

Appendix D – SacPAS Fish Model Inputs and Outputs for Temperature Dependent Mortality Estimates

Table A1. Parameter inputs values and forecasted temperature dependent mortality for stage dependent and stage independent mortality models.

<b>Parameter</b>	<b>Forecasts</b>	<b>Forecasts</b>
Model Type	Martin Model (stage independent)	Anderson Model (stage dependent)
Egg emergence timing model	Linear. 958 ATUs (degrees C), as indicated for Zeug et al. on SacPAS under Egg to emergence timing model.	Linear. 958 ATUs (degrees C), as indicated for Zeug et al. on SacPAS under Egg to emergence timing model
TDM redd time distribution	Average of 2007-2014	Average of 2007-2014
TDM redd space distribution	Average of 2007-2014	Average of 2007-2014
TDM Tcrit (50 <sup>th</sup> percentile)	11.96 degrees C	11.9 degrees C
TDM bT (50 <sup>th</sup> percentile)	0.024 °C <sup>-1</sup> d <sup>-1</sup>	0.5 °C <sup>-1</sup> d <sup>-1</sup>
Critical Days	All	5
Water Temperature	HEC 5Q Output (See HEC5Q Assumptions) at the following locations: River miles 229, 257, 266, 271, 275, 284, 296, and 298. Linear relationship between volume < 56 F and Clear Creek temps used Sep 15 and after	HEC 5Q Output (See HEC5Q Assumptions) at the following locations: River miles 229, 257, 266, 271, 275, 284, 296, and 298. Linear relationship between volume < 56 F and Clear Creek temps used Sep 15 and after

Table 2A. Parameter inputs values and estimated hindcast temperature dependent mortality for stage dependent and stage independent mortality models.

<b>Parameter</b>	<b>Hindcast 12/06/20</b>	<b>Hindcast 12/06/20</b>
Model Type	Martin Model (stage independent)	Anderson Model (stage dependent)
Egg emergence timing model	Linear. 958 ATUs (degrees C), as indicated for Zeug et al. on SacPAS under Egg to emergence timing model.	Linear. 958 ATUs (degrees C), as indicated for Zeug et al. on SacPAS under Egg to emergence timing model
TDM redd time distribution	2020	2020
TDM redd space distribution	2020	2020
TDM Tcrit (50 <sup>th</sup> percentile)	11.96 degrees C	11.9 degrees C
TDM bT (50 <sup>th</sup> percentile)	0.024 °C <sup>-1</sup> d <sup>-1</sup>	0.5 °C <sup>-1</sup> d <sup>-1</sup>
Critical Days	All	5
Water Temperature	Actual water temperatures measured at KWK and CCR	Actual water temperatures measured at KWK and CCR
TDM Estimates	Prehatch Exposure: 8.6% Pre-emerge Exposure: 70.5% <b>Incubation Mortality: 7.2%</b>	Prehatch Exposure: 35.8% Pre-emerge Exposure: 100% <b>Incubation Mortality: 3.0%</b>

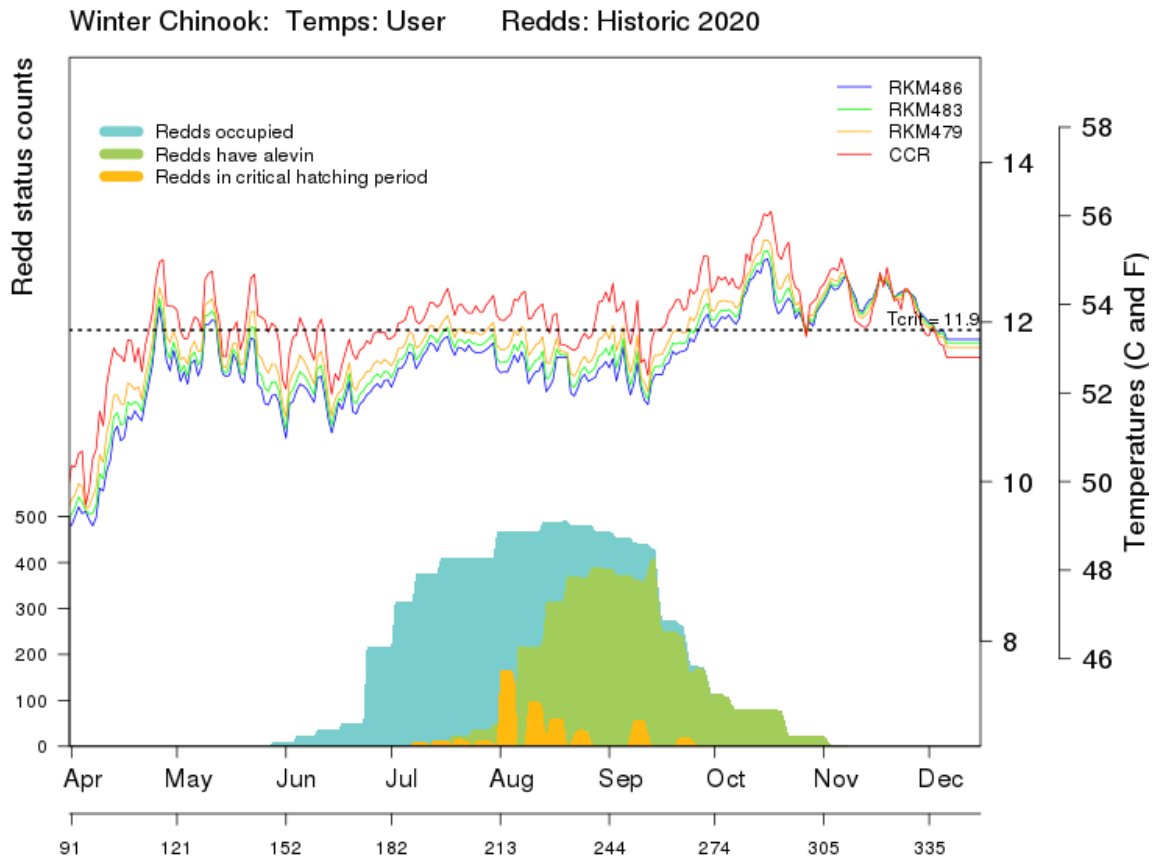


Figure 1A. 2020 winter-run Chinook salmon redd data with Sacramento River water temperatures and critical egg mortality threshold (12 degrees C).

Table 3A. Mean prehatching exposure estimates for redds using the Stage Dependent Mortality Model and other model inputs described in Table 2A.

Day	RKM483	RKM479	RKM470
148	11.6	0	0
155	11.8	12	12.2
161	11.7	11.9	12.2
168	11.8	11.9	0
175	11.6	11.7	12.1

183	11.5	11.7	12.2
189	11.5	11.6	11.9
196	11.4	11.5	11.7
212	11.3	11.5	11.9
225	11.8	11.9	12.2
231	12.1	12.3	0

Table 4A. Maximum prehatching exposure estimates for redds using the Stage Dependent Mortality Model and other model inputs described in Table 2A.

Day	RKM483	RKM479	RKM470
148	11.7	0	0
155	11.9	12.1	12.3
161	11.8	11.9	12.4
168	11.8	11.9	0
175	11.7	11.9	12.1
183	11.6	11.8	12.4
189	11.7	11.8	12.1
196	11.4	11.6	11.9
212	11.6	11.8	12.3
225	11.9	12.1	12.3
231	12.2	12.4	0

Table 5A. Survival to emergence estimates for redds using the Stage Dependent Mortality Model and other model inputs described in Table 2A.

Days	RKM483	RKM479	RKM470
148	1	NA	NA
155	0.983	0.814	0.418
161	1	0.987	0.428
168	1	0.977	NA
175	1	1	0.673
183	1	1	0.519
189	1	1	0.794
196	1	1	1
212	1	1	0.807
225	0.995	0.916	0.458
231	0.585	0.405	NA

Table 6A. Mean prehatching exposure estimates for redds using the Stage Independent Mortality Model and other model inputs described in Table 2A.

Day	RKM483	RKM479	RKM470
148	11.6	0	0
155	11.8	12	12.2
161	11.7	11.9	12.2
168	11.8	11.9	0
175	11.6	11.7	12.1
183	11.5	11.7	12.2
189	11.5	11.6	11.9

Day	RKM483	RKM479	RKM470
196	11.4	11.5	11.7
212	11.3	11.5	11.9
225	11.8	11.9	12.2
231	12.1	12.3	0

Table 7A. Maximum prehatching exposure estimates for redds using the Stage Independent Mortality Model and other model inputs described in Table 2A.

Day	RKM483	RKM479	RKM470
148	11.7	0	0
155	11.9	12.1	12.3
161	11.8	11.9	12.4
168	11.8	11.9	0
175	11.7	11.9	12.1
183	11.6	11.8	12.4
189	11.7	11.8	12.1
196	11.4	11.6	11.9
212	11.6	11.8	12.3
225	11.9	12.1	12.3
231	12.2	12.4	0

Table 8A. Survival to emergence estimates for redds using the Stage Independent Mortality Model and other model inputs described in Table 2A.

Days	RKM483	RKM479	RKM470
148	1	NA	NA

Days	RKM483	RKM479	RKM470
155	1	0.994	0.805
161	1	0.994	0.787
168	1	0.994	NA
175	1	0.994	0.755
183	1	0.994	0.736
189	0.983	0.959	0.705
196	0.958	0.917	0.655
212	0.782	0.723	0.514
225	0.733	0.666	0.476
231	0.679	0.612	NA



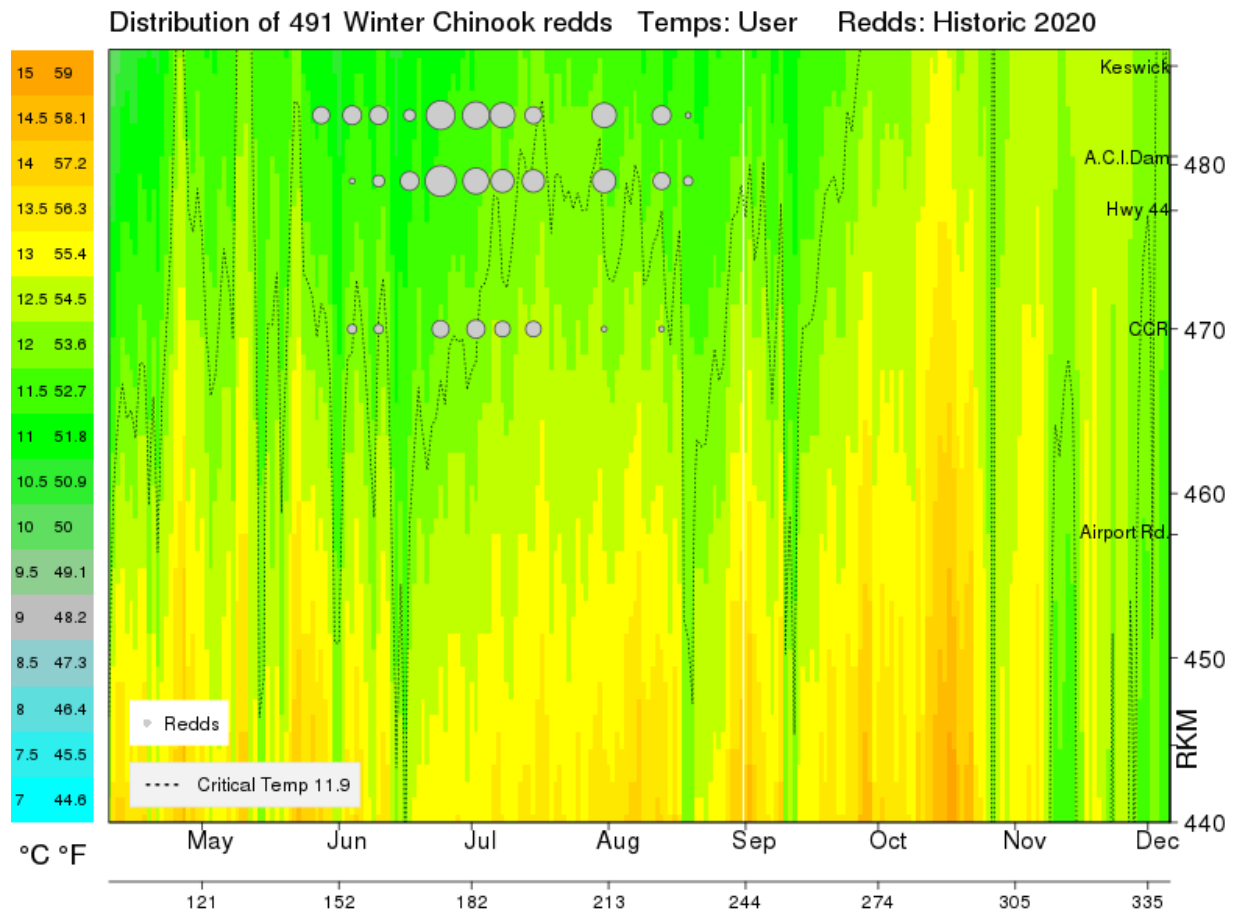


Figure 2A. 2020 distribution and timing of winter-run Chinook salmon redds and water temperatures using Stage Dependent Mortality Model and other model inputs described in Table 2A.

Hatching of 491 Winter Chinook redds Temps: User Redds: Historic 2020

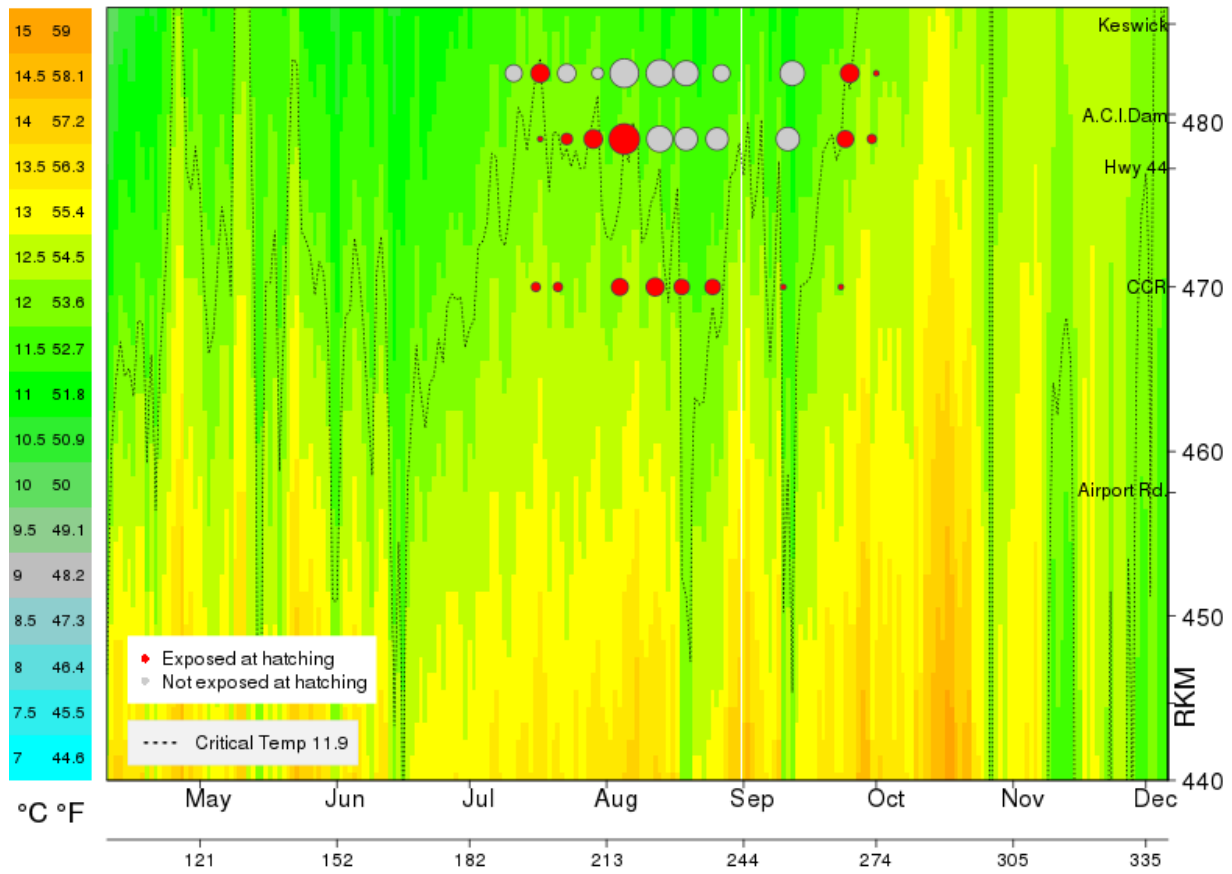


Figure 3A. 2020 distribution and timing of winter-run Chinook salmon hatching with water temperatures using Stage Dependent Mortality Model and other model inputs described in Table 2A. Winter-run Chinook salmon redds exposed to water temperatures that exceed critical temperature threshold during hatch time in red with gray circles indicating winter-run redds that were not exposed to water temperatures that exceeded critical temperature threshold indicated in gray.

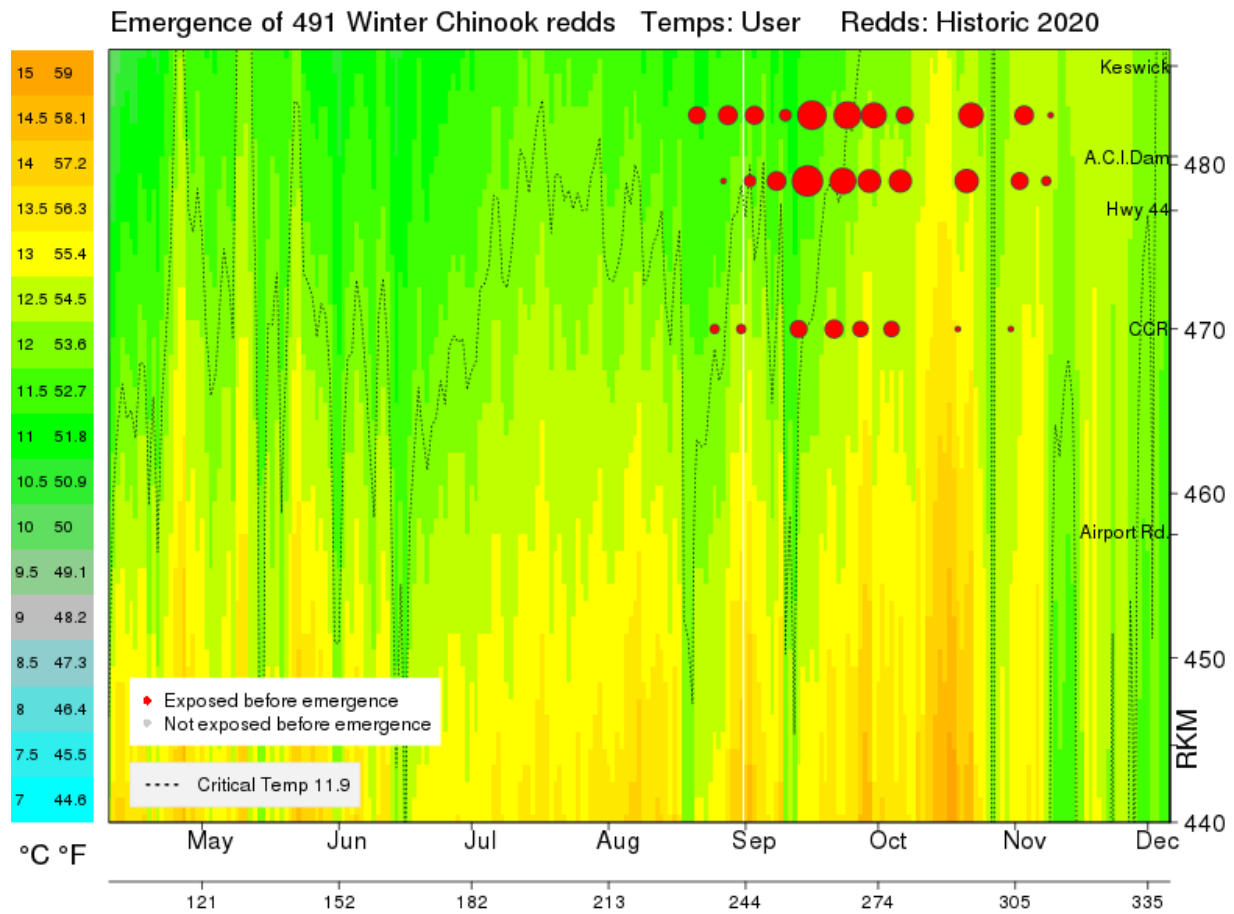


Figure 4A. 2020 distribution and timing of winter-run Chinook salmon hatching with water temperatures using Stage Dependent Mortality Model and other model inputs described in Table 2A. Winter-run Chinook salmon redds exposed to water temperatures that exceed critical temperature threshold during emergency in red with gray circles indicating winter-run redds that were not exposed to water temperatures that exceeded critical temperature threshold indicated in gray.

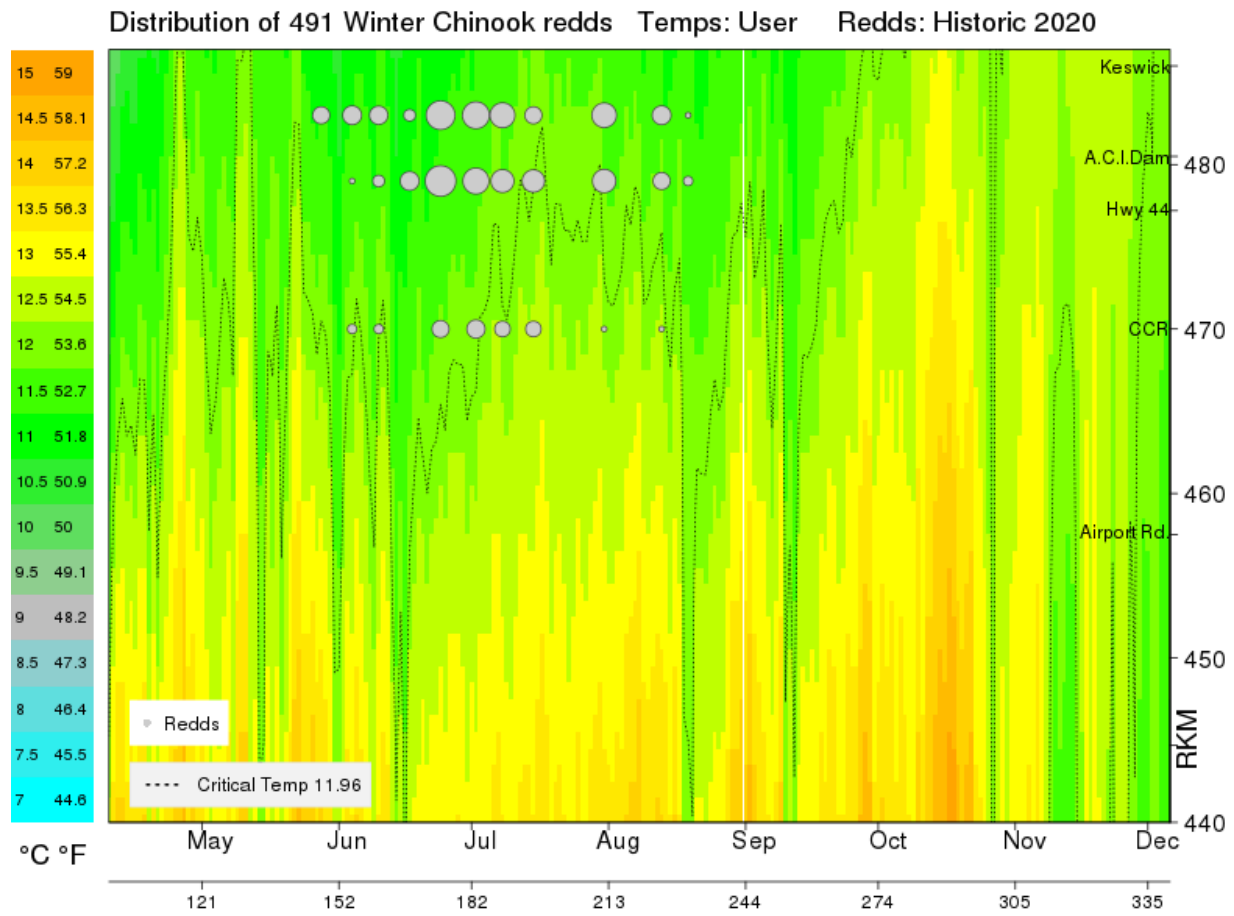


Figure 5A. 2020 distribution and timing of winter-run Chinook salmon redds and water temperatures using Stage Independent Mortality Model and other model inputs described in Table 2A.

Hatching of 491 Winter Chinook redds Temps: User Redds: Historic 2020

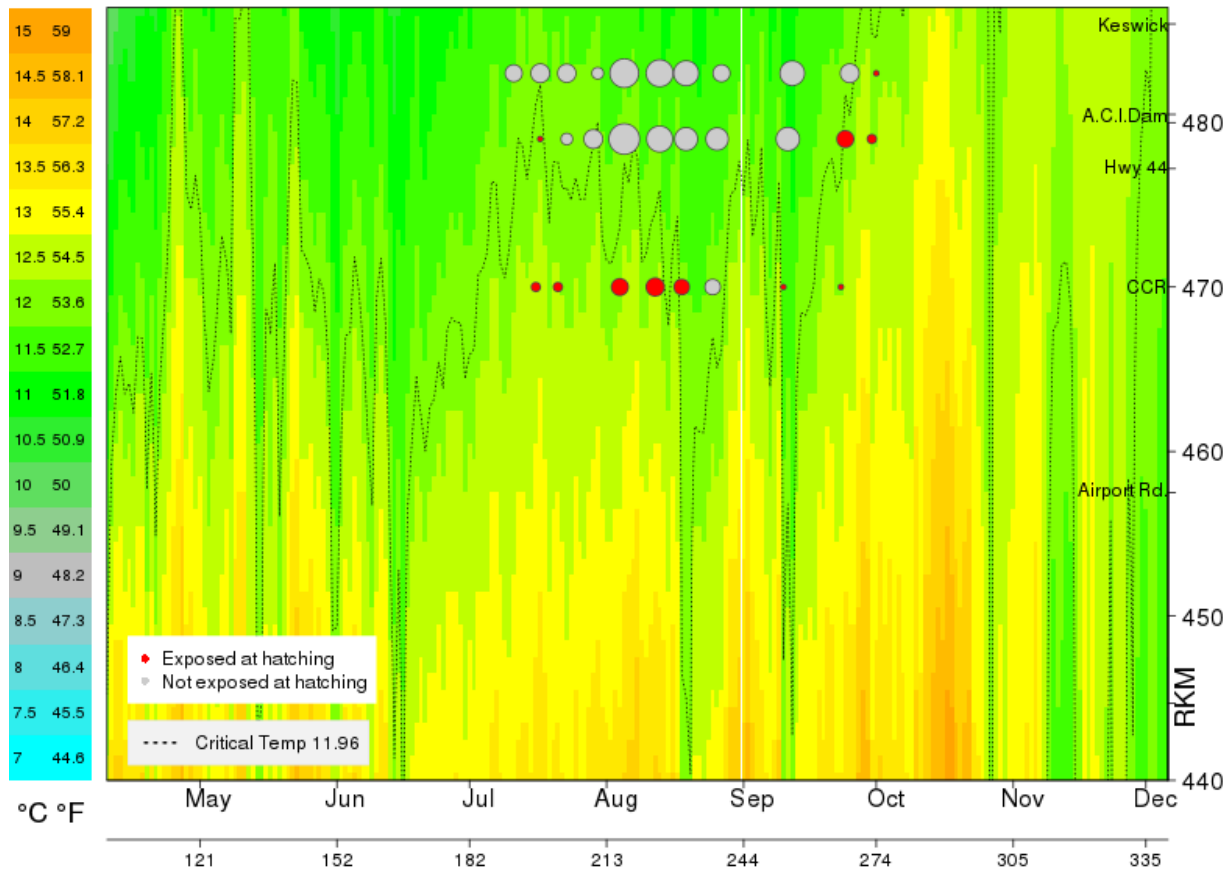


Figure 6A. 2020 distribution and timing of winter-run Chinook salmon hatching with water temperatures using Stage Independent Mortality Model and other model inputs described in Table 2A. Winter-run Chinook salmon redds exposed to water temperatures that exceed critical temperature threshold during hatch time in red with gray circles indicating winter-run redds that were not exposed to water temperatures that exceeded critical temperature threshold indicated in gray.

Emergence of 491 Winter Chinook redds Temps: User Redds: Historic 2020

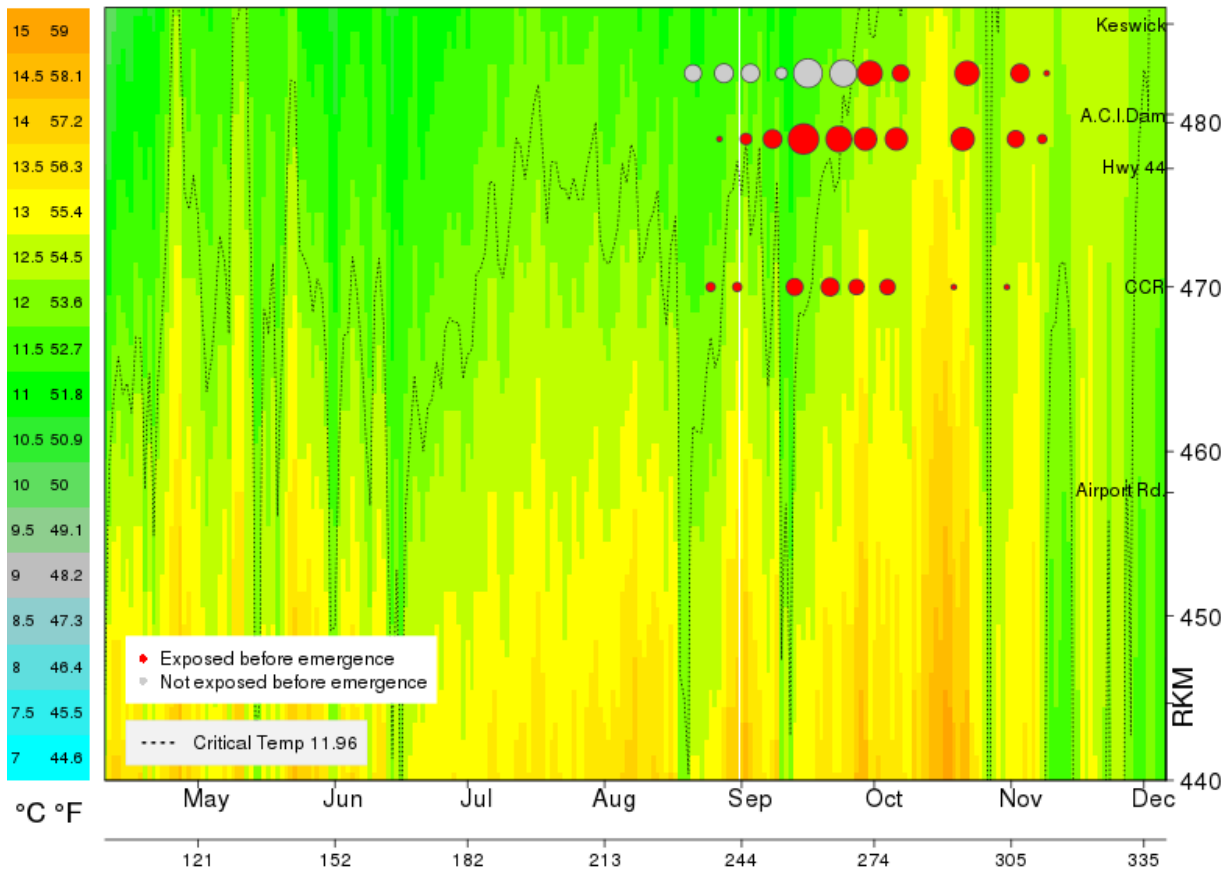


Figure 7A. 2020 distribution and timing of winter-run Chinook salmon hatching with water temperatures using Stage Independent Mortality Model and other model inputs described in Table 2A. Winter-run Chinook salmon redds exposed to water temperatures that exceed critical temperature threshold during emergency in red with gray circles indicating winter-run redds that were not exposed to water temperatures that exceeded critical temperature threshold indicated in gray.

**Table 9A Fish Model Hindcast Using the 2007-2014 Redd Data Forecasts with Actual Temperatures.**

<b>Parameter</b>	<b>Hindcast 12/06/20</b>	<b>Hindcast 12/06/20</b>
Model Type	Martin Model (stage independent)	Anderson Model (stage dependent)
Egg emergence timing model	Linear. 958 ATUs (degrees C), as indicated for Zeug et al. on SacPAS under Egg to emergence timing model.	Linear. 958 ATUs (degrees C), as indicated for Zeug et al. on SacPAS under Egg to emergence timing model
TDM redd time distribution	Average of 2007-2014	Average of 2007-2014
TDM redd space distribution	Average of 2007-2014	Average of 2007-2014
TDM Tcrit (50 <sup>th</sup> percentile)	11.96 degrees C	11.9 degrees C
TDM bT (50 <sup>th</sup> percentile)	0.024 °C <sup>-1</sup> d <sup>-1</sup>	0.5 °C <sup>-1</sup> d <sup>-1</sup>
Critical Days	All	5
Water Temperature	Actual water temperatures measured at KWK and CCR	Actual water temperatures measured at KWK and CCR
TDM Estimates	Prehatch Exposure: 12.2% Pre-emerge Exposure: 68.9% <b>Incubation Mortality: 6.6%</b>	Prehatch Exposure: 30.7% Pre-emerge Exposure: 100% <b>Incubation Mortality: 2.7%</b>

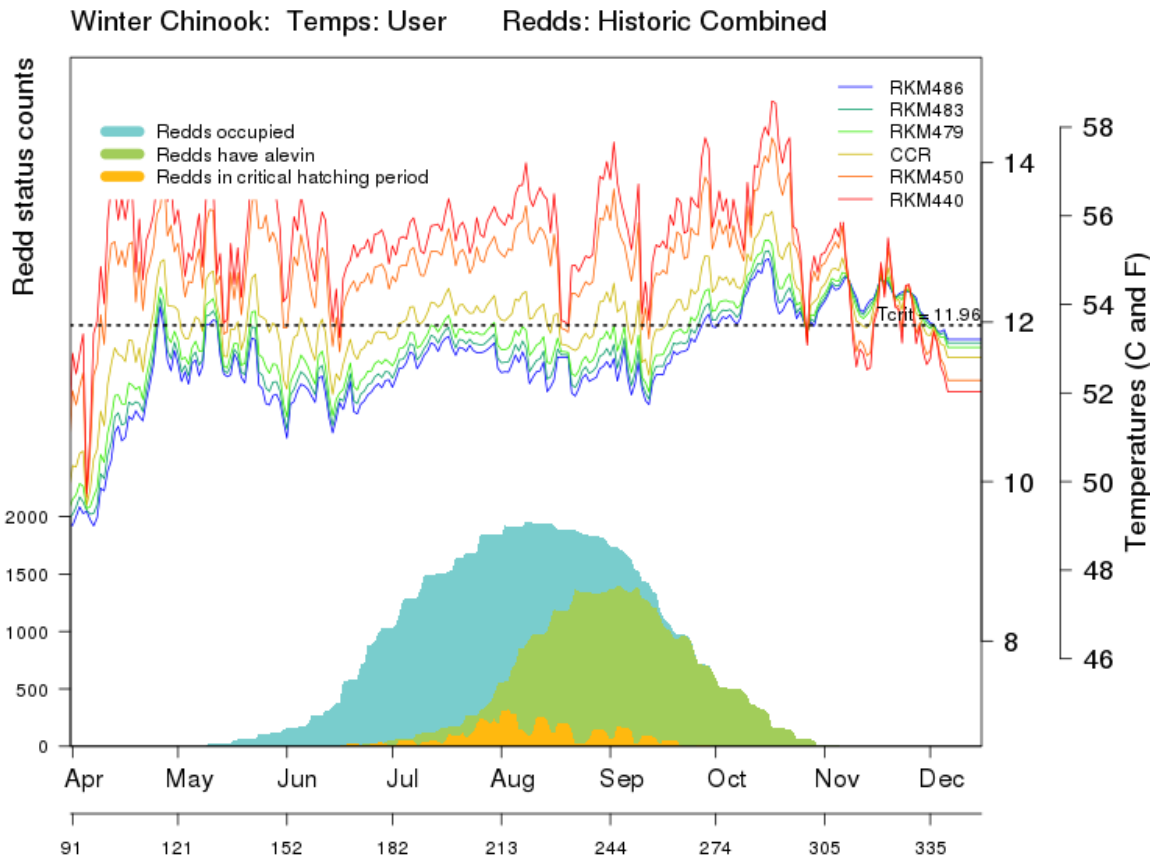


Figure 8A. 2007-2014 winter-run Chinook salmon redd data with Sacramento River water temperatures and critical egg mortality threshold (12 degrees C).

Table 10A. Mean prehatching exposure estimates for redds using the Stage Dependent Mortality Model and other model inputs described in

Day	RKM483	RKM479	RKM470	RKM450	RKM440
120	0	11.4	0	0	0
130	11.1	11.3	11.6	12	12.3
137	11.3	11.5	11.8	0	0
138	11.3	11.5	0	0	0
144	11.6	11.7	11.9	12.6	0



Day	RKM483	RKM479	RKM470	RKM450	RKM440
148	0	11.8	0	0	0
149	0	11.8	0	0	0
150	11.7	0	0	0	0
151	11.8	11.8	12.1	12.8	0
152	11.8	11.9	0	0	0
154	11.8	12	0	0	0
156	0	12	0	0	0
157	11.8	12	0	0	0
158	11.8	12	0	0	0
159	11.8	11.9	12.3	13	13.2
163	11.7	11.9	12.2	0	0
165	11.7	11.9	12.2	0	0
166	11.7	11.9	12.1	0	0
168	11.8	11.9	12.2	0	0
170	11.7	11.9	0	0	0
173	11.6	11.7	12.1	0	0
174	0	11.7	0	0	0
175	11.6	11.7	12.1	0	0
177	0	11.8	0	0	0
178	11.7	11.9	12.2	0	0
179	11.6	11.8	0	0	0
181	11.6	11.8	0	0	0
183	11.5	11.7	0	0	0

Day	RKM483	RKM479	RKM470	RKM450	RKM440
184	11.5	11.7	0	0	0
185	11.5	11.6	12.1	0	0
186	11.4	11.6	0	0	0
187	0	11.6	0	0	0
190	11.6	11.7	11.9	0	0
191	11.5	11.6	11.9	12.9	0
194	11.3	11.4	0	0	0
195	0	11.4	11.7	0	0
198	11.4	11.5	11.8	0	0
199	11.5	11.6	0	0	0
200	11.5	11.6	0	0	0
203	11.6	11.8	0	0	0
206	11.6	11.8	12.3	0	0
207	11.5	11.8	0	0	0
208	0	11.7	0	0	0
212	11.3	11.5	11.9	0	0
214	11.2	11.4	11.7	0	0
216	0	11.4	0	0	0
217	0	11.5	0	0	0
219	11.6	11.6	11.9	0	0
220	11.6	11.7	0	0	0
221	11.7	0	0	0	0
231	0	12.3	12.6	0	0

Table 11A. Maximum prehatching exposure estimates for redds using the Stage Dependent Mortality Model and other model inputs described in Table 9A

Day	RKM483	RKM479	RKM470	RKM450	RKM440
120	0	11.6	0	0	0
130	11.4	11.5	11.8	12.3	12.5
137	11.4	11.5	11.9	0	0
138	11.4	11.5	0	0	0
144	11.7	11.9	12	12.7	0
148	0	11.9	0	0	0
149	0	11.9	0	0	0
150	11.8	0	0	0	0
151	11.8	12	12.2	12.9	0
152	11.8	12	0	0	0
154	11.9	12	0	0	0
156	0	12.1	0	0	0
157	11.9	12.1	0	0	0
158	11.9	12.1	0	0	0
159	11.9	12.1	12.4	13.2	13.4
163	11.8	11.9	12.2	0	0
165	11.8	11.9	12.2	0	0
166	11.8	11.9	12.2	0	0
168	11.8	11.9	12.2	0	0
170	11.8	12	0	0	0

Day	RKM483	RKM479	RKM470	RKM450	RKM440
173	11.8	12	12.3	0	0
174	0	11.7	0	0	0
175	11.7	11.9	12.1	0	0
177	0	11.9	0	0	0
178	11.8	11.9	12.4	0	0
179	11.8	11.9	0	0	0
181	11.8	11.9	0	0	0
183	11.6	11.8	0	0	0
184	11.6	11.8	0	0	0
185	11.6	11.8	12.2	0	0
186	11.6	11.8	0	0	0
187	0	11.8	0	0	0
190	11.7	11.8	12.1	0	0
191	11.7	11.8	12.1	13.1	0
194	11.6	11.6	0	0	0
195	0	11.6	11.8	0	0
198	11.6	11.6	11.9	0	0
199	11.6	11.8	0	0	0
200	11.7	11.8	0	0	0
203	11.7	12	0	0	0
206	11.8	12	12.5	0	0
207	11.8	12	0	0	0
208	0	11.9	0	0	0

Day	RKM483	RKM479	RKM470	RKM450	RKM440
212	11.6	11.8	12.3	0	0
214	11.4	11.8	12.3	0	0
216	0	11.6	0	0	0
217	0	11.6	0	0	0
219	11.7	11.8	12	0	0
220	11.7	11.9	0	0	0
221	11.7	0	0	0	0
231	0	12.4	12.8	0	0

Table 12A. Survival to emergence estimates for redds using the Stage Dependent Mortality Model and other model inputs described in Table 9A

Days	RKM483	RKM479	RKM470	RKM450	RKM440
120	NA	1	NA	NA	NA
130	1	1	1	0.64	0.392
137	1	1	1	NA	NA
138	1	1	NA	NA	NA
144	1	1	0.851	0.186	NA
148	NA	1	NA	NA	NA
149	NA	1	NA	NA	NA
150	1	NA	NA	NA	NA
151	1	0.948	0.642	0.111	NA
152	1	0.948	NA	NA	NA
154	1	0.865	NA	NA	NA

Days	RKM483	RKM479	RKM470	RKM450	RKM440
156	NA	0.82	NA	NA	NA
157	0.983	0.82	NA	NA	NA
158	0.983	0.835	NA	NA	NA
159	0.983	0.887	0.404	0.07	0.035
163	1	0.994	0.526	NA	NA
165	1	1	0.519	NA	NA
166	1	1	0.543	NA	NA
168	1	0.977	0.522	NA	NA
170	1	0.93	NA	NA	NA
173	1	0.952	0.54	NA	NA
174	NA	1	NA	NA	NA
175	1	1	0.673	NA	NA
177	NA	0.977	NA	NA	NA
178	1	0.977	0.454	NA	NA
179	1	0.977	NA	NA	NA
181	1	0.977	NA	NA	NA
183	1	1	NA	NA	NA
184	1	1	NA	NA	NA
185	1	1	0.582	NA	NA
186	1	1	NA	NA	NA
187	NA	1	NA	NA	NA
190	1	1	0.821	NA	NA
191	1	1	0.821	0.072	NA

Days	RKM483	RKM479	RKM470	RKM450	RKM440
194	1	1	NA	NA	NA
195	NA	1	1	NA	NA
198	1	1	1	NA	NA
199	1	1	NA	NA	NA
200	1	1	NA	NA	NA
203	1	0.971	NA	NA	NA
206	1	0.951	0.385	NA	NA
207	1	0.951	NA	NA	NA
208	NA	0.979	NA	NA	NA
212	1	1	0.807	NA	NA
214	1	1	0.821	NA	NA
216	NA	1	NA	NA	NA
217	NA	1	NA	NA	NA
219	1	1	0.951	NA	NA
220	1	1	NA	NA	NA
221	1	NA	NA	NA	NA
231	NA	0.405	0.165	NA	NA

Table 13A. Mean prehatching exposure estimates for redds using the Stage Independent Mortality Model and other model inputs described in Table 9A

Day	RKM483	RKM479	RKM470	RKM450	RKM440
120	0	11.4	0	0	0
130	11.1	11.3	11.6	12	12.3

Day	RKM483	RKM479	RKM470	RKM450	RKM440
137	11.3	11.5	11.8	0	0
138	11.3	11.5	0	0	0
144	11.6	11.7	11.9	12.6	0
148	0	11.8	0	0	0
149	0	11.8	0	0	0
150	11.7	0	0	0	0
151	11.8	11.8	12.1	12.8	0
152	11.8	11.9	0	0	0
154	11.8	12	0	0	0
156	0	12	0	0	0
157	11.8	12	0	0	0
158	11.8	12	0	0	0
159	11.8	11.9	12.3	13	13.2
163	11.7	11.9	12.2	0	0
165	11.7	11.9	12.2	0	0
166	11.7	11.9	12.1	0	0
168	11.8	11.9	12.2	0	0
170	11.7	11.9	0	0	0
173	11.6	11.7	12.1	0	0
174	0	11.7	0	0	0
175	11.6	11.7	12.1	0	0
177	0	11.8	0	0	0
178	11.7	11.9	12.2	0	0



Day	RKM483	RKM479	RKM470	RKM450	RKM440
179	11.6	11.8	0	0	0
181	11.6	11.8	0	0	0
183	11.5	11.7	0	0	0
184	11.5	11.7	0	0	0
185	11.5	11.6	12.1	0	0
186	11.4	11.6	0	0	0
187	0	11.6	0	0	0
190	11.6	11.7	11.9	0	0
191	11.5	11.6	11.9	12.9	0
194	11.3	11.4	0	0	0
195	0	11.4	11.7	0	0
198	11.4	11.5	11.8	0	0
199	11.5	11.6	0	0	0
200	11.5	11.6	0	0	0
203	11.6	11.8	0	0	0
206	11.6	11.8	12.3	0	0
207	11.5	11.8	0	0	0
208	0	11.7	0	0	0
212	11.3	11.5	11.9	0	0
214	11.2	11.4	11.7	0	0
216	0	11.4	0	0	0
217	0	11.5	0	0	0
219	11.6	11.6	11.9	0	0

Day	RKM483	RKM479	RKM470	RKM450	RKM440
220	11.6	11.7	0	0	0
221	11.7	0	0	0	0
231	0	12.3	12.6	0	0

Table 14A. Maximum prehatching exposure estimates for redds using the Stage Independent Mortality Model and other model inputs described in Table 9A

Day	RKM483	RKM479	RKM470	RKM450	RKM440
120	0	11.6	0	0	0
130	11.4	11.5	11.8	12.3	12.5
137	11.4	11.5	11.9	0	0
138	11.4	11.5	0	0	0
144	11.7	11.9	12	12.7	0
148	0	11.9	0	0	0
149	0	11.9	0	0	0
150	11.8	0	0	0	0
151	11.8	12	12.2	12.9	0
152	11.8	12	0	0	0
154	11.9	12	0	0	0
156	0	12.1	0	0	0
157	11.9	12.1	0	0	0
158	11.9	12.1	0	0	0
159	11.9	12.1	12.4	13.2	13.4
163	11.8	11.9	12.2	0	0

Day	RKM483	RKM479	RKM470	RKM450	RKM440
165	11.8	11.9	12.2	0	0
166	11.8	11.9	12.2	0	0
168	11.8	11.9	12.2	0	0
170	11.8	12	0	0	0
173	11.8	12	12.3	0	0
174	0	11.7	0	0	0
175	11.7	11.9	12.1	0	0
177	0	11.9	0	0	0
178	11.8	11.9	12.4	0	0
179	11.8	11.9	0	0	0
181	11.8	11.9	0	0	0
183	11.6	11.8	0	0	0
184	11.6	11.8	0	0	0
185	11.6	11.8	12.2	0	0
186	11.6	11.8	0	0	0
187	0	11.8	0	0	0
190	11.7	11.8	12.1	0	0
191	11.7	11.8	12.1	13.1	0
194	11.6	11.6	0	0	0
195	0	11.6	11.8	0	0
198	11.6	11.6	11.9	0	0
199	11.6	11.8	0	0	0
200	11.7	11.8	0	0	0

Day	RKM483	RKM479	RKM470	RKM450	RKM440
203	11.7	12	0	0	0
206	11.8	12	12.5	0	0
207	11.8	12	0	0	0
208	0	11.9	0	0	0
212	11.6	11.8	12.3	0	0
214	11.4	11.8	12.3	0	0
216	0	11.6	0	0	0
217	0	11.6	0	0	0
219	11.7	11.8	12	0	0
220	11.7	11.9	0	0	0
221	11.7	0	0	0	0
231	0	12.4	12.8	0	0

Table 15A. Survival to emergence estimates for redds using the Stage Independent Mortality Model and other model inputs described in Table 9A.

Days	RKM483	RKM479	RKM470	RKM450	RKM440
120	NA	0.963	NA	NA	NA
130	0.993	0.975	0.808	0.27	0.146
137	1	0.986	0.8	NA	NA
138	1	0.986	NA	NA	NA
144	1	0.994	0.807	0.242	NA
148	NA	0.994	NA	NA	NA
149	NA	0.994	NA	NA	NA

Days	RKM483	RKM479	RKM470	RKM450	RKM440
150	1	NA	NA	NA	NA
151	1	0.994	0.805	0.236	NA
152	1	0.994	NA	NA	NA
154	1	0.994	NA	NA	NA
156	NA	0.994	NA	NA	NA
157	1	0.994	NA	NA	NA
158	1	0.994	NA	NA	NA
159	1	0.994	0.8	0.252	0.134
163	1	0.994	0.783	NA	NA
165	1	0.994	0.77	NA	NA
166	1	0.994	0.766	NA	NA
168	1	0.994	0.76	NA	NA
170	1	0.994	NA	NA	NA
173	1	0.994	0.755	NA	NA
174	NA	0.994	NA	NA	NA
175	1	0.994	0.755	NA	NA
177	NA	0.994	NA	NA	NA
178	1	0.994	0.755	NA	NA
179	1	0.994	NA	NA	NA
181	1	0.994	NA	NA	NA
183	1	0.994	NA	NA	NA
184	1	0.991	NA	NA	NA
185	1	0.99	0.73	NA	NA

Days	RKM483	RKM479	RKM470	RKM450	RKM440
186	0.996	0.987	NA	NA	NA
187	NA	0.979	NA	NA	NA
190	0.981	0.955	0.691	NA	NA
191	0.978	0.951	0.678	0.204	NA
194	0.964	0.93	NA	NA	NA
195	NA	0.924	0.66	NA	NA
198	0.946	0.911	0.651	NA	NA
199	0.935	0.902	NA	NA	NA
200	0.921	0.888	NA	NA	NA
203	0.873	0.839	NA	NA	NA
206	0.835	0.8	0.595	NA	NA
207	0.819	0.78	NA	NA	NA
208	NA	0.761	NA	NA	NA
212	0.782	0.723	0.514	NA	NA
214	0.773	0.705	0.494	NA	NA
216	NA	0.696	NA	NA	NA
217	NA	0.694	NA	NA	NA
219	0.765	0.692	0.479	NA	NA
220	0.761	0.69	NA	NA	NA
221	0.761	NA	NA	NA	NA
231	NA	0.612	0.435	NA	NA

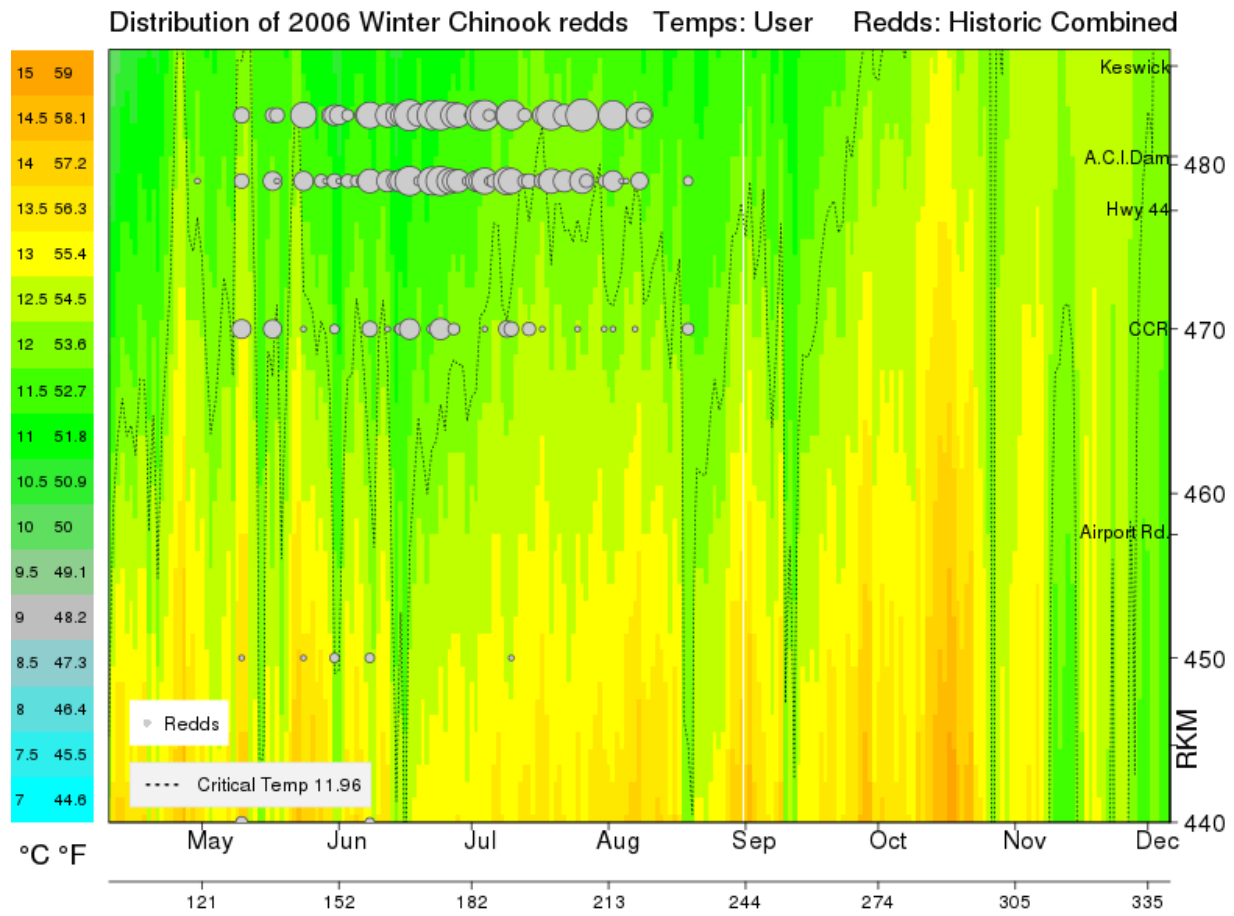


Figure 9A. Distribution and timing of winter-run Chinook salmon redds and water temperatures using Stage Independent Mortality Model and other model inputs described in Table 9A.

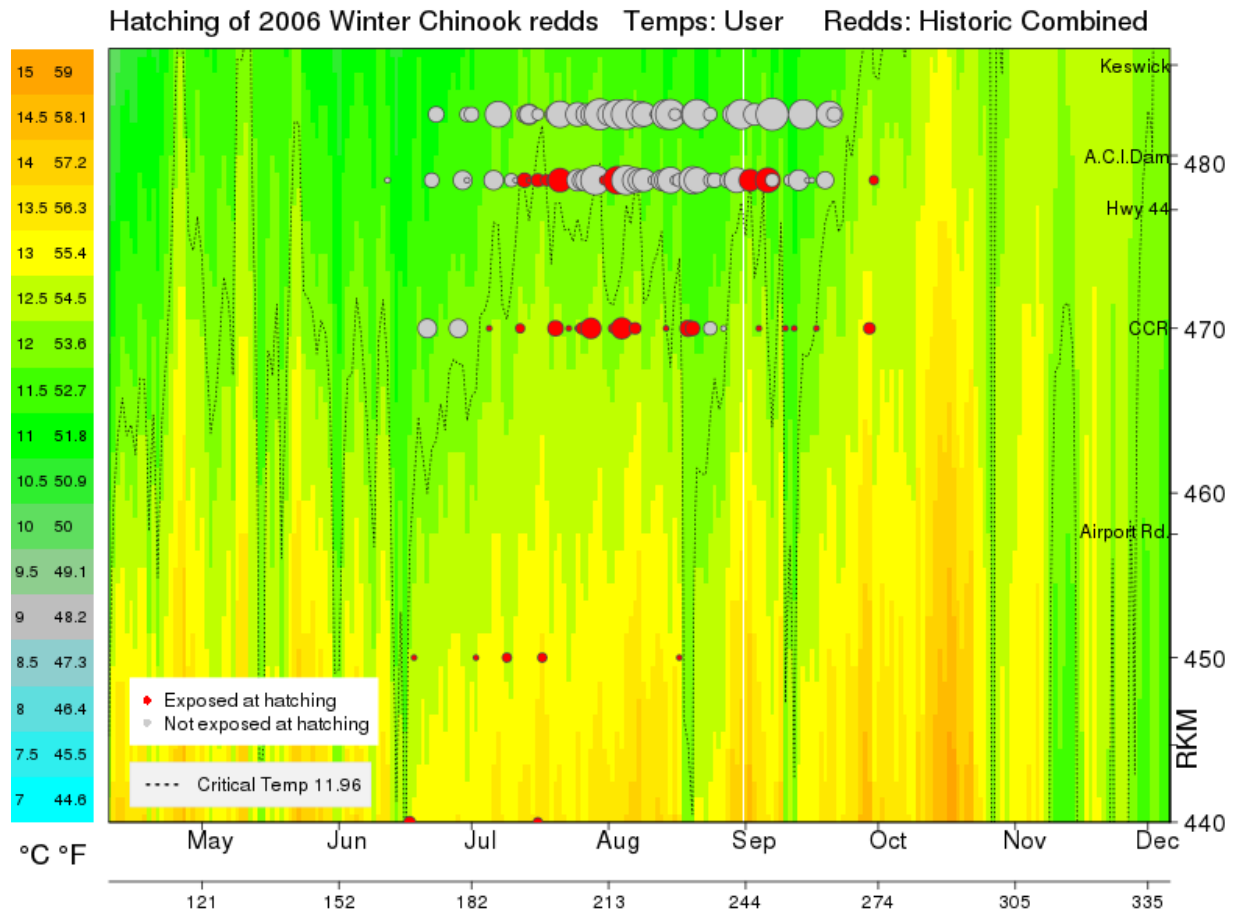


Figure 10A. Distribution and timing of winter-run Chinook salmon hatching with water temperatures using Stage Independent Mortality Model and other model inputs described in Table 9A. Winter-run Chinook salmon redds exposed to water temperatures that exceed critical temperature threshold during hatch time in red with gray circles indicating winter-run redds that were not exposed to water temperatures that exceeded critical temperature threshold indicated in gray



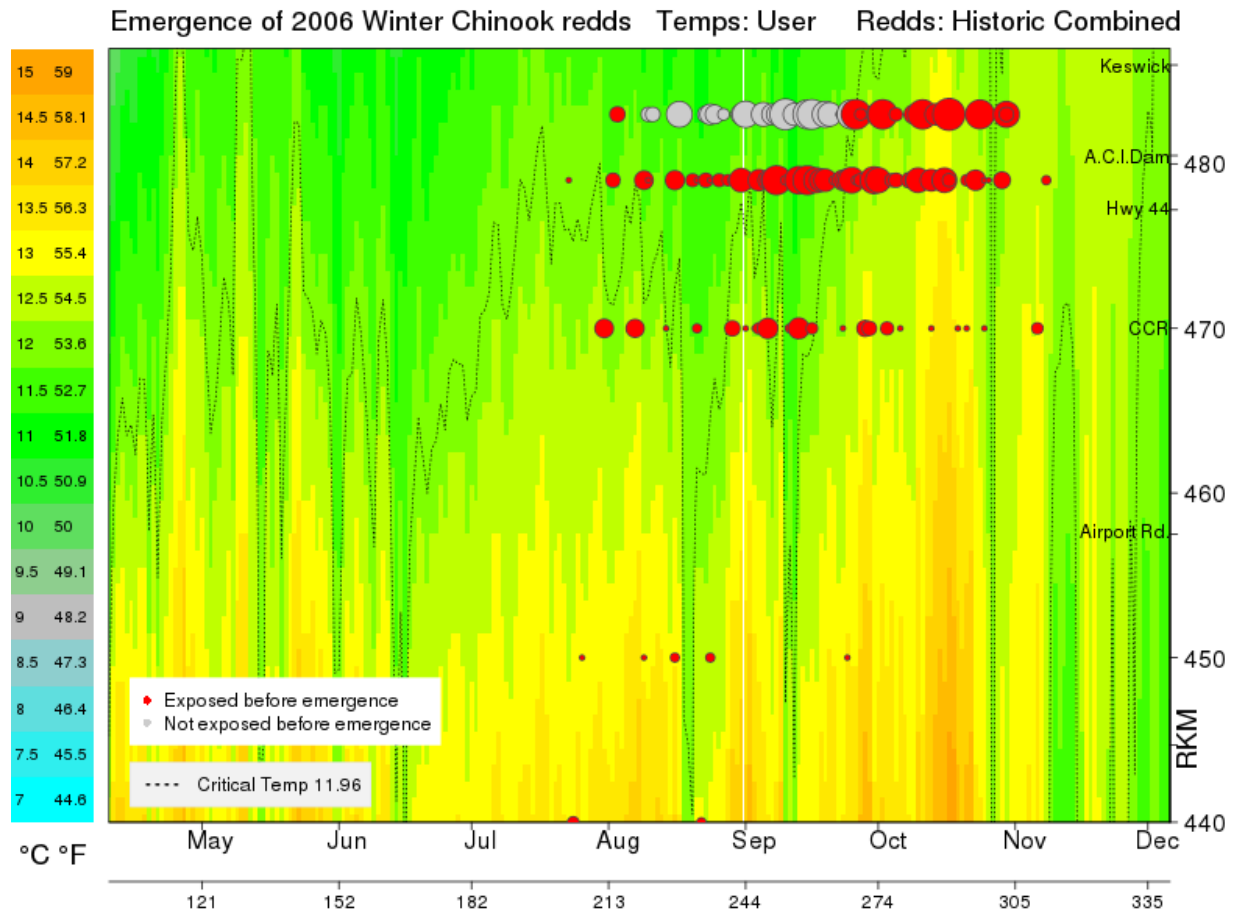


Figure 11A. Distribution and timing of winter-run Chinook salmon hatching with water temperatures using Stage Independent Mortality Model and other model inputs described in Table 9A. Winter-run Chinook salmon redds exposed to water temperatures that exceed critical temperature threshold during emergency in red with gray circles indicating winter-run redds that were not exposed to water temperatures that exceeded critical temperature threshold indicated in gray.

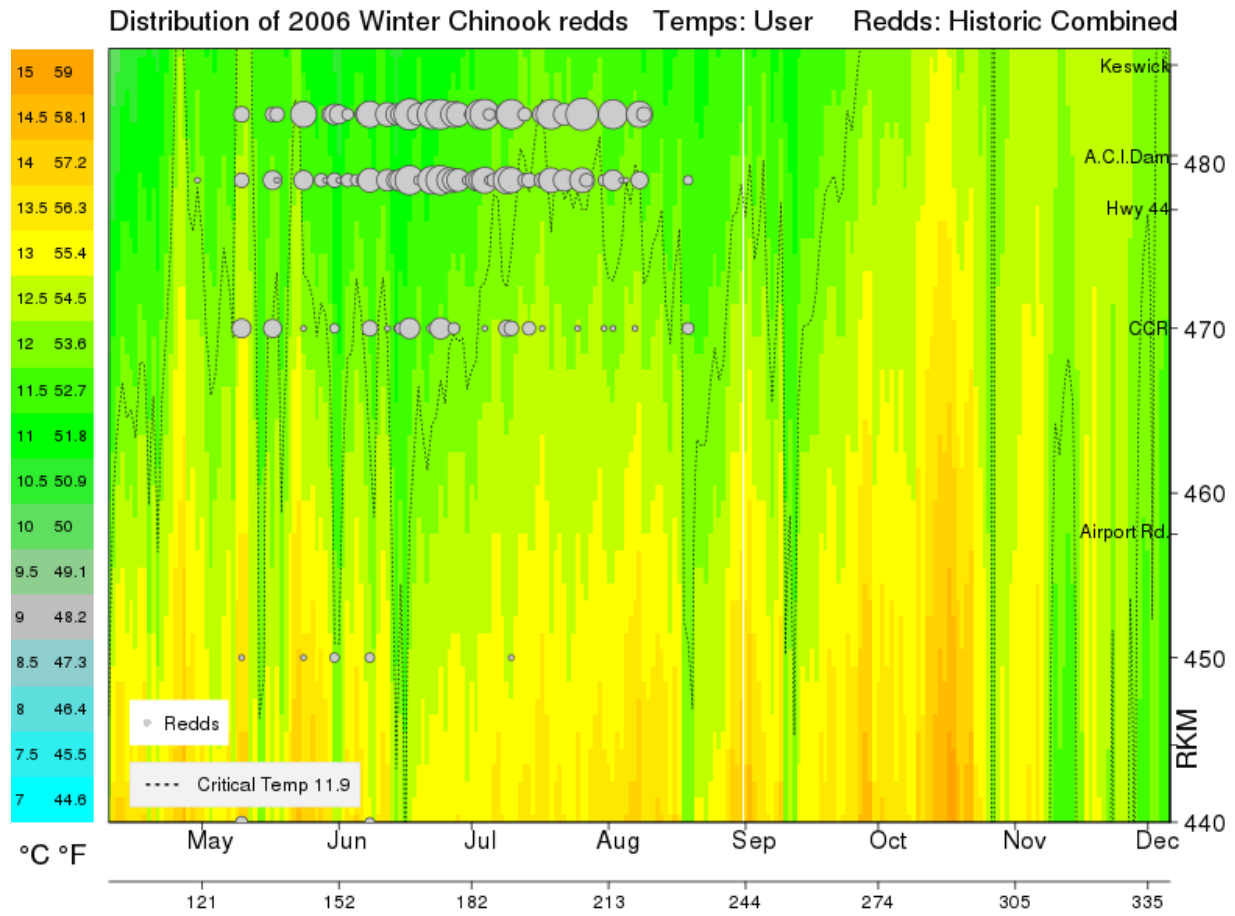


Figure 12A. Distribution and timing of winter-run Chinook salmon redds and water temperatures using Stage Dependent Mortality Model and other model inputs described in Table 9A.

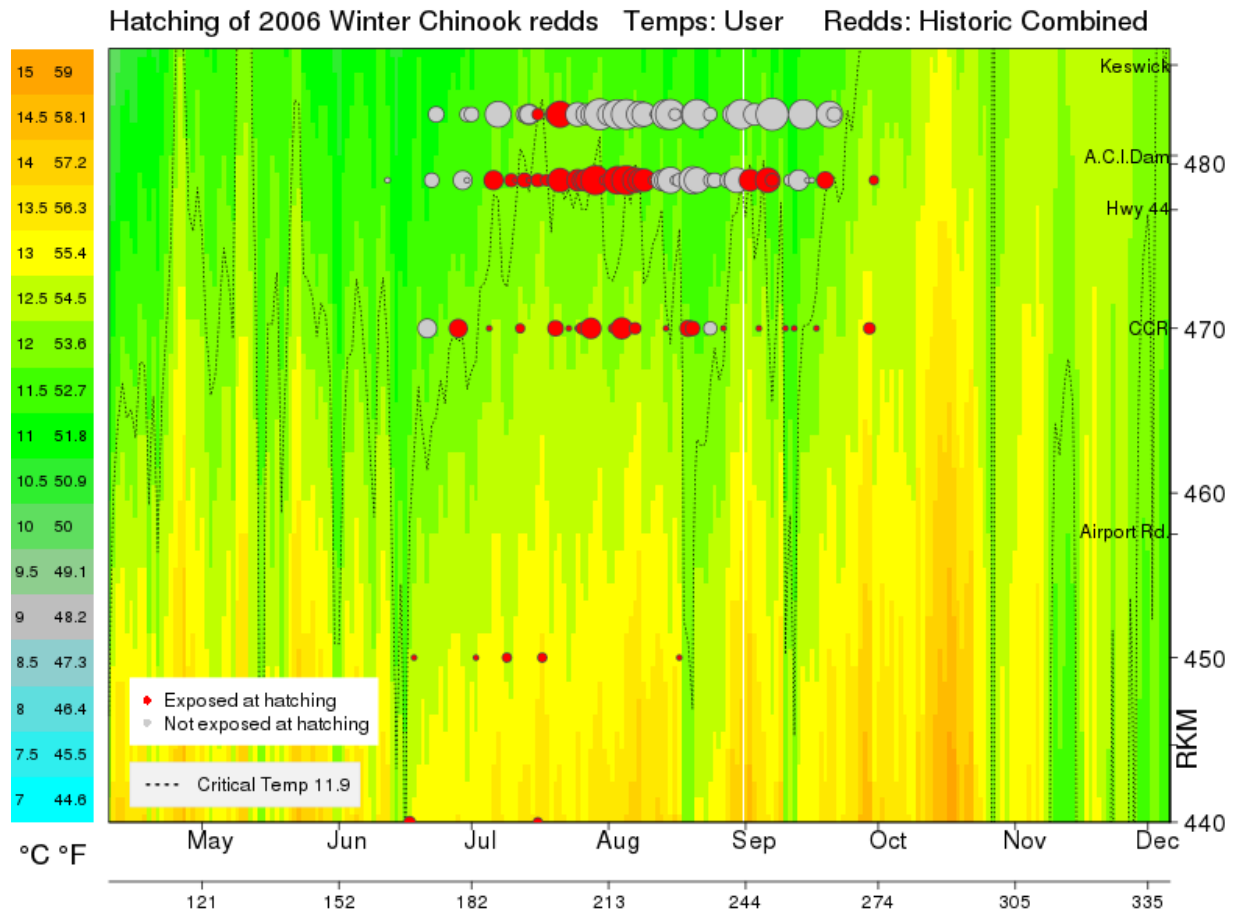


Figure 13A. Distribution and timing of winter-run Chinook salmon hatching with water temperatures using Stage Dependent Mortality Model and other model inputs described in Table 9A. Winter-run Chinook salmon redds exposed to water temperatures that exceed critical temperature threshold during hatch time in red with gray circles indicating winter-run redds that were not exposed to water temperatures that exceeded critical temperature threshold indicated in gray.

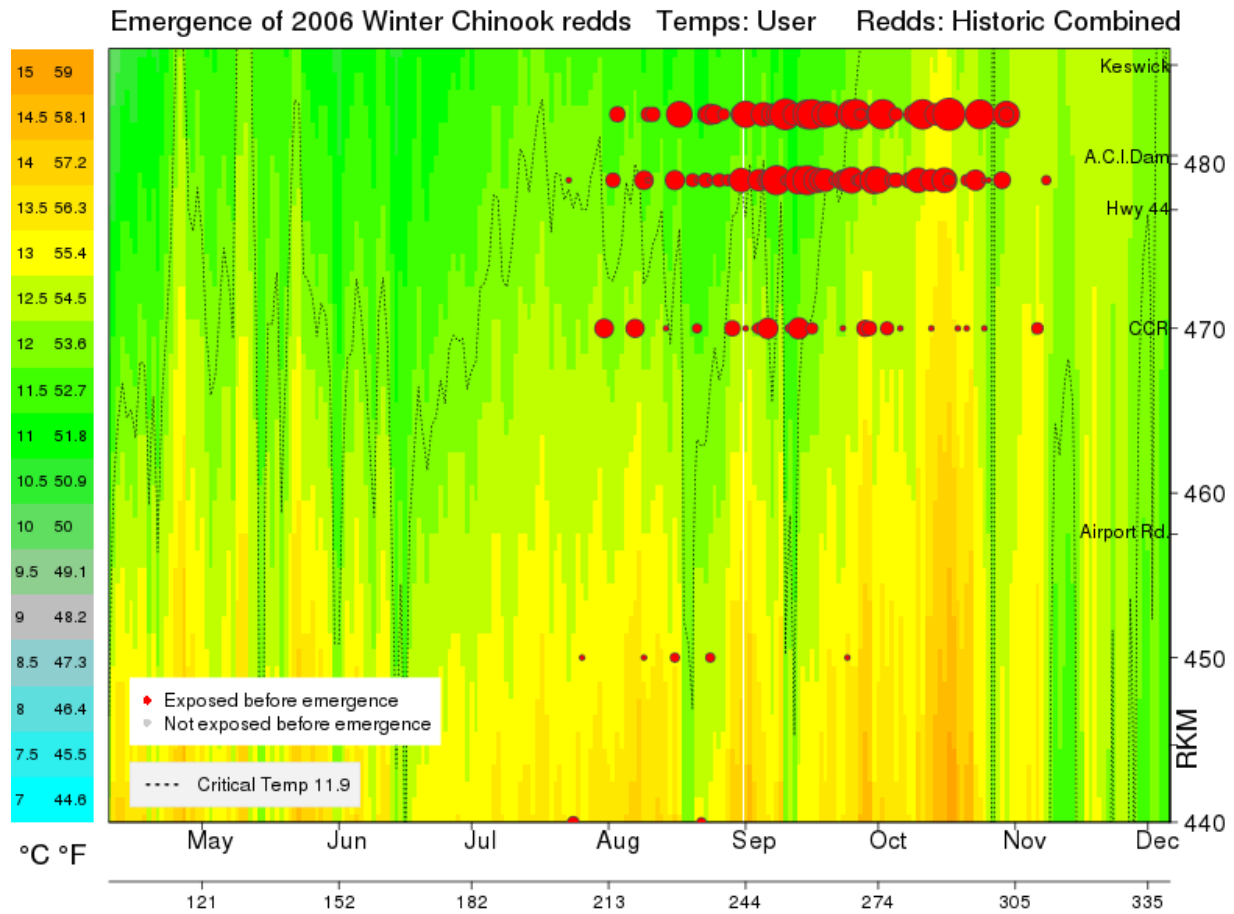


Figure 14A. Distribution and timing of winter-run Chinook salmon hatching with water temperatures using Stage Dependent Mortality Model and other model inputs described in Table 9A. Winter-run Chinook salmon redds exposed to water temperatures that exceed critical temperature threshold during emergency in red with gray circles indicating winter-run redds that were not exposed to water temperatures that exceeded critical temperature threshold indicated in gray

Table 16A. Parameter inputs values and hindcast egg-to-fry survival for stage dependent and stage independent mortality models.

<b>Parameter</b>	<b>Hindcast 12/09/20</b>	<b>Hindcast 12/09/20</b>
Model Type	Martin Model (stage independent)	Anderson Model (stage dependent)
Egg emergence timing model	Linear. 958 ATUs (degrees C), as indicated for Zeug et al. on SacPAS under Egg to emergence timing model.	Linear. 958 ATUs (degrees C), as indicated for Zeug et al. on SacPAS under Egg to emergence timing model
TDM redd time distribution	2020	2020
TDM redd space distribution	2020	2020
TDM Tcrit (50 <sup>th</sup> percentile)	11.96 degrees C	11.9 degrees C
TDM bT (50 <sup>th</sup> percentile)	0.024 °C <sup>-1</sup> d <sup>-1</sup>	0.5 °C <sup>-1</sup> d <sup>-1</sup>
Critical Days	All	5
Water Temperature	Actual water temperatures measured at KWK and CCR	Actual water temperatures measured at KWK and CCR
Density effects per kilometer base rate	0.399	0.47
Carrying Capacity	1028 redds	39 per km averaged by reach
Egg-to-fry Survival Estimates	<b>25%</b>	<b>20.5%</b>

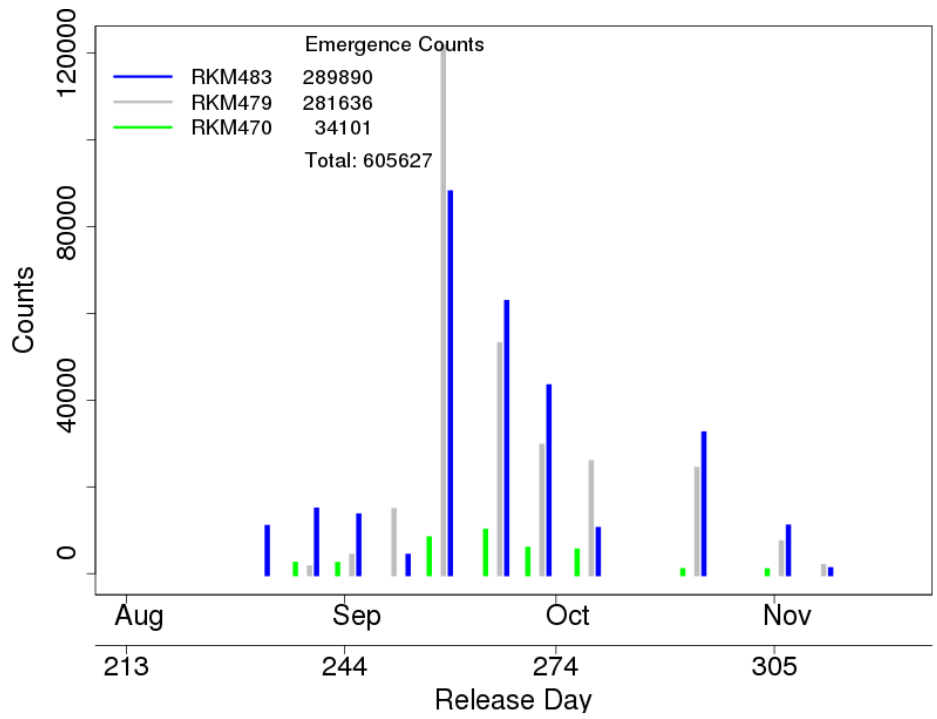


Figure 15A. Spatial and temporal SacPAS Fish Model emergence counts.