Fish Benefits Overview

- Temperature Benefits
- Floodplain Benefits
- SalSim

Ecosystem Benefits of the Flow Proposal

- Restore the pattern and some limited magnitude of flow that are more closely aligned to the conditions to which native fish species are adapted

Benefits of Flow

- The benefits of increased instream flows expected from this project have a functionally useful effect, and are evaluated and quantified in this SED in two key ways:
  – Increased attainment of beneficial water temperatures for salmonids over space (more river miles) and time (more days)
  – Increased floodplain inundation, also in space and time, meaning that more acreage is inundated more of the time, thus benefitting growth and survival of juvenile salmonids

Importance of Temperature on Salmonids

- Behavior
- Disease
- Predation
- Migration
- Reproduction
- Growth
- Smoltification

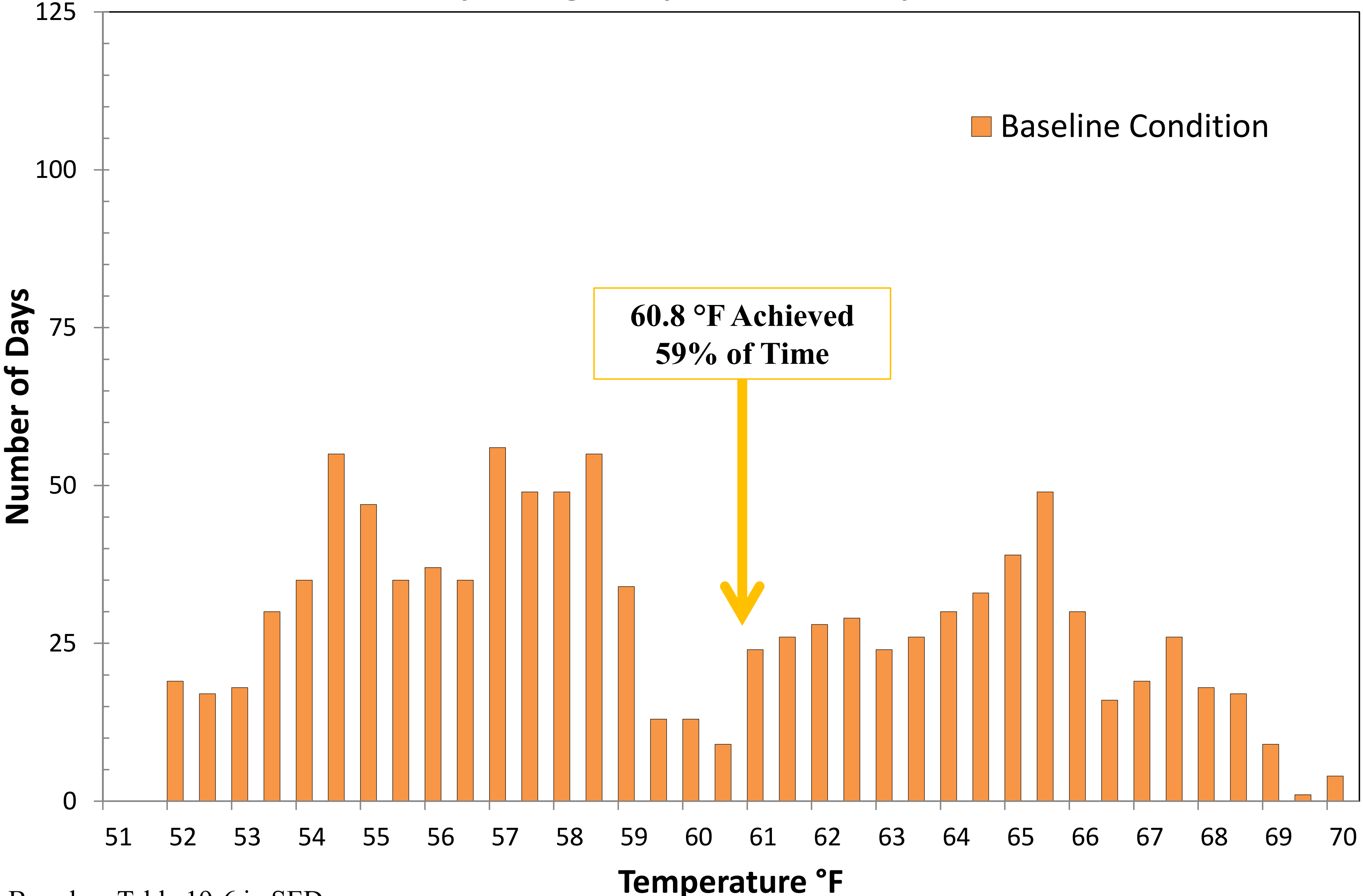
Evaluation of Temperature Benefits

- USEPA Criteria
- Average Temperature
- 90th Percentile Temperature

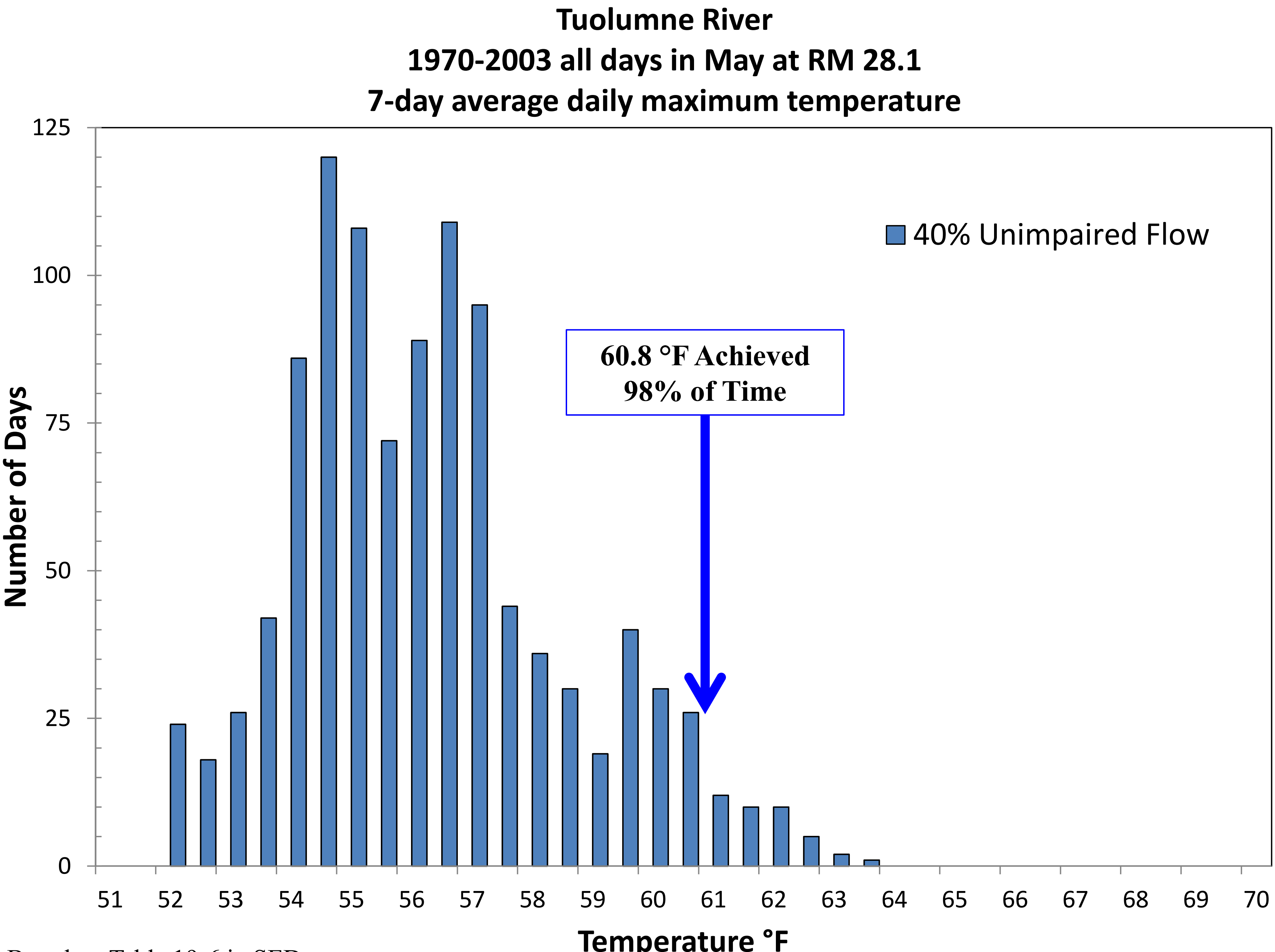
USEPA Temperature Criteria

CALIFORNIA
Water Boards

Tuolumne River
1970-2003 all days in May at RM 28.1
7-day average daily maximum temperature

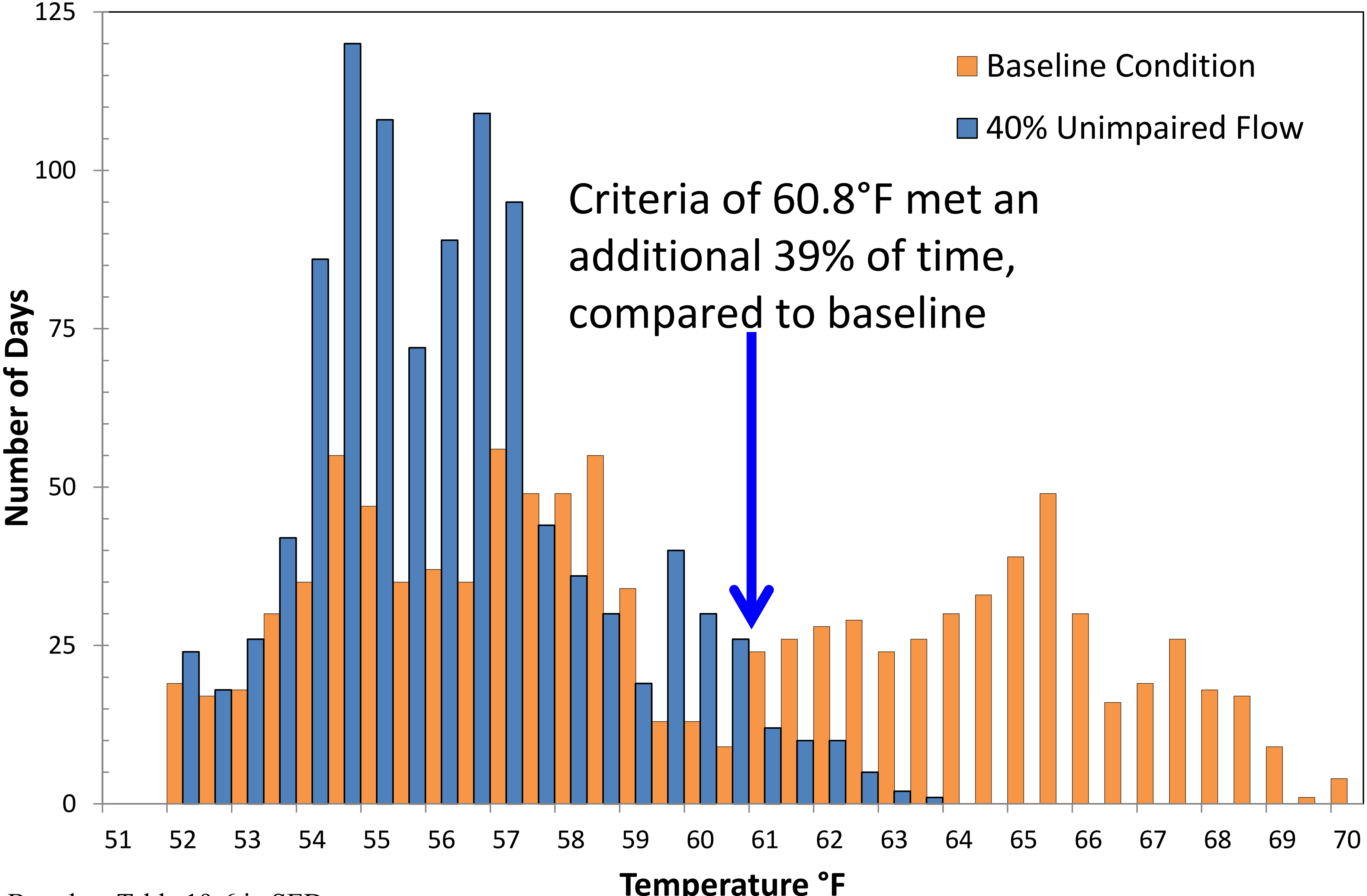


Based on Table 19-6 in SED



Based on Table 19-6 in SED

Percent of Time USEPA Temperature Criteria Met in the Tuolumne River in May at RM 28.1



Based on Table 19-6 in SED

Increase in Percent of Time Temperature Criteria Achieved – Tuolumne River at River Mile 28.1

Life Stage	Month	USEPA Criteria (degrees F)	**Base**	**Unimpaired Flow Percent**				
				20	30	40	50	60
Reproduction	Feb	55.4	**72%**	5%	8%	9.8%	14%	18%
Reproduction	Mar	55.4	**54%**	5%	8%	14%	22%	27%
Core Rearing	Mar	60.8	**84%**	9%	14%	15%	15%	16%
Core Rearing	Apr	60.8	**74%**	16%	22%	22%	24%	25%
Core Rearing	May	60.8	**59%**	21%	30%	39%	41%	41%
Smoltification	Apr	57.2	**57%**	3%	16%	28%	34%	37%
Smoltification	May	57.2	**38%**	9%	26%	39%	43%	46%
Smoltification	Jun	57.2	**23%**	-1%	6%	13%	21%	23%
Summer Rearing	Jun	64.4	**42%**	24%	33%	37%	45%	48%

59% + 39% = 98%

Based on Table 19-6 in SED

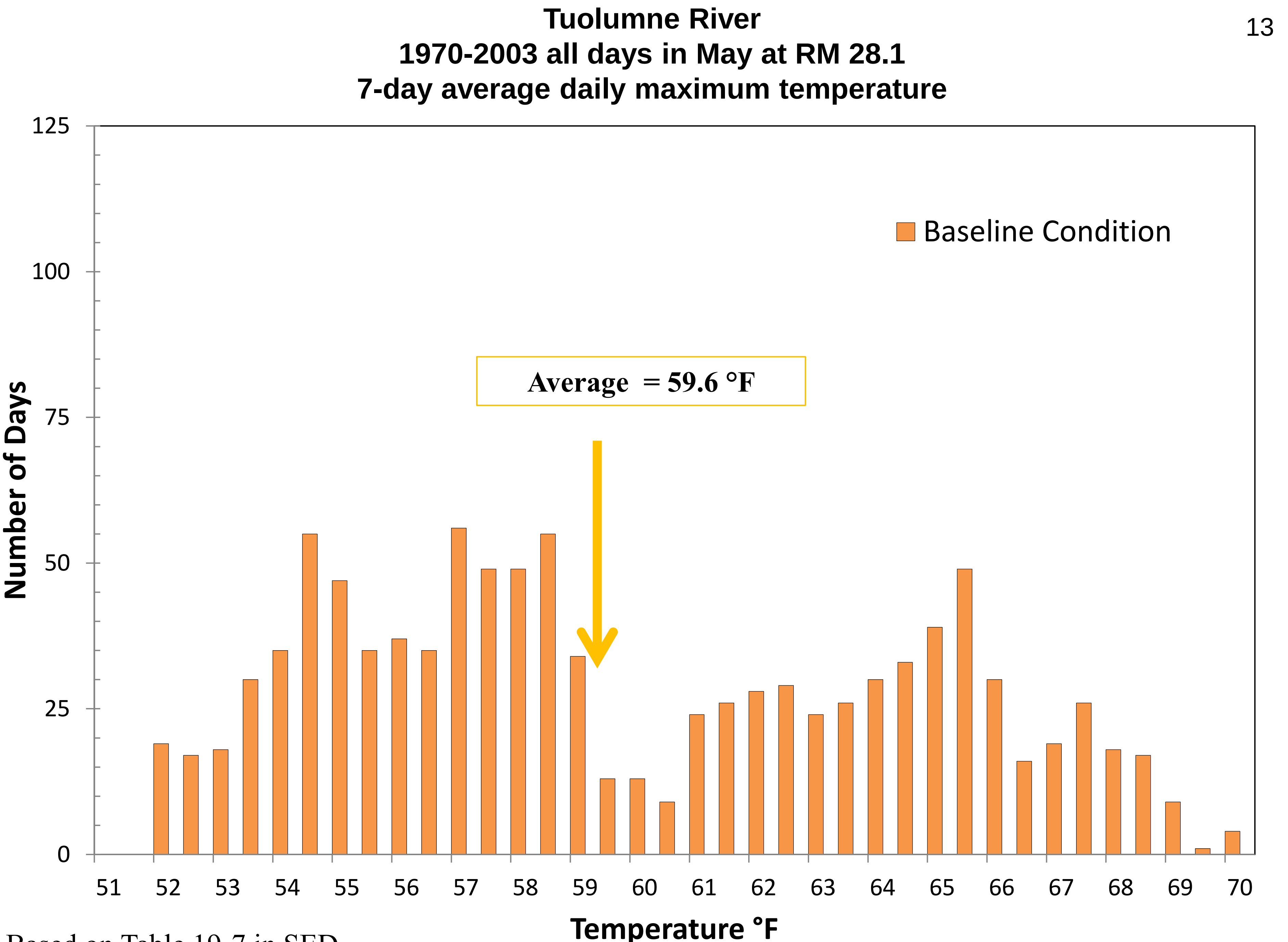
Increase in Percent of Time Temperature Criteria Achieved – **Tuolumne River** – All Times and Locations

Tuolumne River		Confluence (RM0)						1/4 River (RM13.2)						1/2 River (RM28.1)						3/4 River (RM38.3)						Below La Grange (RM53.5)					
Life Stage	Month / USEPA Criteria (°F)	Base	Percent Unimpaired Flow					Base	Percent Unimpaired Flow					Base	Percent Unimpaired Flow					Base	Percent Unimpaired Flow					Base	Percent Unimpaired Flow				
			20%	30%	40%	50%	60%		20%	30%	40%	50%	60%		20%	30%	40%	50%	60%		20%	30%	40%	50%	60%		20%	30%	40%	50%	60%
AM	Sep (64.4)	**2%**	0%	0%	0%	0%	0%	**3%**	0%	0%	2%	2%	1%	**11%**	0%	-2%	17%	17%	16%	**33%**	0%	-3%	7%	6%	6%	**100%**	0%	0%	0%	0%	0%
AM	Oct (64.4)	**25%**	0%	-1%	6%	5%	6%	**37%**	0%	-1%	4%	3%	3%	**63%**	0%	0%	3%	4%	4%	**81%**	1%	0%	0%	0%	0%	**100%**	0%	0%	0%	0%	0%
R	Oct (55.4)	**0%**	0%	0%	0%	0%	0%	**0%**	0%	0%	0%	0%	0%	**0%**	0%	0%	0%	0%	0%	**1%**	0%	-1%	-1%	-1%	-1%	**85%**	3%	3%	3%	4%	-2%
R	Nov (55.4)	**27%**	0%	0%	1%	0%	-1%	**34%**	0%	0%	1%	-1%	-2%	**23%**	0%	-1%	-1%	-4%	-5%	**27%**	0%	-2%	-3%	-9%	-9%	**85%**	4%	4%	5%	6%	0%
R	Dec (55.4)	**98%**	0%	0%	0%	0%	0%	**100%**	0%	0%	-1%	-1%	-1%	**95%**	0%	0%	0%	-1%	-2%	**93%**	1%	0%	0%	-2%	-2%	**95%**	1%	1%	1%	1%	-2%
R	Jan (55.4)	**98%**	0%	0%	0%	0%	0%	**98%**	0%	0%	0%	0%	0%	**97%**	0%	0%	0%	0%	0%	**99%**	0%	0%	0%	0%	-1%	**99%**	0%	0%	0%	0%	0%
R	Feb (55.4)	**69%**	2%	3%	6%	8%	10%	**75%**	3%	5%	6%	8%	9.9%	**72%**	5%	8%	9.8%	14%	18%	**79%**	1%	4%	9.99%	12%	13%	**100%**	0%	0%	0%	0%	0%
R	Mar (55.4)	**37%**	-3%	-3%	-3%	-1%	9%	**50%**	-1%	0%	2%	7%	12%	**54%**	5%	8%	14%	22%	27%	**56%**	9%	14%	25%	30%	35%	**100%**	0%	0%	0%	0%	0%
CR	Mar (60.8)	**65%**	6%	8%	18%	24%	28%	**72%**	5%	11%	20%	23%	25%	**84%**	9%	14%	15%	15%	16%	**91%**	8%	9%	9%	9%	9%	**100%**	0%	0%	0%	0%	0%
CR	Apr (60.8)	**50%**	0%	6%	21%	35%	41%	**57%**	4%	18%	31%	36%	38%	**74%**	16%	22%	22%	24%	25%	**92%**	6%	6%	7%	8%	8%	**100%**	0%	0%	0%	0%	0%
CR	May (60.8)	**19%**	2%	20%	34%	47%	37%	**34%**	9%	32%	46%	52%	58%	**59%**	21%	30%	39%	41%	41%	**74%**	14%	24%	26%	26%	26%	**100%**	0%	0%	0%	0%	0%
S	Apr (57.2)	**22%**	0%	2%	5%	9%	15%	**36%**	-2%	2%	7%	21%	31%	**57%**	3%	16%	28%	34%	37%	**65%**	14%	25%	29%	30%	31%	**100%**	0%	0%	0%	0%	0%
S	May (57.2)	**3%**	0%	1%	2%	4%	3%	**15%**	3%	9%	16%	30%	40%	**38%**	9%	26%	39%	43%	46%	**56%**	14%	28%	35%	40%	43%	**100%**	0%	0%	0%	0%	0%
S	Jun (57.2)	**0%**	0%	0%	0%	0%	0%	**5%**	1%	1%	2%	5%	10%	**23%**	-1%	6%	13%	21%	23%	**34%**	8%	20%	31%	37%	39%	**100%**	0%	0%	0%	0%	0%
SR	Jun (64.4)	**30%**	1%	11%	24%	35%	36%	**34%**	7%	25%	33%	41%	42%	**42%**	24%	33%	37%	45%	48%	**46%**	29%	37%	45%	45%	47%	**100%**	0%	0%	0%	0%	0%
SR	Jul (64.4)	**6%**	-1%	0%	1%	1%	-1%	**19%**	0%	-2%	0%	-2%	-4%	**23%**	2%	-2%	16%	17%	14%	**26%**	3%	-3%	15%	16%	16%	**100%**	0%	0%	0%	0%	0%
SR	Aug (64.4)	**0%**	0%	0%	0%	0%	0%	**2%**	0%	0%	-1%	-1%	-2%	**8%**	0%	0%	1%	1%	0%	**9%**	0%	-1%	8%	6%	5%	**100%**	0%	0%	0%	0%	0%

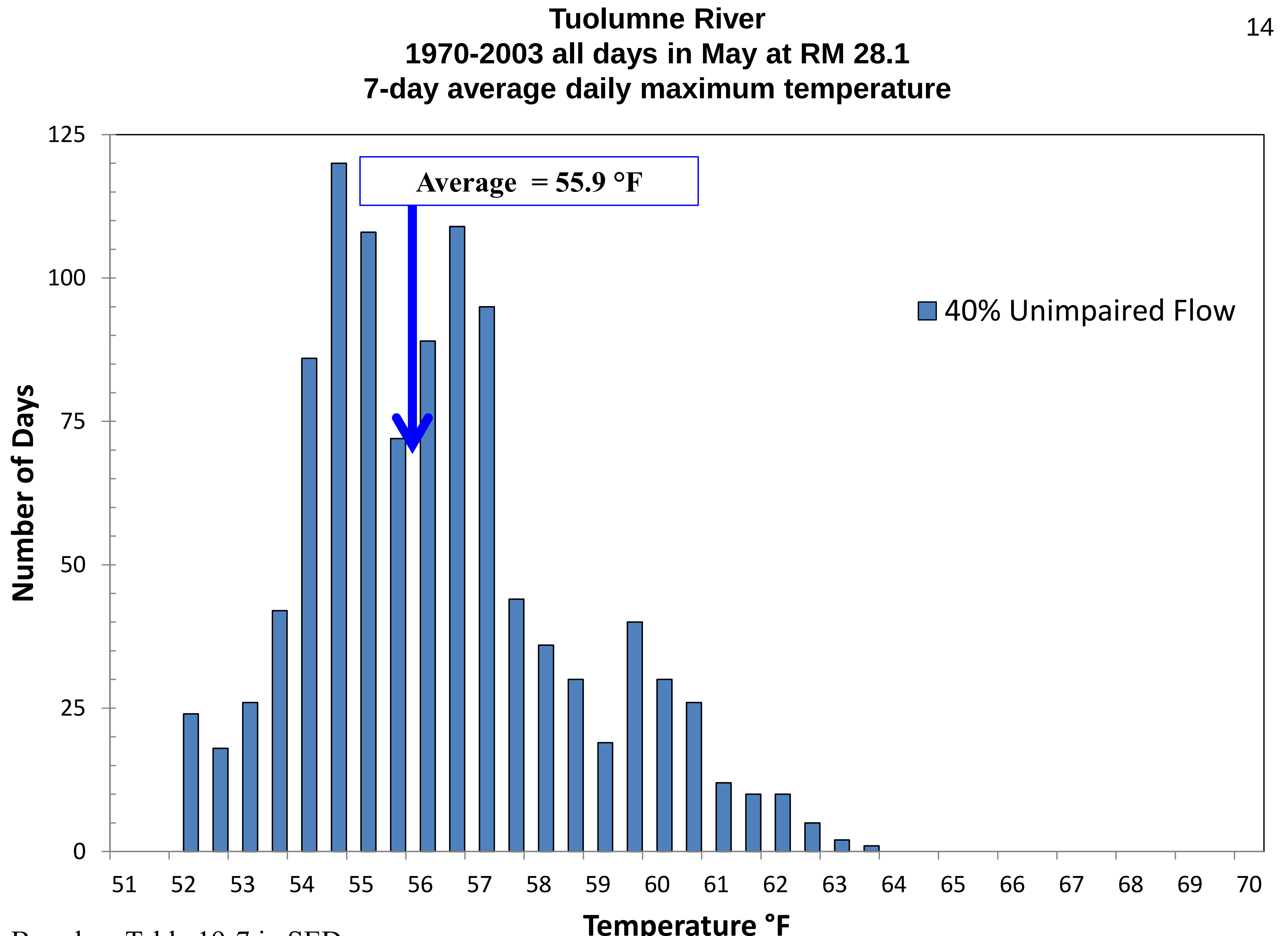
Table 19-6 in SED

CALIFORNIA Water Boards

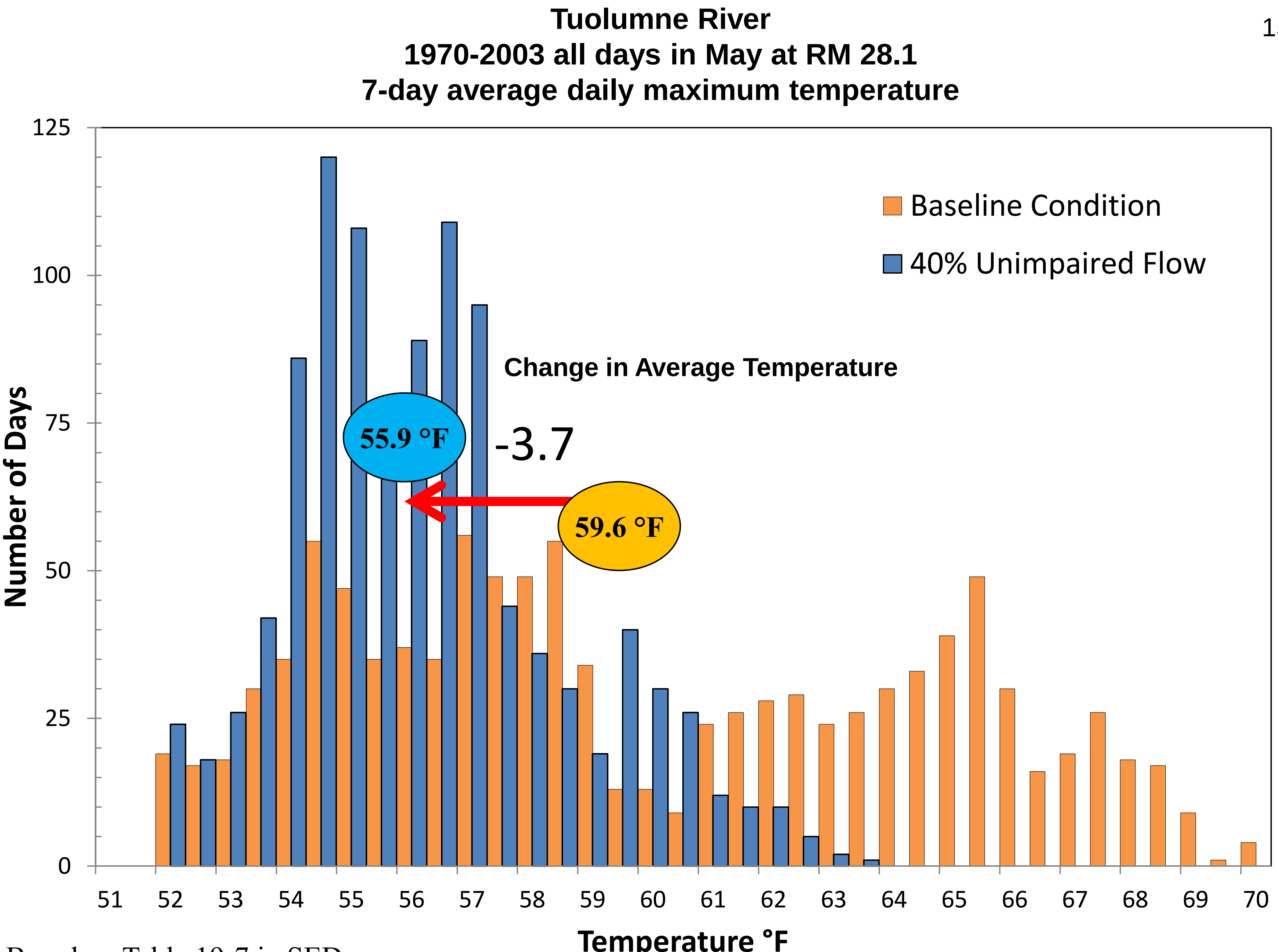
Average Temperature



Based on Table 19-7 in SED



Based on Table 19-7 in SED



Based on Table 19-7 in SED

Tuolumne River Average Temperature

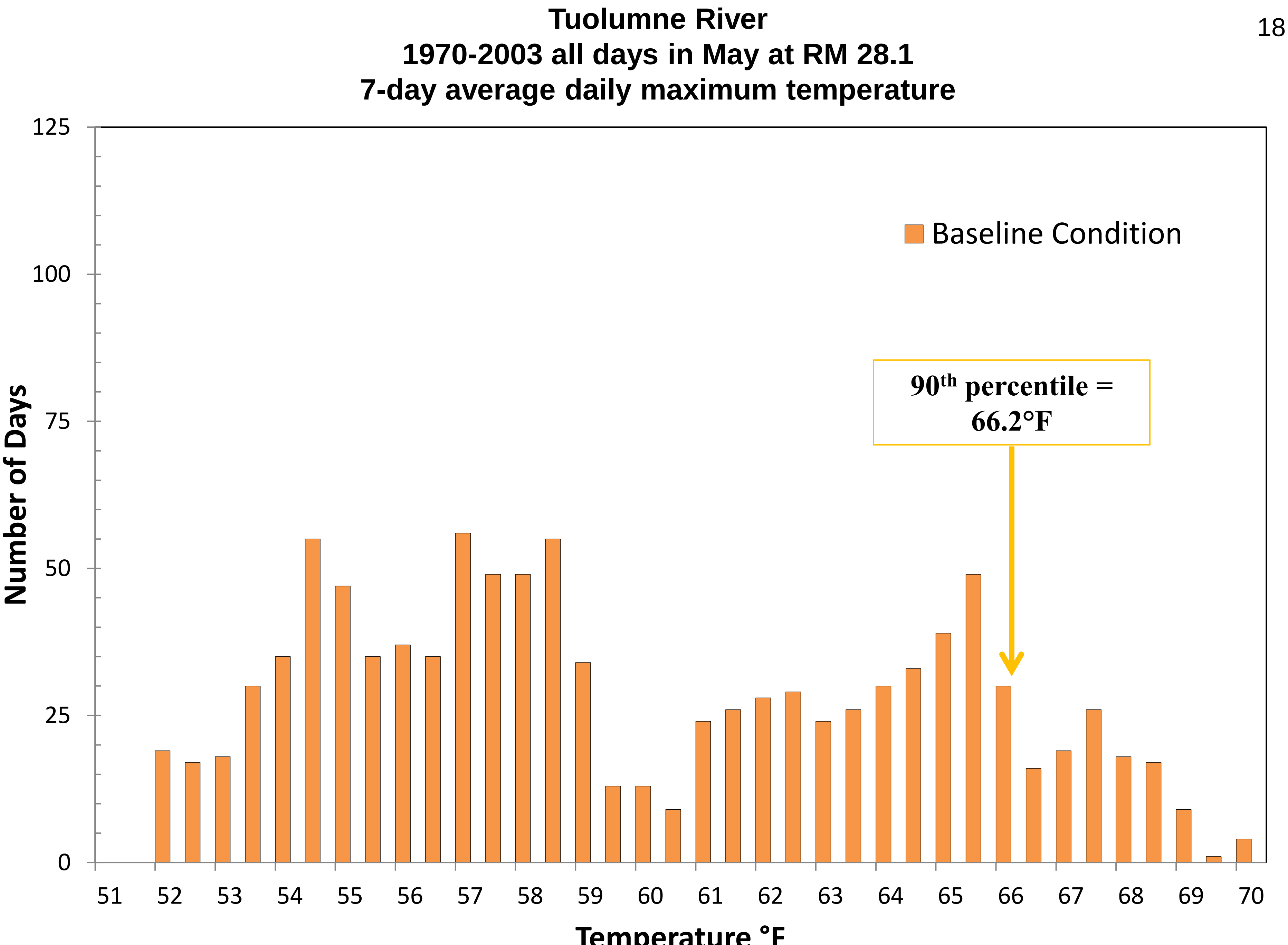
Tuolumne Average 7DADM	Confluence (RM0)						1/4 River (RM13.2)						1/2 River (RM28.1)						3/4 River (RM38.29)						Below La Grange (RM53.5)					
	Base (°F)	Percent Unimpaired Flow					Base (°F)	Percent Unimpaired Flow					Base (°F)	Percent Unimpaired Flow					Base (°F)	Percent Unimpaired Flow					Base (°F)	Percent Unimpaired Flow				
		20%	30%	40%	50%	60%		20%	30%	40%	50%	60%		20%	30%	40%	50%	60%		20%	30%	40%	50%	60%		20%	30%	40%	50%	60%
Sep	**75.5**	0.0	0.1	-1.1	-1.1	-1.0	**74.9**	0.0	0.1	-1.2	-1.2	-1.1	**70.9**	0.0	0.2	-1.1	-1.0	-1.0	**68.3**	0.0	0.2	-0.8	-0.7	-0.7	**53.5**	0.0	0.2	0.4	0.6	0.6
Oct	**67.3**	0.0	0.2	-0.6	-0.5	-0.5	**66.4**	0.0	0.2	-0.6	-0.5	-0.5	**63.1**	0.0	0.2	-0.3	-0.2	-0.2	**61.2**	0.0	0.2	-0.2	0.0	0.0	**53.8**	-0.1	0.1	0.3	0.4	0.5
Nov	**57.8**	0.0	0.0	-0.2	-0.1	-0.1	**56.9**	0.0	0.0	-0.1	0.0	0.0	**57.2**	0.0	0.1	0.0	0.1	0.1	**56.7**	0.0	0.1	0.0	0.1	0.1	**53.7**	-0.1	0.0	0.3	0.4	0.4
Dec	**50.2**	0.0	0.0	0.0	0.0	0.0	**49.6**	0.0	-0.1	0.0	0.0	0.0	**52.6**	0.0	0.0	0.1	0.2	0.2	**53.3**	0.0	0.0	0.2	0.2	0.2	**52.9**	0.0	0.0	0.2	0.3	0.3
Jan	**50.0**	0.0	0.0	0.0	0.0	0.0	**49.4**	0.0	0.0	-0.1	0.0	0.0	**51.9**	0.0	0.1	0.1	0.2	0.2	**52.2**	0.0	0.1	0.2	0.2	0.2	**51.0**	0.0	0.0	0.1	0.1	0.1
Feb	**54.2**	-0.1	-0.2	-0.3	-0.4	-0.7	**53.3**	-0.1	-0.2	-0.2	-0.5	-0.7	**53.6**	-0.1	-0.4	-0.5	-0.8	-1.0	**53.1**	-0.1	-0.4	-0.5	-0.7	-1.0	**50.0**	0.0	0.0	0.0	-0.1	-0.1
Mar	**58.5**	-0.4	-0.7	-1.2	-1.6	-2.2	**57.2**	-0.5	-0.9	-1.3	-1.7	-2.2	**55.7**	-0.8	-1.2	-1.7	-2.0	-2.4	**54.5**	-0.8	-1.2	-1.6	-1.9	-2.2	**49.7**	0.0	-0.1	-0.1	-0.2	-0.2
Apr	**61.7**	-0.7	-1.6	-2.5	-3.2	-3.8	**60.1**	-0.8	-1.7	-2.5	-3.2	-3.8	**57.0**	-0.7	-1.4	-2.0	-2.5	-2.9	**55.2**	-0.6	-1.2	-1.7	-2.1	-2.5	**49.7**	0.0	0.0	-0.1	-0.1	-0.2
May	**65.9**	-1.7	-3.8	-4.8	-5.6	-5.4	**63.8**	-1.9	-3.9	-5.1	-6.0	-6.6	**59.6**	-1.5	[illegible]	-3.7	-4.2	-4.4	**57.2**	-1.3	-2.5	-3.1	-3.4	-3.4	**50.0**	0.0	0.0	-0.1	-0.1	0.0
Jun	**72.2**	-2.8	-4.7	-6.0	-7.0	-7.3	**70.7**	-3.4	-5.5	-6.9	-8.1	-9.0	**67.4**	-4.3	-6.1	-7.2	-8.1	-8.6	**65.3**	-4.8	-6.4	-7.4	-8.2	-8.5	**50.9**	-0.1	-0.1	0.0	0.1	0.2
Jul	**77.6**	-0.6	-0.4	-2.1	-2.1	-1.9	**76.5**	-0.7	-0.3	-2.2	-2.2	-2.0	**72.6**	-0.9	-0.5	-2.4	-2.4	-2.1	**69.8**	-0.8	-0.4	-2.0	-1.9	-1.7	**51.9**	0.1	0.2	0.4	0.6	0.9
Aug	**79.1**	0.0	0.2	-0.5	-0.4	-0.3	**78.5**	0.0	0.2	-0.6	-0.5	-0.3	**74.0**	0.0	0.2	-0.6	-0.5	-0.3	**71.1**	0.0	0.2	-0.4	-0.3	-0.2	**52.9**	0.0	0.2	0.4	0.6	0.8

$$\boxed{59.6 - 3.7 = 55.9}$$

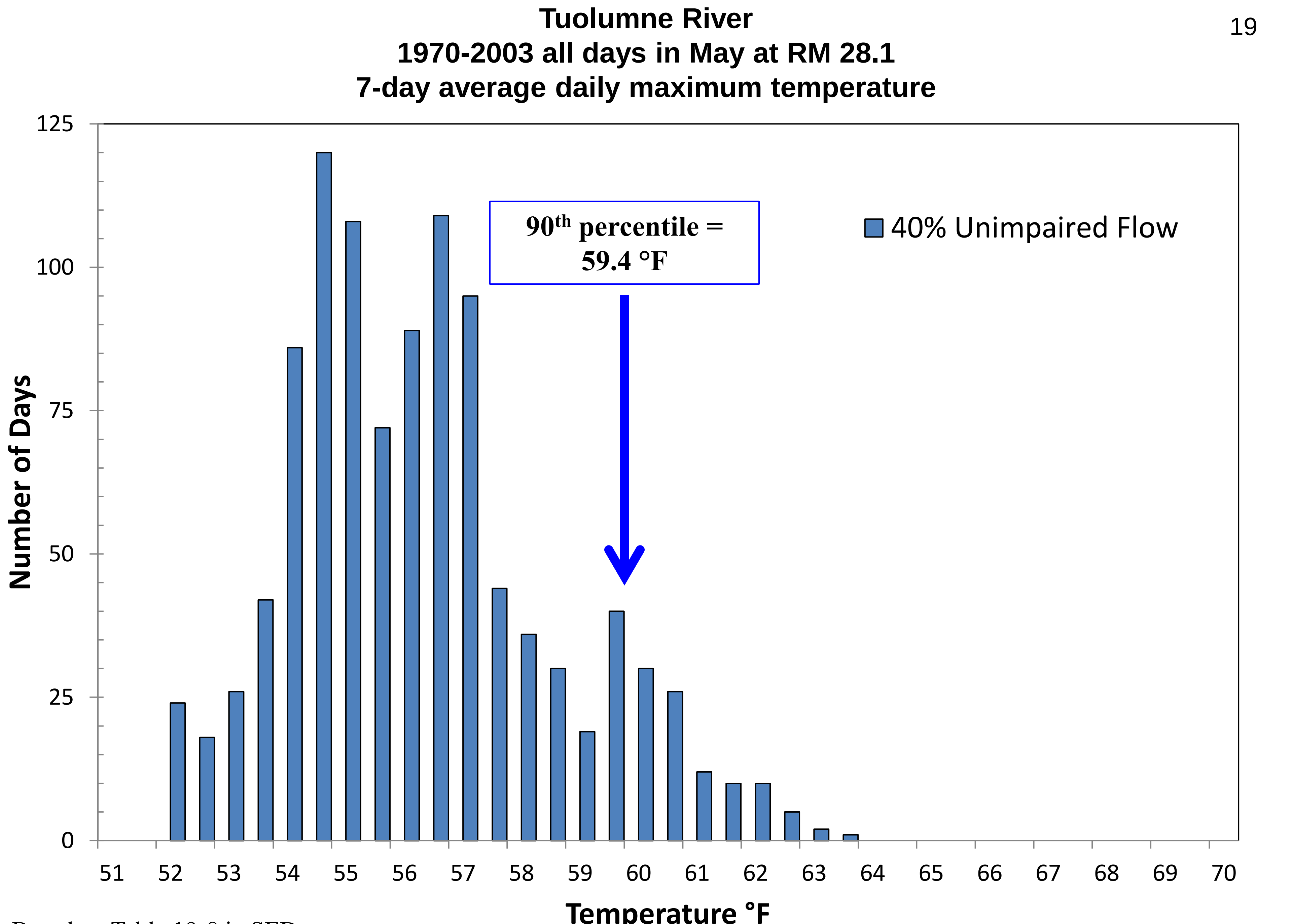
Table 19-7 in SED

California Water Boards

90th Percentile Temperature

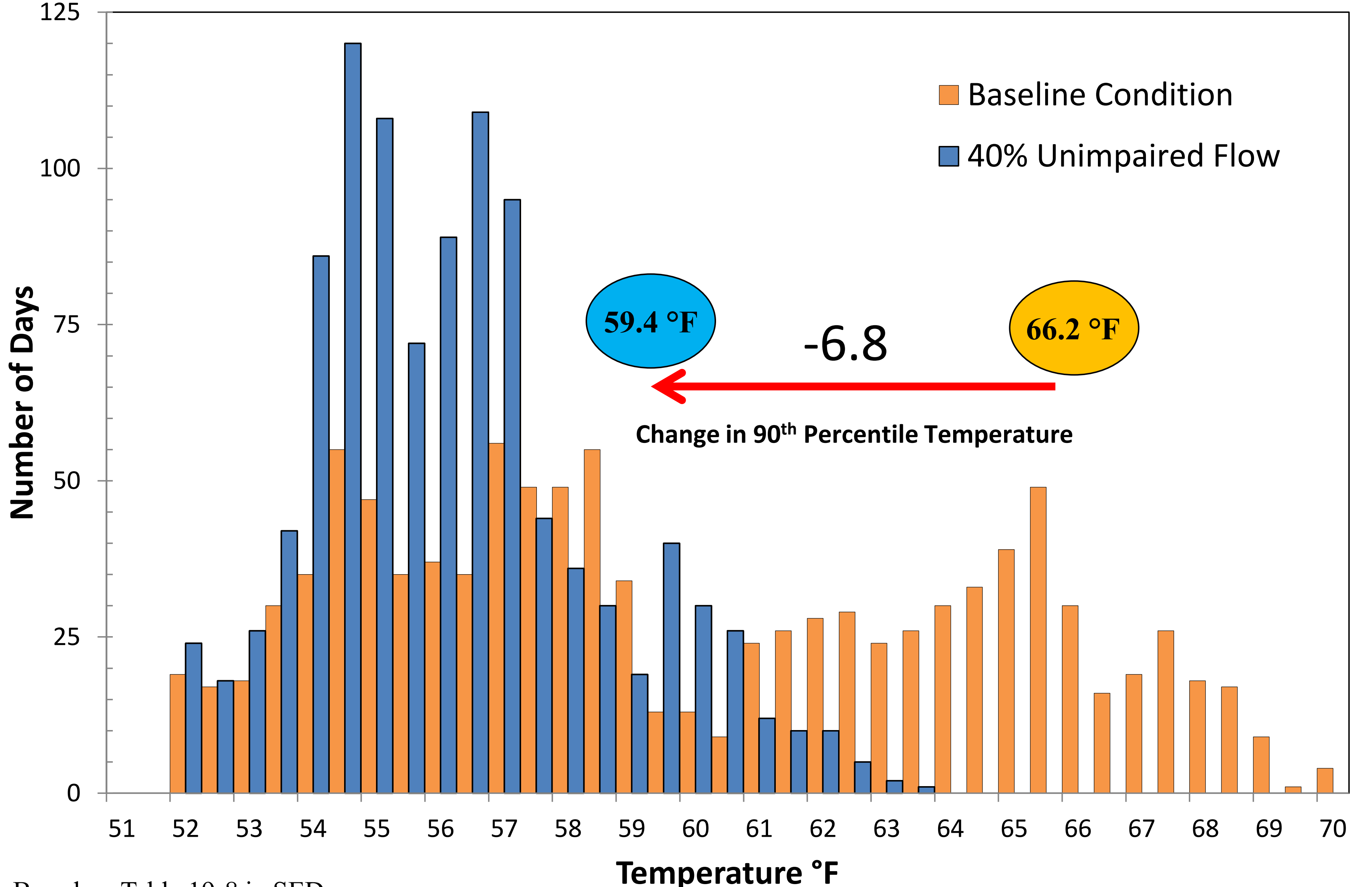


Based on Table 19-8 in SED



Based on Table 19-8 in SED

Tuolumne River
1970-2003 all days in May at RM 28.1
7-day average daily maximum temperature



Based on Table 19-8 in SED

Tuolumne River 90th Percentile Temperature

Tuolumne 90th Percentile 7DADM	Confluence (RM0)						1/4 River (RM13.2)						1/2 River (RM28.1)						3/4 River (RM38.29)						Below La Grange (RM53.5)					
	Base (°F)	Percent Unimpaired Flow					Base (°F)	Percent Unimpaired Flow					Base (°F)	Percent Unimpaired Flow					Base (°F)	Percent Unimpaired Flow					Base (°F)	Percent Unimpaired Flow				
		20%	30%	40%	50%	60%		20%	30%	40%	50%	60%		20%	30%	40%	50%	60%		20%	30%	40%	50%	60%		20%	30%	40%	50%	60%
Sep	**80.1**	0.0	0.0	0.0	0.0	0.0	**80.2**	0.0	0.0	0.0	0.0	0.0	**77.7**	0.0	0.0	0.0	0.0	0.0	**75.8**	0.0	0.0	0.0	0.0	0.0	**55.6**	-0.3	-0.1	-0.1	-0.3	-0.3
Oct	**73.5**	0.0	0.0	-0.6	-0.6	-0.6	**72.6**	0.0	0.0	-0.3	-0.2	-0.2	**69.7**	-0.1	-0.1	-0.1	-0.1	-0.1	**66.9**	-0.2	-0.2	-0.2	-0.3	-0.2	**56.3**	-0.5	-0.5	-0.4	-0.6	-0.4
Nov	**62.8**	0.0	0.1	-0.1	-0.1	-0.1	**61.9**	0.0	0.1	-0.1	-0.1	-0.2	**60.7**	0.0	0.0	-0.1	-0.3	-0.3	**59.7**	-0.2	-0.2	-0.5	-0.5	-0.6	**56.0**	-0.3	-0.4	-0.5	-0.6	-0.1
Dec	**53.9**	0.0	0.1	0.0	0.1	0.1	**53.4**	0.0	0.1	0.1	0.2	0.2	**54.8**	0.0	0.0	0.1	0.2	0.2	**55.1**	-0.1	0.0	0.1	0.3	0.3	**54.6**	-0.3	-0.3	-0.1	0.3	0.4
Jan	**53.4**	0.0	0.0	0.2	0.1	0.2	**52.9**	0.0	0.0	0.0	0.0	0.0	**54.1**	0.0	0.1	0.2	0.2	0.2	**54.1**	0.0	0.0	0.2	0.3	0.3	**52.2**	0.0	0.1	0.4	0.6	0.8
Feb	**59.1**	-0.2	-0.5	-0.8	-1.2	-1.7	**58.5**	-0.3	-0.7	-1.1	-1.5	-2.0	**57.8**	0.1	-0.7	-1.4	-1.8	-2.3	**56.7**	0.1	-0.6	-1.2	-1.5	-1.7	**51.7**	0.0	0.0	0.0	0.1	0.2
Mar	**65.5**	-1.5	-2.5	-3.8	-4.6	-5.5	**64.6**	-1.5	-2.8	-4.1	-5.0	-5.7	**62.6**	-2.1	-3.6	-4.4	-5.3	-6.0	**60.6**	-2.0	-3.3	-4.1	-4.8	-5.3	**51.3**	-0.1	0.0	-0.1	0.0	0.0
Apr	**69.0**	-2.5	-4.5	-6.1	-7.5	-8.5	**67.4**	-2.6	-4.5	-6.2	-7.4	-8.3	**63.4**	-2.5	-4.2	-5.6	-6.5	-7.1	**60.6**	-2.1	-3.4	-4.6	-5.4	-5.8	**51.1**	0.0	-0.1	-0.1	0.0	0.0
May	**73.2**	-3.0	-5.7	-8.0	-9.6	-10.0	**71.5**	-2.8	-6.0	-8.3	-9.8	-11.0	**66.2**	-2.1	[illegible]	-6.8	-7.7	-8.4	**62.8**	-1.9	-4.5	-5.7	-6.5	-6.9	**51.5**	-0.1	-0.1	0.0	0.0	0.1
Jun	**81.2**	-2.5	-3.7	-5.7	-7.7	-9.4	**81.0**	-2.9	-4.7	-7.3	-9.5	-11.5	**79.0**	-4.9	-8.5	-11.5	-13.3	-14.7	**77.0**	-6.1	-10.8	-13.1	-14.4	-15.4	**52.6**	-0.2	-0.2	-0.1	0.0	0.2
Jul	**83.8**	-0.2	-0.2	-0.3	-0.3	-0.3	**84.0**	-0.2	-0.2	-0.3	-0.4	-0.5	**81.2**	-0.3	-0.4	-0.4	-0.5	-0.5	**79.3**	-0.2	-0.2	-0.2	-0.2	-0.2	**53.4**	0.0	0.1	0.3	0.5	0.8
Aug	**83.2**	0.0	0.0	0.0	0.0	0.0	**83.3**	0.0	0.0	0.0	0.0	0.0	**80.5**	0.0	0.0	0.0	0.0	0.0	**78.6**	0.0	0.0	0.0	0.0	0.1	**54.7**	-0.2	0.0	0.0	0.0	0.2

$$\boxed{66.2 - 6.8 = 59.4}$$

Table 19-8 in SED

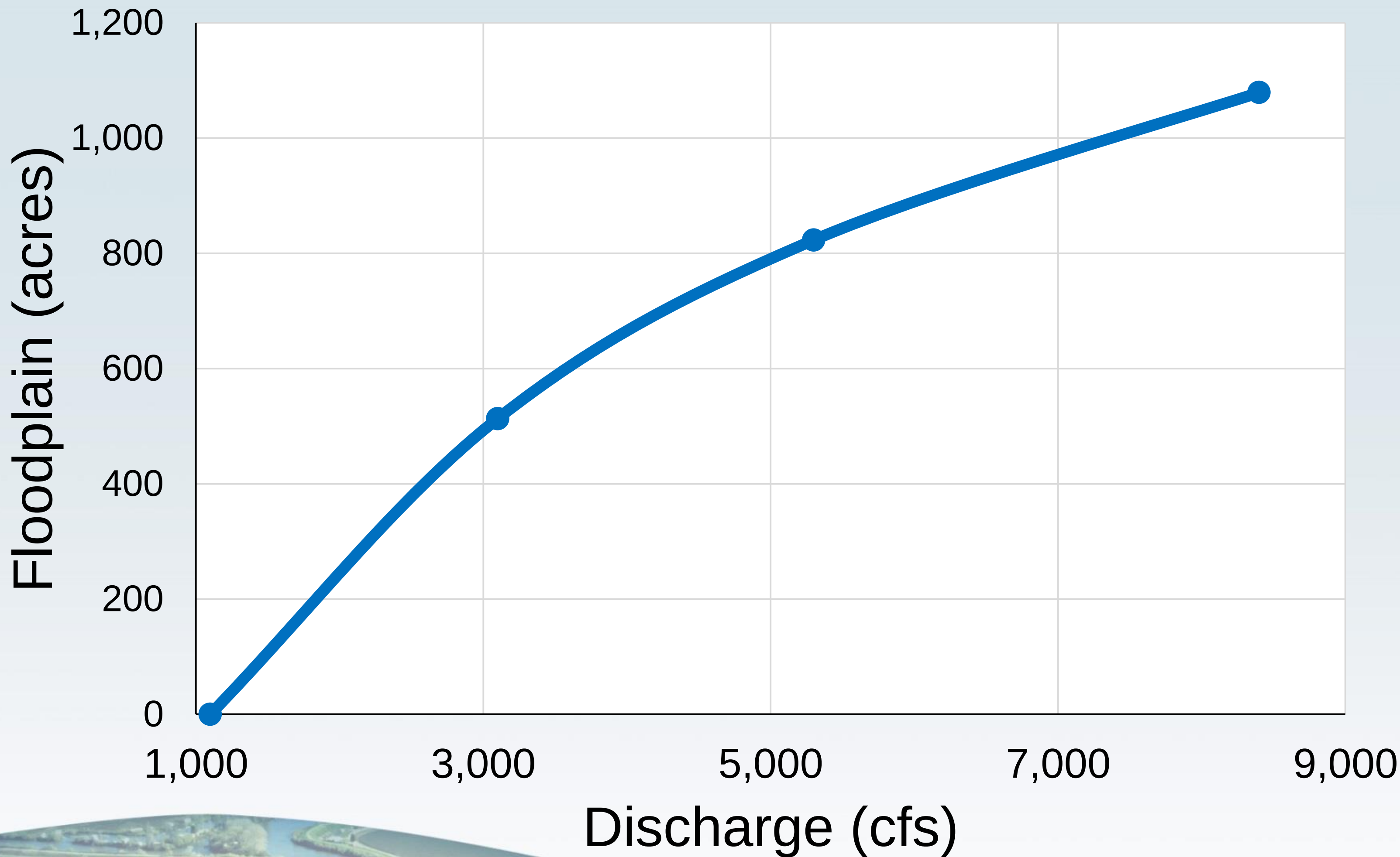
Temperature Summary

- Big improvements in temperature conditions from increased flows
- These results include no optimization
- Optimized flow shaping would improve temperature for key life stages
- USEPA criteria were used as only as a benchmark, not as proposed objectives

Floodplain Benefits

- Food availability
- Predator avoidance
- Faster growth
- Better survival
- Some native species spawn on floodplains

Tuolumne River Floodplain Area



From Figure 19-12 (figure and relationship developed by USFWS (2008) – river mile 52 to 21.5

Floodplain vs Flow Relationships

- Stanislaus River – USFWS
- Tuolumne River – USFWS
- Merced River – SWRCB
- San Joaquin River – cbec, inc. / FISHBIO

Tuolumne River Floodplain Inundation

May							
Flow (cfs)	Floodplain Acreage	**Base**	Percent Unimpaired Flow				
			20	30	40	50	60
75	0	**100%**	0%	0%	0%	0%	0%
150	0	**100%**	0%	0%	0%	0%	0%
300	0	**95%**	2%	5%	5%	5%	5%
500	0	**66%**	22%	32%	34%	34%	34%
1000	0	**51%**	9%	32%	45%	46%	48%
1100	Initiates	**35%**	15%	45%	57%	62%	63%
1250	56	**26%**	22%	52%	60%	72%	72%
1500	152	**20%**	13%	44%	63%	70%	78%
2000	305	**17%**	1%	29%	51%	65%	68%
3000	520	**13%**	1%	2%	18%	45%	59%
4000	673	**11%**	1%	1%	0%	13%	38%
5000	791	**7%**	1%	0%	0%	4%	15%

17% + 51% = 68%

Based on Table 19-23 in SED

CALIFORNIA Water Boards

Tuolumne River Floodplain Inundation

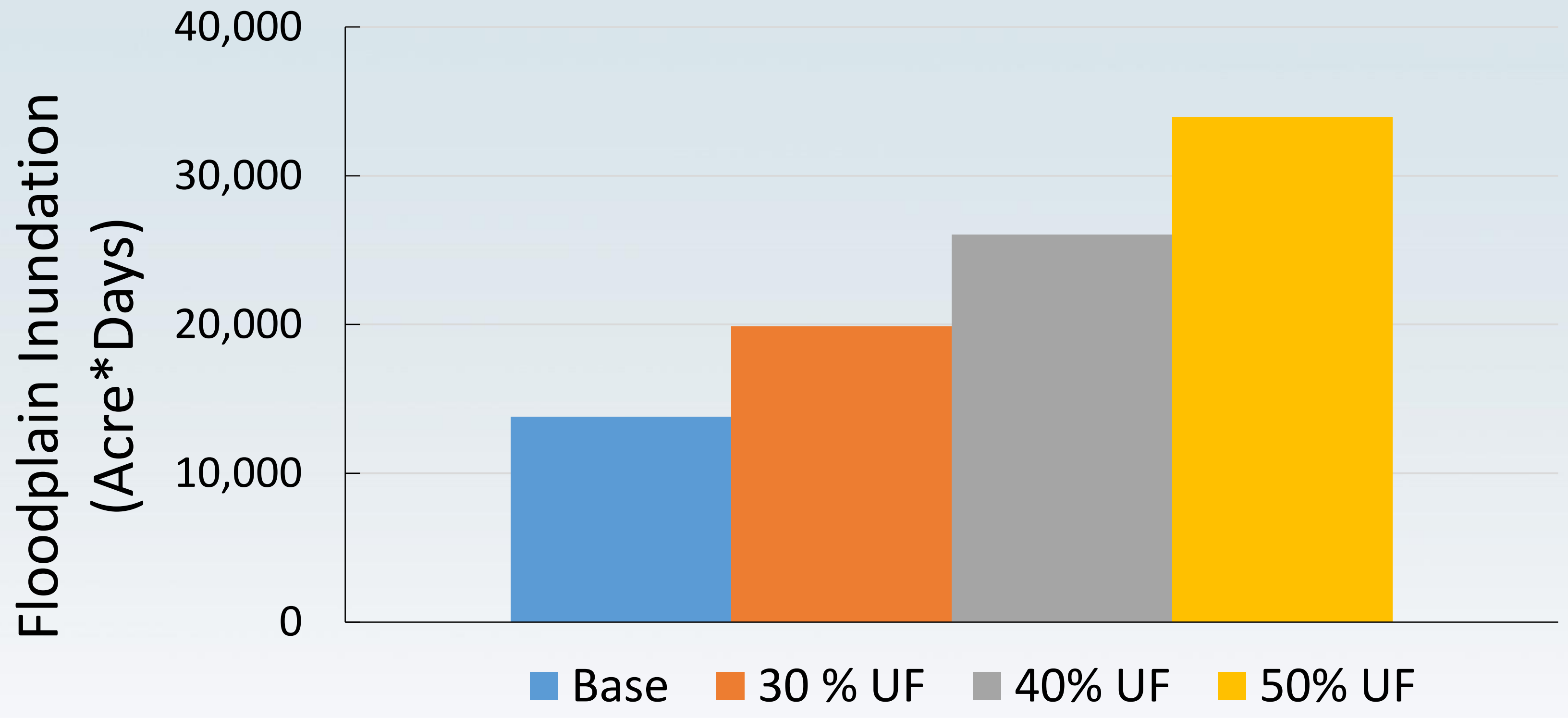
Tuolumne River		February						March						April						May						June					
Flow (cfs)	Floodplain Acreage	**Base**	20%	30%	40%	50%	60%	**Base**	20%	30%	40%	50%	60%	**Base**	20%	30%	40%	50%	60%	**Base**	20%	30%	40%	50%	60%	**Base**	20%	30%	40%	50%	60%
75	0	**100%**	0%	0%	0%	0%	0%	**100%**	0%	0%	0%	0%	0%	**100%**	0%	0%	0%	0%	0%	**100%**	0%	0%	0%	0%	0%	**78%**	16%	18%	18%	21%	21%
150	0	**93%**	2%	6%	6%	6%	6%	**91%**	7%	9%	9%	9%	9%	**100%**	0%	0%	0%	0%	0%	**100%**	0%	0%	0%	0%	0%	**49%**	38%	43%	46%	48%	50%
300	0	**46%**	9%	16%	23%	34%	41%	**67%**	5%	23%	26%	30%	32%	**94%**	2%	5%	6%	6%	6%	**95%**	2%	5%	5%	5%	5%	**28%**	46%	59%	63%	67%	68%
500	0	**44%**	4%	10%	10%	18%	28%	**56%**	4%	6%	24%	30%	37%	**70%**	12%	22%	28%	30%	30%	**66%**	22%	32%	34%	34%	34%	**27%**	40%	49%	60%	63%	65%
1000	0	**38%**	0%	0%	-2%	1%	11%	**55%**	-2%	-2%	-10%	0%	15%	**52%**	0%	13%	27%	40%	45%	**51%**	9%	32%	45%	46%	48%	**24%**	18%	37%	48%	51%	59%
1100	Initiates	**38%**	-1%	-2%	-5%	0%	6%	**55%**	-4%	-2%	-9.8%	-7%	7%	**44%**	-2%	15%	33%	44%	54%	**35%**	15%	45%	57%	62%	63%	**24%**	13%	35%	48%	50%	55%
1250	56	**37%**	-1%	-4%	-5%	-1%	2%	**51%**	-4%	-4%	-9.8%	-9.8%	-1%	**41%**	-1%	11%	29%	39%	50%	**26%**	22%	52%	60%	72%	72%	**22%**	7%	34%	45%	50%	54%
1500	152	**34%**	-1%	-5%	-9%	-2%	1.2%	**46%**	-4%	-7%	-7%	-9.8%	-4%	**37%**	-1%	4%	20%	38%	45%	**20%**	13%	44%	63%	70%	78%	**22%**	0%	24%	38%	50%	50%
2000	305	**28%**	0%	-4%	-7%	-5%	4%	**40%**	-2%	-4%	-9%	-9%	-5%	**33%**	-1%	-1%	2%	18%	37%	**17%**	1%	[illegible]	51%	65%	68%	**21%**	-1%	7%	23%	39%	48%
3000	520	**22%**	-4%	-5%	-5%	-6%	-4%	**34%**	0%	-5%	-11%	-12%	-9.8%	**21%**	0%	0%	-2%	-4%	5%	**13%**	1%	2%	18%	45%	59%	**15%**	0%	0%	2%	26%	34%
4000	673	**11%**	0%	-1%	-2%	-1%	-1%	**16%**	-2%	-2%	-2%	-5%	-5%	**11%**	0%	-1%	0%	-1%	-2%	**11%**	1%	1%	0%	13%	38%	**10%**	0%	0%	0%	6%	22%
5000	791	**10%**	0%	-1%	-2%	-2%	-1%	**7%**	0%	0%	0%	-1%	0%	**5%**	0%	0%	-1%	-1%	-1%	**7%**	1%	0%	0%	4%	15%	**5%**	0%	0%	1%	2%	9%

Table 19-23 in SED

CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

Annual Average Floodplain Inundation

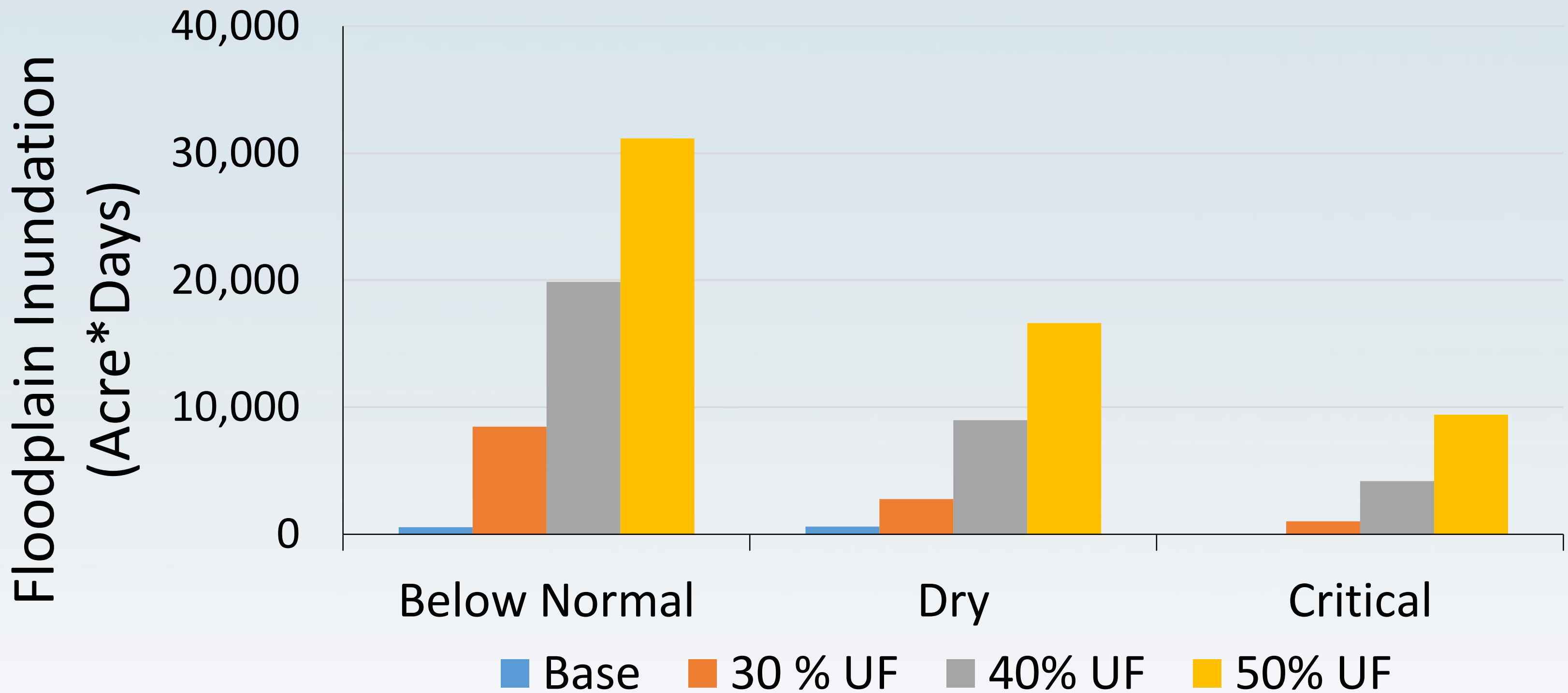
Tuolumne River, April – June



Based on Table 19-29

Annual Average Floodplain Inundation

Tuolumne River, April – June in Below Normal, Dry, and Critical Years



Based on Table 19-30

California Water Boards

Floodplain Summary

- Large increases in floodplain inundation, especially in dry years
- Results are not optimized for floodplain habitat
- Bigger results are possible from flow shaping
- Flows can be optimized to achieve desired water depths and durations of inundation

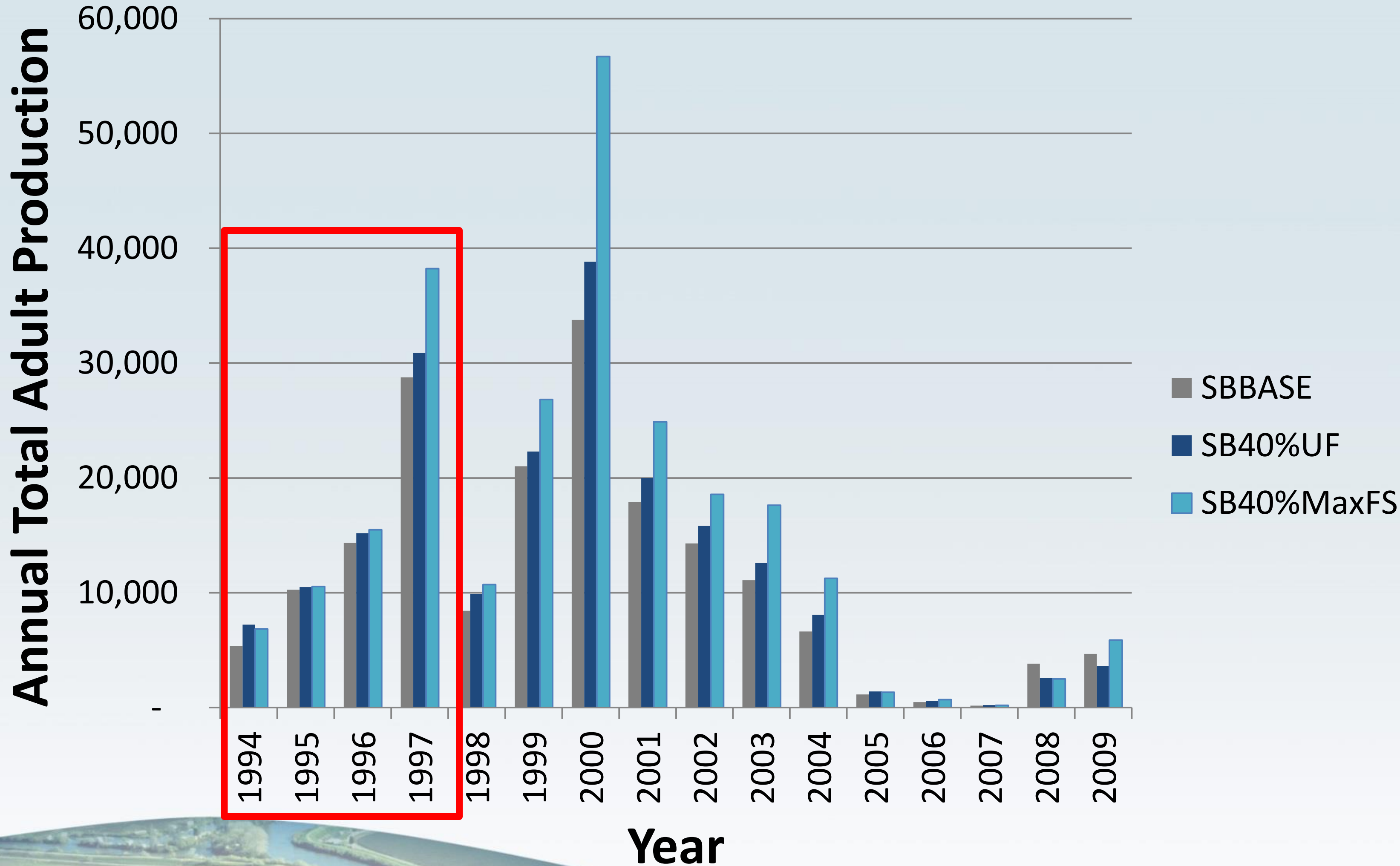
SalSim

- Population simulation model for fall-run Chinook salmon in the San Joaquin Basin Developed by California Dept. of Fish and Wildlife (CDFW), Region 4
- Tracks daily growth, movement, and survival as functions of flow, temperature, predation, and other factors
- Designed to estimate changes in:
    - juveniles produced by each tributary
    - total juveniles out-migrating to the Delta
    - total juveniles entering the ocean
    - total adults returning to tributaries

Limitations of SalSim

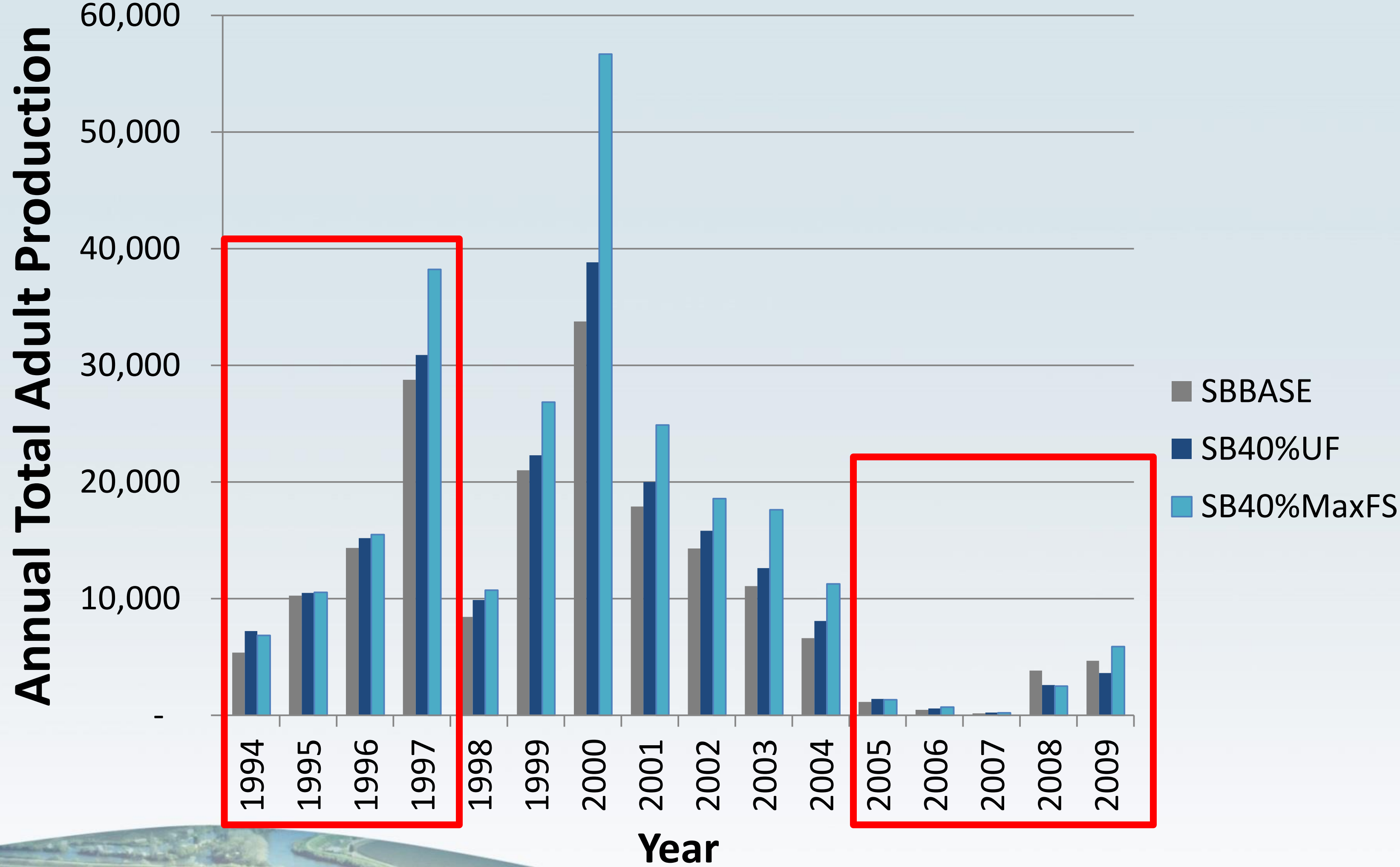
- First 4 years are "priming years"
- Includes an ocean crash which affects adult returns during 2005-2009
- Data used to construct the model has many uncertainties

SalSim has only 7 years that reflect comparative production; first 4 years are "priming years"



Adapted from Figure 19-14

Last 5 years reflect an ocean crash



Adapted from Figure 19-14

CALIFORNIA Water Boards

Average Salmon Production Using SalSim

(Total Adult Chinook Salmon Production)

SalSim Run	16-year Average	Difference from Baseline	7-year Average	Difference from Baseline
Baseline	11,373	0	16,151	0
40% Unimpaired Flow	12,476	1,103	18,210	2,059
40% Unimpaired Flow with Maximum Flow Shifting	15,512	4,138	23,788	7,637

Adapted from Table 19-32

Average Salmon Production Using SalSim

(Total Adult Chinook Salmon Production)

SalSim Run	16-year Average	Difference from Baseline	7-year Average	Difference from Baseline
Baseline	11,373	0	16,151	0
40% Unimpaired Flow	12,476	1,103	18,210	2,059
40% Unimpaired Flow with Maximum Flow Shifting	15,512	4,138	23,788	7,637

Adapted from Table 19-32

Why is SalSim not useful for SED?

- Conditions proposed in the SED are different than conditions used to construct SalSim
- Is inaccurate with regard to temperature:
  - It is oversensitive relative to egg mortality during egg incubation
  - Juvenile mortality is under sensitive relative to lethal temperatures in SalSim
- Underestimates the benefits of floodplain inundation during the spring time period

SED Quantified Benefits

- Temperature habitat to evaluate temperature benefits
- Floodplain habitat to evaluate floodplain benefits

White sturgeon,
courtesy of USFWS

Lamprey
From Dan Worth, CDFW

Prickly sculpin
From Dan Worth, CDFW

Rainbow trout / steelhead (*Oncorhynchus mykiss*)
courtesy of DFW

Sacramento Splittail
Courtesy of Prof. P. Moyle, UC Davis

CALIFORNIA
Water Boards

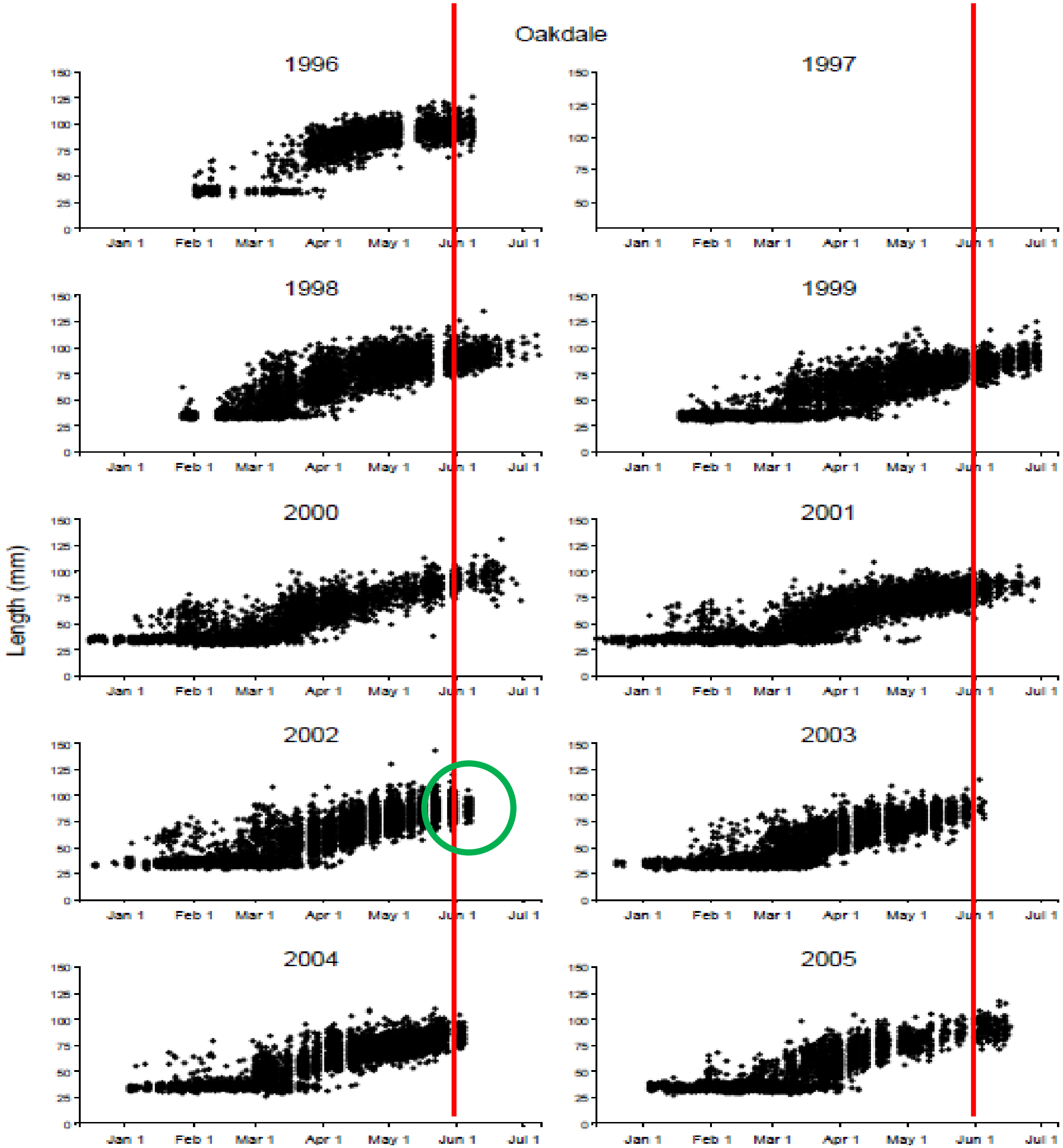
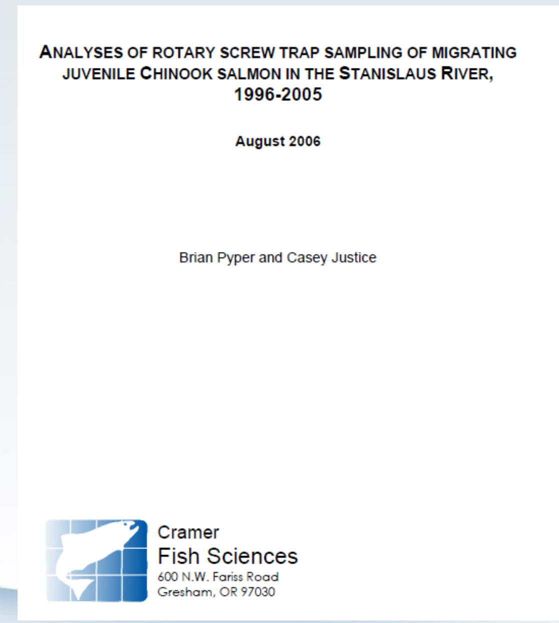


Figure 26. Lengths of all sampled juvenile Chinook salmon by day at the Oakdale trap site.


ANALYSES OF ROTARY SCREW TRAP SAMPLING OF MIGRATING JUVENILE CHINOOK SALMON IN THE STANISLAUS RIVER, 1996-2005

August 2006

Brian Pyper and Casey Justice

Cramer Fish Sciences
600 N.W. Fariss Road
Gresham, OR 97030

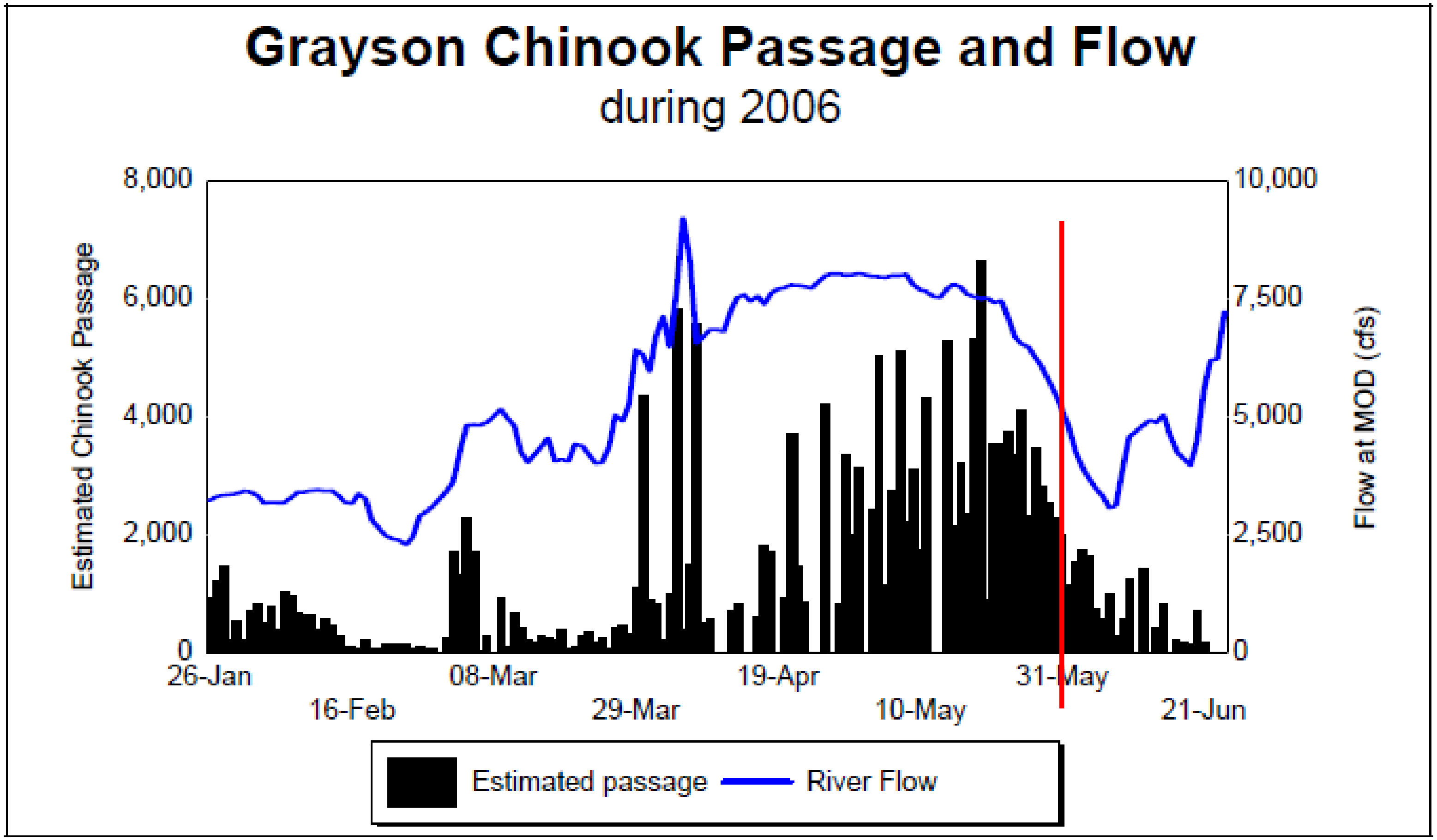


Figure 10. Daily estimated passage of unmarked Chinook salmon at Grayson and river flow at Modesto (MOD) during 2006.

Outmigrant Trapping of Juvenile Salmonids in the Lower Tuolumne River, 2006

FINAL REPORT
March 2007

Prepared by
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and
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Submitted to
Turlock and Modesto Irrigation Districts

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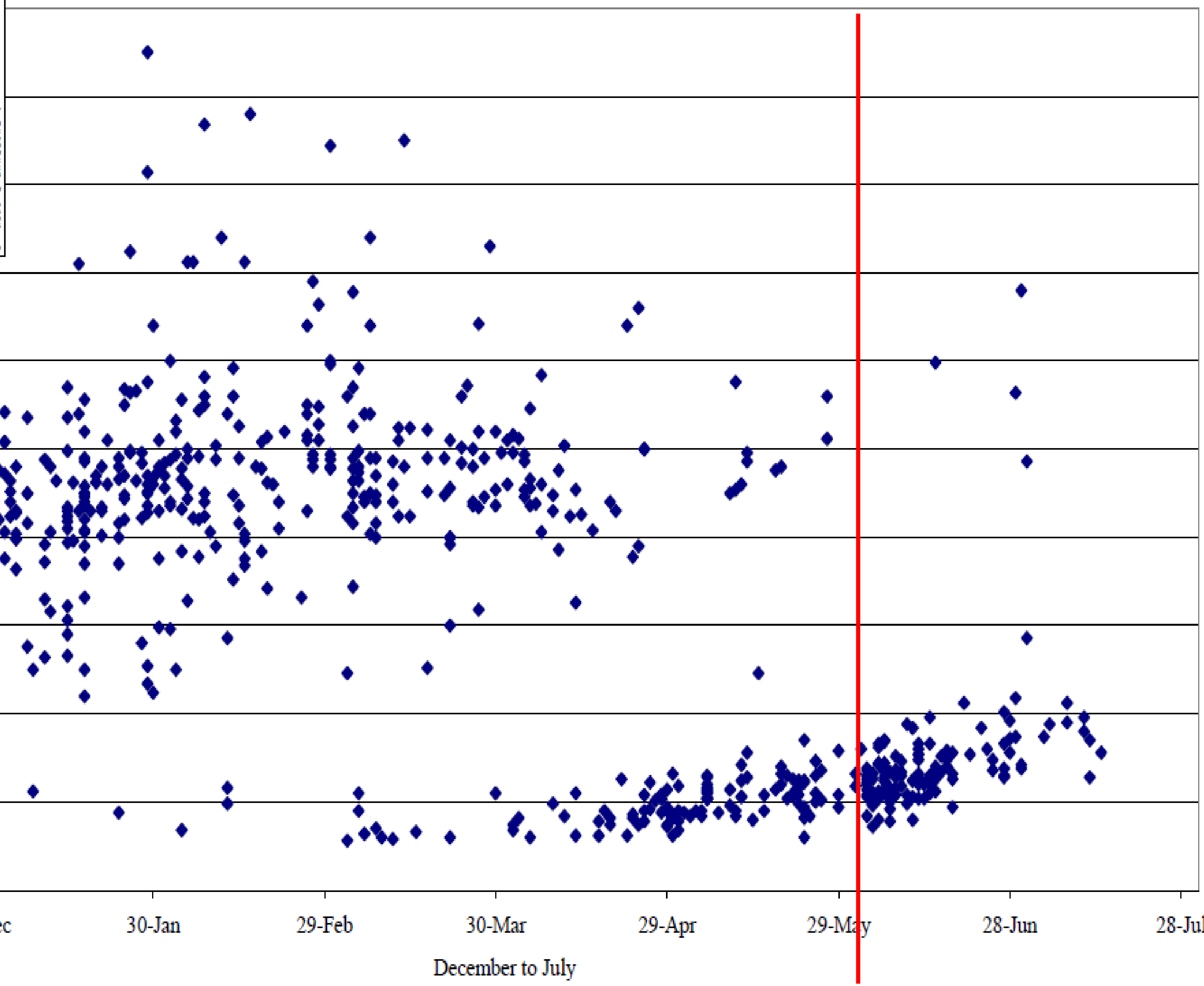
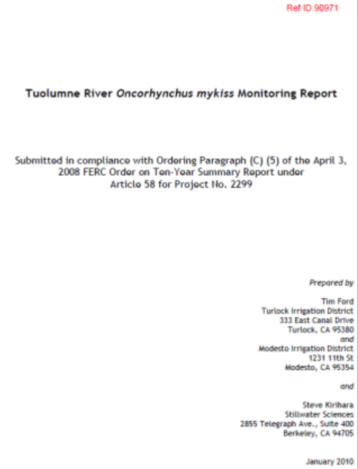
Chico, CA 95928
(530) 342-9262

O. mykiss captured at the Oakdale screw trap on the Stanislaus River (1995-2009)




Ref ID 90971

Tuolumne River *Oncorhynchus mykiss* Monitoring Report

Submitted in compliance with Ordering Paragraph (C) (5) of the April 3, 2008 FERC Order on Ten-Year Summary Report under Article 58 for Project No. 2299

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January 2010