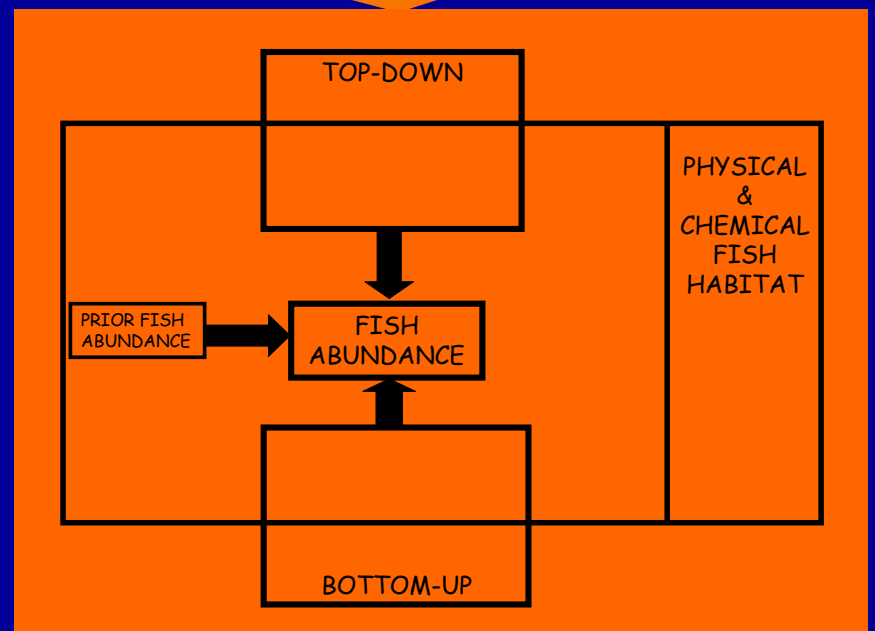
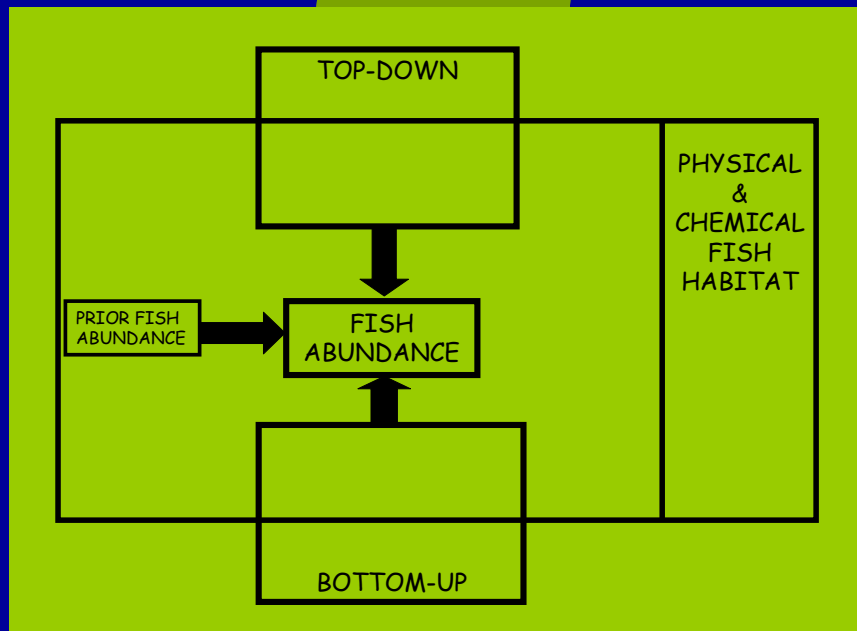
HOME



Emerging POD Story: "Regime Shift"



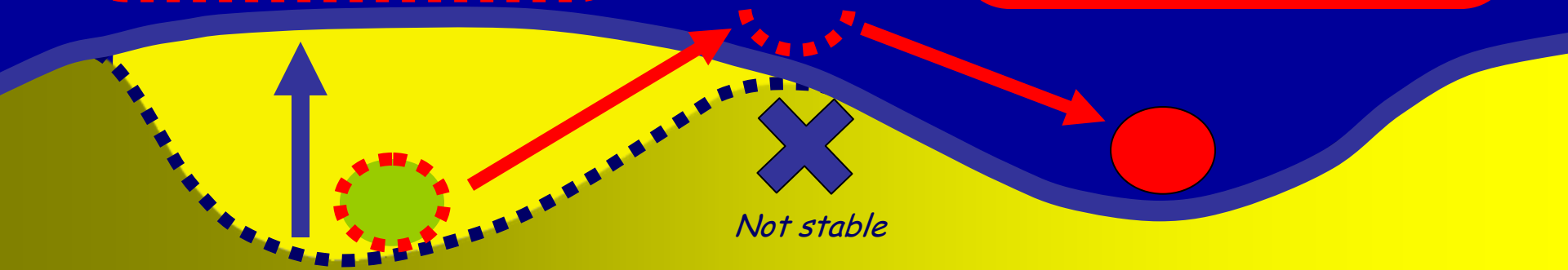
Many Causes, Many Consequences



Little	← Ammonium →	Lots
Low	← Contaminants →	High
Highly variable	← Outflow →	Constant, low
Low	← "Harvest" →	High
Lots	← Phosphorus →	Limited
Cool	← Temperature →	Warm
High	← Turbidity →	Low

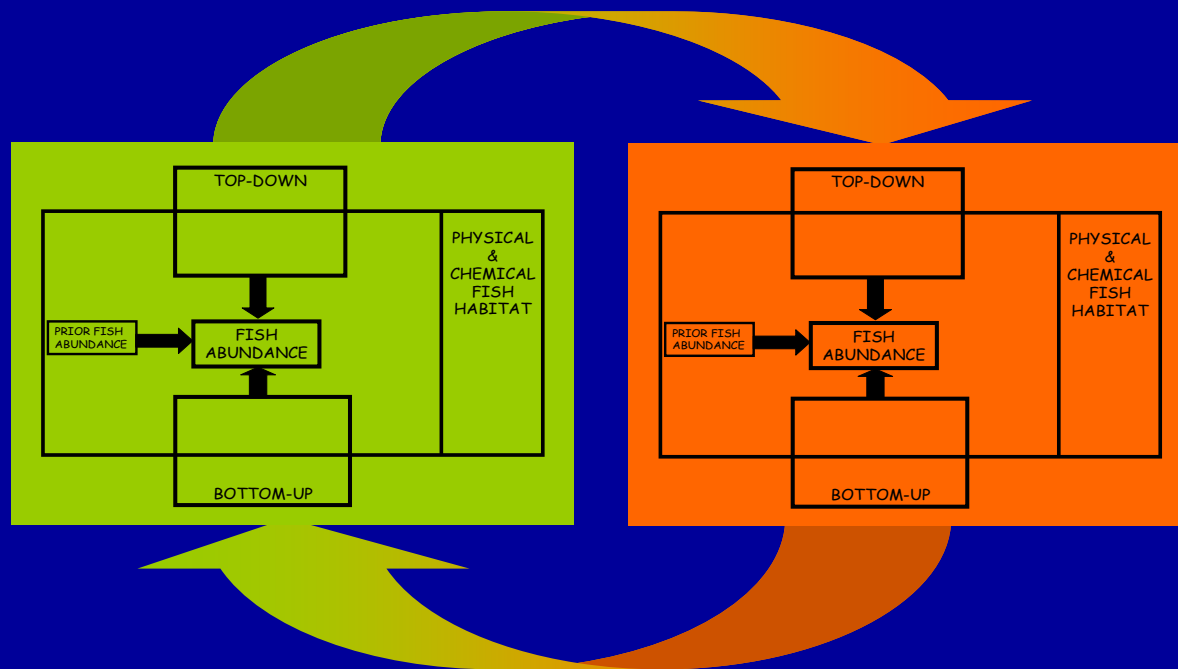
Natives dominate
 Pelagic fish
 Large copepods, mysids
 Diatoms

Invasives dominate
 Edge & benthic fish, jellyfish
 Clams, small copepods
Microcystis, aquatic weeds



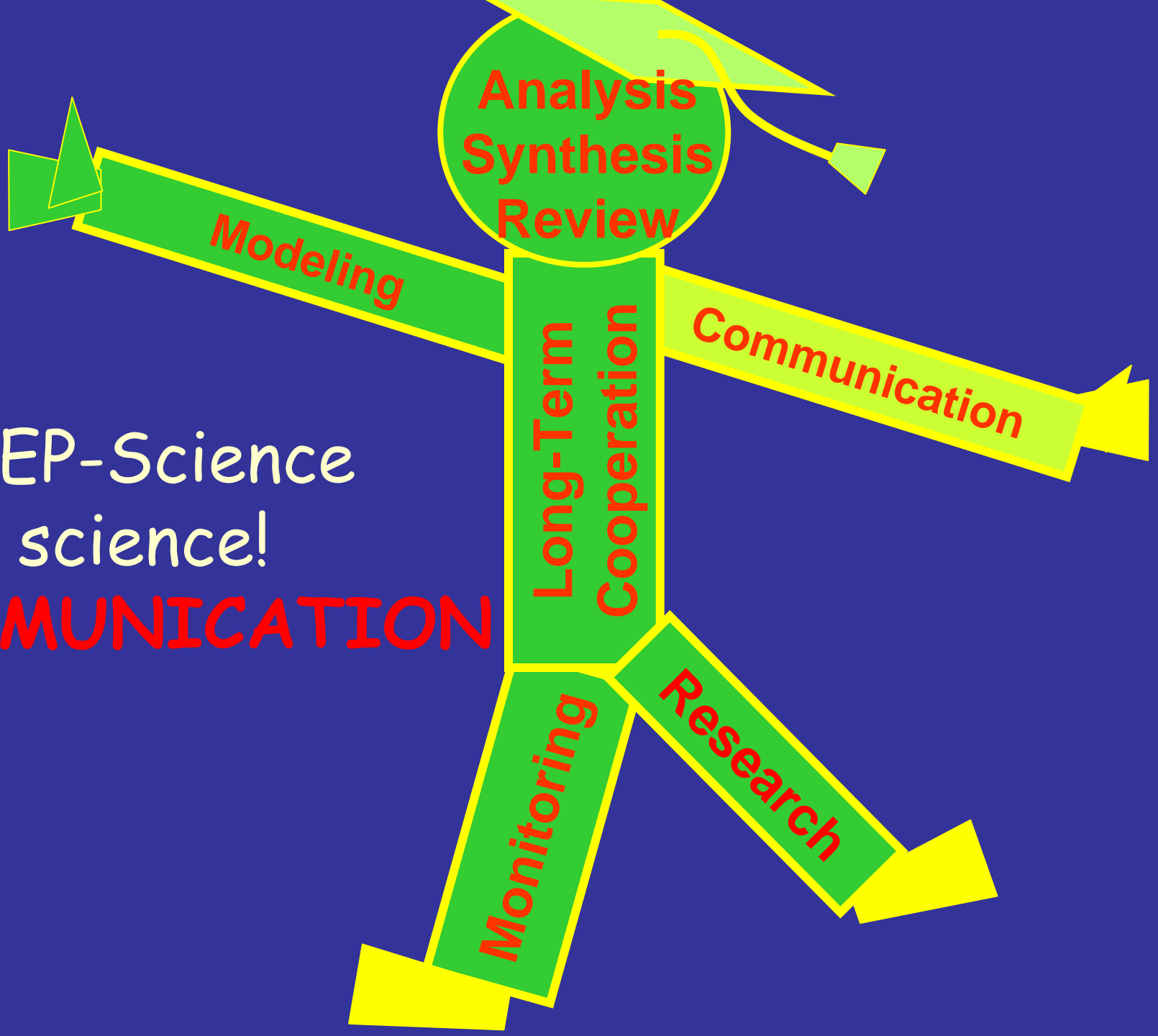
Not stable

POD investigations of many causes, many consequences continue...



... more emphasis on "shift" drivers &
mechanisms and "return" options

Resilience, Thresholds, Hysteresis, Stochasticity, ...
→ Integrated Environmental Assessment



Dr. IEP-Science
does science!

COMMUNICATION

Analysis
Synthesis
Review

Modeling

Long-Term
Cooperation

Communication

- Conferences & Workshops
- Publications and Reports
- IEP Website - redesign!
- IEP Data portals - update!
- IEP Newsletter
- rejuvenation!

Monitoring

Research



IEP NEWSLETTER

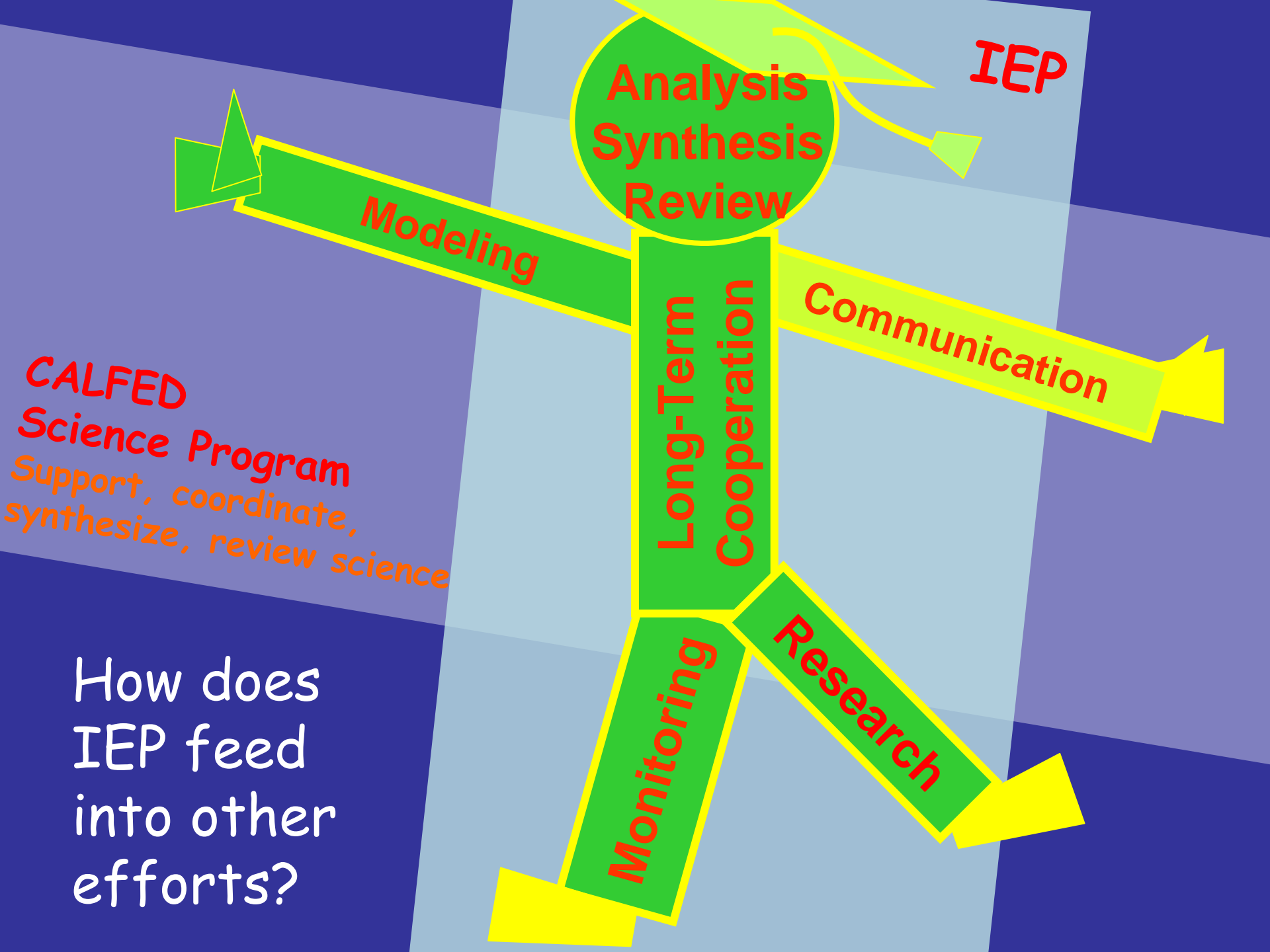
The IEP Newsletter is now available online.

2009 IEP workshop series:

- May 26-27: Physical Modeling & Fish Management (with SAG review)
- June 25: Monitoring & Food Web
- August 18-19: Ammonia Summit
- September 8-9: POD-NCEAS "Systems Ecology" Modeling Results
- October: Bay-Delta monitoring questions and tools for the 21st century

Related workshops:

- CALFED, March 10-11: Ammonia Research Framework
- HSG, June 18: HSG Study Concept
- CALFED, August 6: 2-Gates Review
- CALFED, Fall 2008: HSG Study Plan Review



**Analysis
Synthesis
Review**

IEP

Modeling

Communication

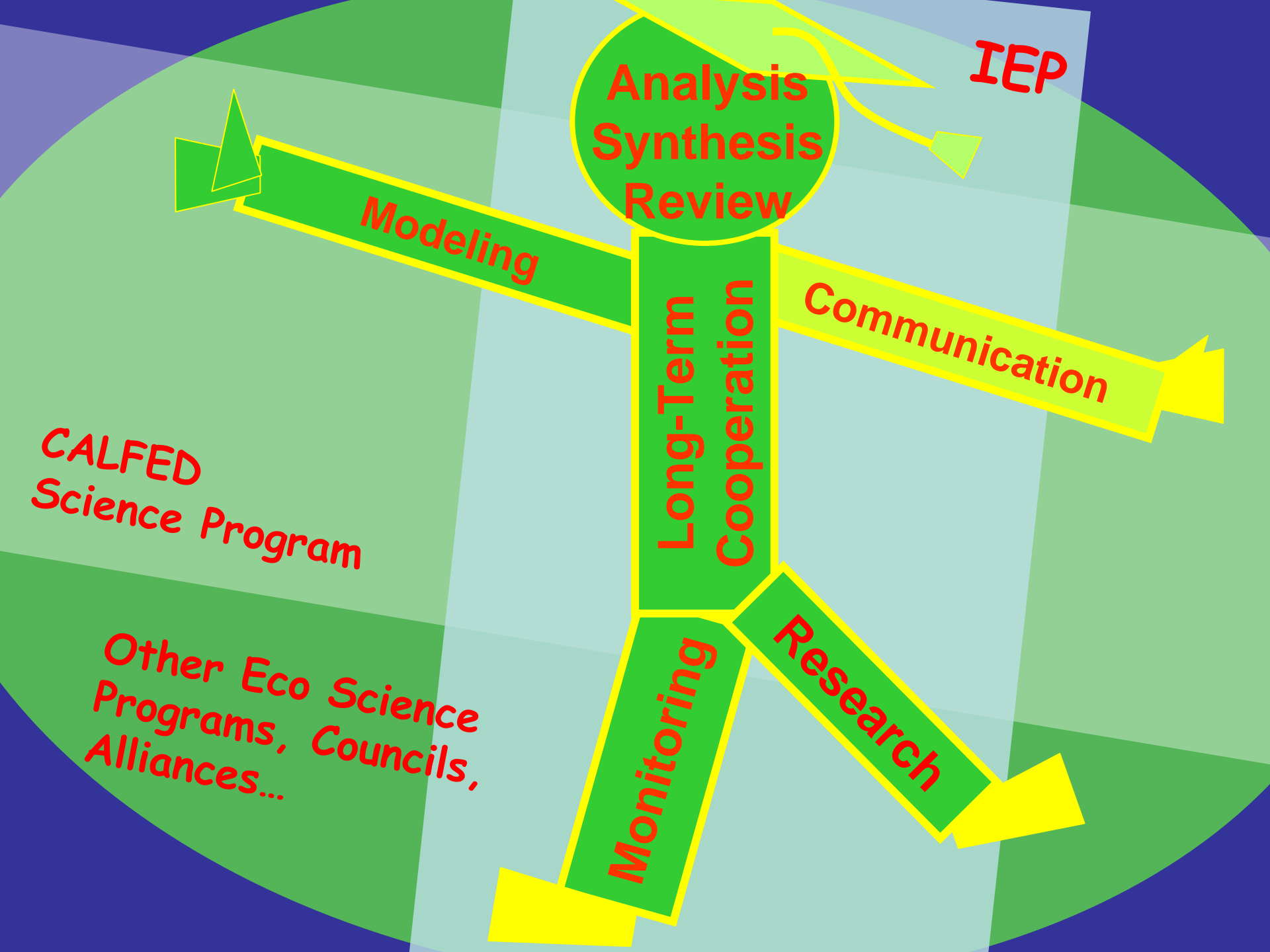
**Long-Term
Cooperation**

**CALFED
Science Program**

**Other Eco Science
Programs, Councils,
Alliances...**

Monitoring

Research



IEP

- Is the Delta ecosystem healthy?
- What stressors affect Delta water and environmental quality?

CALFED
Science Program

Other Eco Science
Programs, Councils,
Alliances...

New IEP Website!

Interagency Ecological Program (IEP) - Windows Internet Explorer

http://www.water.ca.gov/iep/

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CALFED Bay-D... Interagency ...


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 **Interagency Ecological Program**
Cooperative Ecological Investigations
in the San Francisco Estuary since 1970

IEP Home

ACTIVITIES

- Monitoring
- Research
- Pelagic Organism Decline (POD) Investigations
- Program Reviews
- Workshops and Events
- Archive


PRODUCTS

- Data and Metadata
- IEP Newsletter
- Technical Reports
- Journal Publications
- Maps
- Pictures

WELCOME TO THE IEP'S WEBSITE!

This site was launched on June 24, 2009. Please explore the site and send feedback to wtemplin@water.ca.gov. You can still visit the old IEP website (www.iep.ca.gov) until September 2009. (Friday, June 26, 2009)


[IEP Website](#)



[DWR News Archives](#)

Please [click here](#) to take the IEP Data Users Survey


MONITORING

 USFWS launches new boat, the RV Confluence

RESEARCH

 IEP provides funding for research and opportunities for display of

WORKSHOPS AND EVENTS

 September 8-9 "Modeling the Pelagic Organism

Done Internet 100%

IEP

Thanks!

CALFED
Science Program

Other Eco Science
Programs, Councils,
Alliances...