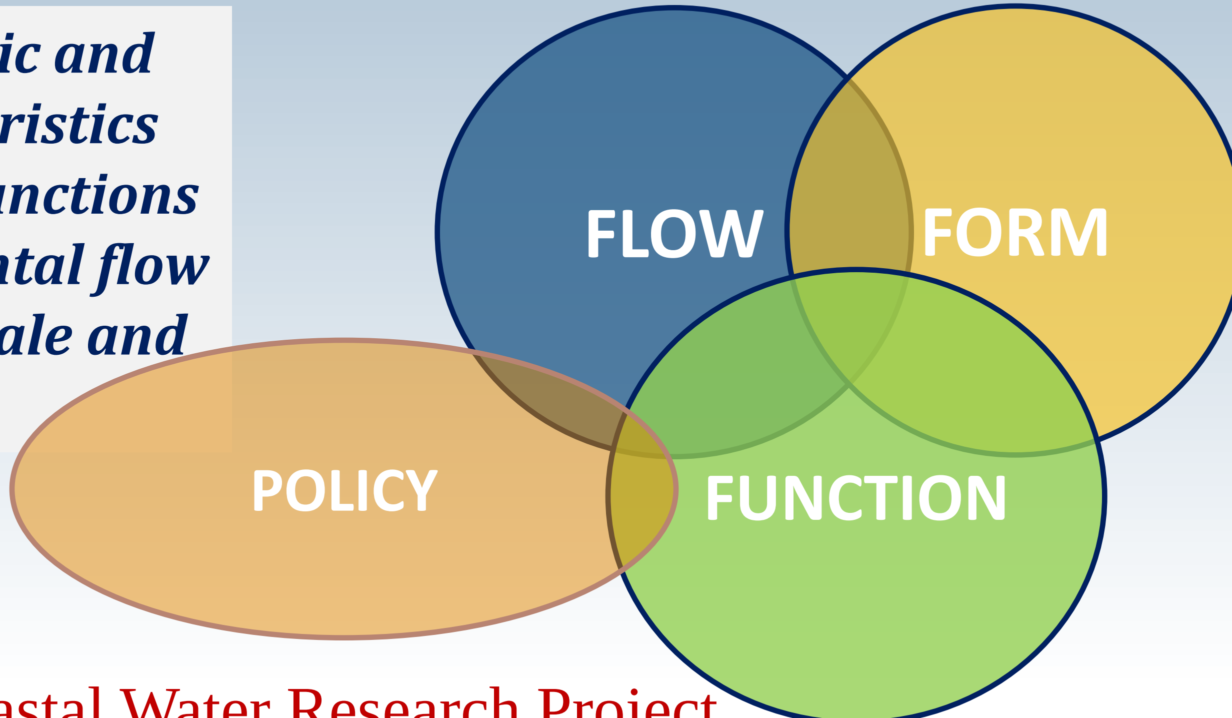
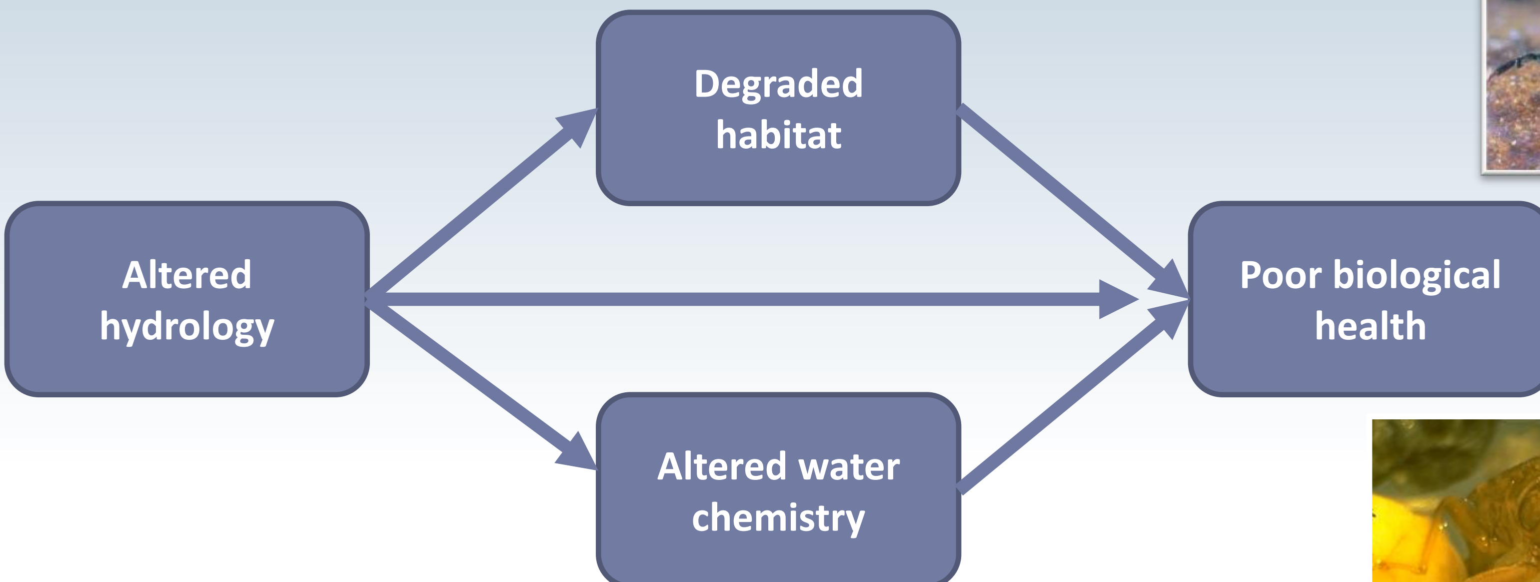
Statewide Efforts to Develop Biologically-relevant Instream Flow Recommendations

Integrating hydrologic and geomorphic characteristics with river ecosystem functions to estimate environmental flow targets at the reach scale and planning level



Eric Stein
Southern California Coastal Water Research Project

Hydrology is an Integrative Driver of Stream Health

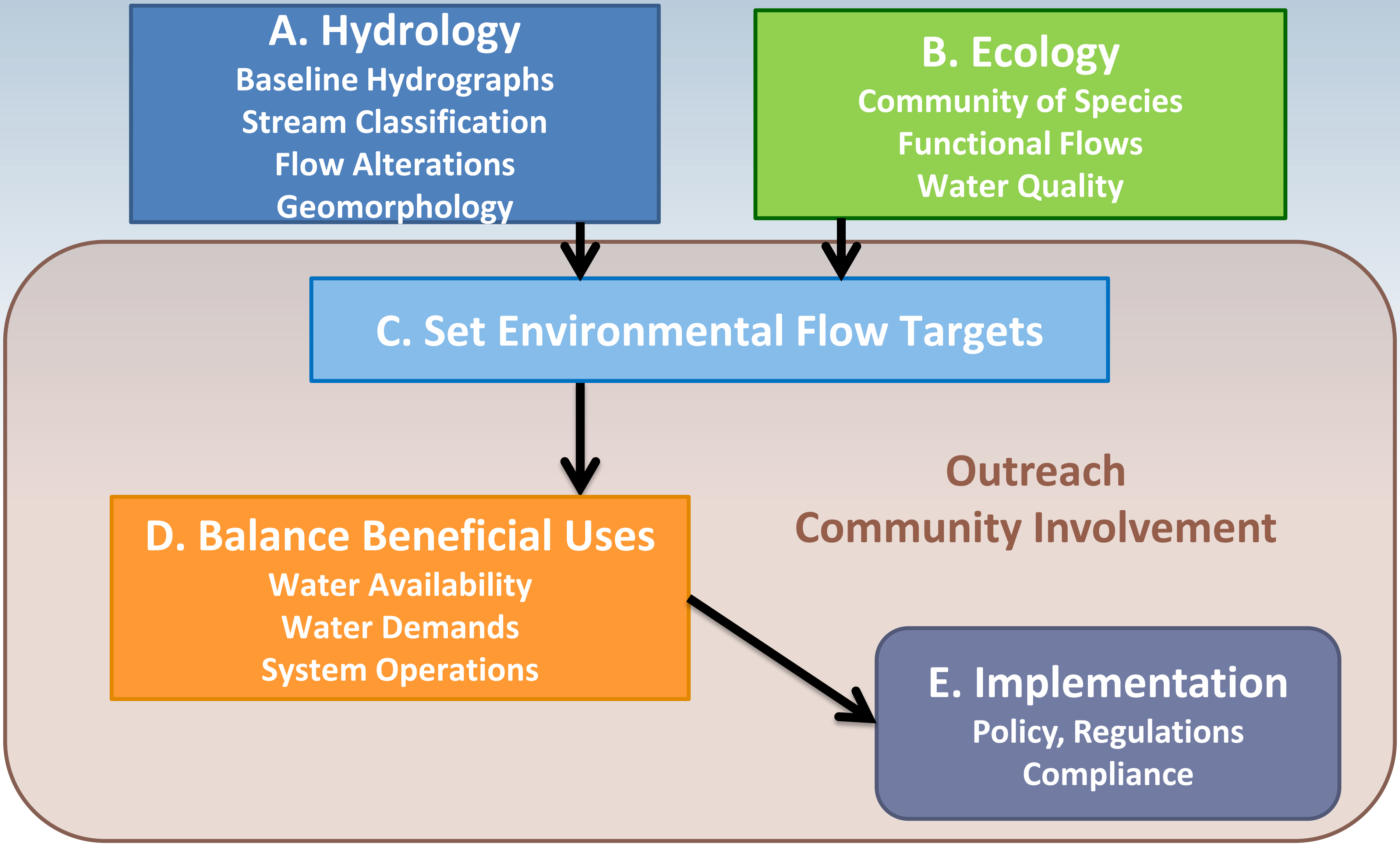


If you can mitigate hydrologic alteration, you'll solve a lot of other problems


Urban runoff
Floodplain encroachment
Water quality basins
Retention/detention
2591 ft


Los Angeles Stormwater Capture Master Plan

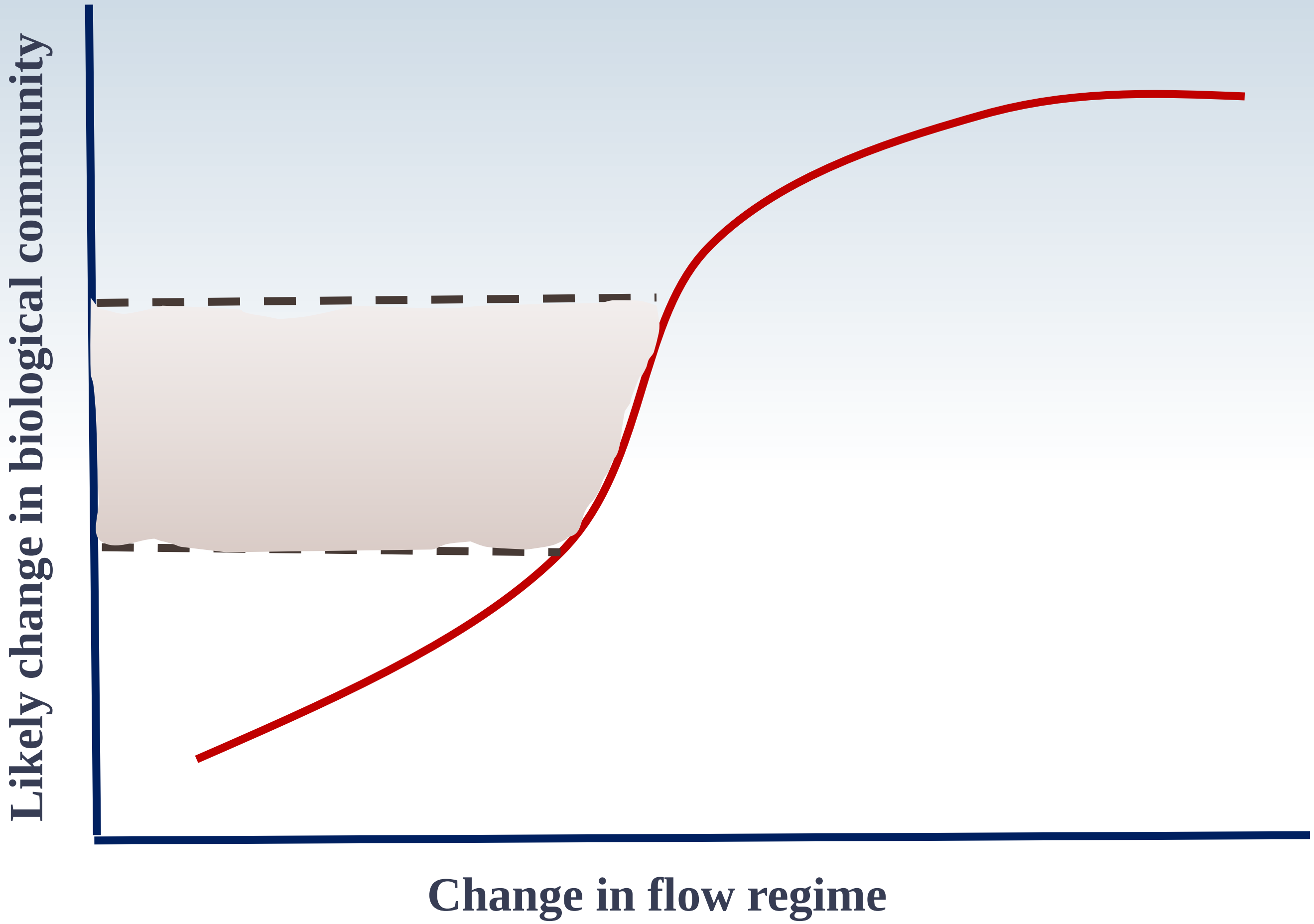
California Environmental Flows Framework



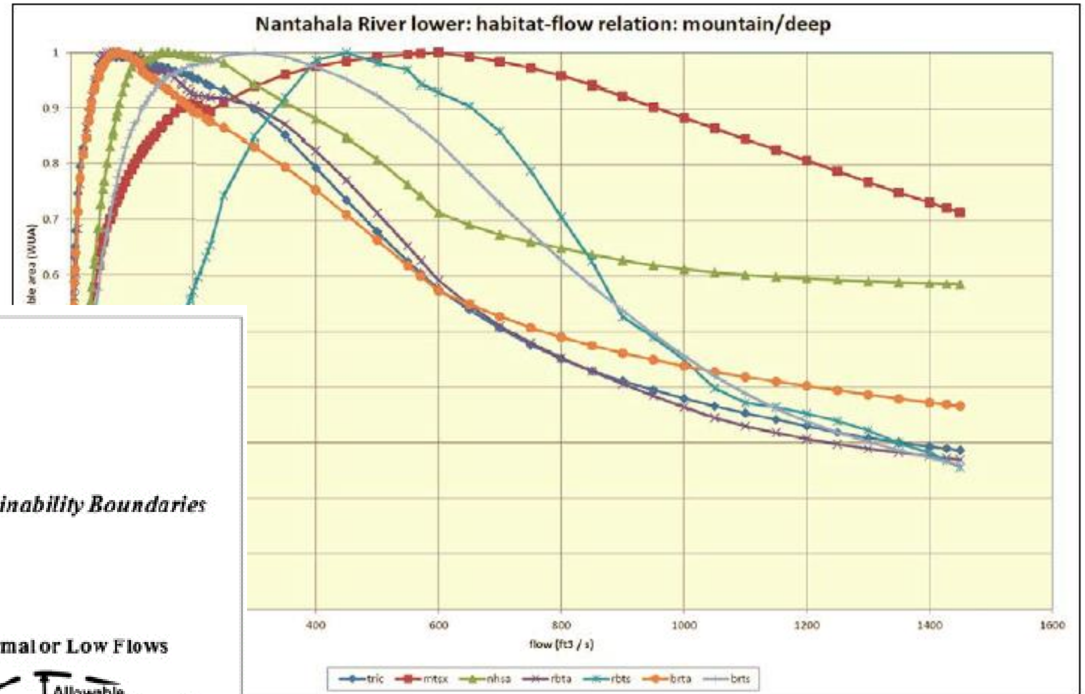
Potential Applications

- **MS4** – effects of stormwater management practices on instream biology
- **Bio-integrity** – causal assessment, hydrology is a key factor affecting biological condition
- **401** – effects of proposed projects on stream condition, mitigation planning
- **Hydromodification** – hydrologic change is highly correlated with hydromodification effects
- **NNE** – flow management is key factor influencing nutrient effects on biological endpoints
- **IWRM** – understanding biological effects of water management practices
- **Climate change** – understanding potential role of climate induced flow changes (short and long term) on biological condition
- **SGMA** – ensuring groundwater management practices protect instream beneficial uses

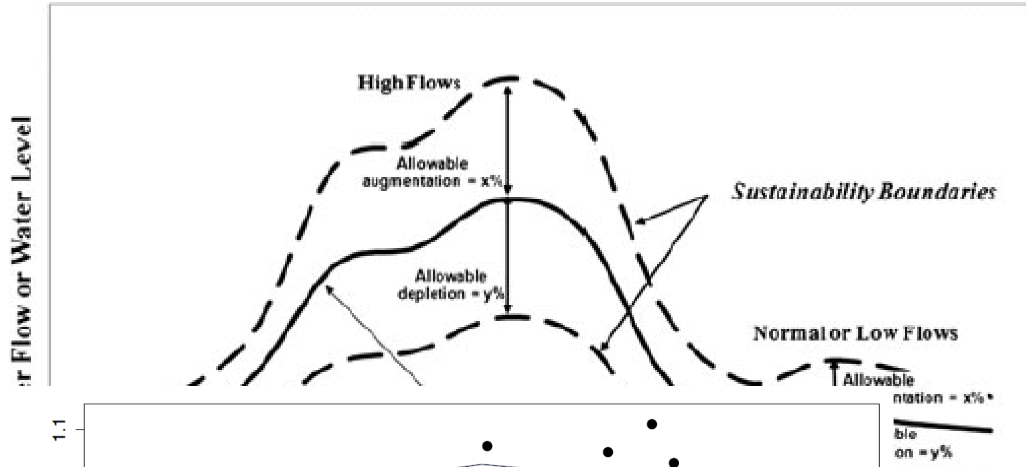
Setting Flow Targets

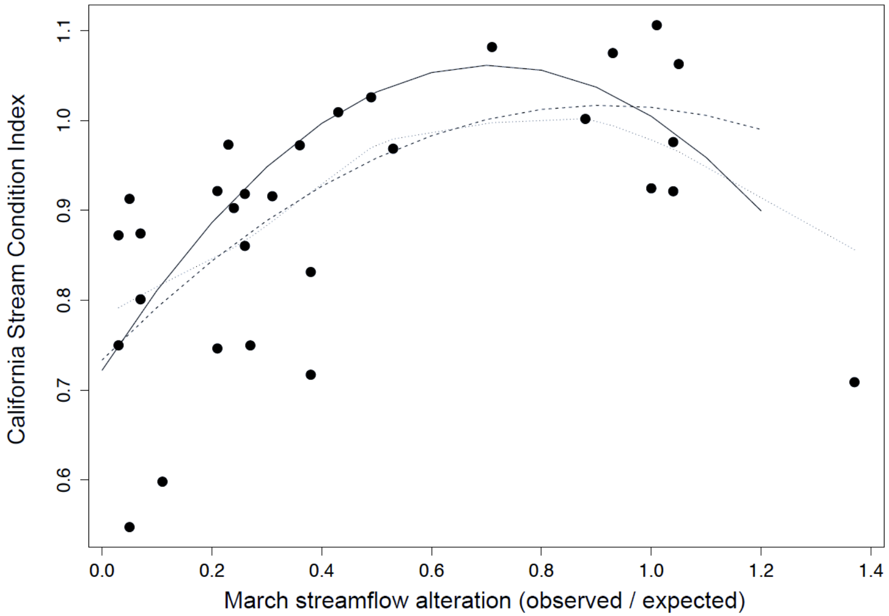


Many Technical Approaches

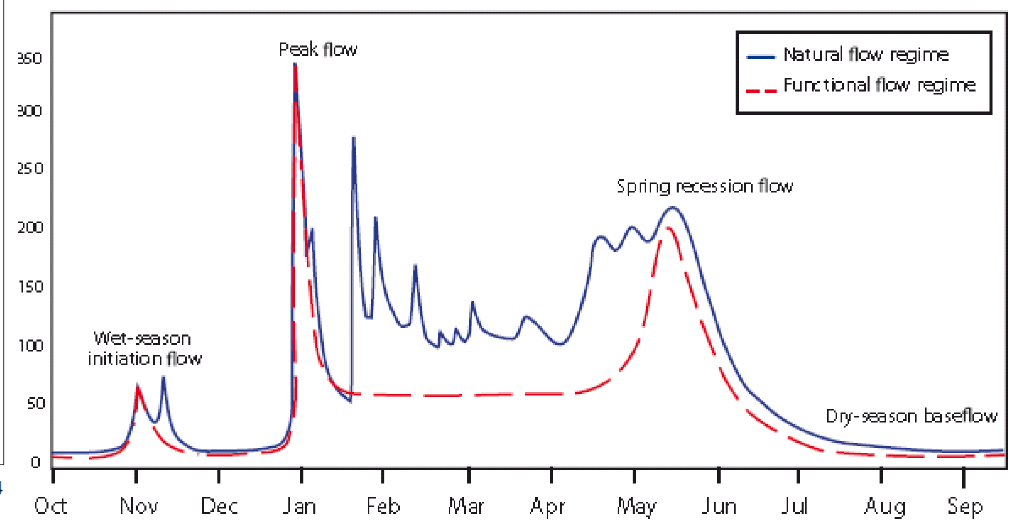


ıf WUA habitat-discharge relation (mountain-deep species/life stages)
n PHABSIM modeling.





ELOHA -Carlisle et al. 2015



Functional Flows - Yarnell et al. 2015

Considerations for In-stream Flow Targets

1. Scientifically defensible
2. Appropriate for stream type
3. Relevant to biological endpoints
4. Explainable/understandable
5. Implementable relative to management options
6. Amenable to monitoring
7. Scalable and consistent for other basins

Key Challenges

- How to deal with heterogeneity in the landscape?
- How to apply flow targets to ungaged streams?
- How to select the most appropriate endpoints?
  - Flow metrics
  - Biological metrics
- How to inform management decisions?

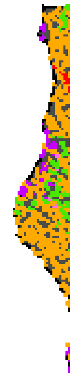
Stream Classification

Catchment Properties

Rainfall Patterns

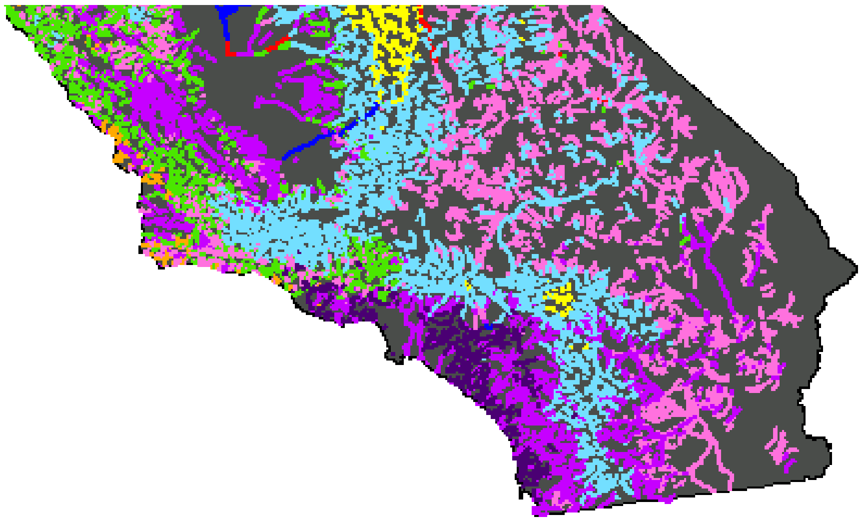
Geology

Soil Properties



Natural Flow Class

(**SM**) Snowmelt
(**HSR**) High-volume snowmelt and rain
(**LSR**) Low-volume snowmelt and rain
(**RSG**) Rain and seasonal groundwater
(**WS**) Winter Storms
(**GW**) Groundwater
(**PGR**) Perennial groundwater and rain
(**FER**) Flashy, ephemeral rain
(**HELP**) High elevation & low precipitation
(**LELP**) Low elevation & low precipitation

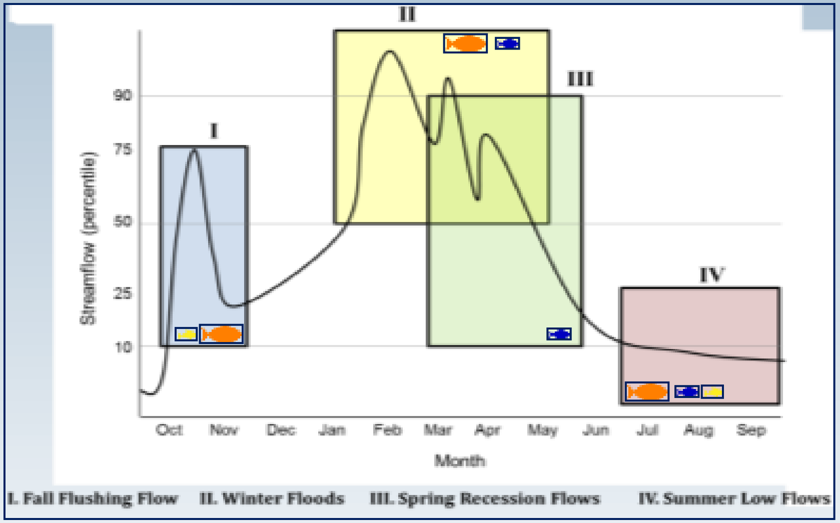


California Case Study Examples

- Functional Flows Method
  - ex: Sierran Rivers
- Flow-Ecology Approach (ELOHA)
  - ex: Southern California Streams
- Modified Percent of Flow Approach
  - ex: North Coast Streams

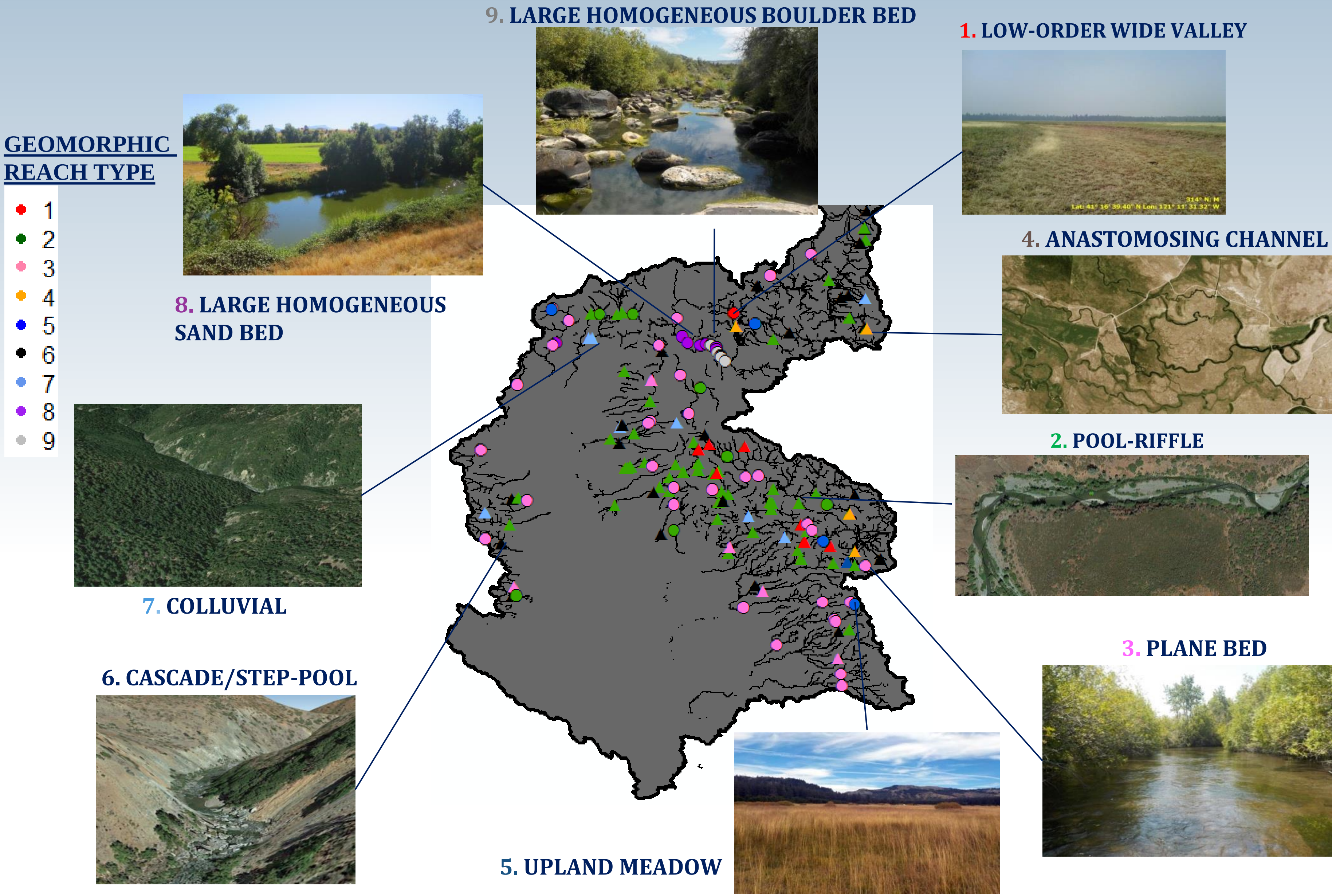
Functional Flows Approach (fish)

I. Fall Flushing Flows
II. Winter Floods
III. Spring Recession Flows
IV. Summer Low Flows



Season	Function	Season	Flow Metrics	Frequency (duration)
Fall	Cue fish migration	Sept 1 - Nov 30	peak magnitude, percent over baseflow	Annually (2 weeks)
Winter	Clean spawning gravels	Dec 1 – Apr 1	Peak magnitude, recurrence interval	Once every 5 years (2-4 weeks)
Spring	Cue and support spawning	March 1 – May 30	Recession rate, starting magnitude	Annually (6-8 weeks)
Summer	Oversummering habitat	Apr 1-Sept 30	Magnitude, recurrence interval	annually

Geomorphic Effects on Functional Flows



ELOHA Framework

classification

Community response

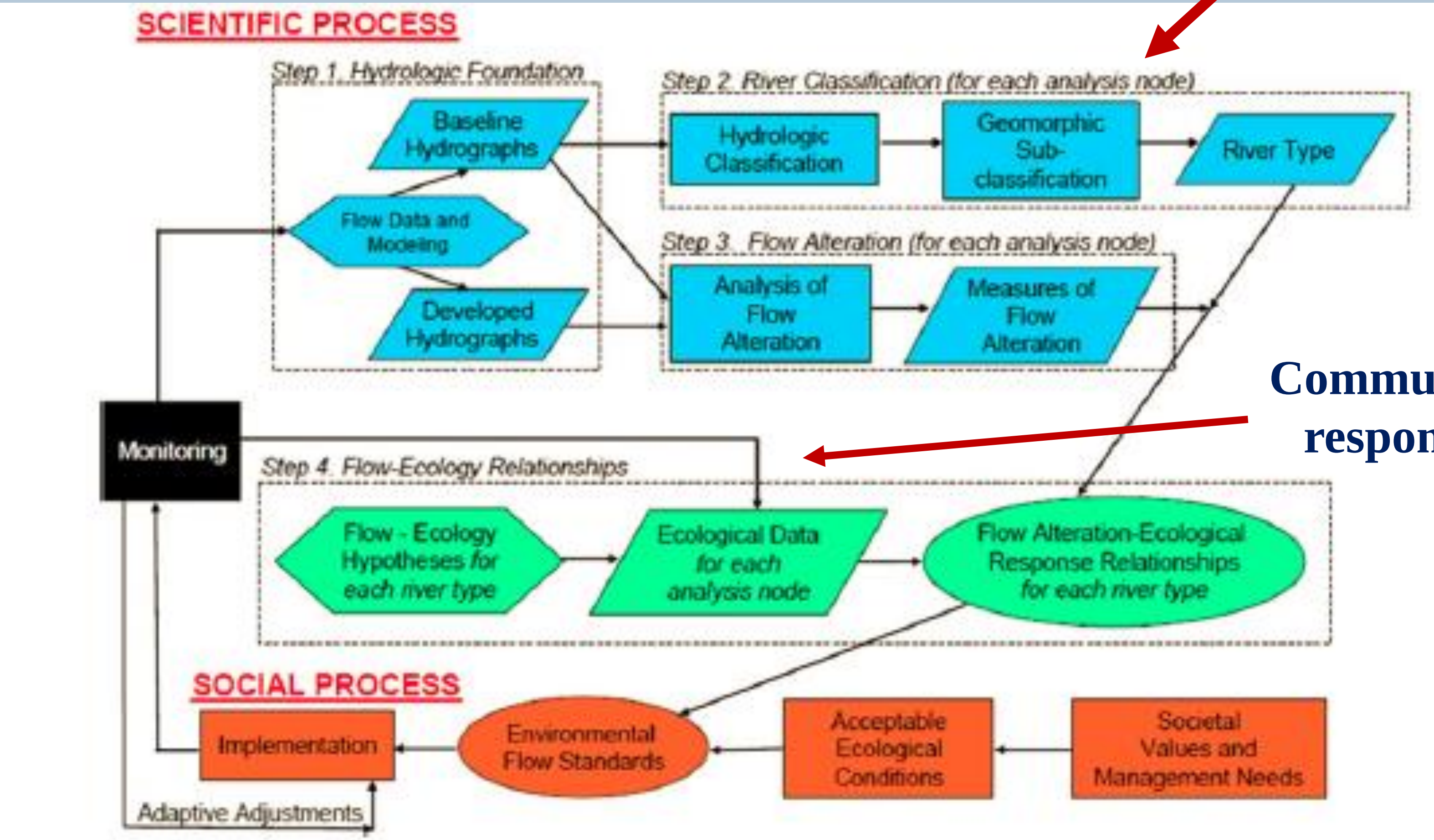


Fig. 1 The ELOHA framework (taken directly from Poff and others 2010)

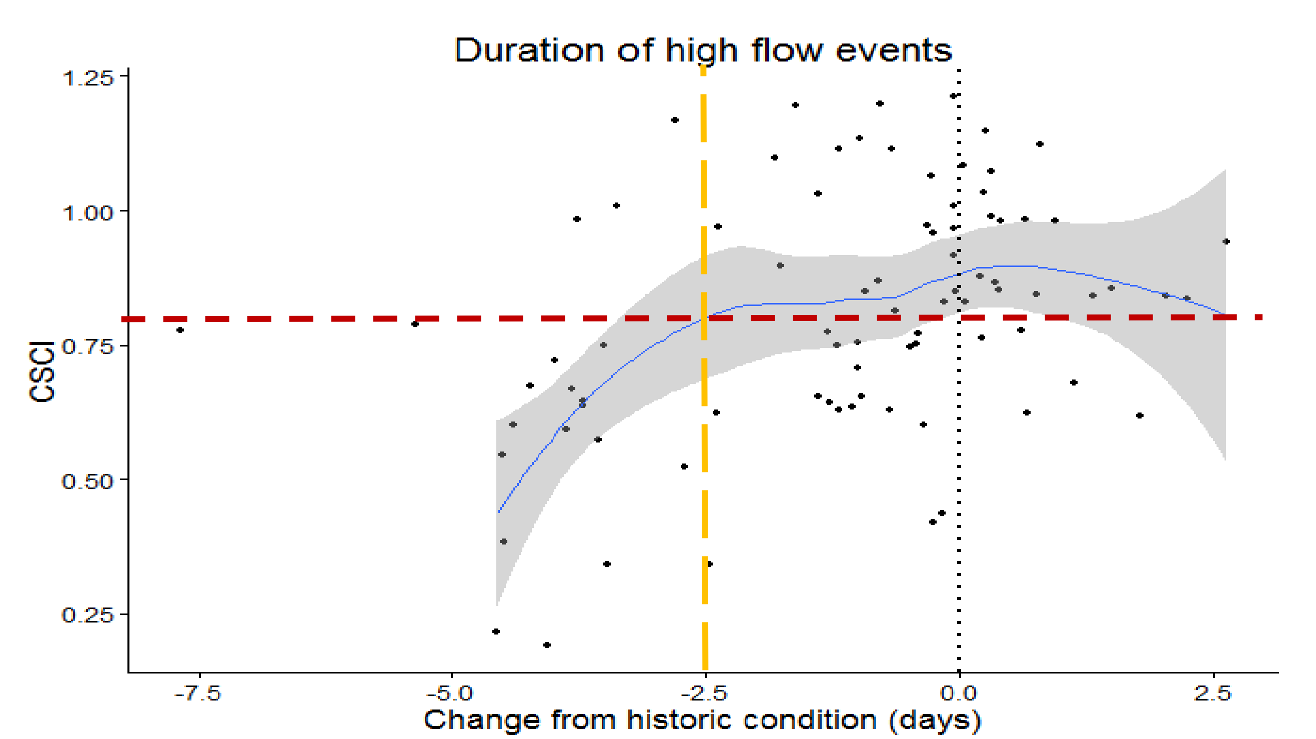
Relate biological alteration (ΔB) to hydrologic alteration (ΔH)
using a biological community approach

Features of ELOHA Approach

- Based on health of target biological community vs. a target species
- Provides a framework for balancing environmental flow needs with other water management needs
- Intended to be applied across geographic regions vs. at specific locations

Biological Response Curves

Develop curves based on ecological meaningful relationships:
Index, metrics, traits, individual spp
For several key hydrologic metrics



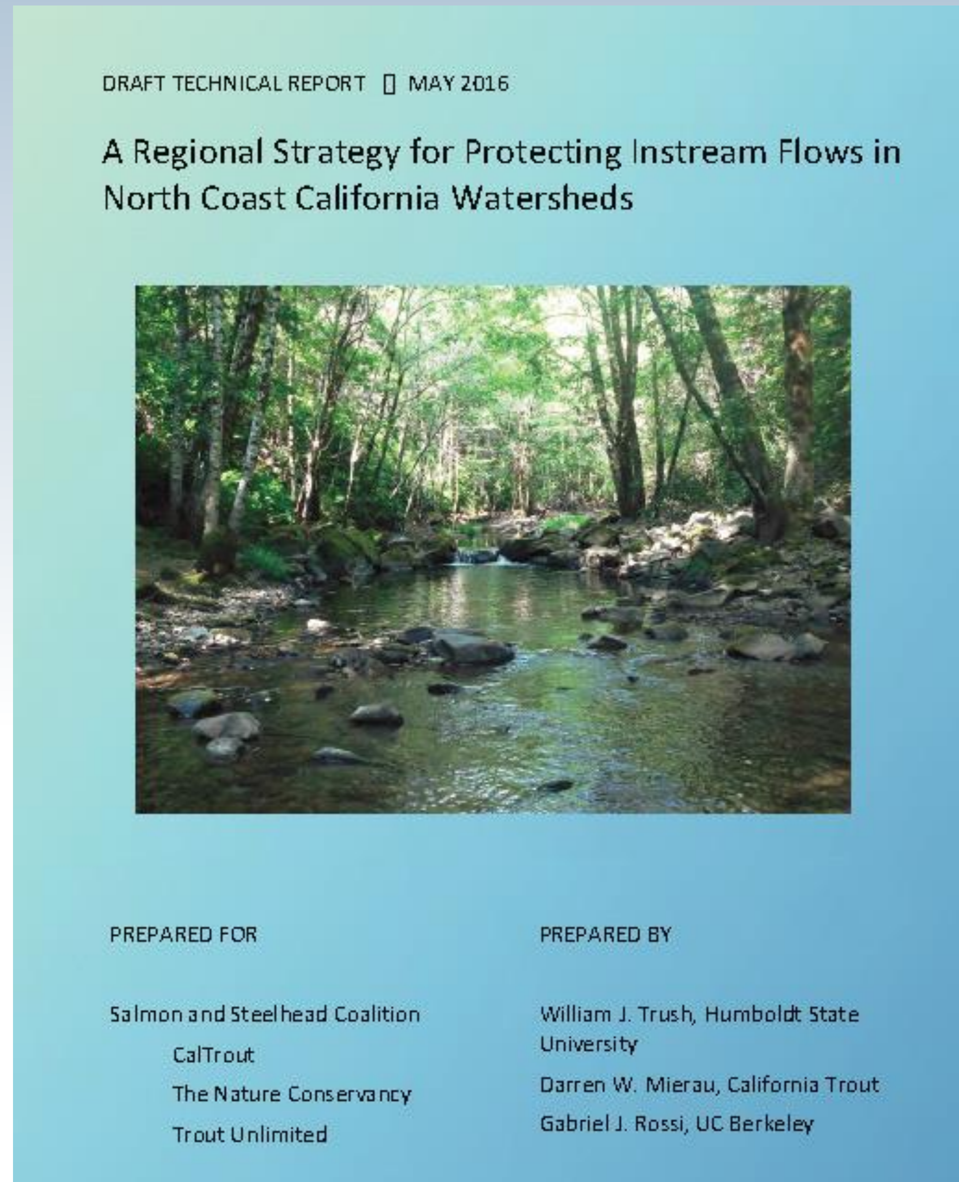
Relationships that could be used to set thresholds that limit biological responses

Relationships Developed by applying modeled hydrologic change to 800 bioassessment sites in S. CA

Modified Percent of Flow

- Prescribes cumulative maximum daily diversion volume
  - Variable diversion rate

- Maximum diversion based on percent change in stream stage
  - < 5% decrease in stage
  - 10% reduction is streamflow



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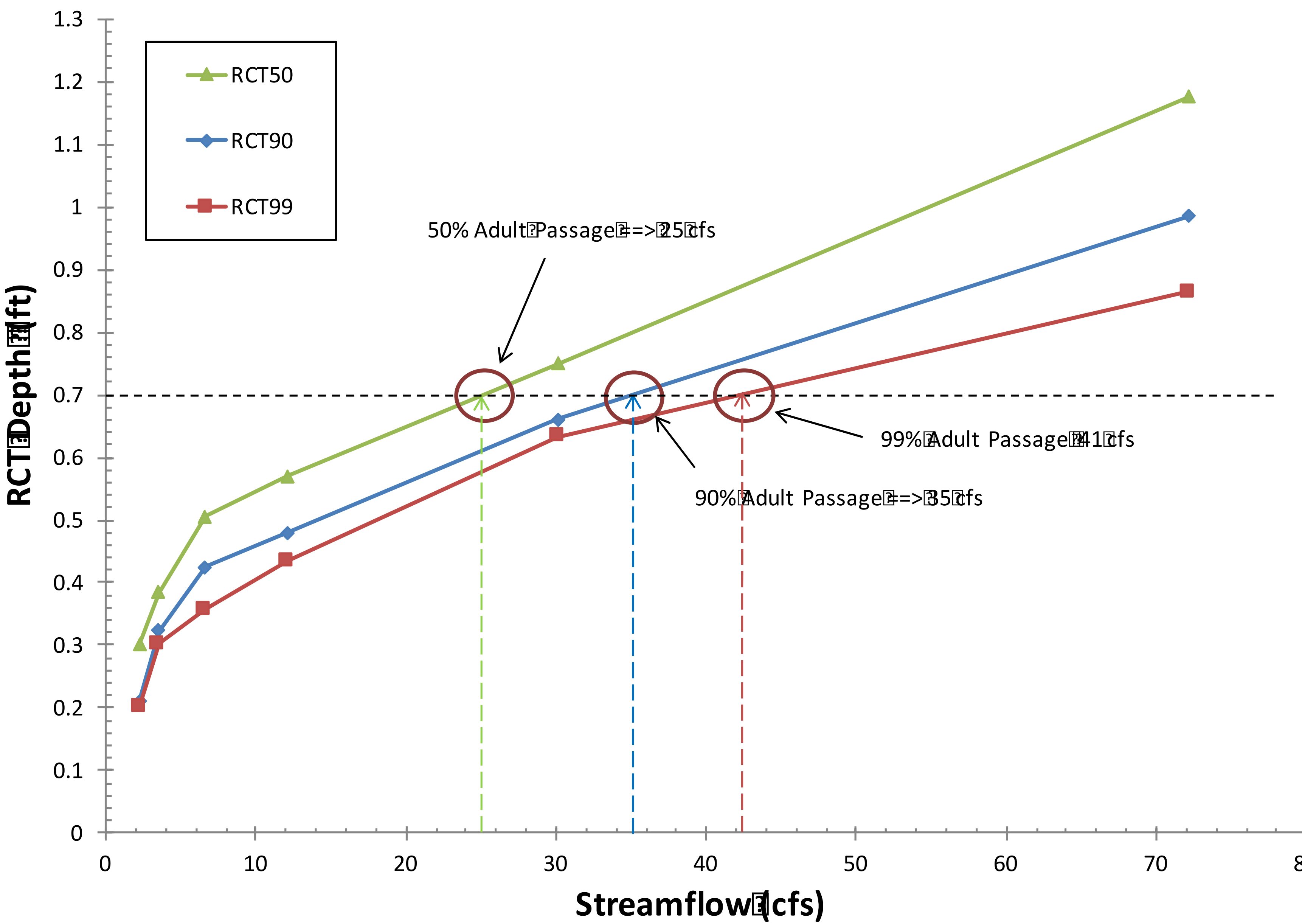
A Regional Strategy for Protecting Instream Flows in North Coast California Watersheds

PREPARED FOR

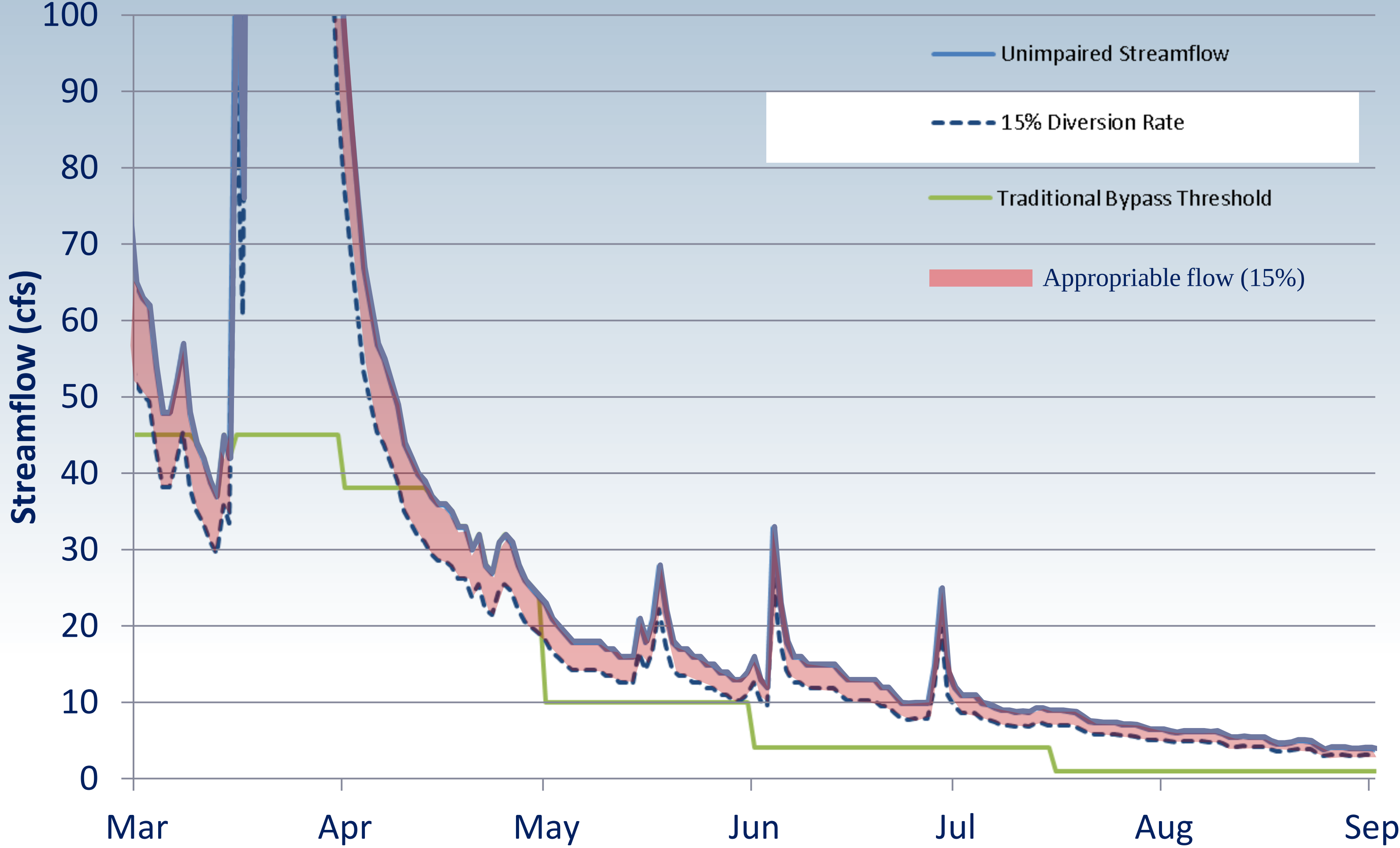
Salmon and Steelhead Coalition
CalTrout
The Nature Conservancy
Trout Unlimited

PREPARED BY

William J. Trush, Humboldt State University
Darren W. Mierau, California Trout
Gabriel J. Rossi, UC Berkeley



RCT50
RCT90
RCT99
50% Adult Passage => 25 cfs
90% Adult Passage => 35 cfs
99% Adult Passage 41 cfs
RCT Depth (ft)
Streamflow (cfs)
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
10
20
30
40
50
60
70
80



Unimpaired Streamflow
15% Diversion Rate
Traditional Bypass Threshold
Appropriable flow (15%)
Streamflow (cfs)
100
90
80
70
60
50
40
30
20
10
0
Mar
Apr
May
Jun
Jul
Aug
Sep

Roadmap for the Session

- Setting regional targets based on flow-ecology relationships (ELOHA) – ***Raphael Mazor***

- Managing functional flows in regulated rivers (functional flows) – ***Sarah Yarnell***

- Assessing hydrologic changes in nation's rivers (flow alteration) – ***Ted Grantham***

- Developing a coordinated flow strategy for CA (statewide framework) – ***Jeanette Howard***