Hi Rick,

I've looked at both the egg stage and the juvenile steelhead stage, and the answer I got for both is half a degree F. The attached Word doc has plots and tables showing the data.
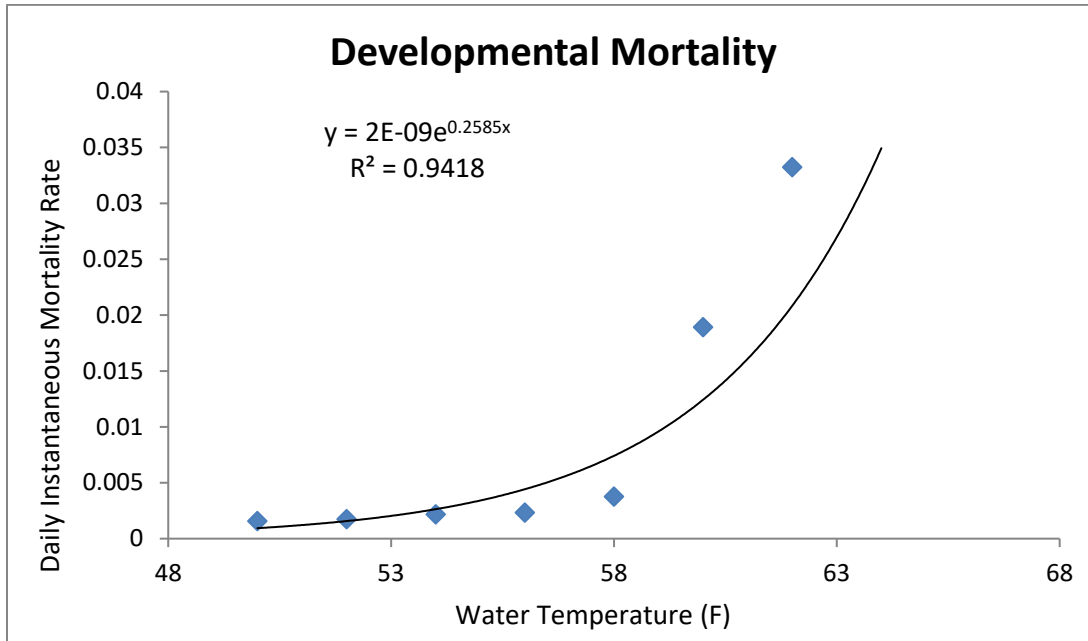
For eggs I used the mortality rate curve from the egg mortality model I developed, and chose 58F as a baseline value (I used 58F as the temperature experienced by all eggs every day). I chose 58 because above this point mortality rates get really bad very quickly (see plot). Then I simply increased the temperature in 0.1 degree increments, and found the increase that resulted in a 5% total increase in mortality.

I used the same basic approach based on survival rates from a Master's Thesis on age-1 rainbow trout. I'm starting to suspect that juveniles and adults may not actually be that much more "tolerant" of high temperatures than eggs once they are at a threshold, its just that the threshold for them is at a higher temperature.

Dave

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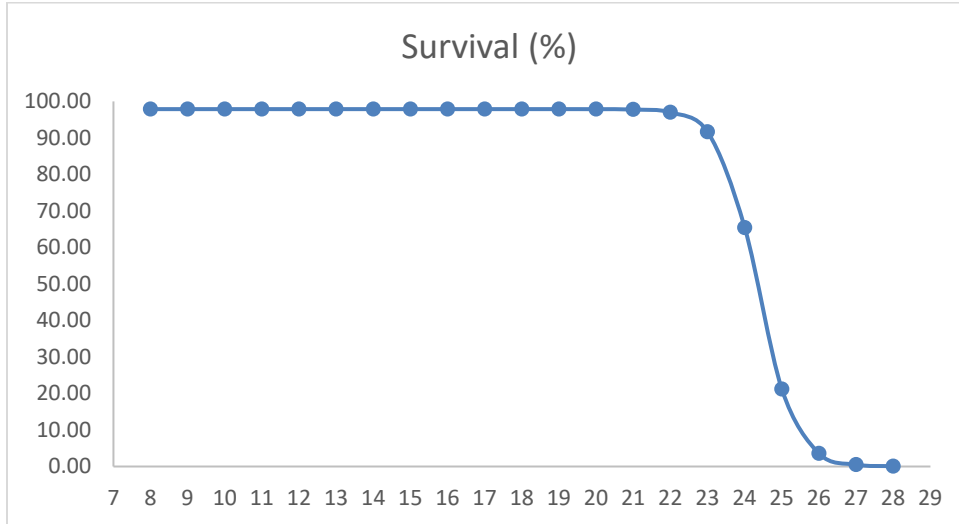Sacramento, CA 95814
916-930-3685

Eggs

Developmental Mortality

$y = 2\text{E-}09e^{0.2585x}$

$R^2 = 0.9418$

X-axis: Water Temperature (F)
Y-axis: Daily Instantaneous Mortality Rate

Constant Daily Temp	Total Survival	Absolute Change in total survival	% Change in total egg survival
58	0.75379	na	na
58.1	0.74570	0.00810	1.1%
58.2	0.73761	0.01618	2.1%
58.3	0.73307	0.02073	2.7%
58.4	0.72402	0.02978	4.0%
58.5	**0.71430**	**0.03949**	**5.2%**
58.6	0.70387	0.04992	6.6%
58.7	0.69802	0.05577	7.4%
58.8	0.68305	0.07074	9.4%
58.9	0.67016	0.08363	11.1%
59	0.65639	0.09740	12.9%

Juvenile steelhead stage:

Data are from:
Bear, E.A. 2005. Effects of temperature on survival and growth of Westslope cutthroat trout and rainbow trout:Implications for conservation and restoration. M.S. Thesis. Montana State University.

Survival (%)

Rainbow trout survival (age-1 fish)
$97.8846 / 1+e - ((temperature-24.3522) / -0.5033)$

Temperature	Survival (%)
8	97.88
9	97.88
10	97.88
11	97.88
12	97.88
13	97.88
14	97.88
15	97.88
16	97.88
17	97.88
18	97.88
19	97.88
20	97.87
21	97.76
22	96.98
23	91.64
24	65.40
25	21.18
26	3.57
27	0.51
28	0.07

Temperature	Temp in F	Survival (%)	Absolute change in % survival	% change in % survival
23	**73.40**	91.64	na	na
23.1	73.58	90.38	1.27	0.0138
23.2	73.76	88.88	2.77	0.0302
23.3	**73.94**	87.12	4.53	**0.0494**
23.4	74.12	85.06	6.58	0.0718
23.5	74.30	82.68	8.97	0.0978
23.6	74.48	79.95	11.69	0.1276
23.7	74.66	76.85	14.79	0.1614
23.8	74.84	73.39	18.26	0.1992
23.9	75.02	69.56	22.08	0.2410
24	75.20	65.40	26.24	0.2864