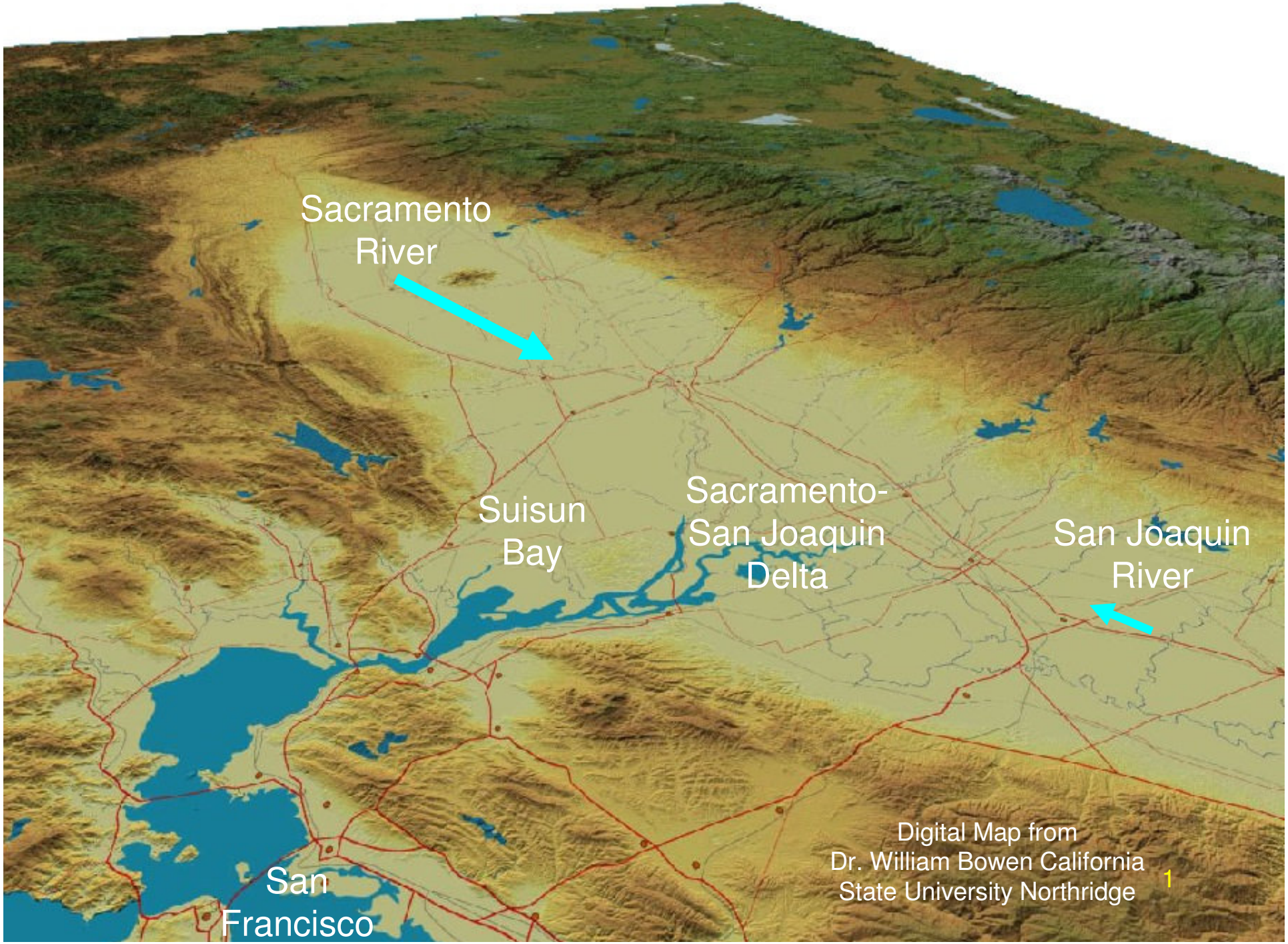
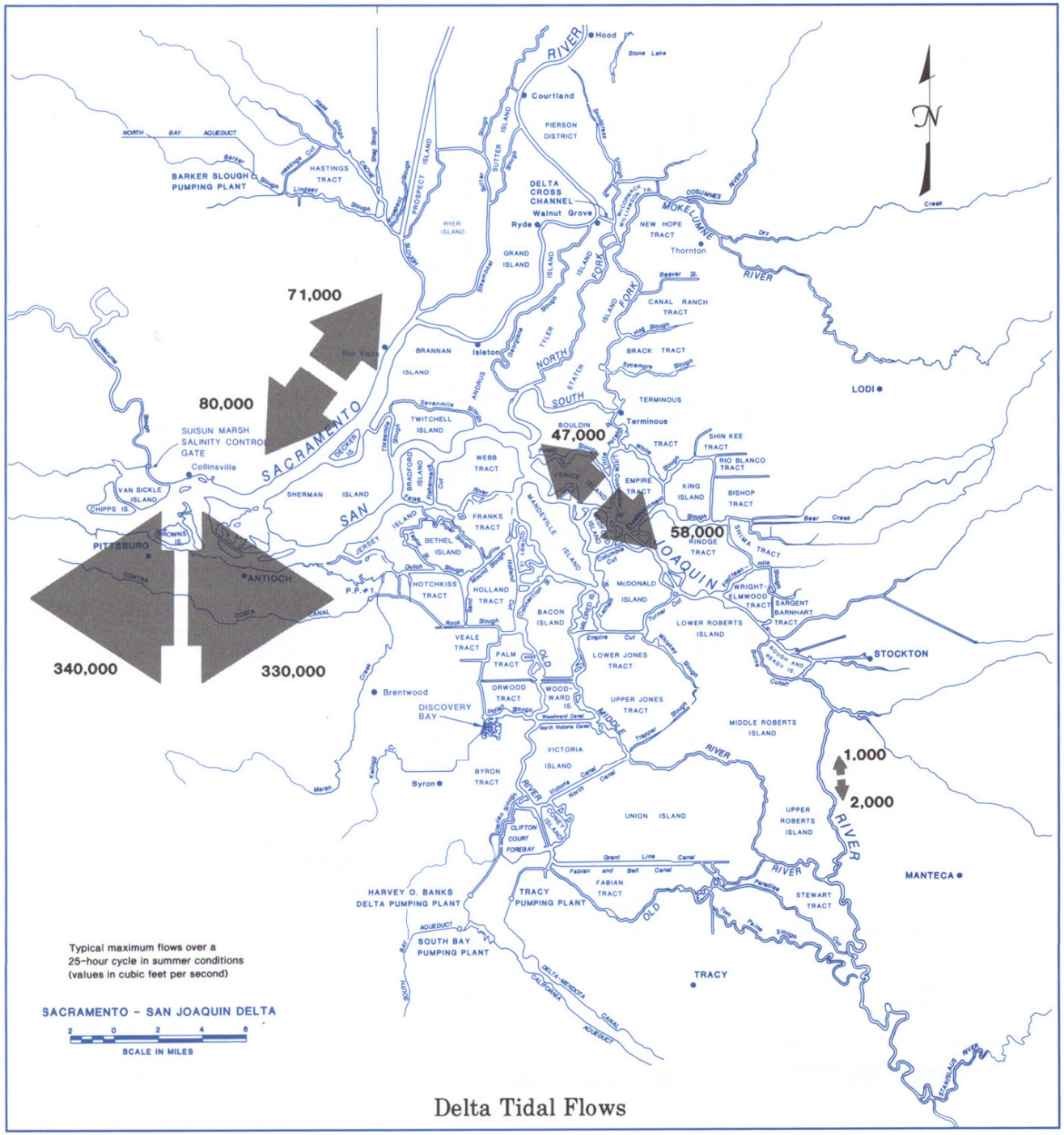

Sacramento
River
Suisun
Bay
Sacramento-
San Joaquin
Delta
San Joaquin
River
San
Francisco
Digital Map from
Dr. William Bowen California
State University Northridge


71,000
80,000
340,000
330,000
47,000
58,000
1,000
2,000
Typical maximum flows over a
25-hour cycle in summer conditions
(values in cubic feet per second)
SACRAMENTO – SAN JOAQUIN DELTA
SCALE IN MILES
Delta Tidal Flows

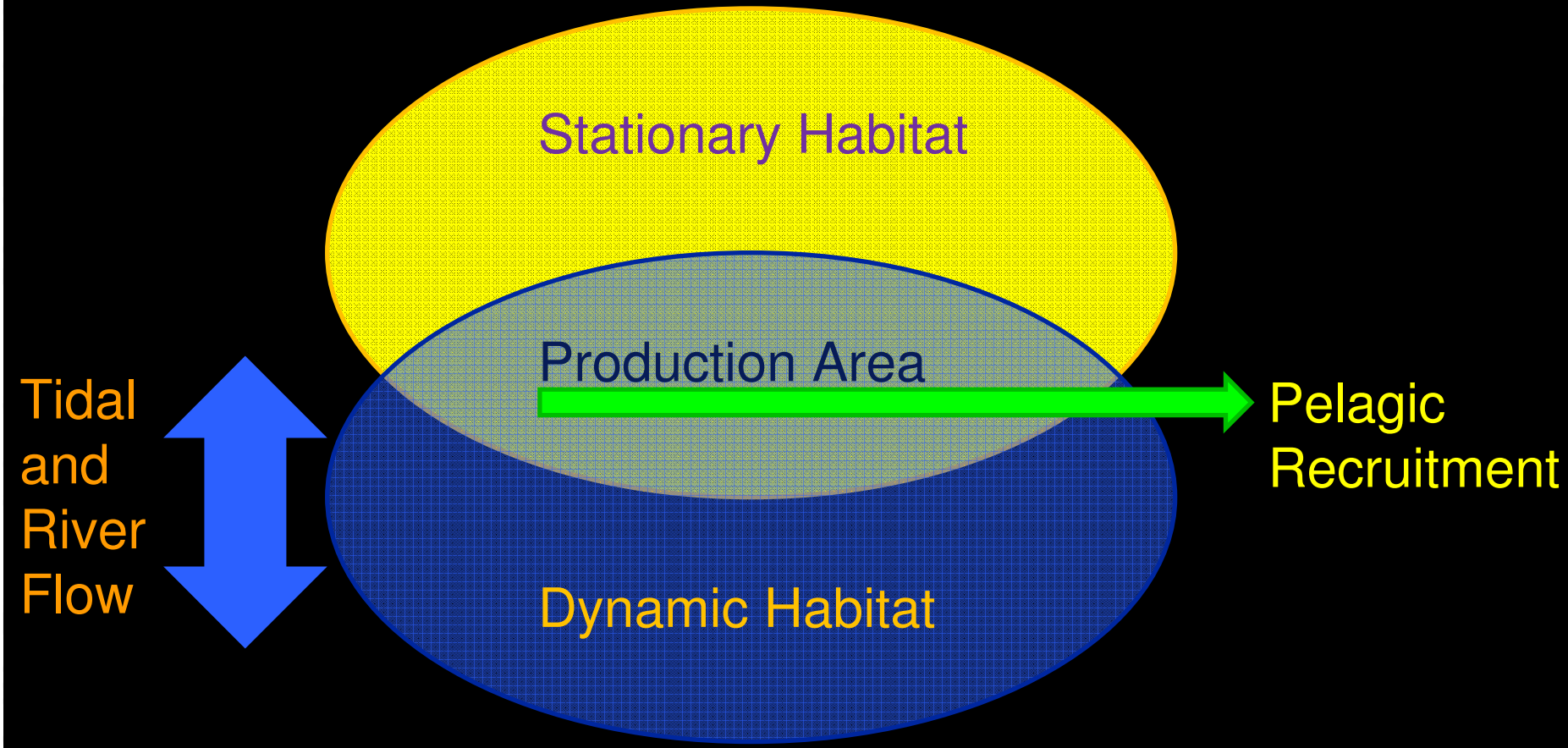
Stationary Habitat ---Geometry

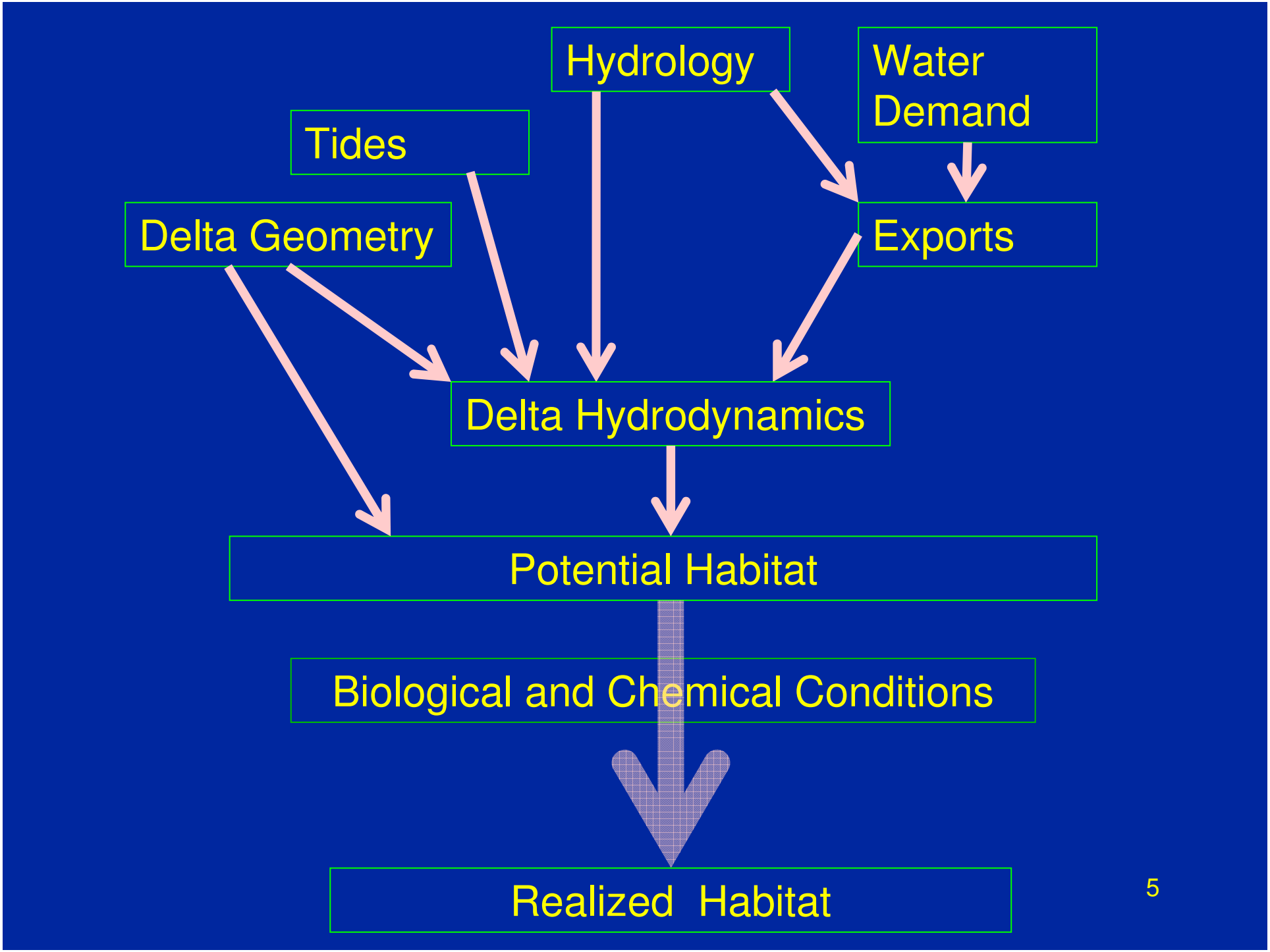
Dynamic Habitat ---
Hydrodynamics, ocean conditions, weather

Biological Conditions

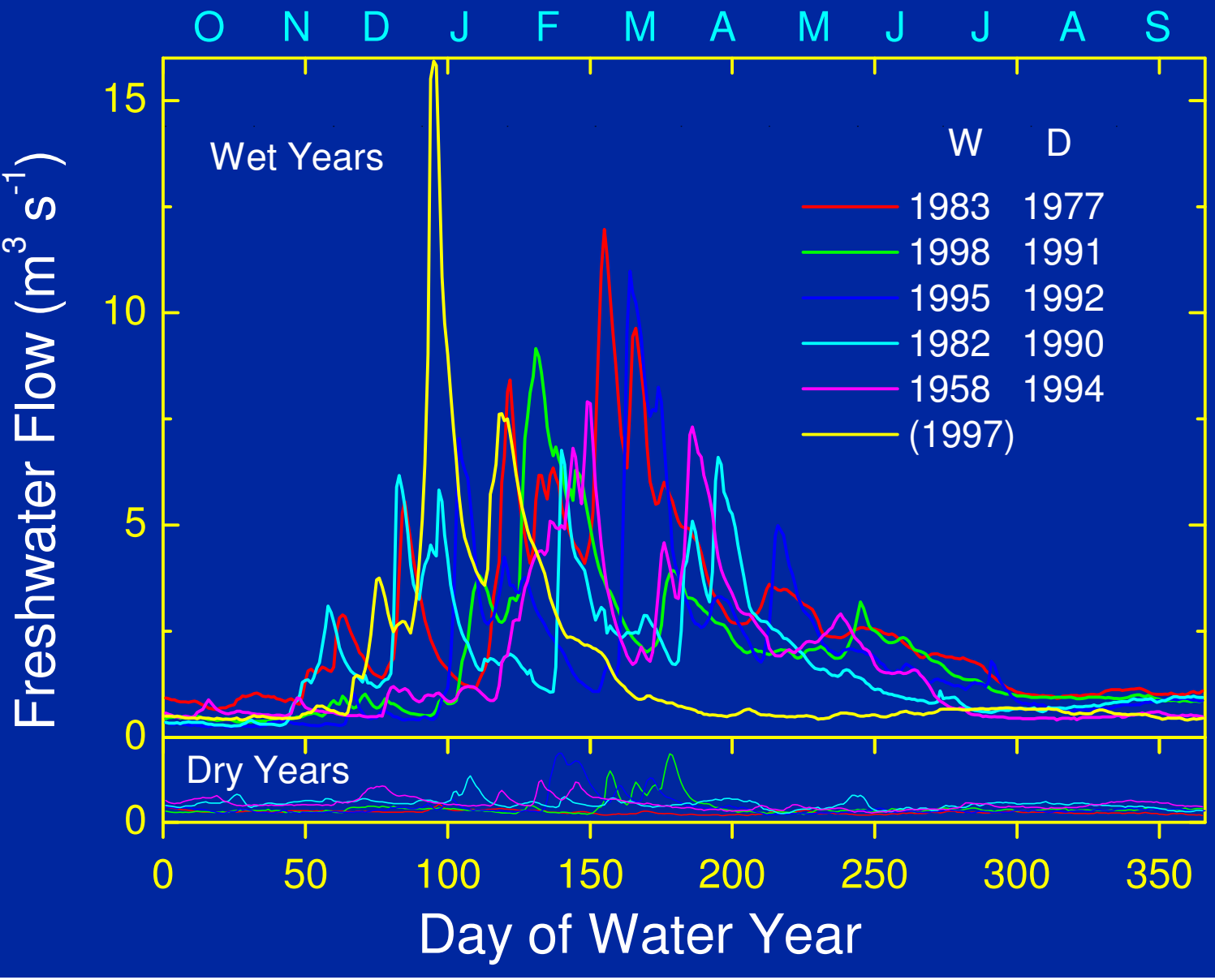
Environment

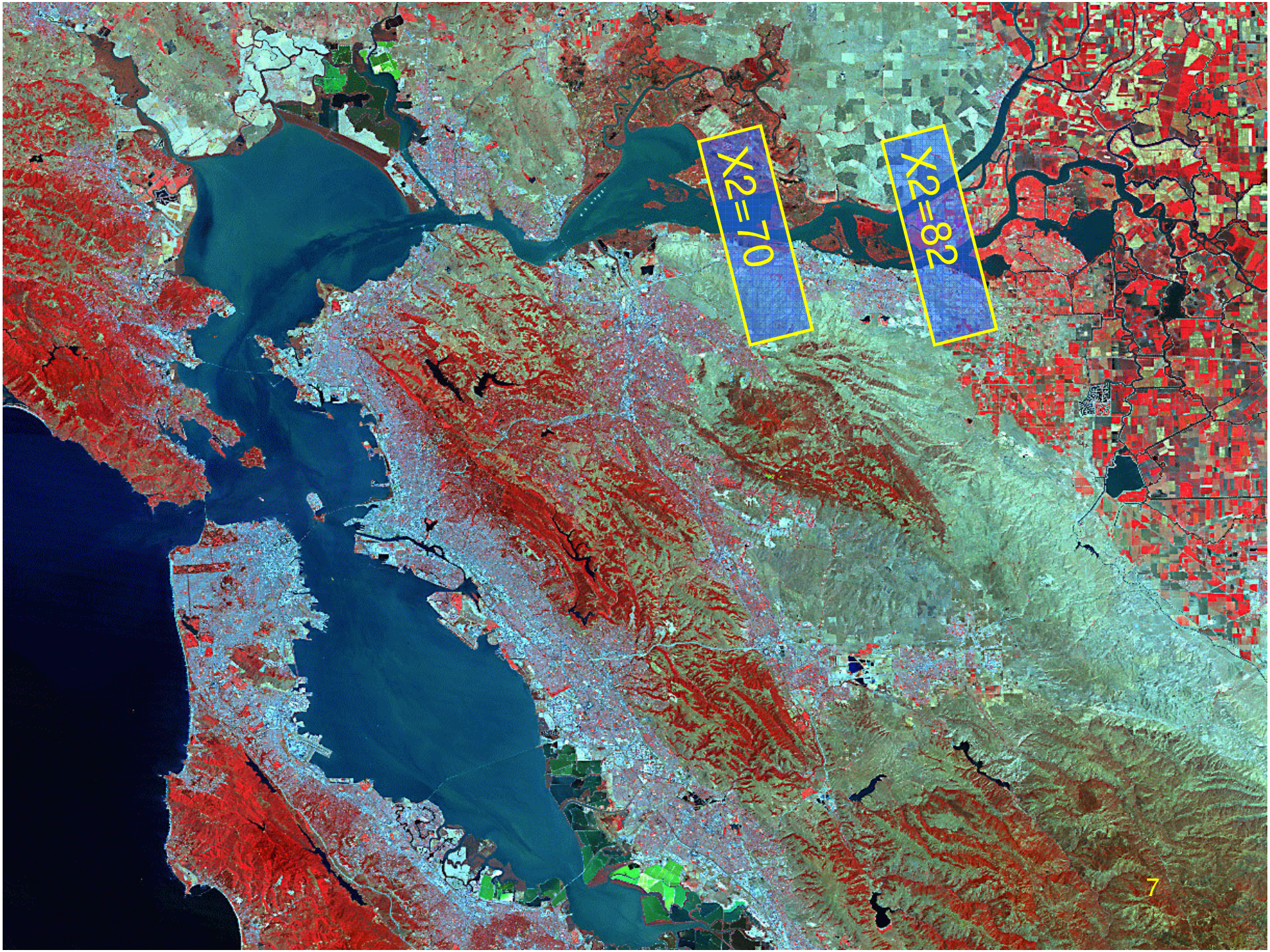
Estuarine habitat conceptual model
(Peterson 2003)



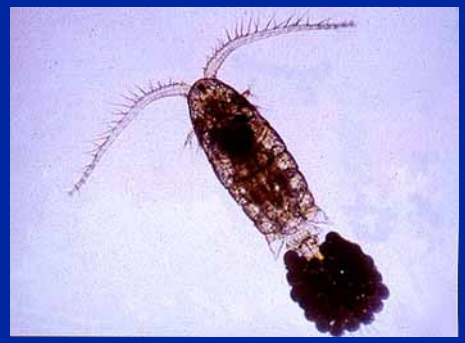

Hydrology
Water Demand
Tides
Delta Geometry
Exports
Delta Hydrodynamics
Potential Habitat
Biological and Chemical Conditions
Realized Habitat

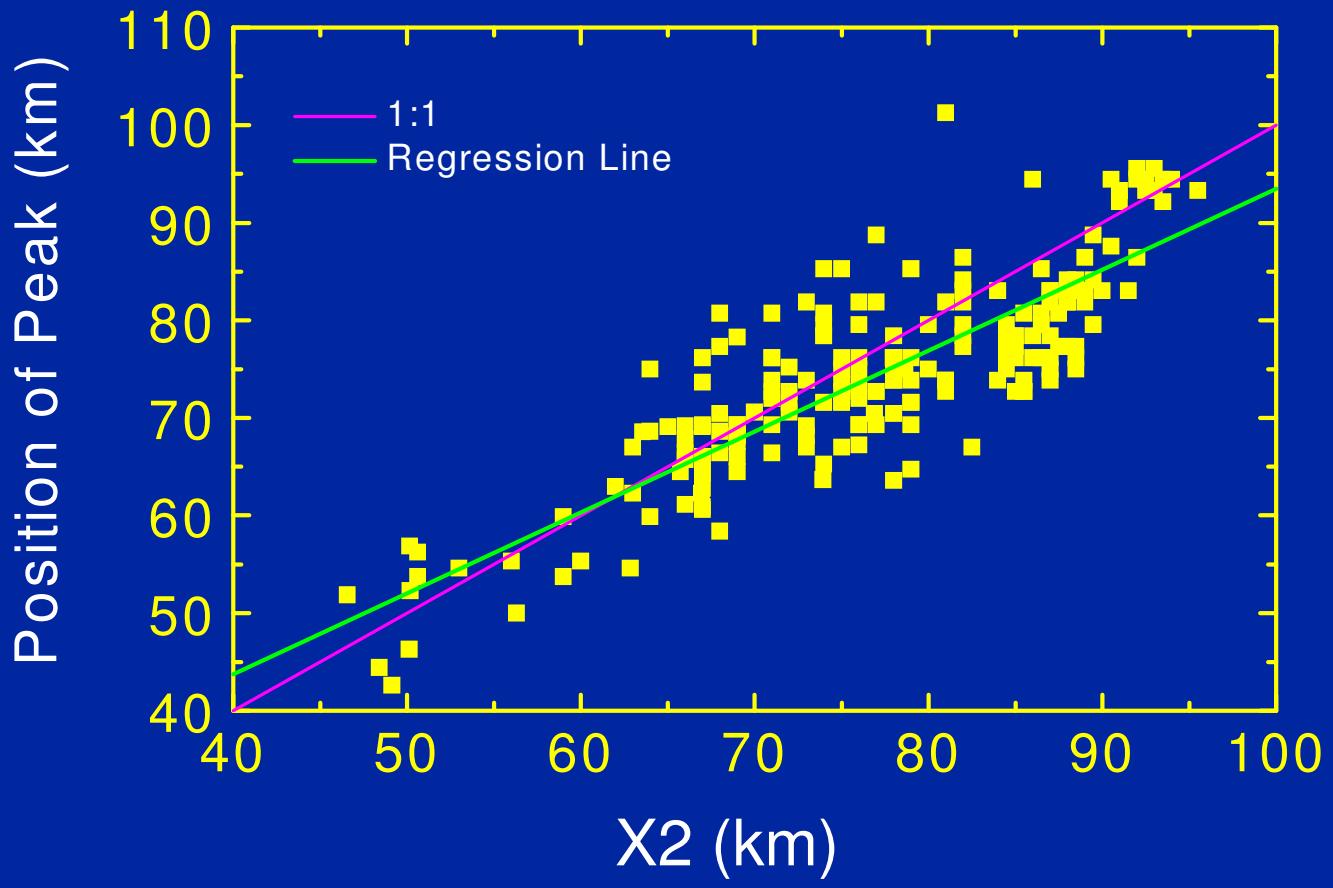
Variability of Freshwater Delta Inflow




X2=70
X2=82

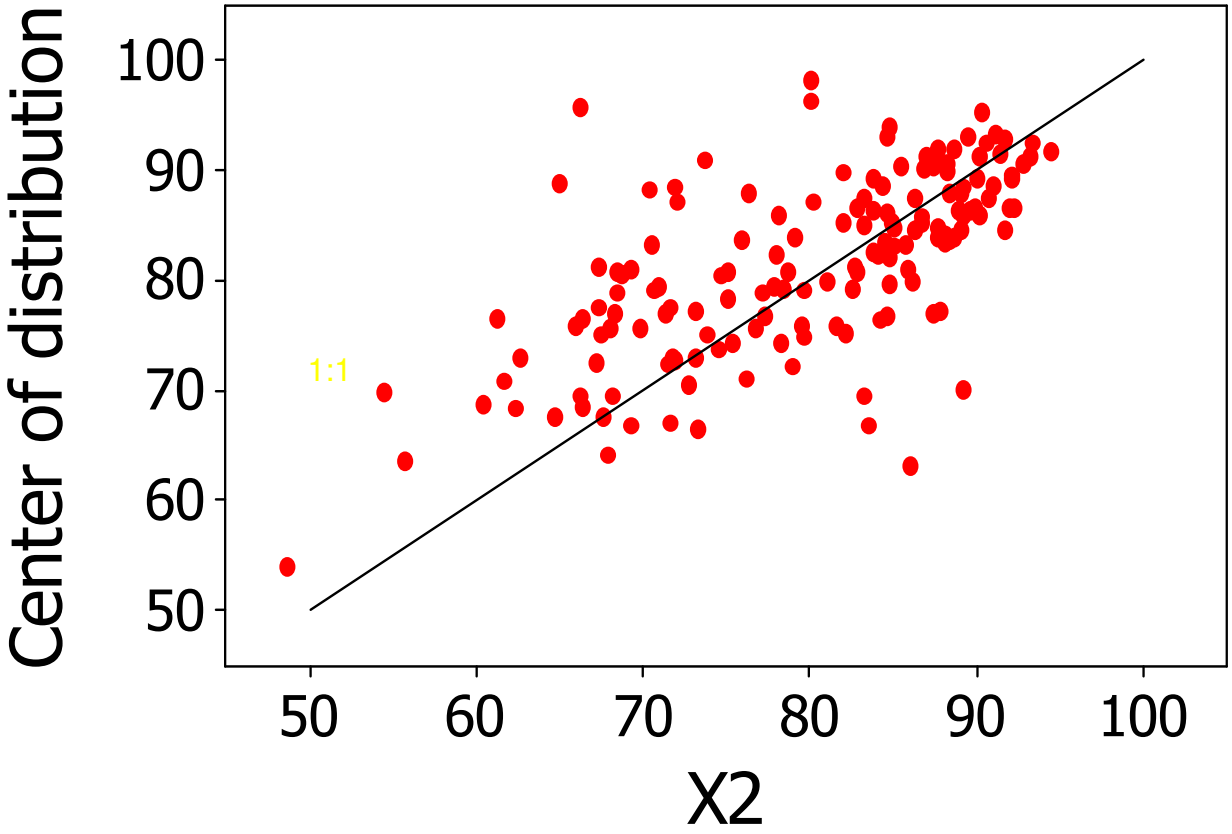
Pelagic organisms follow salinity: The copepod *Eurytemora affinis*



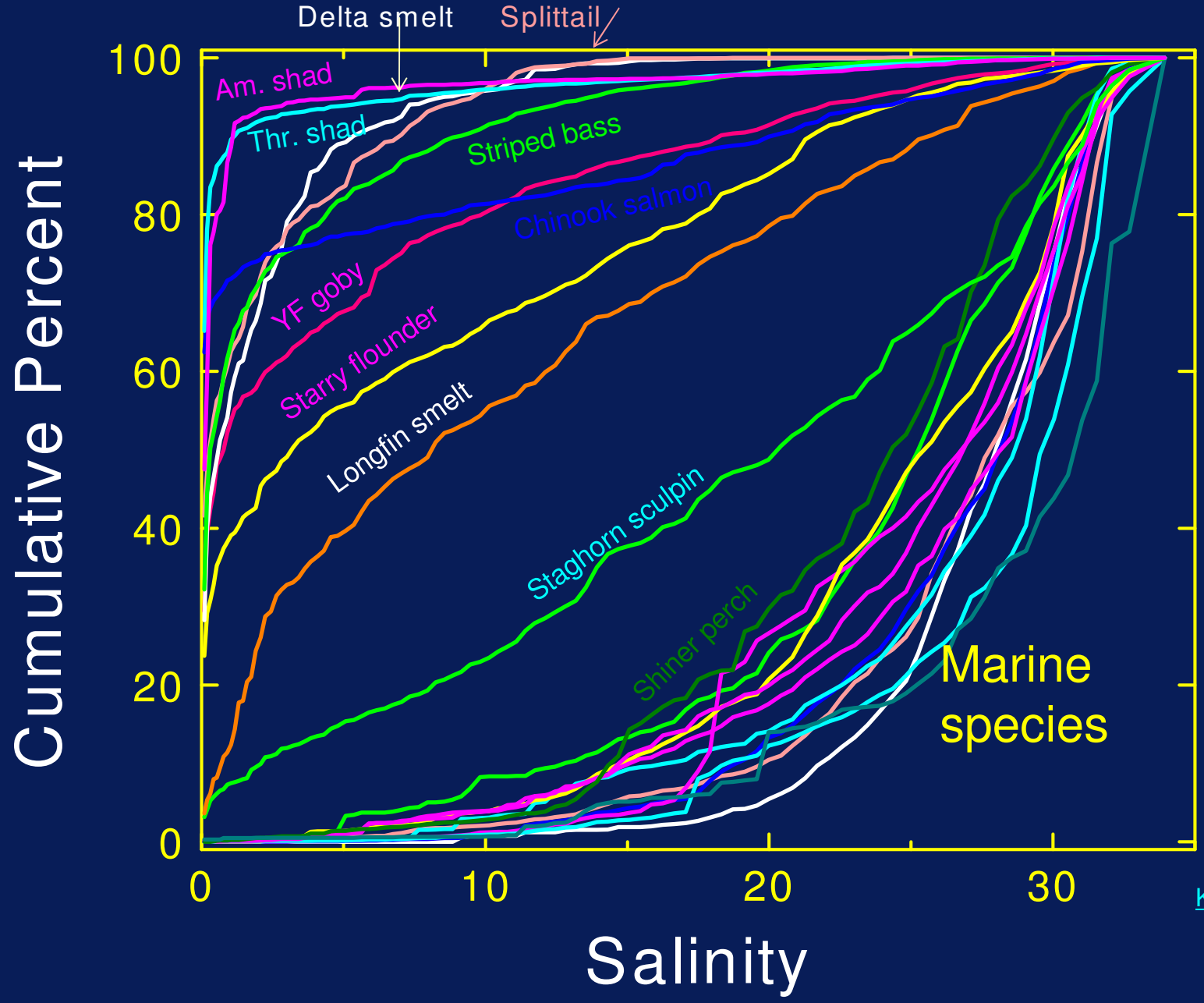


Kimmerer 1998

Pelagic organisms follow salinity: Delta smelt

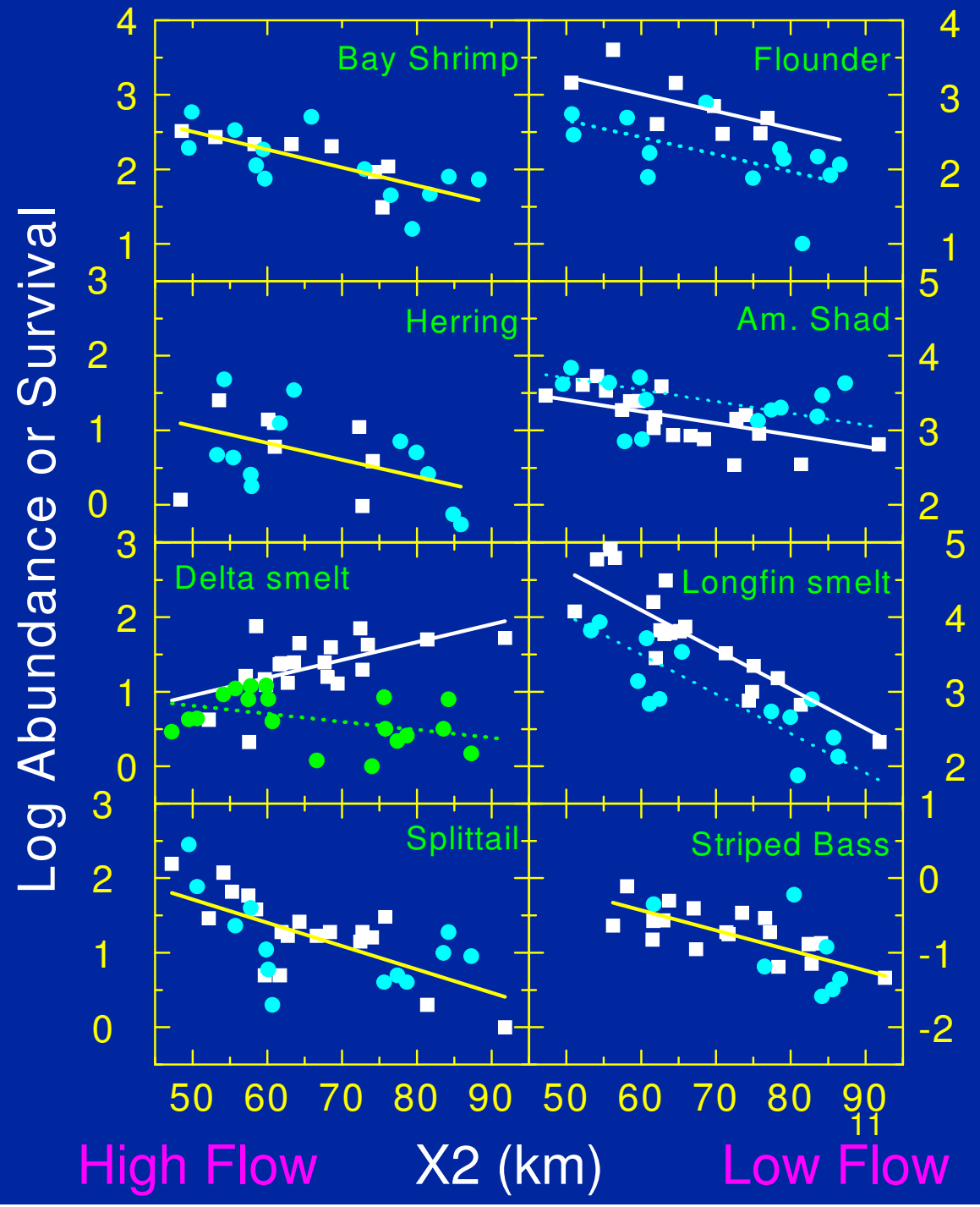


Most fishes follow salinities



Kimmerer 2004

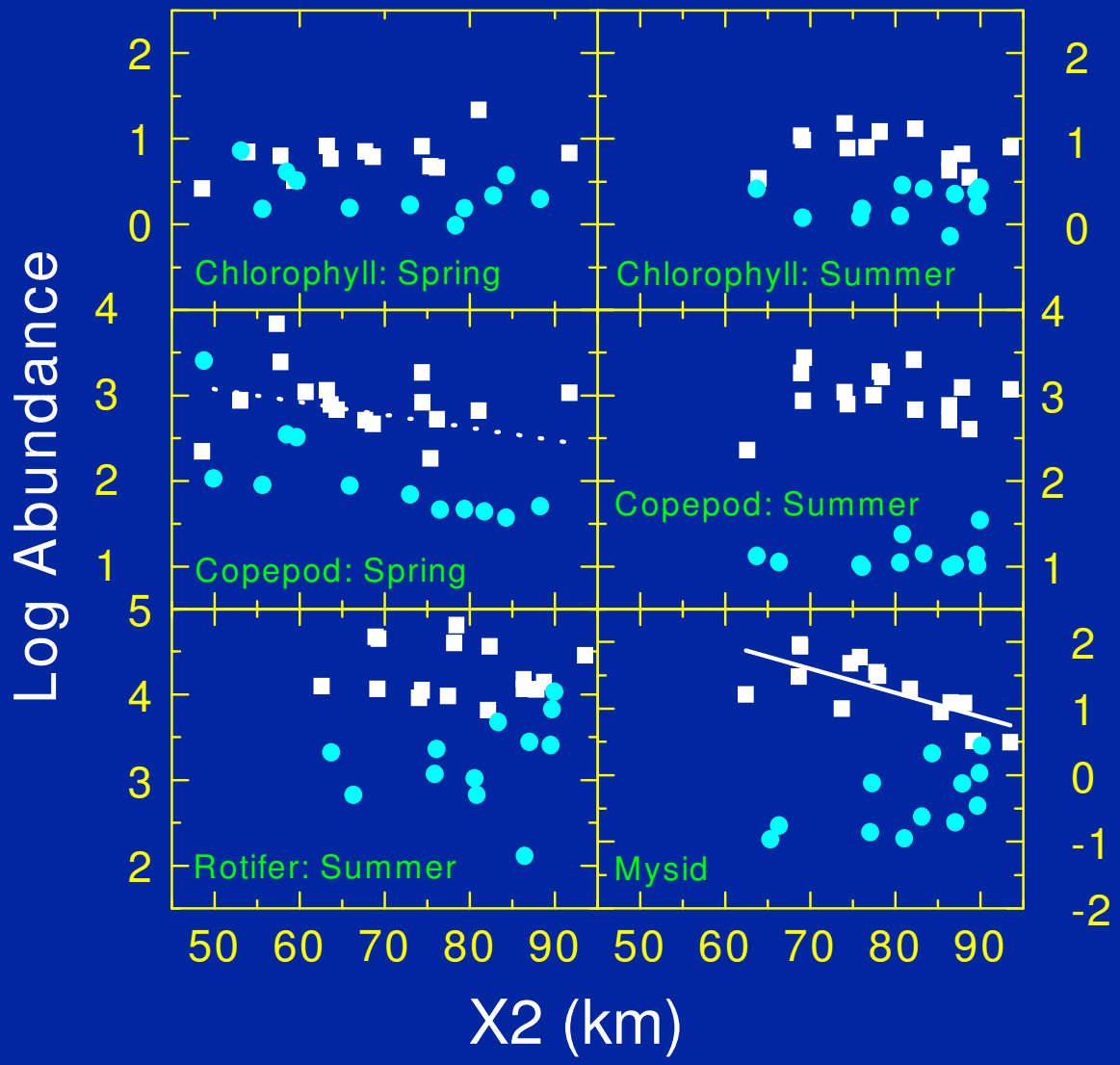
Higher trophic levels show many relationships of abundance to freshwater flow



1967-87
1988-2000
1982-2000 (DS)
All Years

Source:
Kimmerer 2002MEPS

Lower trophic levels show few relationships of abundance to freshwater flow



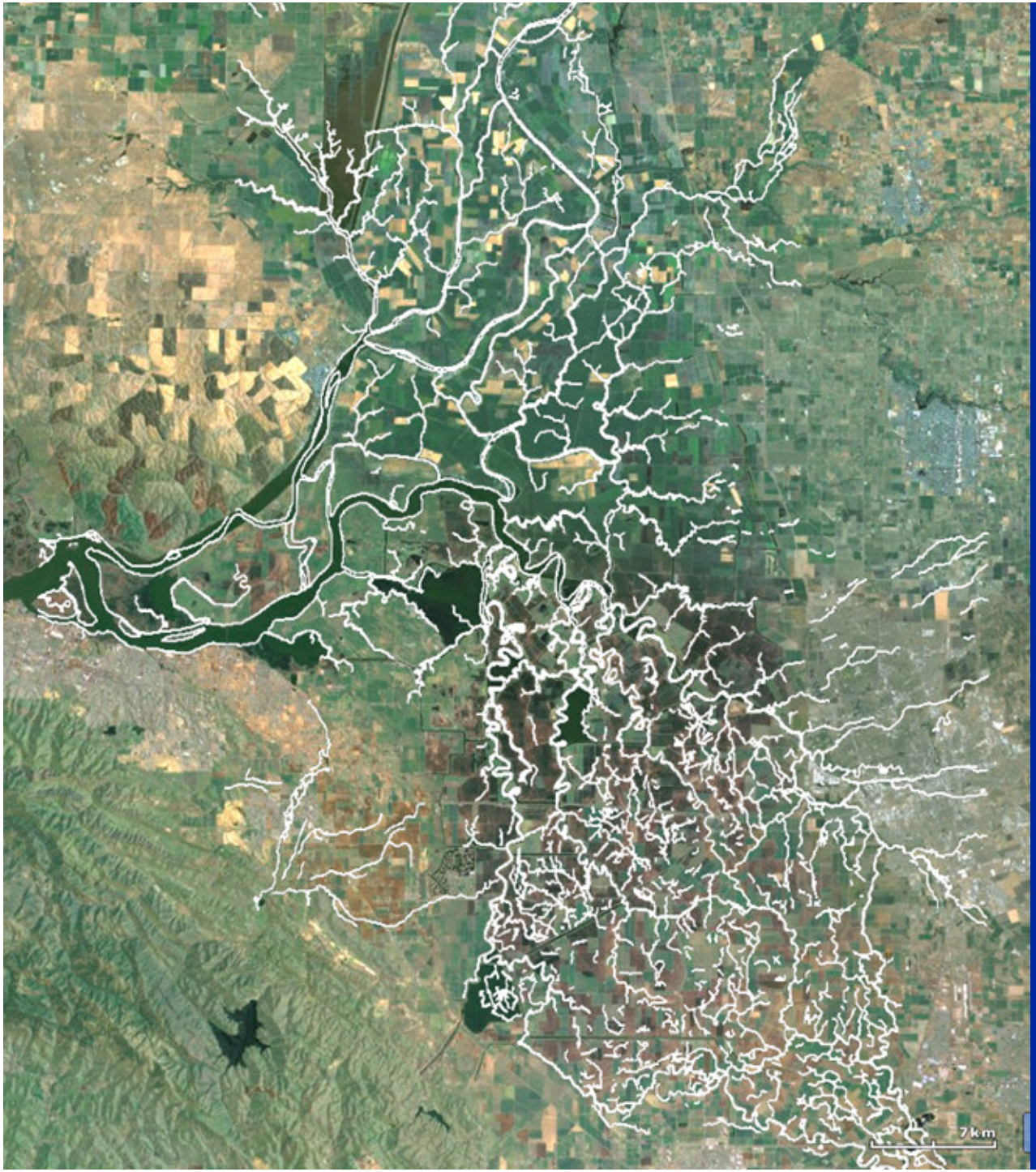
1972-1987

1988-2000

Source:
Kimmerer 2002 MEPS

High Flow

Low Flow



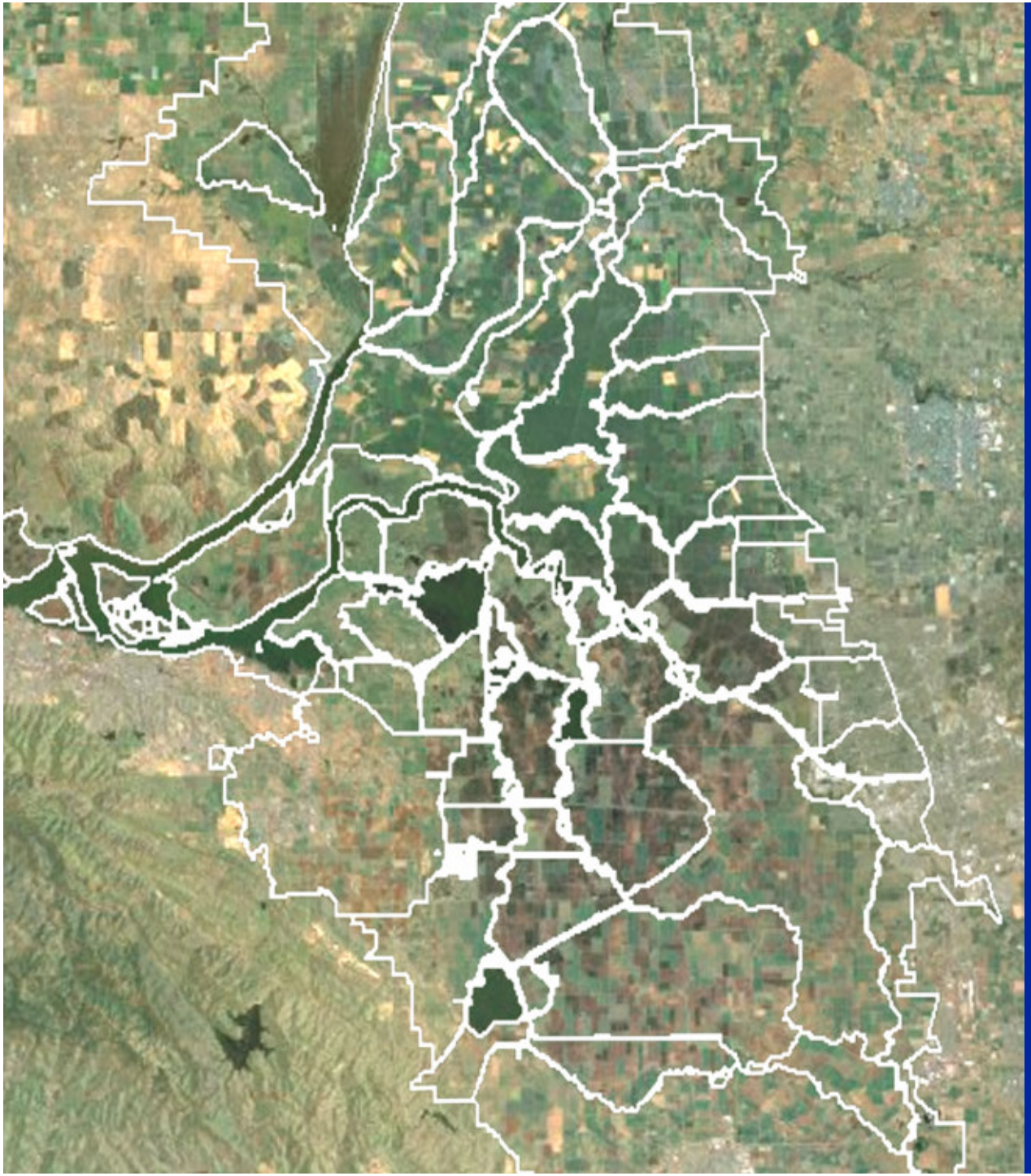
1873 Delta:

Long residence time

Marsh connections

Two rivers connect to bay

Waterways dendritic



Modern delta

Short residence times

Rip-rapped

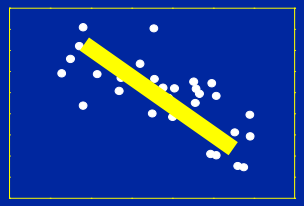
Cross Delta flows

Rare San Joaquin connection to bay

Waterways web-like

What Changes As Flow Increases?

Salinity and X2



FLOW

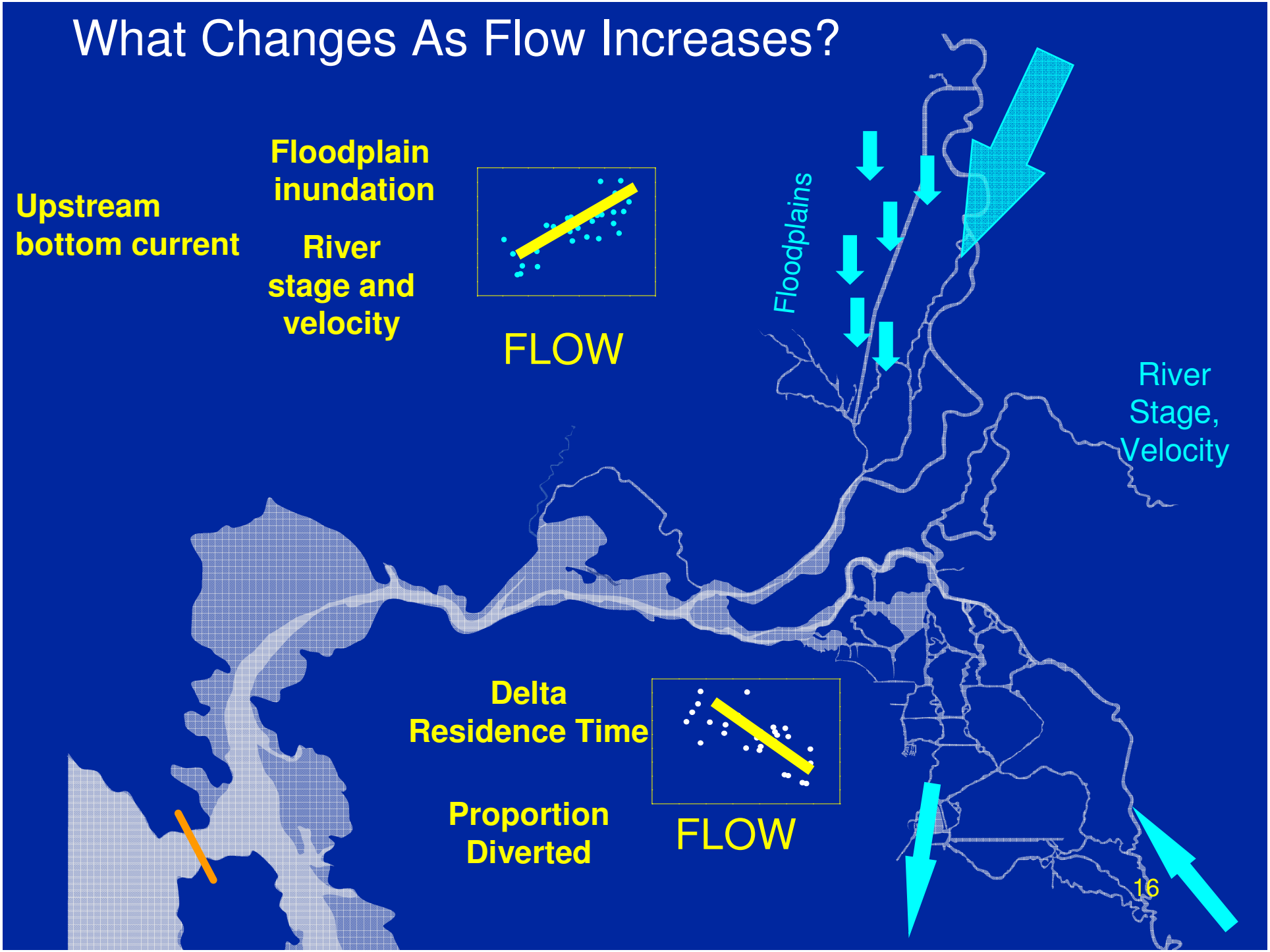
Location of Any Salinity Range

X2

L S Z

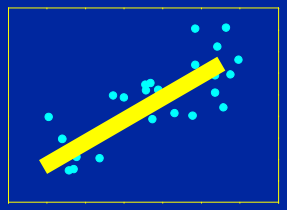
stratification

What Changes As Flow Increases?



What Changes As Flow Increases?

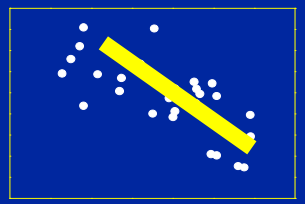
Loadings



FLOW

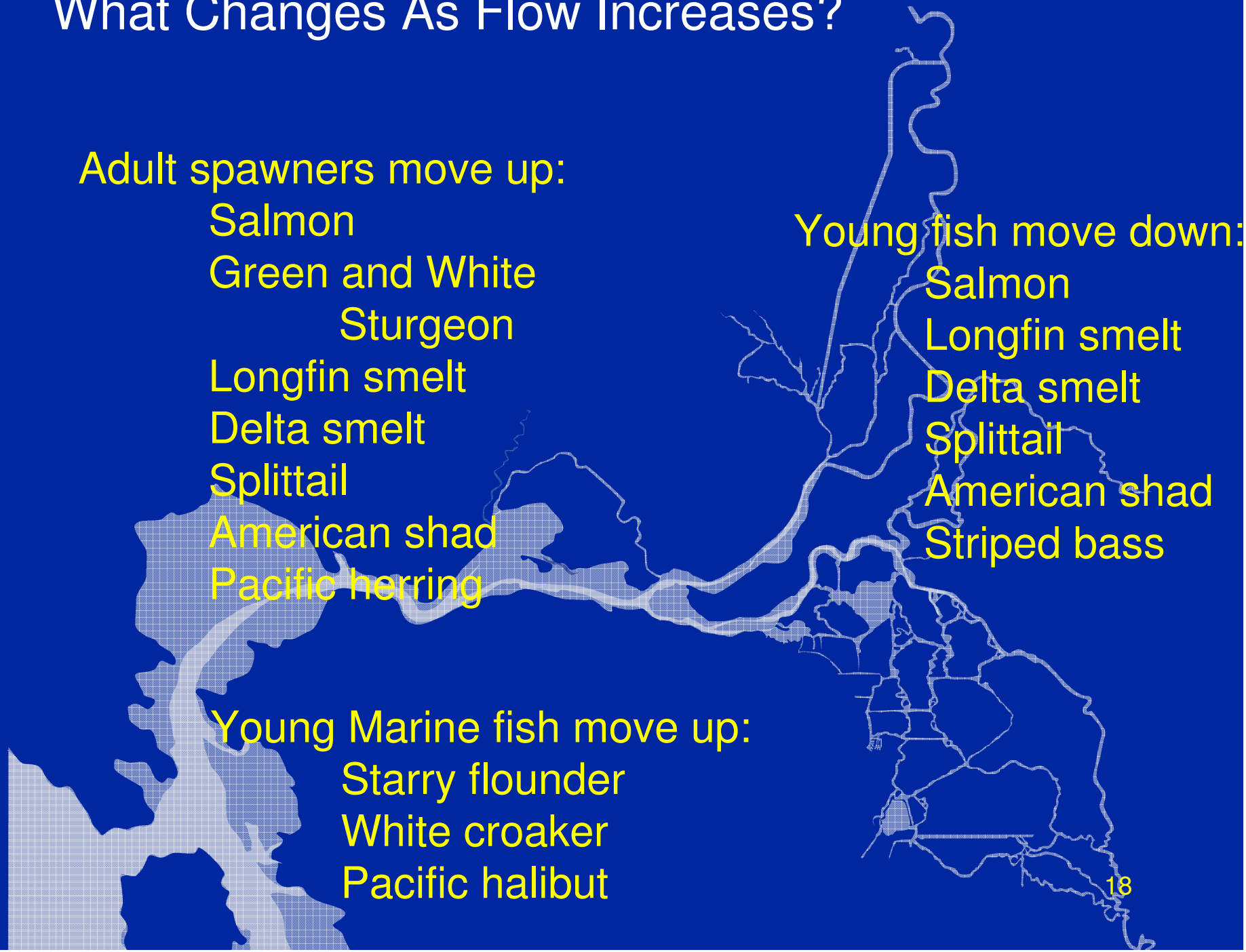
Nutrients
Contaminants
Organic matter
Sediment

Concentrations



FLOW

What Changes As Flow Increases?



Adult spawners move up:

- Salmon
- Green and White Sturgeon
- Longfin smelt
- Delta smelt
- Splittail
- American shad
- Pacific herring

Young fish move down:

- Salmon
- Longfin smelt
- Delta smelt
- Splittail
- American shad
- Striped bass

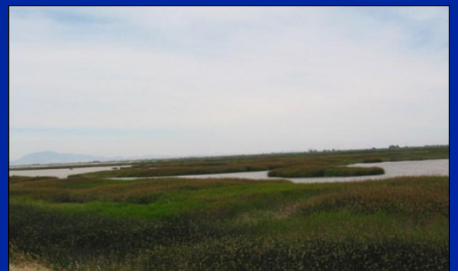
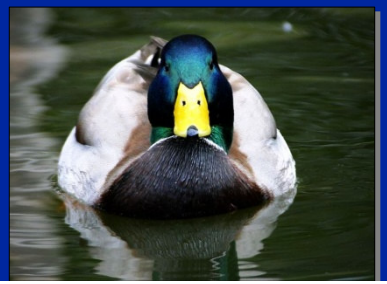
Young Marine fish move up:

- Starry flounder
- White croaker
- Pacific halibut

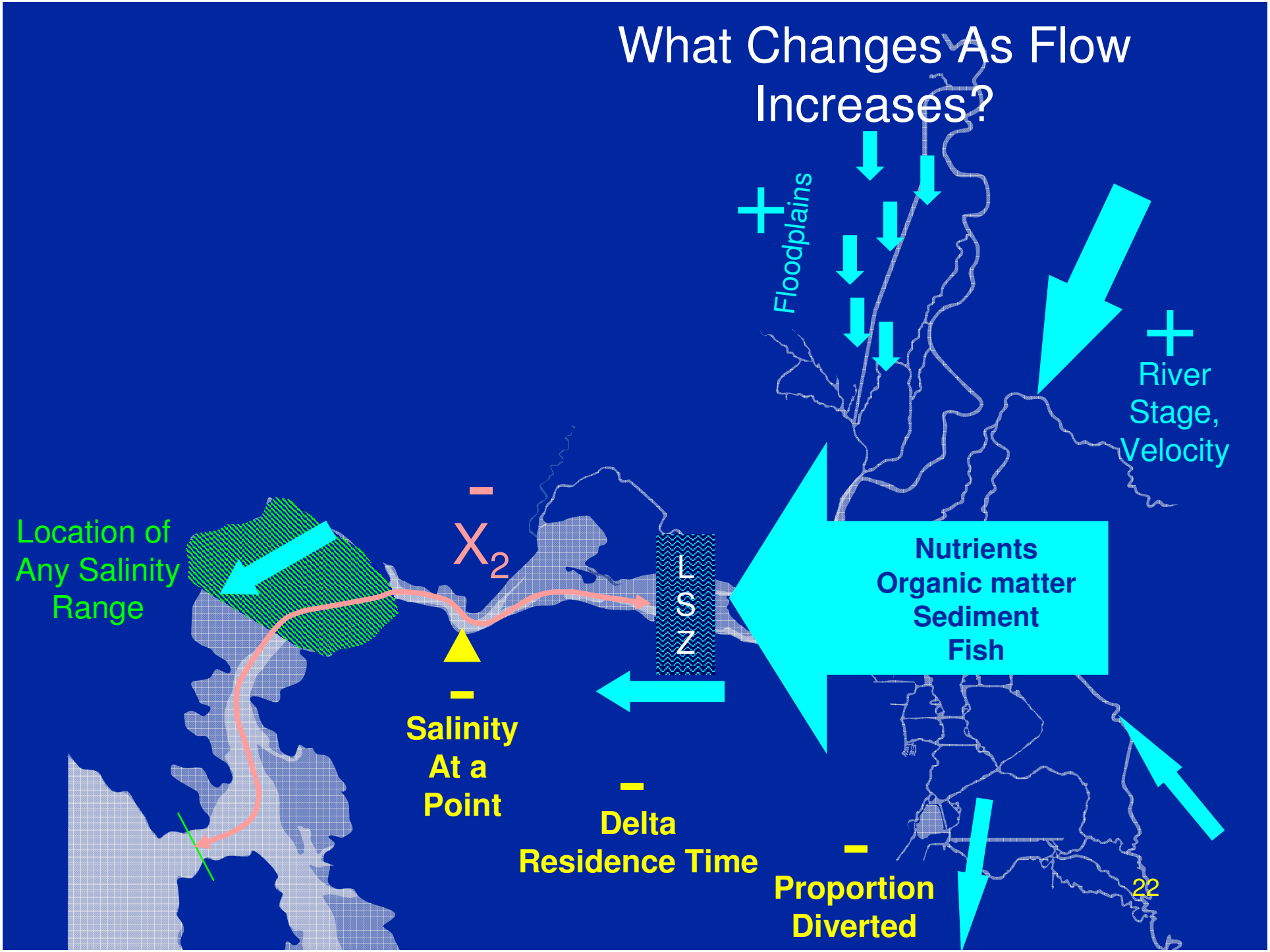
Flows are important but so is geometry

Five Key Points

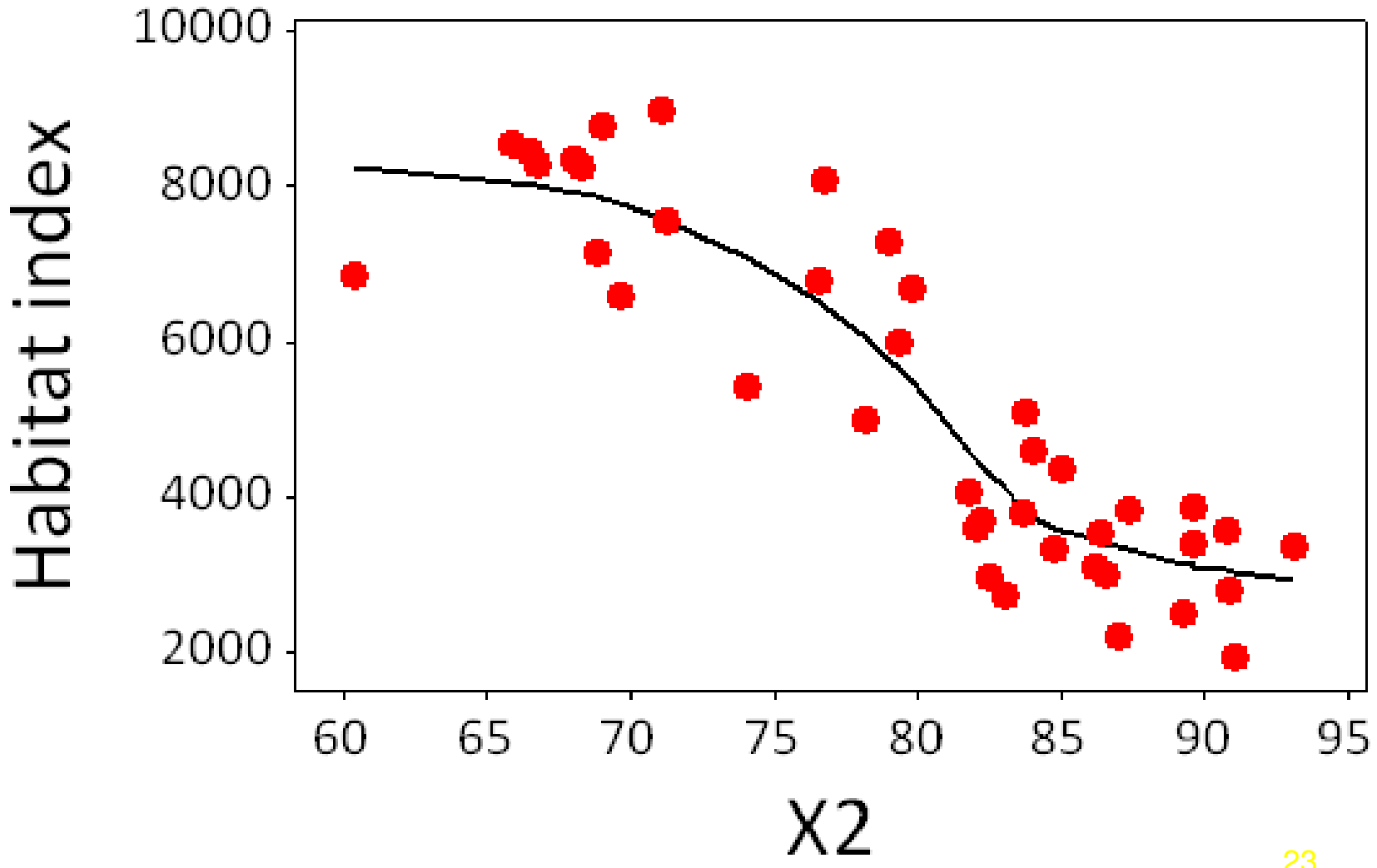
1. Environmental flows are more than just volumes of inflows and outflows
2. Recent flow regimes both harm native species and encourage non-native species
3. Flow is a major determinant of habitat and transport
4. Recent Delta environmental flows are insufficient to support native Delta fishes for today's habitats
5. A strong science program and a flexible management regime are essential to improving flow criteria

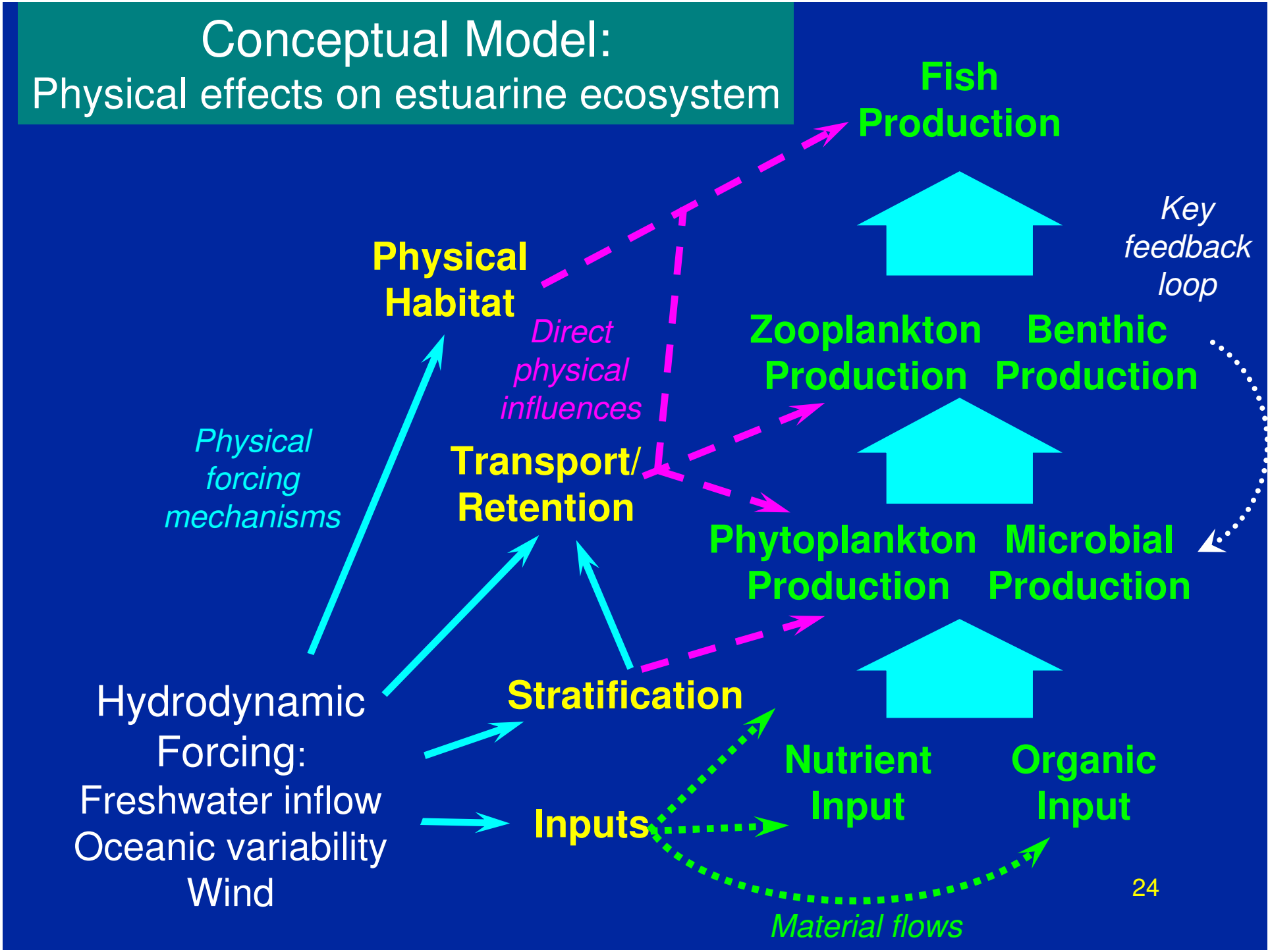

What Changes As Flow Increases?



Delta smelt habitat abundance in relation to X2



Conceptual Model:
Physical effects on estuarine ecosystem



How much water do fish need?