Multi-species ecosystem effects analysis & flow criteria evaluation

DeltaEFT

Delta Ecological Flows Tool

The Nature Conservancy
Protecting nature. Preserving life.™

State Water Resources Control Board
-Leo Winternitz
- Clint Alexander

November 13 2012

EFT's Geographical Scope

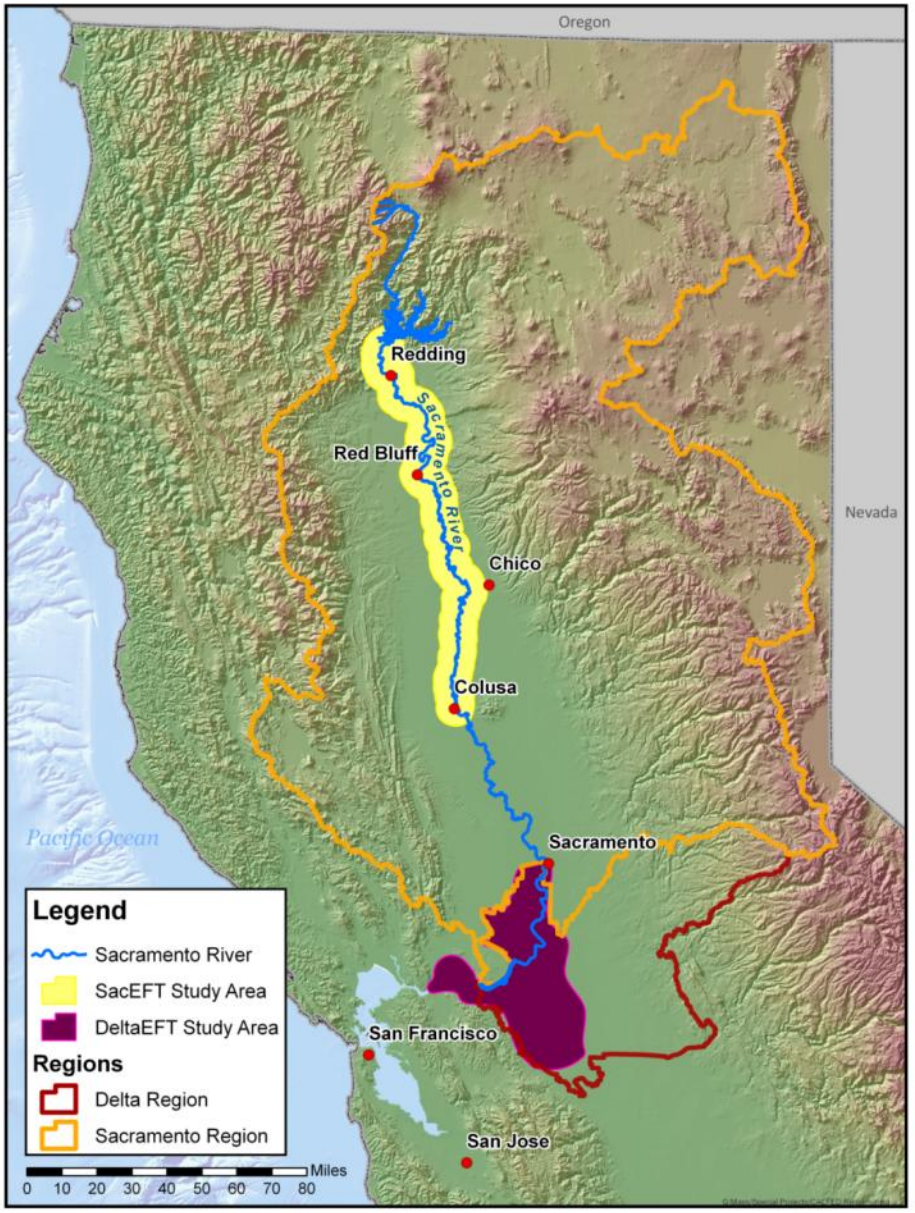
DeltaEFT
Delta Ecological Flows Tool

Sacramento EFT

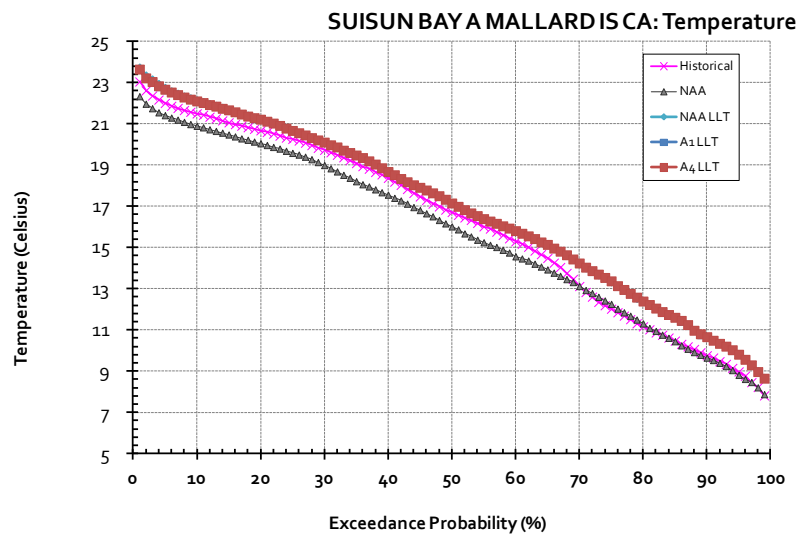
Keswick Dam to Colusa

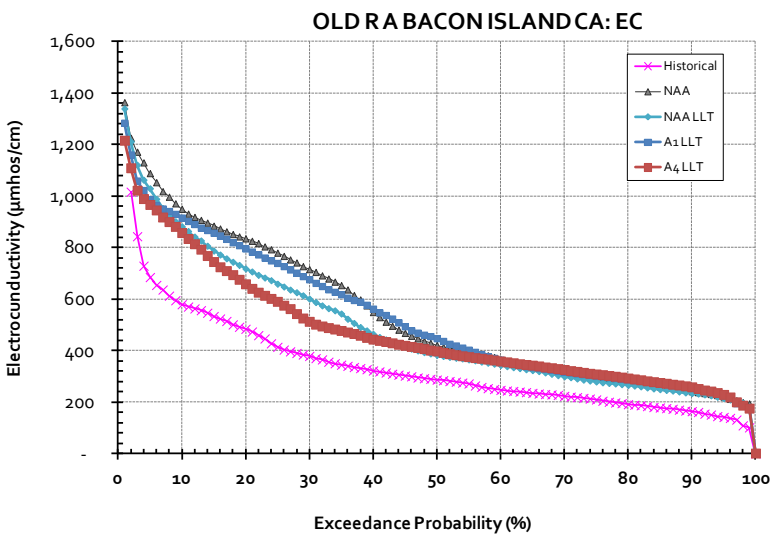
Delta EFT

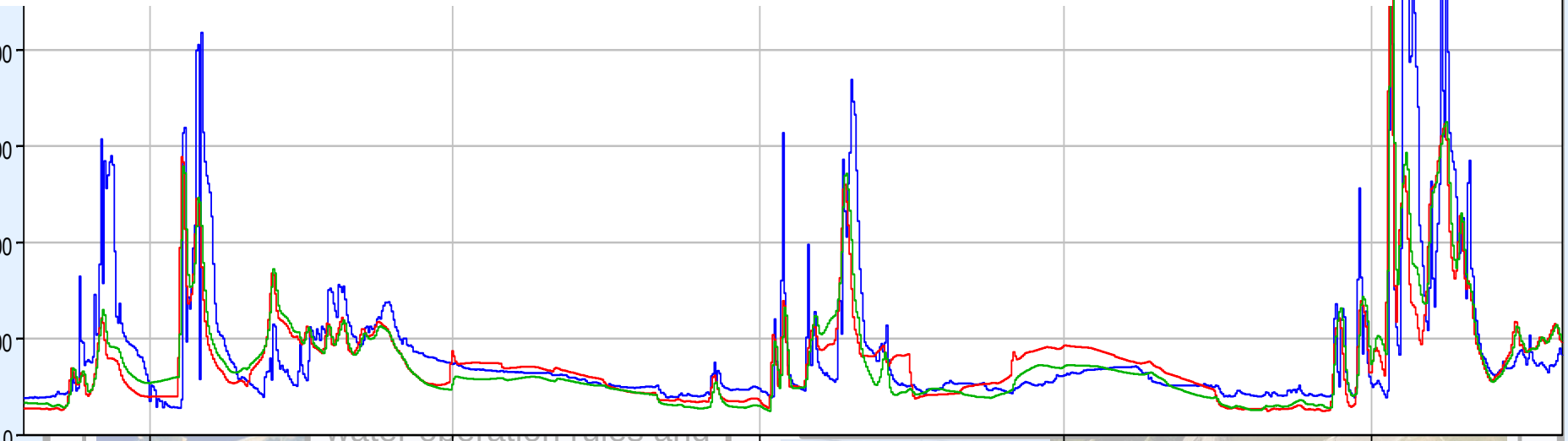
Delta region including Suisun Marsh



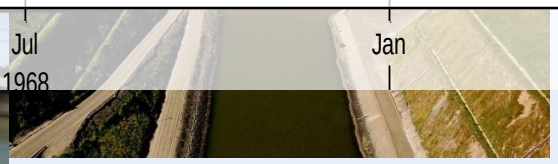
Multiple management questions



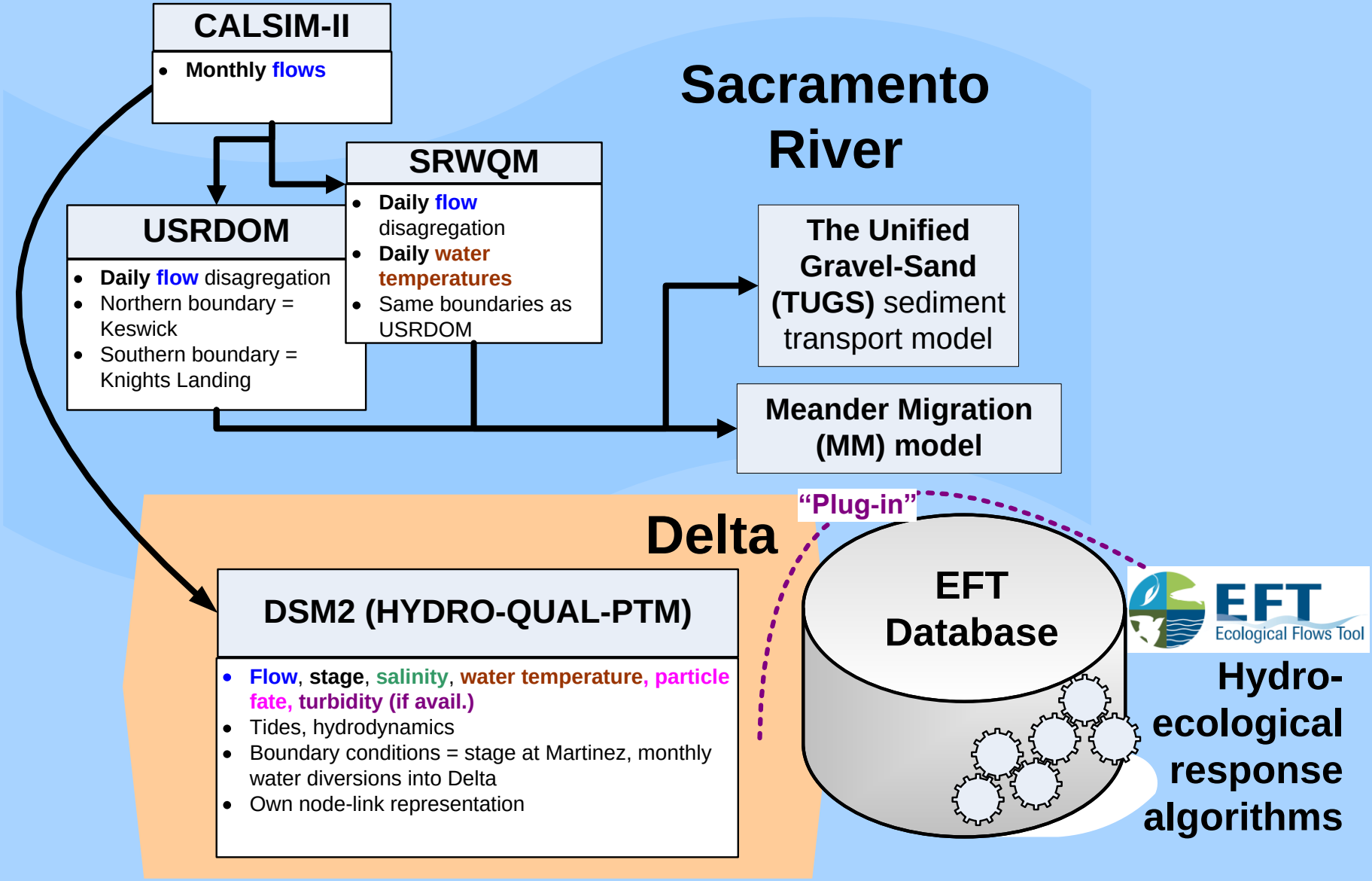




guidelines. (e.g., flood Yolo bypass more frequently)

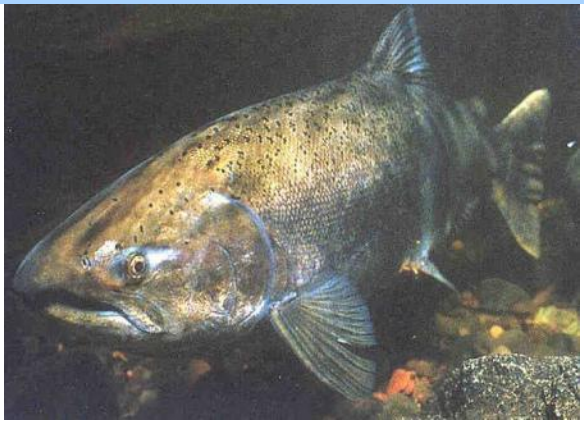


EFT: plug-in to preferred hydrologic & water quality models



SacEFT focal species & habitats

Steelhead
(*Oncorhynchus mykiss*)



Chinook Salmon
(*Oncorhynchus tshawytscha)*

Green Sturgeon
(Acipenser medirostris)

Bank Swallow
(Riparia riparia)

Western Pond Turtle *(Clemmys marmorata)*
Proxy: Large Woody Debris Recruitment

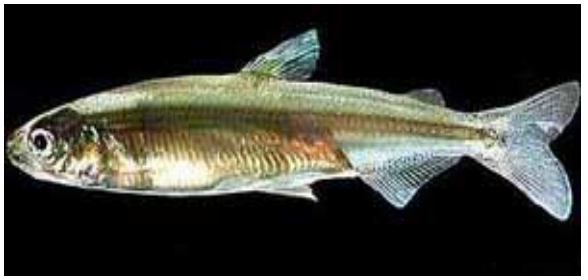
Fremont Cottonwood
(Populus fremontii)

DeltaEFT focal species & habitats

DeltaEFT
Delta Ecological Flows Tool

Steelhead
(*Oncorhynchus mykiss*)

Chinook Salmon
(*Oncorhynchus tshawytscha)*



Delta Smelt
(Hypomesus transpacificus)

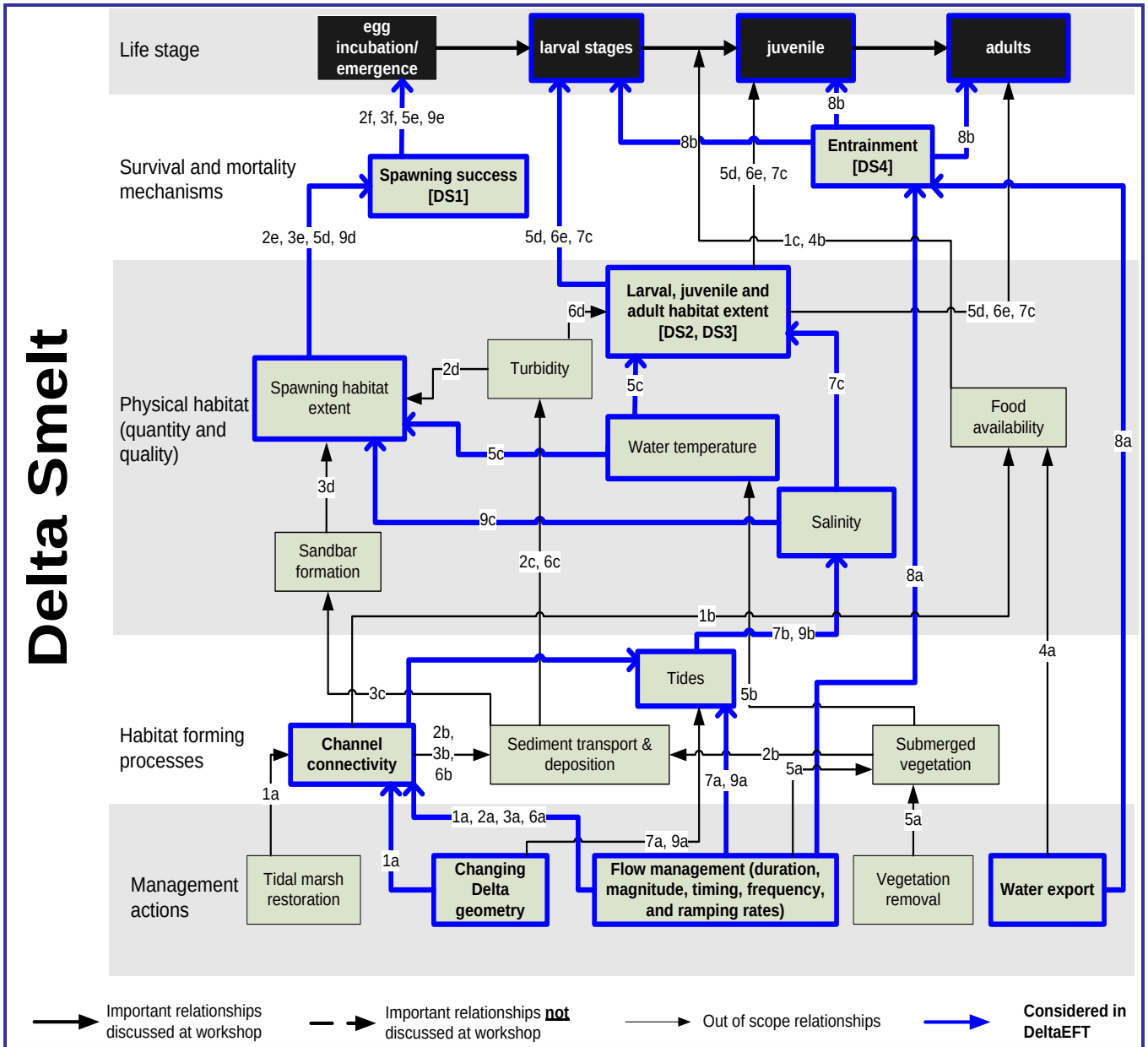
Splittail
(Pogonichthys macrolepidotus)

Tidal Wetlands

Invasive deterrence
(*E. Densa, Corbicula, Corbula*)

Performance indicators based on causally reasoned, functional relationships

DeltaEFT
Delta Ecological Flows Tool



SacEFT indicators

	Focal Species & Habitats	Performance Measures
Sacramento River	Fremont cottonwood (FC)	FC1 – Successful Fremont cottonwood initiation
		FC2 – Cottonwood seedling scour.
	Bank swallow (BASW)	BASW1 – Habitat potential/suitability
		BASW2 – Risk of nest inundation and bank sloughing during nesting
	Western pond turtle	LWD1 – Index of old vegetation recruited to the Sacramento River mainstem.
	Green sturgeon (GS)	GS1 – Egg-to-larvae survival
	Chinook salmon, Steelhead trout (CS)	CS1 – Area of suitable spawning habitat (ft2)
		CS3 – Egg-to-fry survival (proportion) CS5 – Redd scour risk CS6 – Redd dewatering (proportion)
		CS2 – Area of suitable rearing habitat (ft2) CS4 – Juvenile stranding (index)

DeltaEFT indicators

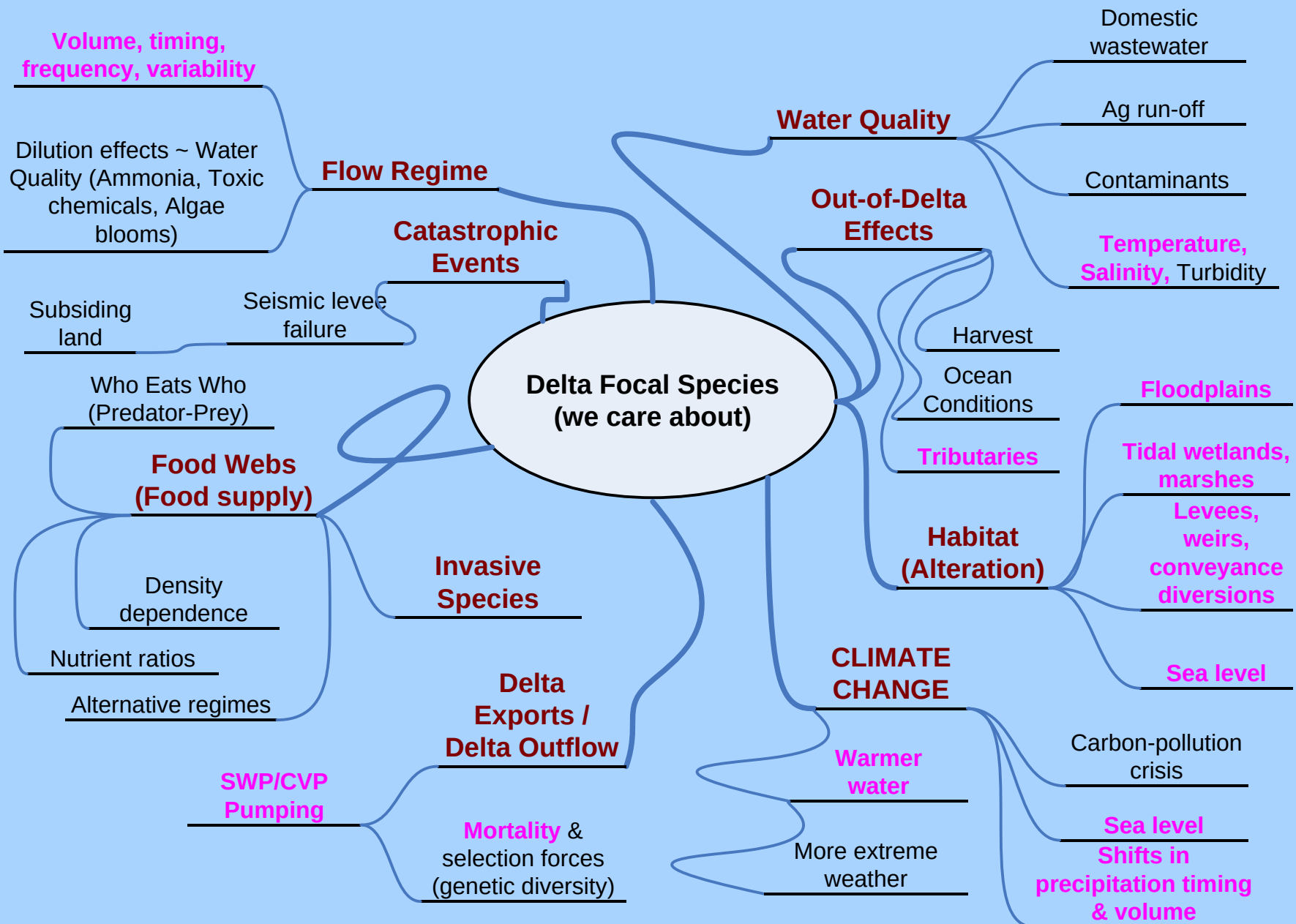
DeltaEFT
Delta Ecological Flows Tool

	Focal Species & Habitats	Performance Measures
Delta Ecoregion	Chinook & Steelhead (CS)	CS7 – Smolt weight gain in alt. migration corridors
		CS9 – smolt mortality index as a function of passage time (negatively correlated with CS7)
		CS10 – smolt temperature preference index (departures from optimum v. weight gain)
	Delta smelt (DS)	DS1 – spawning success index
		DS2 – index of habitat suitability
		DS4 – entrainment risk (index)
	Splittail (SS)	SS1 – proportion of maximum potential spawning habitat (index)
	Fresh / brackish tidal wetlands (TW)	TW1 – brackish wetland area
		TW2 – freshwater wetland area
	Invasive species deterrence (ID)	ID1 – Brazilian waterweed suppression
		ID2 (Corbula), ID3 (Corbicula) – invasive clam larvae and recruit suppression

EFT: Not developed in a vacuum

Core Team	SacEFT Workshop Participants		Delta EFT Workshop Participants & DeltaEFT Design contributors
Ryan Luster, TNC	Tricia Brachter, DFG	Peter Klimley, UC	Lori Chamurro, DFG
Mike Roberts, (formerly TNC)	Ron Schlorff, DFG	Eric Larsen, UC Davis	Dan Kratville, DFG
Greg Golet, TNC	Dave Zezulak DFG	Richard Corwin, USBR	Neil Clipperton, DFG
Maurice Hall, TNC	George Edwards, DFG	Ron Ganzfried, USBR	Tara Smith, DWR
Campbell Ingram, Delta Conservancy (formerly TNC)	Barry Garrison, DFG	John Hannon, USBR	Jim Long, DWR
Anthony Saracino, (formerly TNC)	Stacy Cepello, DWR	Buford Holt, USBR	Bill Harrell, DWR
Leo Winternitz, TNC	Dan Easton, DWR	David Lewis, USBR	Eric Reyes, DWR
Clint Alexander, ESSA	Jim Wieking, DWR	Tom Morstein-Marx, USBR	Sushil Arora, DWR
Don Robinson, ESSA	Adam Henderson, DWR	Mike Tansey, USBR	Nazrul Islam, DWR
Frank Poulsen, ESSA	Aric Lester, DWR	Don Ashton, USFS	Lars Anderson, USDA
Alex Embrey, ESSA	Bruce Ross, DWR	Ed Ballard, USFWS	Rosalie del Rosario, NMFS
Katherine Wieckowski, ESSA	Koll Buer, DWR	Matt Brown, USFWS	Bill Fleenor, UC Davis
Marc Nelitz, ESSA	Jason Kindopp, DWR	Dan Cox, USFWS	Patrick Crain, UC Davis
David Marmorek, ESSA	Ryon Kurtis, DWR	Mark Gard, USFWS	Tom Kimball, SWRCB
Katy Bryan, ESSA	Sean Sou, DWR	Andrew Hamilton, USFWS	Chandra Chimalkuri, CH2M Hill
David Carr, ESSA	Howard Brown, NMFS	Derek Hilts, USFWS	Michael Tansey, USBR
	Steve Lindley, NMFS	Brenda Olson, USFWS	Allison Willy, USFWS
	Bruce Oppenheim, NMFS	Bill Poytress, USFWS	Jon Rosenfield , The Bay Institute
	Naseem Alston, NMFS	Joe Silveira, USFWS	Lisa Lucas, USGS
	Brian Ellrott, NMFS	Jim Smith, USFWS	Larry Brown, USGS
	Tag Engstrom, CSU Chico	Joseph Terry, USFWS	Brett Kawakami, CCWD
	Dave Germano, CSU	Bruce Bury, USGS	John DeGeorge, RMA
	Josh Israel, UC Davis	Larry Brown, USGS	Dave Harlow, SWS
	Steve Greco, UC Davis	John Bair, McBain and Trush	Dave Fullerton, MWD
	Joe Heubler, UC Davis	Brad Cavallo, Cramer Fish Sciences	Michael Williams, consultant
	Michael Singer, UCSB	Nadav Nur, PRBO	Matt Nobriga, USFWS
	Ken Kirby	Nat Seavy, PRBO	Frederick Feyrer, USBR
	Tom Smith, Ayres Associates	Chrissy Howell, PRBO	Wim Kimmerer, SFSU
	Dave Vogel	Joel Van Eenennaam, UC Davis	Ted Sommer, DWR

Cumulative Effects & Multiple Mechanisms (DeltaEFT)



2060s	Strong beneficial impact owing to project alternative and/or climate & demand state
+5% to +9%	Small beneficial impact owing to project alternative and/or climate & demand state
–3% to +4%	Negligible impact owing to project alternative and/or climate & demand state
–4%	Slight negative impact owing to project alternative and/or climate & demand state
–5% to –9%	Small negative impact owing to project alternative and/or climate & demand state
≤ –10%	Strong negative impact owing to project alternative and/or climate & demand state

High-level summary:

% change in *number of simulation years* having a favorable rating

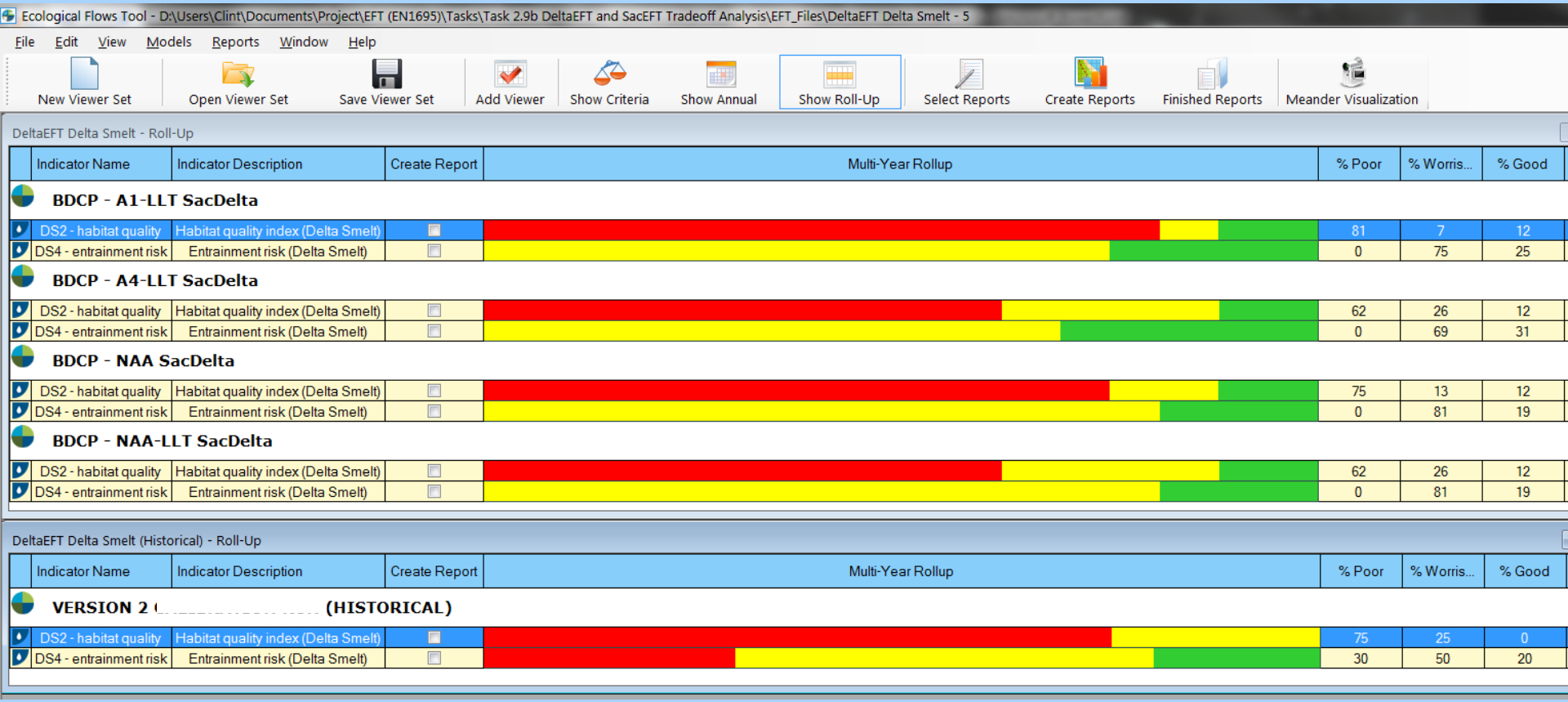
ce measure		Baseline Reference Case NAA-Current vs. Alternative Scenarios			
		NAA-LLT (Scenario 225)	A1-LLT (Scenario 226)	A4-LLT (Scenario 228)	
Delta Smelt	Spawning success (DS1)	0	0	0	
	Habitat suitability (DS2)	0	0	0	
	Entrainment risk (DS4)	0	6	***11***	
Splittail	Splittail habitat (Yolo) (SS1)	2	***82***	***82***	
Tidal Wetlands	Tidal wetland area (brackish) (TW1)	-35	-35	-35	
	Tidal wetland area (freshwater) (TW2)	-29	-29	-29	
Invasive deterrence	Egeria suppression (ID1)	-6	3	-3	
	Corbula suppression (ID2)	0	-3	-3	
	Corbicula suppression (ID3)	0	0	0	
Fall Chinook	Yolo Bypass rearing (CS7)	-29	-29	-29	
	Smolt temperature stress (CS10)	-12	-12	-12	
	Smolt predation risk (CS9)	0	-6	-6	
Late Fall Chinook	Yolo Bypass rearing (CS7)	-12	***13***	***13***	
	Smolt temperature stress (CS10)	-6	-6	-6	
	Smolt predation risk (CS9)	-6	-6	-6	
Spring Chinook	Yolo Bypass rearing (CS7)	-6	0	0	
	Smolt temperature stress (CS10)	-12	-12	-12	
	Smolt predation risk (CS9)	-7	-7	-7	
Winter Chinook	Yolo Bypass rearing (CS7)	-19	6	***12***	
	Smolt temperature stress (CS10)	-31	-31	-31	
	Smolt predation risk (CS9)	0	0	0	
Steelhead	Yolo Bypass rearing (CS7)	-13	-13	-13	
	Smolt temperature stress (CS10)	-6	-6	-6	
	Smolt predation risk (CS9)	-6	-6	-6	

Key Message

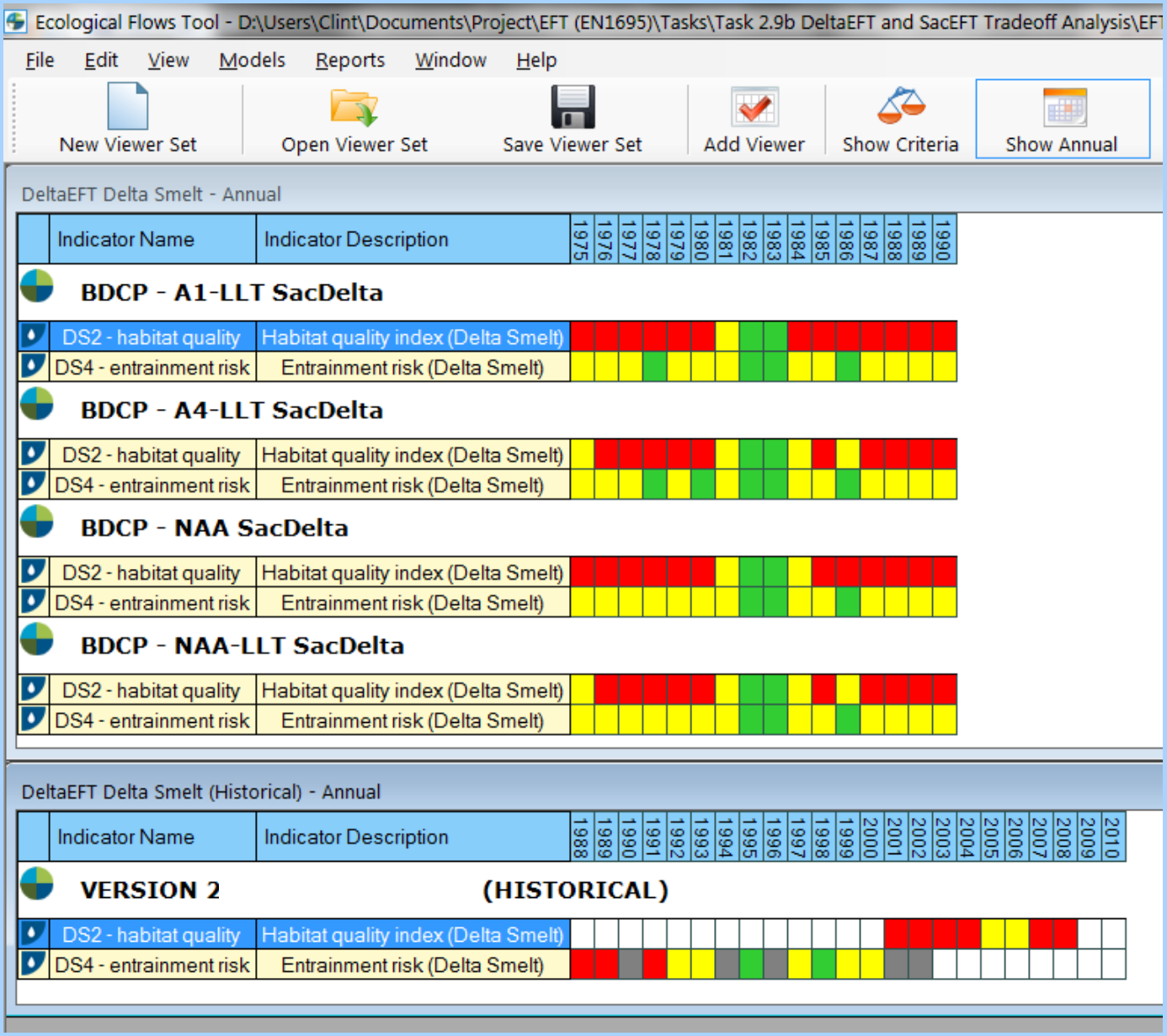
The climate of 2060s (and its associated sea level) + increased human water demands = strong downward impacts on most DeltaEFT performance measures

Exceptions: 1) Yolo Bypass habitats, which benefit from notching of the Fremont Weir under the A1 and A4 alts and 2) Delta smelt entrainment which is reduced by lessening of frequency of reverse flows in Old and Middle Rivers under A1/A4 operations.

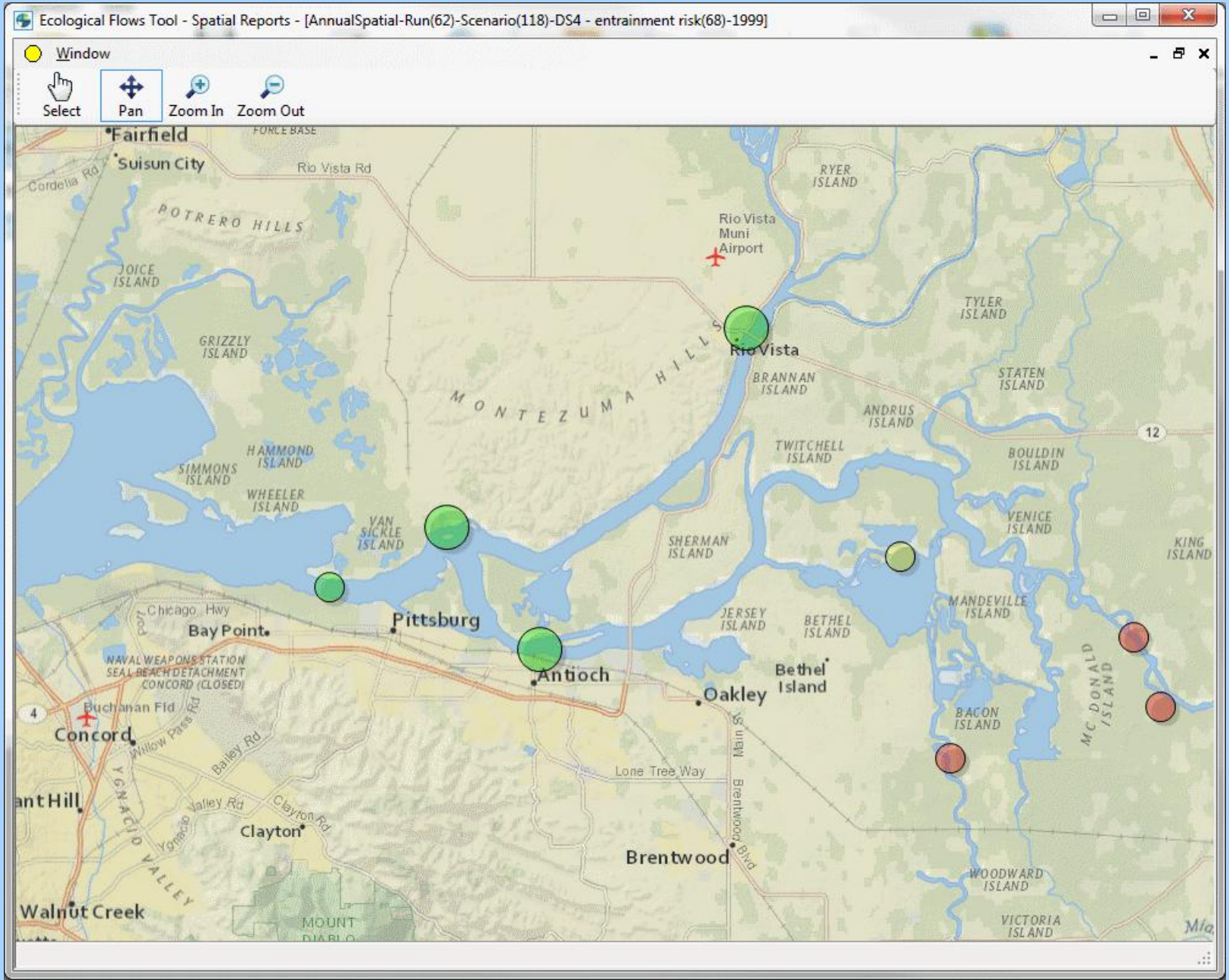
Multi-year “roll-up”



Annual “roll-up”

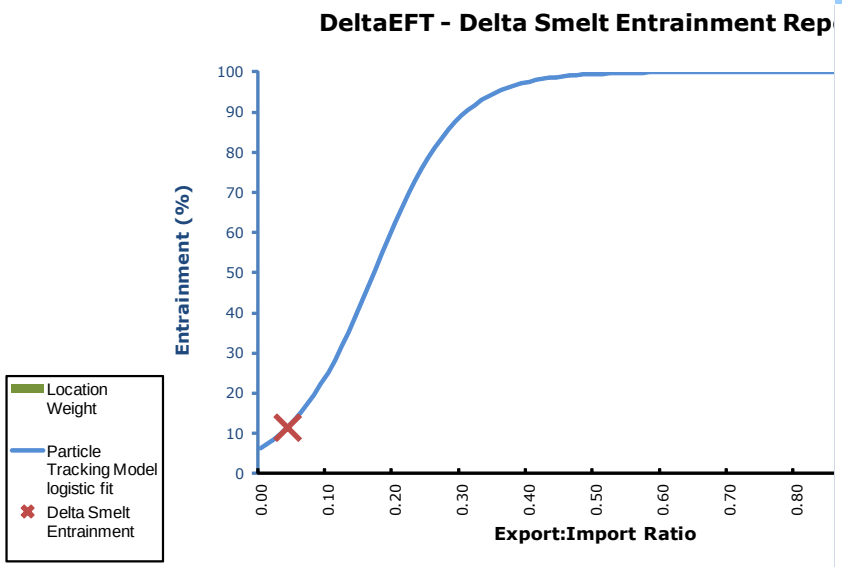


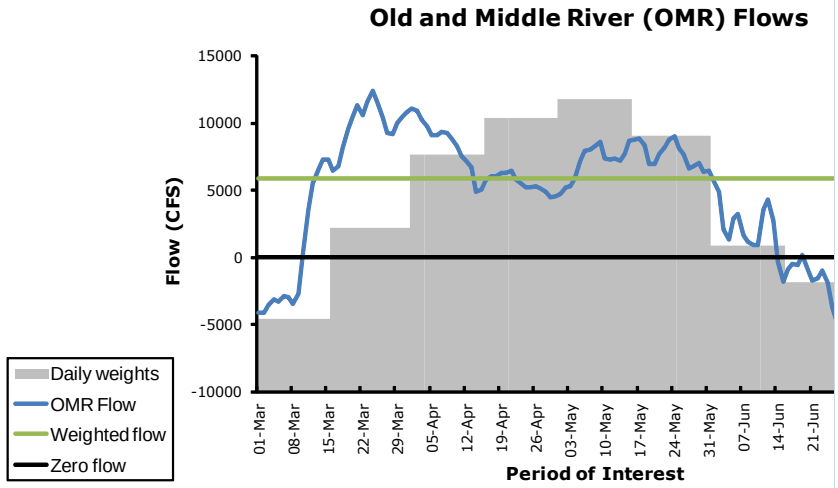
Spatial data visualizations (e.g. entrainment risk)



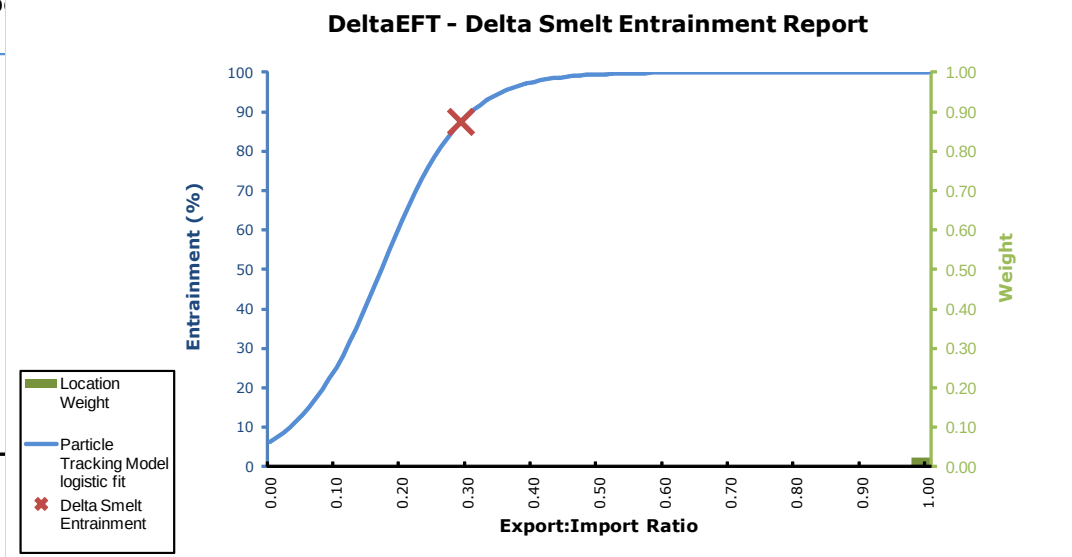
Delta Smelt Entrainment (DS4): Annual details

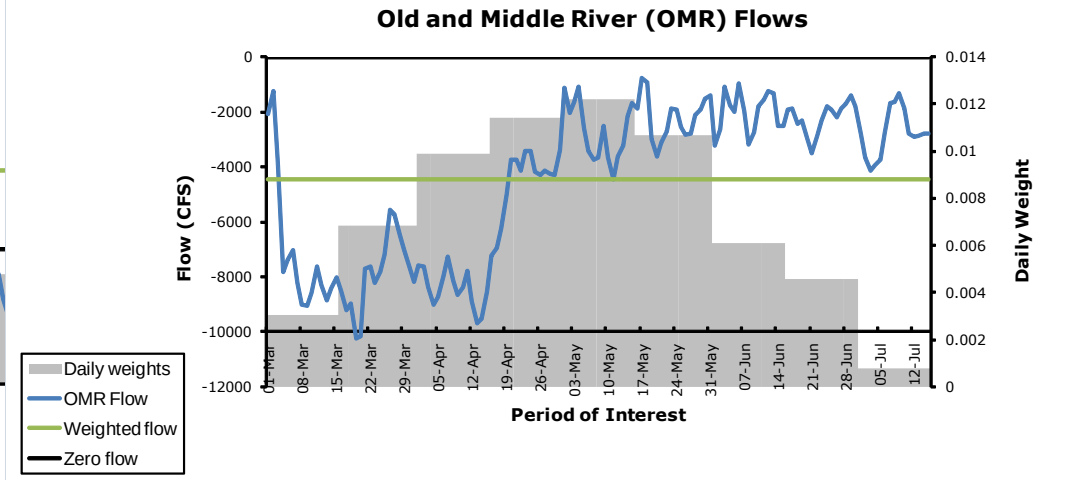
Scenario: VERSION 2 (HISTORICAL)
Water year: 1995
Location of interest: TURNER CUT NR HOLT CA
Units Percentage





Scenario: VERSION 2 (HISTORICAL)
Water year: 1991
Location of interest: TURNER CUT NR HOLT CA
Units Percentage





Question 1: What types of analyses should be completed?

1. Determine priorities for ecological needs & develop alternative ecological flow regimes x water year class
   - Include both flow and non-flow actions
2. Test alternative eFlow regimes (& paired non-flow actions) vs. other beneficial uses.
   - What would these guidelines do to ability to meet established rights & standards? Which ones have least impact on water deliveries, power production, water temperatures, etc.?

Question 1: What types of analyses should be completed?

3. Effects on major linked eco-regions (Sacramento, San Joaquin).
4. Develop more specific statements of frequency different targets needed & characterize within year trade-offs (e.g., “species *x* over species *y* if…”).
5. Resilience of strategies vs. future climate change effects on water supplies, demand and sea level.

Question 2: What tools should be used? Advantages & limitations?

Tool	DeltaEFT, SacEFT

Advantages	Limitations
• More representative: **multiple focal species & habitats**. • **Rapid scenario comparison** – trade-offs in one framework. • **Eco-regions linked**: **Sacramento & Delta**. • **Broad synthesis** of **science** & **advice of experts**. • Evaluate **multiple actions** (*gravel*, *channel migration*, *floodplain activation*, *conveyance*, *operations*). • **Intuitive outputs simplify communication.** • **Speed / agility** – EFT effects analyses can be run in "days" and "weeks" (rather than months/years). • **Plug-in** to <u>any</u> hydrodynamic / water quality model. • **Extensible**. **Improve/add** performance indicators as science evolves. Design anticipates being refined over time. • **"Goldilocks" level of detail.** Not as data hungry & assumption rich as life-cycle models.	• Does not permit a definitive assessment of population level benefits (not a life-cycle tool). • As with other tools, criteria & thresholds identified by EFT need to be accompanied by monitoring & adaptive management. • Does not consider effects on other beneficial uses (water deliveries, power, etc.) • Not applicable to real-time decision making.

Question 2: What tools should be used? Advantages & limitations?

Tools	WEAP, CALVIN, CALSIM-USRWQM/USRDOM, DSM2, etc. & related hydro-power, water temperature models
Advantages	**Limitations / Challenges**
• **Numerous**. These tools have multiple applications & are *essential* to planning. • Physical hydrosystem effects on water deliveries, storage, exports, water temperature, power generation, flood control for SWP and CVP. • Scenario evaluation - tradeoffs.	• Options for integrating and accurately representing ecological criteria / guidelines into operations. • Ability to "unwind" and "re-constrain" hydrosystem to rapidly evaluate ecological flow regime criteria (rather than simply cumulatively add ever more low-priority constraints). • Economic evaluations not always included. (Including economic benefits of fish/wildlife/recreation). • Future climate / sea level / demand and resilience of boundary conditions & calibration assumptions?