Declining Downstream: modeling efforts to assess recruitment to frog populations in California's regulated rivers

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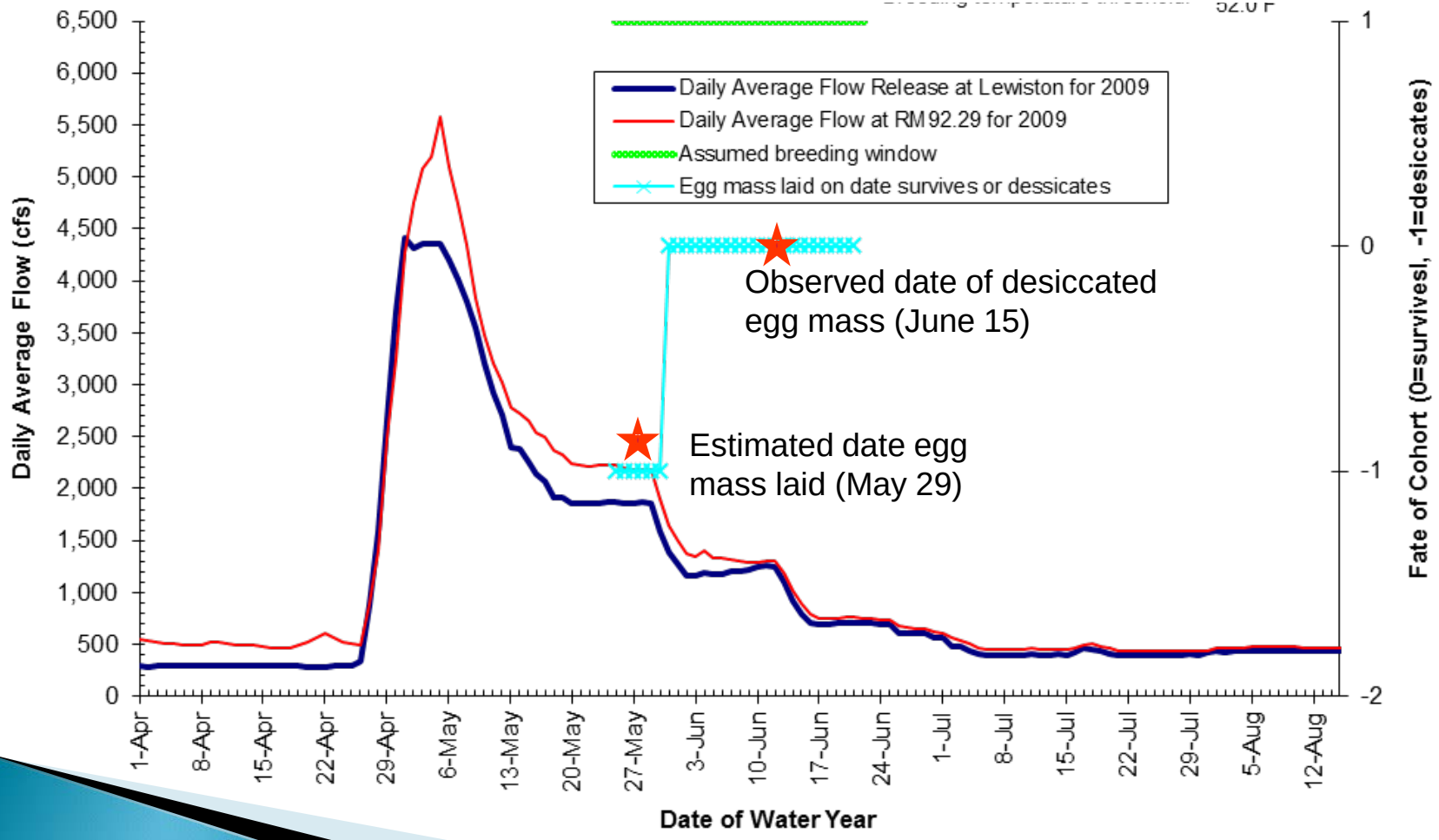
Summary of 2009 example site

- Egg Mass 12
- Douglas City Campground, RKm 148.53 (RM 92.3)
- Egg mass laid on May 29, 2009
- Flow at site when egg mass laid: 2,180 cfs
- Flow when egg mass desiccated: 896 cfs

Example of Trinity River results: 2009 actual egg depth=11 cm at Douglas City site EM#12



Field data from Jamie Bettaso, USFWS

Apply EM12 to new hydrographs

- ROD hydrograph
- TRRP hydrograph
- “Natural” hydrograph from Salmon River
- Uses on-site flow and water temperature based on water temperature model output for node at RM 92.5 (EM12 is at RM92.3)
- Assume 50 cm (1.64 ft) egg laying depth
- Assess 28 potential breeding days
- Assume two breeding start scenarios;
  - May 26 fixed date
  - Date when 7-day running average temperature >11.1°C

Scenarios run

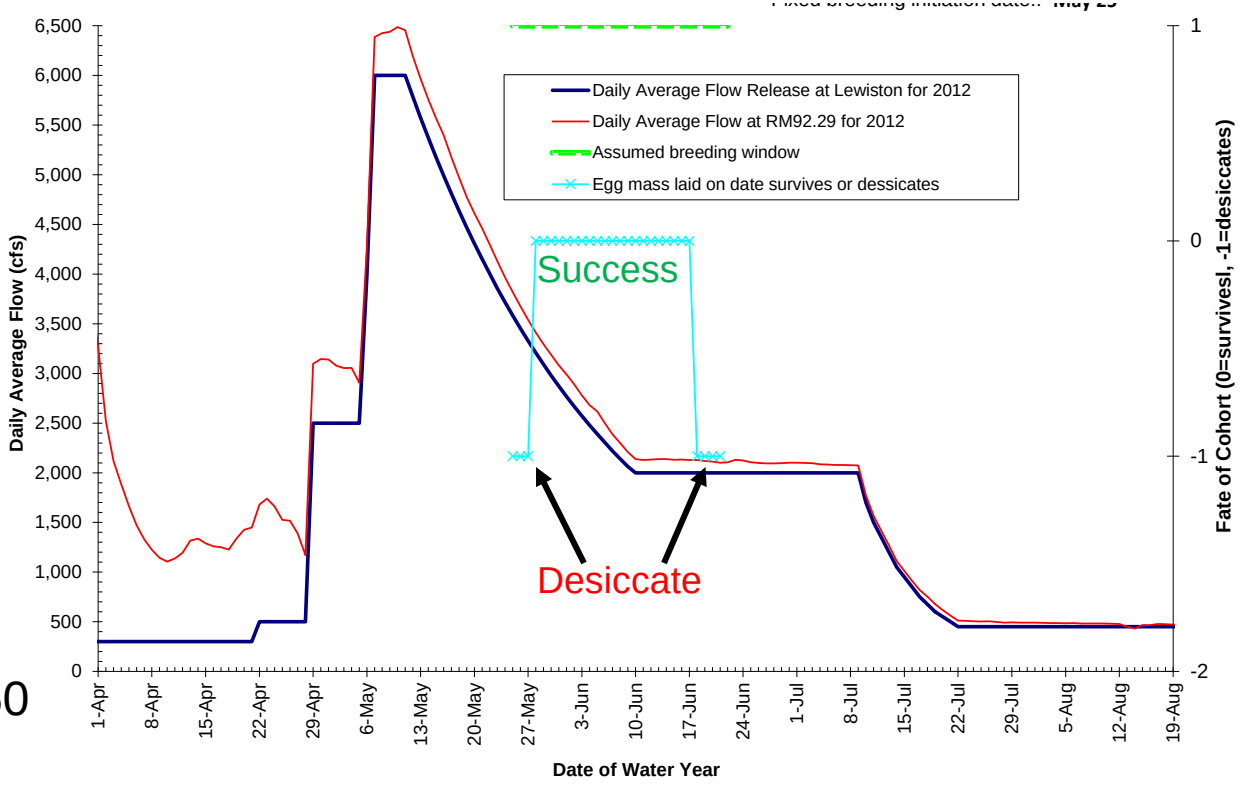
	ROD hydrograph	TRRP Hydrograph	Natural hydrograph
Fixed May 25 breeding start date	X	X	X
Variable date when 7-day water temp>11.1C	X	X	X

ROD hydrograph, May 25 breeding date start

May 25 breeding date<<11.1°C, so likely unrealistically early

21 out of 28 breeding days could have successfully hatched egg masses

Desiccation occurred on high flow recession limb, and transition from 2,000 cfs to 450 cfs baseflows

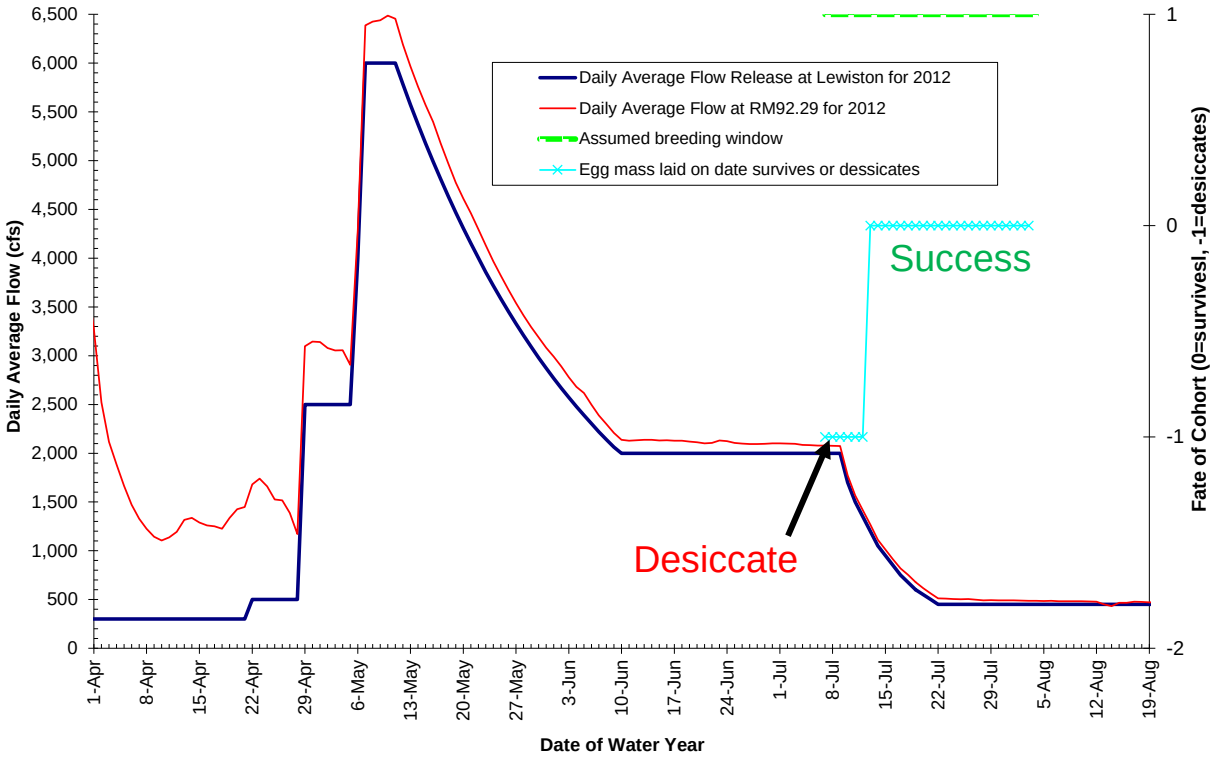


ROD hydrograph, >11.1°C breeding date start (July 7!!)

High (cold) releases cause delay of breeding until July 7

22 out of 28 breeding days could have successfully hatched egg masses, but very late in season. Reproduction success likely very low due to short metamorph time before onset of winter

Desiccation occurred transition from 2,000 cfs to 450 cfs baseflows

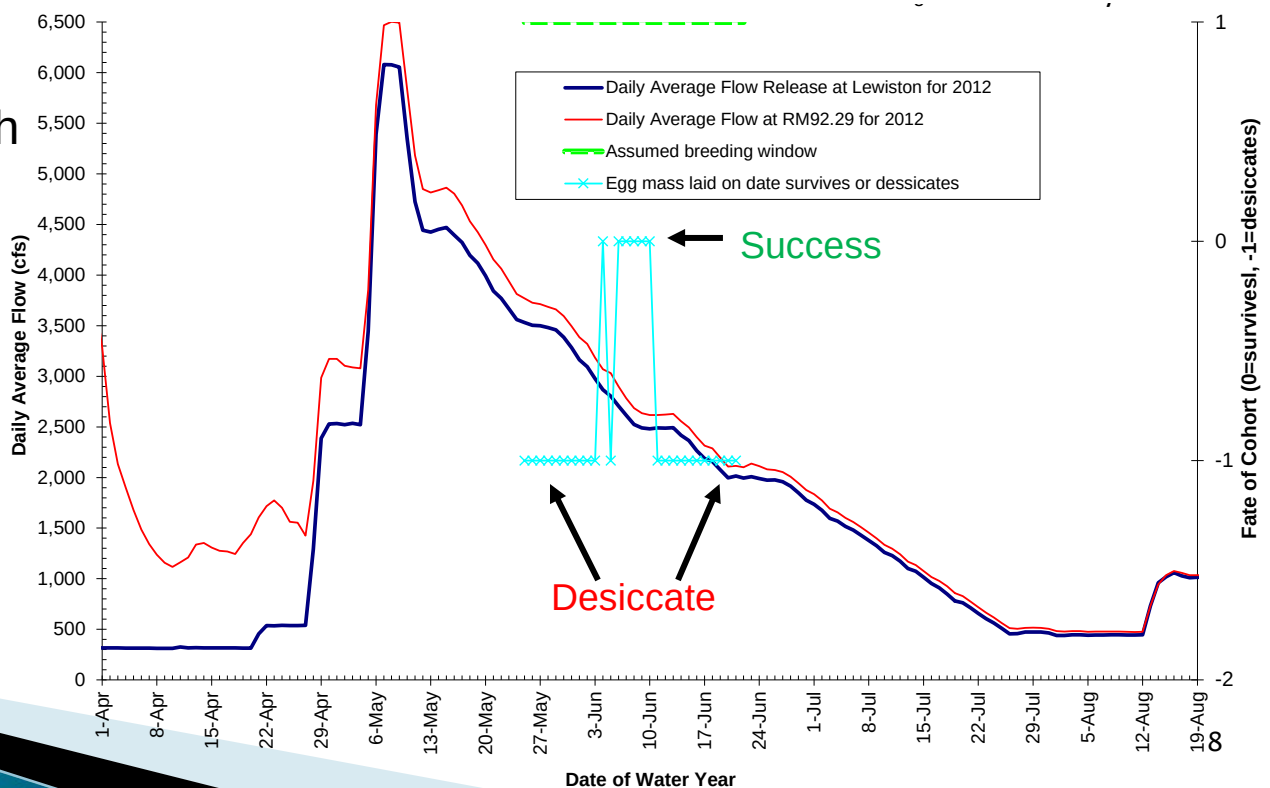


TRRP hydrograph, May 25 breeding date start

May 25 breeding date is appx 10°C, so could be possible

Only 6 out of 28 breeding days could have successfully hatched egg masses

Desiccation occurred on high flow recession limb, and transition from 2,500 cfs to 2,000 cfs bench

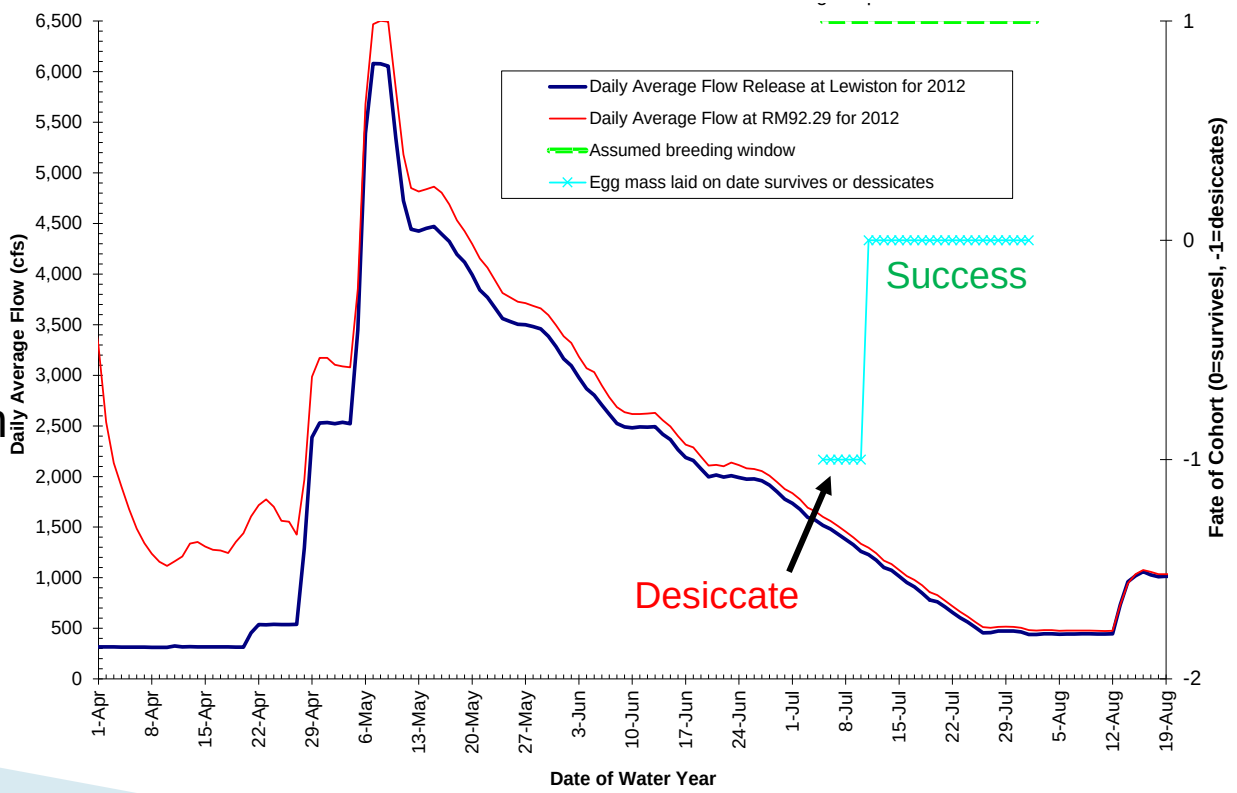


TRRP hydrograph, >11.1°C breeding date start (July 5!!)

High (cold) releases cause delay of breeding until July 5

22 out of 28 breeding days could have successfully hatched egg masses, but very late in season. Reproduction success likely very low due to short metamorph time before onset of winter

Desiccation occurred transition from 2,000 cfs to 450 cfs baseflows

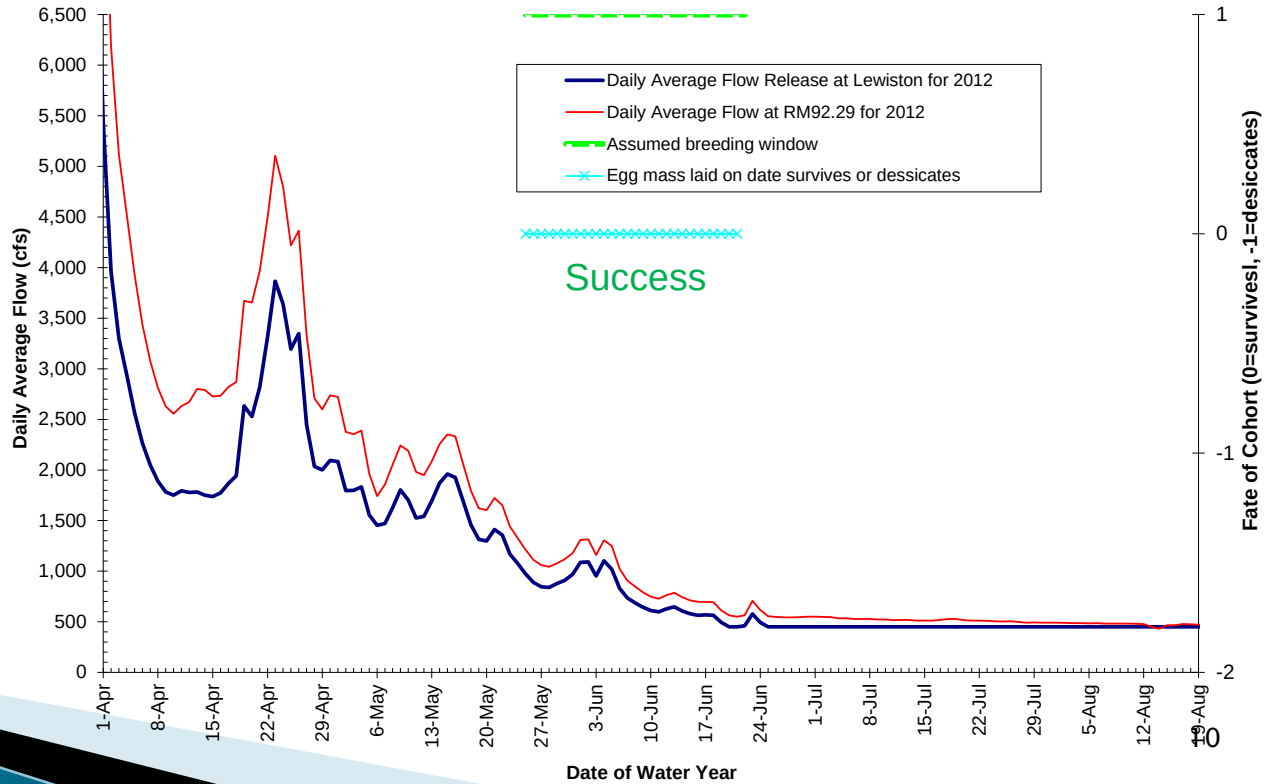


Natural hydrograph, May 25 breeding date start

May 25 breeding date is appx 10.6°C, so not too early

28 out of 28 breeding days could have successfully hatched egg masses

No desiccation occurred because peak and fastest recession occurred prior to breeding

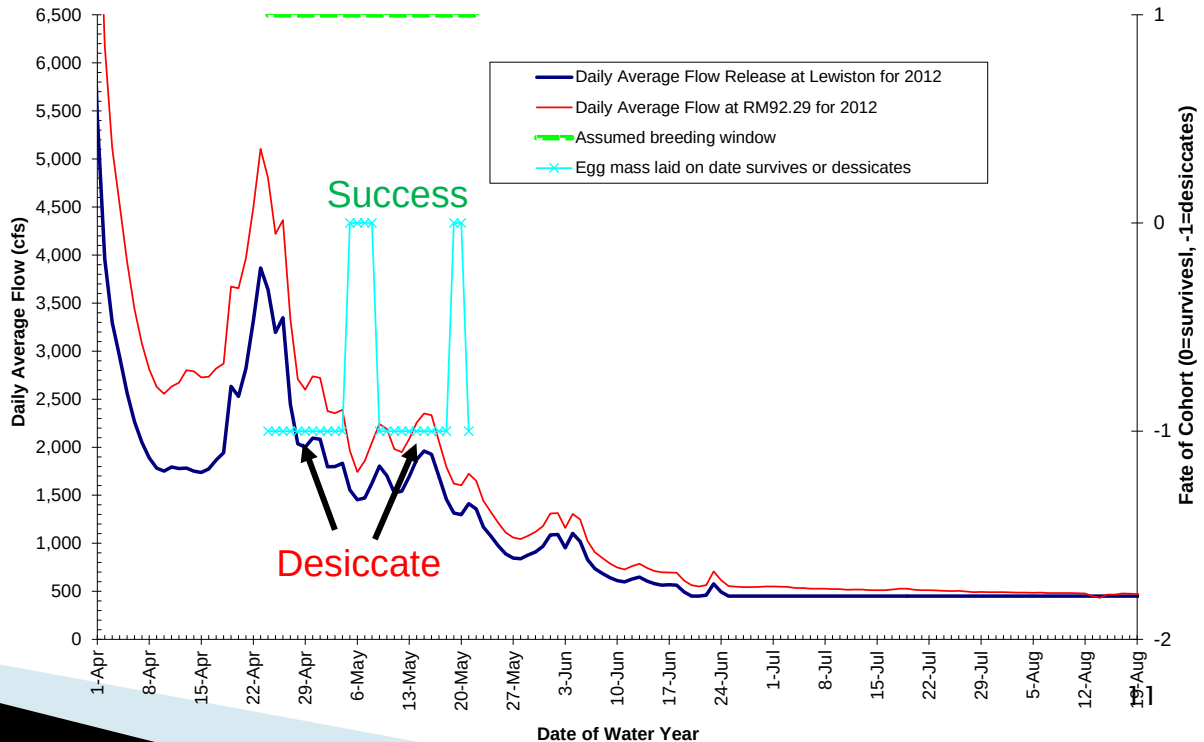


Natural hydrograph, >11.1°C breeding date start (April 24!!)

Lower and warmer flows cause earlier breeding

Only 6 out of 28 breeding days could have successfully hatched egg masses due to earlier breeding (April 24), but reproduction success likely very high for those egg masses due to longer metamorph time before onset of winter

Desiccation occurred at steeper flow fluctuations around 2,000 cfs



Summary of successful breeding days

Flow/Temp Scenario	May 25 fixed breeding start date	>11.1°C breeding start date	Notes
ROD	21	22	11.1°C start date is too late
TRRP	6	22	11.1°C start date is too late
Natural	28	6	

Summary

- For ROD and TRRP scenarios, assuming frog breeding begins when >11.1°C temperature threshold is exceeded, overall reproductive success is likely low due to short time for tadpole metamorphosis and growth before winter. Complex channel features with warmer breeding sites could help considerably.
- Not much difference between ROD and TRRP hydrograph when using >11.1°C breeding start.
- Natural hydrograph with May 25 breeding date predicted much greater breeding success due to peak and steep recession occurring earlier in the season, prior to breeding initiating. Successful reproduction more likely.
- Caveat of this analysis is that highly successful reproduction occurs in drier years and some Normal years, so desiccation for these hydrographs is not necessarily an ecological failure
- Earlier peaks and recessions (e.g., drier years) will decrease desiccation risk and provide longer tadpole and metamorph development time

What is effect on results if egg depth assumption decreased to 30.5 cm (1.0 ft)?

50 cm assumed egg depth (1.64 ft)

Flow/Temp Scenario	May 25 fixed breeding start date	>11.1°C breeding start date
ROD	21	22
TRRP	6	22
Natural	28	6

30.5 cm assumed egg depth (1.0 ft)

Flow/Temp Scenario	May 25 fixed breeding start date	>11.1°C breeding start date
ROD	12	19
TRRP	0	15
Natural	17	0