



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
650 Capitol Mall, Suite 5-100
Sacramento, California 95814-4700

MAR 31 2016

Mr. Ron Milligan
Operations Manager, Central Valley Project
U.S. Bureau of Reclamation
3310 El Camino Avenue, Suite 300
Sacramento, California 95821

Dear Mr. Milligan:

Thank you for the opportunity to review the U.S. Bureau of Reclamation's (Reclamation) March forecast and water supply allocation for water year 2016. Your March 25, 2016, letter included the results of the 90 and 50 percent exceedance forecasts, water temperature modeling, and this year's initial water supply allocation. In addition, after a discussion with NMFS on March 28, 2016, Reclamation adjusted the 50 percent exceedance forecast, reran the water temperature model, and submitted the results to NOAA's National Marine Fisheries Service via electronic mail on March 29, 2016. For purposes of compliance with the reasonable and prudent alternative (RPA) Action I.2.3, described in NOAA's National Marine Fisheries Service's (NMFS) biological opinion (issued June 4, 2009) on the long-term operations of the Central Valley Project (CVP) and State Water Project (CVP/SWP Opinion), NMFS' concurrence is required prior to the initial water supply allocation of the year. The objective is to use a conservative forecast as early as possible to protect the cold water pool in Shasta Reservoir so that suitable spawning and egg/alevin incubation habitat can be maintained in the Sacramento River during the summer and fall season for federally listed endangered Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), and threatened Central Valley spring-run Chinook salmon (*O. tshawytscha*).

Winter-run in brood years 2014 and 2015 experienced very low egg-to-fry survival to Red Bluff as a result of high water temperatures during their egg and alevin incubation stages. As brood year 2016 is the third of three winter-run cohorts, it is very important to operate Shasta Reservoirs conservatively to provide and maintain adequate water temperatures throughout the winter-run early life stages. As such, as part of Reclamation's and the California Department of Water Resources' January 19, 2016, "Central Valley Project and State Water Project 2016 Drought Contingency Plan For Water Project Operations, February – November 2016,"¹ NMFS requested inclusion of attachment 4 that provides a list of suggested model inputs towards Reclamation's temperature modeling scenario. NMFS has reviewed its suggested model inputs and compared it with Reclamation's 50% and 90% exceedance forecasts and associated temperature model runs, and have determined that Reclamation has met NMFS' expectations for model inputs. For example:

¹ http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/plans/2016dcpfebnov.pdf



- Meeting an end of September (EOS) Shasta storage of at least 2.2 million acre-feet (MAF);
- Targeting a daily average Keswick release temperature of 52°F (which will likely meet a 56°F daily average temperature downstream of Balls Ferry) as a surrogate for the 55°F 7-day average of the daily maximum (7DADM) temperatures at the Bonneview Bridge temperature compliance point (CCR CDEC gage station);
- Utilizing a 10% long-term 3-month temperature outlook (L3MTO) that reflects meteorological conditions in 2014; and
- Comparing the quantity and quality of the Shasta cold water pool at the beginning of March and end of May between historically similar years and the temperature model run.

On March 15, 2016, Reclamation submitted² to NMFS a preliminary set of Sacramento River temperature model results based on the February 1, 2016, hydrologic conditions and forecasted reservoir inflow. Because the forecasts were outdated and did not reflect the dry February or the considerable precipitation in the first half of March, Reclamation indicated that it would update the temperature analyses based on the early March storms and new estimates of hydrology. On March 18, 2016, NMFS issued a response letter³ to Reclamation. In addition to looking forward to receiving Reclamation's March 90 percent exceedance forecast with updated hydrology and temperature model runs, NMFS enclosed a memorandum that supports the use of a 56°F daily average temperature at Jellys Ferry as the temperature compliance point this year, which is roughly equivalent to a 55°F 7DADM at CCR.

The March 2016 reservoir operations forecast is based on estimated runoff within the Sacramento River basin as of March 15, 2016. The estimated annual inflow into Shasta Reservoir is 5.56 MAF (100% of mean) in the 90 percent exceedance forecast and 6.11 MAF (110% of mean) in the 50 percent exceedance forecast. The projected storage in Shasta Reservoir is forecast to be at 4.33 MAF at the end of May 2016 and 3.03 MAF at the EOS in the 90 percent exceedance forecast (*i.e.*, more conservative forecast), and the projected storage in Shasta Reservoir is forecast to be at 4.552 MAF at the end of May 2016 and 3.18 MAF at the EOS in the revised 50 percent exceedance forecast. The following table provides Reclamation's initial water supply allocations based on the 90 percent exceedance forecast:

March 90% Exceedance Municipal & Industrial Water Service Contracts – Agricultural Water Service Contracts And Refuge Level 2 Contracts					
	North of Delta M&I	North of Delta Agricultural	South of Delta M&I	South of Delta Agricultural	Level 2 Refuge Supply
Allocation	100%	100%	55%	5%	100%

²

http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/Operations,%20Criteria%20and%20Plan/bureau_of_reclamation_s_february_forecast_-_march_15_2016.pdf

³

http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/Operations,%20Criteria%20and%20Plan/nmfs_march_18_2016_response_to_the_bureau_of_reclamation_s_february_forecast.pdf

NMFS has reviewed Reclamation's March CVP operations 90 percent and 50 percent exceedance forecasts (enclosure 1) and corresponding water temperature model runs (enclosure 2), and a revised 50 percent exceedance forecast and associated water temperature model run (enclosure 3). In addition, the NMFS-Southwest Fisheries Science Center utilized the Keswick release and temperature data as input into its River Assessment for Forecasting Temperature (RAFT) and survival models. Enclosure 4 provides RAFT and survival model results for the March CVP operations 90 percent and 50 percent exceedance forecasts, and enclosure 5 provides RAFT and survival model results for the revised 50 percent exceedance forecast. Finally, NMFS reviewed Reclamation's graph comparing the quantity and quality of the Shasta cold water pool at the beginning of March and end of May between historically similar years and the temperature model run (enclosure 6).

The resulting water temperature model runs based on the 90 percent exceedance forecast indicate that a Keswick release daily average temperature of 52°F, or 56°F daily average temperature compliance point between Balls Ferry and Jellys Ferry (which is comparable and a surrogate for the 55°F 7DADM temperatures at CCR) will be achievable throughout the winter-run and spring-run Chinook salmon spawning and incubation period (*i.e.*, May 15 through October 31). Based on the projected EOS storage in Shasta Reservoir (at least 2.2 MAF) and temperature model runs (meeting a Balls Ferry temperature compliance point), Reclamation and NMFS agree that RPA Action I.2.3.A should be implemented this year. Results from the survival model indicate that the annual mean temperature-dependent related mortality utilizing the Keswick release flows and temperatures from the:

- 90 percent exceedance forecast is 2.17% [median = 0.77%; 95% confidence intervals (CI) = 0 - 25.49%],
- 50 percent exceedance forecast is 3.59% (median = 0.079%; 95% CI = 0 - 34.42%), and
- revised 50 percent exceedance forecasts 2.67% (median = 0.078; 95% CI = 0 - 31.13%).

In addition, Reclamation's graph comparing the quantity and quality of the Shasta cold water pool at the beginning of March and end of May between historically similar years and the temperature model run (enclosure 6) indicates that although the model is relatively accurate in estimating the quantity of cold water at the end of May, it underestimates the quality of cold water available (*i.e.*, there is more of the coldest water than the model predicts). This hindcast comparison provides a buffer of conservatism during the development of the Sacramento River temperature management plan.

In reviewing the monthly Keswick release schedules, NMFS is concerned about the potential for winter-run Chinook salmon redd dewatering prior to complete fry emergence in the fall, and also fall-run Chinook salmon redd dewatering in the late fall and into the winter. The level of concern is based on the uncertainty of the timing and distribution of redd locations and the monthly Keswick release schedule time step. To reduce this concern, NMFS will work with Reclamation in real-time to adjust Keswick releases, as needed, to provide stable flows throughout the winter-run Chinook salmon egg and alevin incubation stages until complete emergence, and also to stabilize flows for fall-run Chinook salmon spawning and egg incubation.

In summary, NMFS concurs with Reclamation's forecasts based on March 15, 2016, hydrologic conditions, and initial water supply allocation, that RPA Action I.2.3.A should be implemented this year, and that a 55°F 7DADM temperature will be attainable at CCR. In addition, NMFS will work with Reclamation to adjust the Keswick release schedules in order to minimize the potential for winter-run and fall-run Chinook salmon redd dewatering. Our concurrence is based on Reclamation implementing the following monthly average Keswick release schedule (in cubic feet per second):

Exceedance	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
90%	5000	6500	9000	10500	10000	9000	6500	6500	6500	4150	4150
Revised 50%	5200	8500	9000	10500	10000	9000	7500	7500	7500	5000	4000

Should Reclamation need to change the monthly average release schedule, NMFS expects close coordination between our agencies to ensure that the habitat needs (*i.e.*, cold water, stable flows) of winter-run Chinook salmon continue to be met. In addition, NMFS will work with Reclamation on real-time management during the temperature management season. It will be critically important this year to target a 55°F 7DADM temperature at CCR as the compliance criterion and location.

Thank you for the recent discussions with your staff in meeting the requirements in the CVP/SWP Opinion and RPA Action I.2.3. I look forward to further communication between our agencies to fully meet the requirements provided in RPA Action I.2.3.A of the CVP/SWP Opinion. If you have any questions regarding this letter, please feel free to contact me, or have your staff contact Mr. Brycen Swart at (916) 930-3712, or via e-mail at brycen.swart@noaa.gov.

Sincerely,



Maria C. Rea

Assistant Regional Administrator

Enclosures:

1. 90 and 50 percent exceedance forecasts (2 pages)
2. Temperature model runs (2 pages)
3. Revised 50 percent exceedance forecast and associated water temperature model run (2 pages)
4. RAFT and survival model results for the 90 and 50 percent exceedance forecasts (5 pages)
5. RAFT and survival model results for the revised 50 percent exceedance forecast (5 pages)
6. Shasta Reservoir cold water storage in the March 15, 2016, model run vs. historic data (3 pages)

cc: Copy to file – ARN 151422SWR2006SA00268

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Estimated CVP Operations BASE 90% Exceedance

Storages

Federal End of the Month Storage/Elevation (TAF/Feet)

		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	
Trinity		854	1171	1350	1315	1242	1114	1035	964	950	939	942	971	1053
	Elev.	2273	2290	2287	2280	2267	2259	2251	2249	2248	2248	2248	2252	2261
Whiskeytown		207	206	238	238	238	238	230	206	206	206	206	206	206
	Elev.	1199	1209	1209	1209	1209	1209	1207	1199	1199	1199	1199	1199	1199
Shasta		2766	4044	4289	4330	4128	3756	3352	3032	2858	2723	2654	2788	3072
	Elev.	1049	1058	1059	1052	1039	1023	1009	1001	995	992	998	998	1011
Folsom		606	667	797	964	908	711	553	522	436	358	313	332	410
	Elev.	436	449	465	460	440	423	419	408	397	389	389	393	405
New Melones		459	567	568	572	548	494	445	402	392	410	427	444	462
	Elev.	871	872	872	868	856	846	835	833	837	841	841	845	849
San Luis		312	426	367	202	91	34	34	111	259	470	687	835	897
	Elev.	459	444	409	377	335	331	353	373	407	443	476	491	491
Total		7081	7609	7620	7155	6346	5659	5262	5102	5106	5228	5576	6099	

State End of the Month Reservoir Storage (TAF)

Oroville	Elev.	
San Luis		
Total San Luis (TAF)		

Monthly River Releases (TAF/cfs)

Trinity	TAF	18	32	260	150	68	45	44	23	18	18	18	17
	cfs	300	540	4,225	2,526	1,102	734	744	373	300	300	300	300
Clear Creek	TAF	11	13	13	9	7	5	9	14	10	11	11	10
	cfs	175	218	216	150	120	85	150	225	175	175	175	175
Sacramento	TAF	246	297	400	535	645	615	535	400	387	400	255	230
	cfs	4000	5000	6500	9000	10500	10000	9000	6500	6500	6500	4150	4150
American	TAF	599	208	215	274	289	245	115	121	118	108	92	83
	cfs	9750	3500	3500	4602	4702	3989	1928	1971	1981	1750	1500	1500
Stanislaus	TAF	12	27	25	9	9	9	9	35	12	12	12	12
	cfs	200	460	400	150	150	150	150	577	200	200	200	213
Feather	TAF												
	cfs												

Trinity Diversions (TAF)

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Carr PP	13	38	37	77	83	37	32	0	14	19	6	5
Spring Crk. PP	28	8	30	70	75	30	30	12	5	12	3	7

Delta Summary (TAF)

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Tracy	210	71	50	184	282	282	272	282	272	258	195	145
USBR Banks	0	0	0	0	0	0	0	0	0	0	0	0
Contra Costa	12.7	12.7	12.7	9.8	11.1	12.7	14.0	16.8	18.4	18.3	14.0	14.0
Total USBR	223	84	63	194	293	295	286	299	290	276	209	159
State Export												
Total Export												
COA Balance	0	0	0	1	1	125	301	374	433	433	433	433
Old/Middle River Std.												
Old/Middle R. calc.	-5,102	-1,271	-1,285	-4,453	-5,267	-6,902	-7,591	-6,510	-7,388	-7,257	-5,099	-4,224
Computed DOI	47435	18171	12965	7816	4994	3497	3009	4002	4505	7109	11403	12499
Excess Outflow	36032	6774	2814	0	0	0	0	0	0	2603	5401	1099
% Export/Inflow	12%	7%	9%	32%	40%	52%	60%	59%	63%	56%	37%	30%
% Export/Inflow std.	35%	35%	35%	35%	65%	65%	65%	65%	65%	65%	65%	45%

Hydrology

	Trinity	Shasta	Folsom	New Melones
Water Year Inflow (TAF)	1536	5,563	2,787	854
Year to Date + Forecasted % of mean	127%	100%	102%	81%

CVP actual operations do not follow any forecasted operation or outlook; actual operations are based on real-time conditions.

CVP operational forecasts or outlooks represent general system-wide dynamics and do not necessarily address specific watershed/tributary details.

CVP releases or export values represent monthly averages.

CVP Operations are updated monthly as new hydrology information is made available December through May.

Estimated CVP Operations BASE 50% Exceedance

Storages

Federal End of the Month Storage/Elevation (TAF/Feet)

		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	
Trinity		854	1173	1376	1366	1379	1286	1169	1061	1009	1002	1040	1105	1212
	Elev.	2273	2293	2292	2293	2284	2273	2262	2256	2255	2260	2267	2277	
Whiskeytown		207	206	238	238	238	238	230	230	225	206	206	206	
	Elev.	1199	1209	1209	1209	1209	1209	1207	1207	1205	1199	1199	1199	
Shasta		2766	3875	4328	4508	4369	4006	3654	3381	3183	3052	2994	3297	3842
	Elev.	1043	1059	1066	1061	1048	1035	1024	1016	1010	1007	1020	1042	
Folsom		606	667	800	957	933	780	610	507	460	430	419	448	515
	Elev.	436	449	464	462	447	430	417	411	407	406	410	418	
New Melones		459	567	589	645	686	644	598	557	552	574	602	638	696
	Elev.	871	876	886	886	894	886	877	869	868	873	878	885	895
San Luis		312	441	376	201	154	83	73	149	294	501	657	807	929
	Elev.	463	447	411	391	393	410	434	449	481	494	523	547	
Total		6930	7707	7917	7758	7038	6342	5886	5727	5785	5918	6500	7399	

State End of the Month Reservoir Storage (TAF)

Oroville	
San Luis	
Total San Luis (TAF)	

Monthly River Releases (TAF/cfs)

Trinity	TAF	18	27	260	150	68	53	52	23	18	18	18	17
	cfs	300	460	4,225	2,526	1,102	855	870	373	300	300	300	300
Clear Creek	TAF	11	13	13	9	7	7	9	12	12	11	11	10
	cfs	175	218	216	150	120	120	150	200	200	175	175	175
Sacramento	TAF	473	297	400	535	645	615	535	461	446	461	307	222
	cfs	7700	5000	6500	9000	10500	10000	9000	7500	7500	7500	5000	4000
American	TAF	599	327	338	350	290	277	208	123	119	123	123	194
	cfs	9750	5500	5500	5881	4714	4500	3500	2000	2000	2000	2000	3500
Stanislaus	TAF	12	27	25	9	9	9	9	35	12	12	12	12
	cfs	200	460	400	150	150	150	150	577	200	200	200	213
Feather													

Trinity Diversions (TAF)

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Carr PP	0	21	24	71	67	68	61	40	19	1	0	5
Spring Crk. PP	28	0	25	68	60	60	60	30	19	25	24	40

Delta Summary (TAF)

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Tracy	230	71	50	272	282	282	272	282	272	200	200	210
USBR Banks	0	0	0	0	7	7	7	0	0	0	0	0
Contra Costa	12.7	12.7	12.7	9.8	11.1	12.7	14	16.8	18.4	18.3	14	14
Total USBR	243	84	63	282	300	302	293	299	290	218	214	224
State Export												
Total Export												
COA Balance	0	0	0	-27	-27	-27	-27	-27	-27	-27	-27	-27
Old/Middle R. std.												
Old/Middle R. calc.	-5,118	-705	-612	-5,890	-8,770	-9,130	-9,159	-7,073	-8,427	-5,242	-5,107	-5,151
Computed DOI	69852	27937	21522	10254	6507	4783	4404	4376	5514	14055	17048	22405
Excess Outflow	58448	16541	10265	0	0	781	1395	374	1009	9549	11045	11004
% Export/Inflow	10%	5%	6%	36%	51%	57%	62%	60%	62%	32%	29%	26%
% Export/Inflow std.	35%	35%	35%	35%	65%	65%	65%	65%	65%	65%	65%	35%

Hydrology

Water Year Inflow (TAF)	Trinity	Shasta	Folsom	New Melones
Year to Date + Forecasted	1642.6	6,112	3,216	1011
% of mean	136%	110%	118%	96%

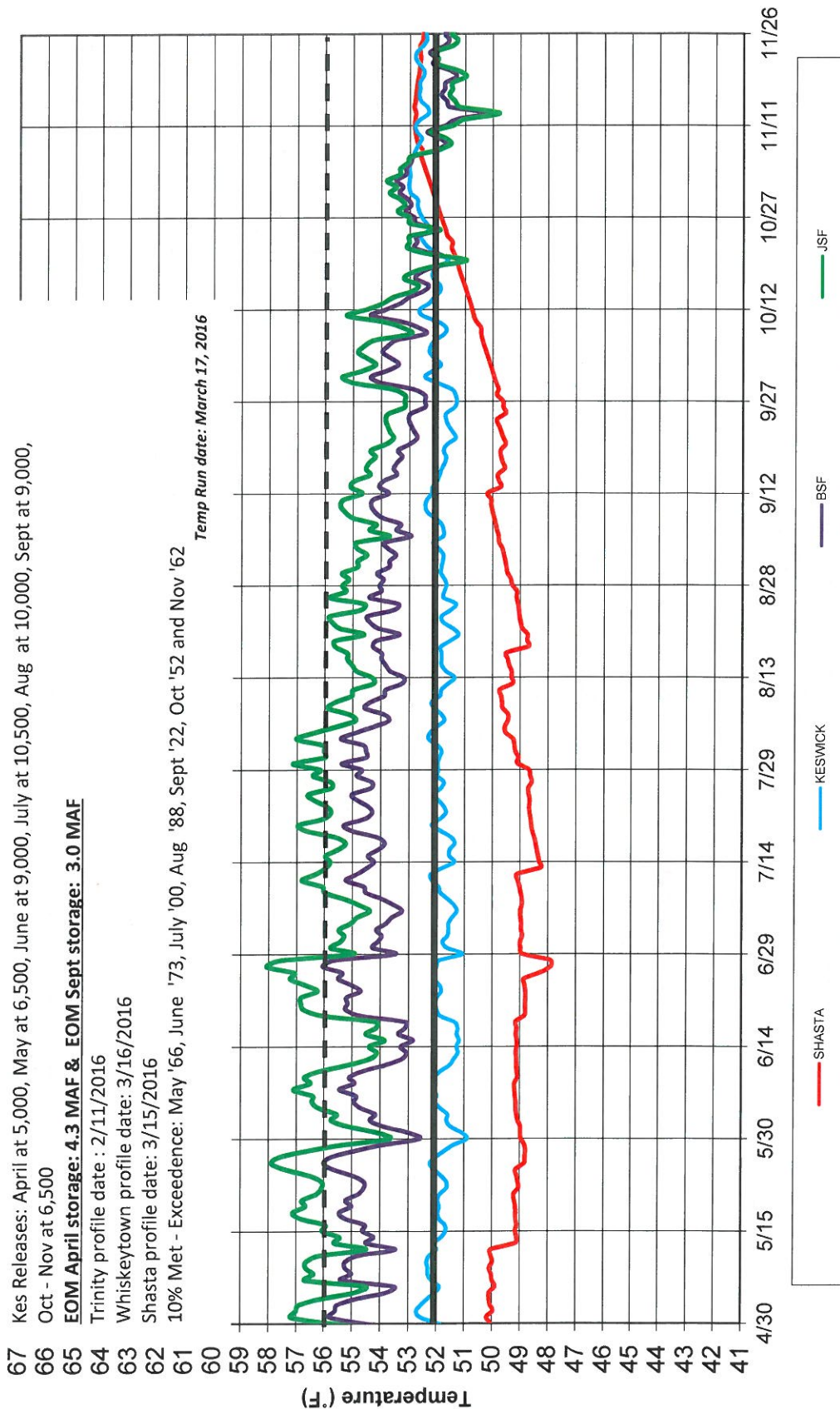
CVP actual operations do not follow any forecasted operation or outlook; actual operations are based on real-time conditions.

CVP operational forecasts or outlooks represent general system-wide dynamics and do not necessarily address specific watershed/tributary details.

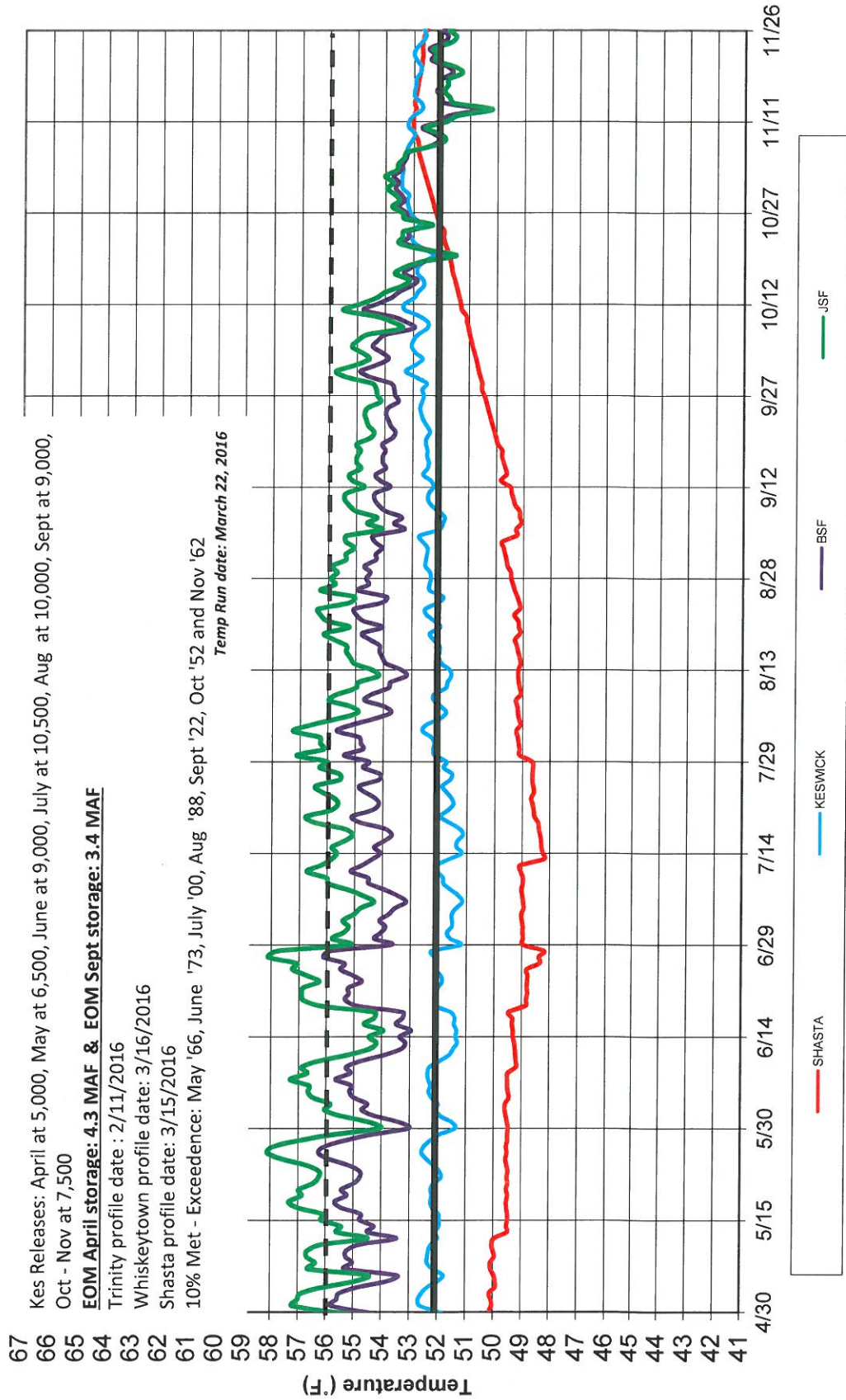
CVP releases or export values represent monthly averages.

CVP Operations are updated monthly as new hydrology information is made available December through May.

**Sacramento River Modeled Temperature
2016 Mar 90%-Exceedance Water Outlook - 10% L3MTO Historical
Approximately 52 degree at Kes**



**Sacramento River Modeled Temperature
2016 Mar 50%-Exceedance Water Outlook - 10% L3MTO Historical
Approximately 52 degree at Kes**



Estimated CVP Operations BASE 50% Exceedance

Storages

Federal End of the Month Storage/Elevation (TAF/Feet)

		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	
Trinity		854	1173	1368	1354	1364	1257	1169	1091	1057	1064	1115	1180	1287
	Elev.	2273	2292	2291	2292	2282	2273	2265	2261	2262	2268	2274	2285	
Whiskeytown		207	206	238	238	238	238	230	230	225	206	206	206	
	Elev.	1199	1209	1209	1209	1209	1207	1207	1205	1199	1199	1199	1199	
Shasta		2766	4041	4489	4552	4414	4066	3684	3381	3165	3020	2949	3252	3797
	Elev.	1049	1065	1067	1062	1050	1036	1024	1015	1009	1005	1019	1040	
Folsom		606	667	800	957	933	780	610	507	460	430	419	448	515
	Elev.	436	449	464	462	447	430	417	411	407	406	410	418	
New Melones		459	567	589	645	686	644	598	557	552	574	602	638	696
	Elev.	871	876	886	894	886	877	869	868	873	878	885	895	
San Luis		312	441	376	201	154	83	73	149	294	501	657	807	929
	Elev.	463	447	411	391	393	410	434	449	481	494	523	547	
Total		7095	7861	7947	7789	7068	6372	5916	5757	5815	5948	6531	7430	

State End of the Month Reservoir Storage (TAF)

Oroville	
San Luis	
Total San Luis (TAF)	

Monthly River Releases (TAF/cfs)

Trinity	TAF	18	27	260	150	68	53	52	23	18	18	18	17
	cfs	300	460	4,225	2,526	1,102	855	870	373	300	300	300	300
Clear Creek	TAF	11	13	13	9	7	7	9	12	12	11	11	10
	cfs	175	218	216	150	120	120	150	200	200	175	175	175
Sacramento	TAF	307	309	523	535	645	615	535	461	446	461	307	222
	cfs	5000	5200	8500	9000	10500	10000	9000	7500	7500	7500	5000	4000
American	TAF	599	327	338	350	290	277	208	123	119	123	123	194
	cfs	9750	5500	5500	5881	4714	4500	3500	2000	2000	2000	2000	3500
Stanislaus	TAF	12	27	25	9	9	9	9	35	12	12	12	12
	cfs	200	460	400	150	150	150	150	577	200	200	200	213
Feather													

Trinity Diversions (TAF)

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Carr PP	0	29	29	73	82	38	31	22	5	-12	0	5
Spring Crk. PP	28	8	30	70	75	30	30	12	5	12	24	40

Delta Summary (TAF)

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Tracy	230	71	50	272	282	282	272	282	272	200	200	210
USBR Banks	0	0	0	0	7	7	7	0	0	0	0	0
Contra Costa	12.7	12.7	12.7	9.8	11.1	12.7	14	16.8	18.4	18.3	14	14
Total USBR	243	84	63	282	300	302	293	299	290	218	214	224
State Export												
Total Export												
COA Balance	0	0	0	-27	-27	-27	-27	-27	-27	-27	-27	-27
Old/Middle R. std.												
Old/Middle R. calc.	-5,118	-705	-612	-5,890	-8,770	-9,130	-9,159	-7,073	-8,427	-5,242	-5,107	-5,151
Computed DOI	67151	28139	23523	10254	6507	4783	4404	4376	5514	14055	17048	22405
Excess Outflow	55748	16742	12266	0	0	781	1395	374	1009	9549	11045	11004
% Export/Inflow	10%	5%	6%	36%	51%	57%	62%	60%	62%	32%	29%	26%
% Export/Inflow std.	35%	35%	35%	35%	65%	65%	65%	65%	65%	65%	65%	35%

Hydrology

Water Year Inflow (TAF)	Trinity	Shasta	Folsom	New Melones
Year to Date + Forecasted	1642.6	6,112	3,216	1011
% of mean	136%	110%	118%	96%

CVP actual operations do not follow any forecasted operation or outlook; actual operations are based on real-time conditions.

CVP operational forecasts or outlooks represent general system-wide dynamics and do not necessarily address specific watershed/tributary details.

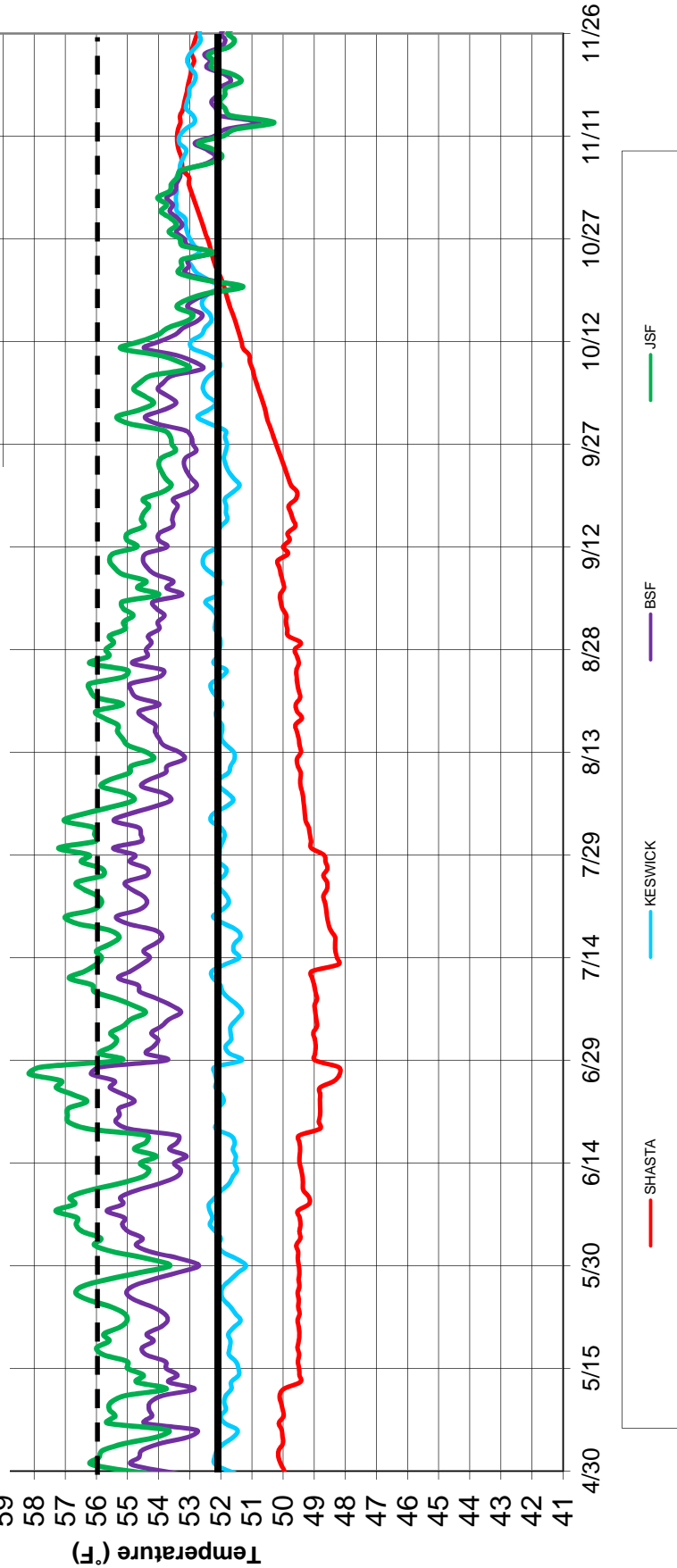
CVP releases or export values represent monthly averages.

CVP Operations are updated monthly as new hydrology information is made available December through May.

**Sacramento River Modeled Temperature
2016 Mar 50%-Exceedance Water Outlook - 10% L3MTO Historical
Approximately 52 degree at Kes**

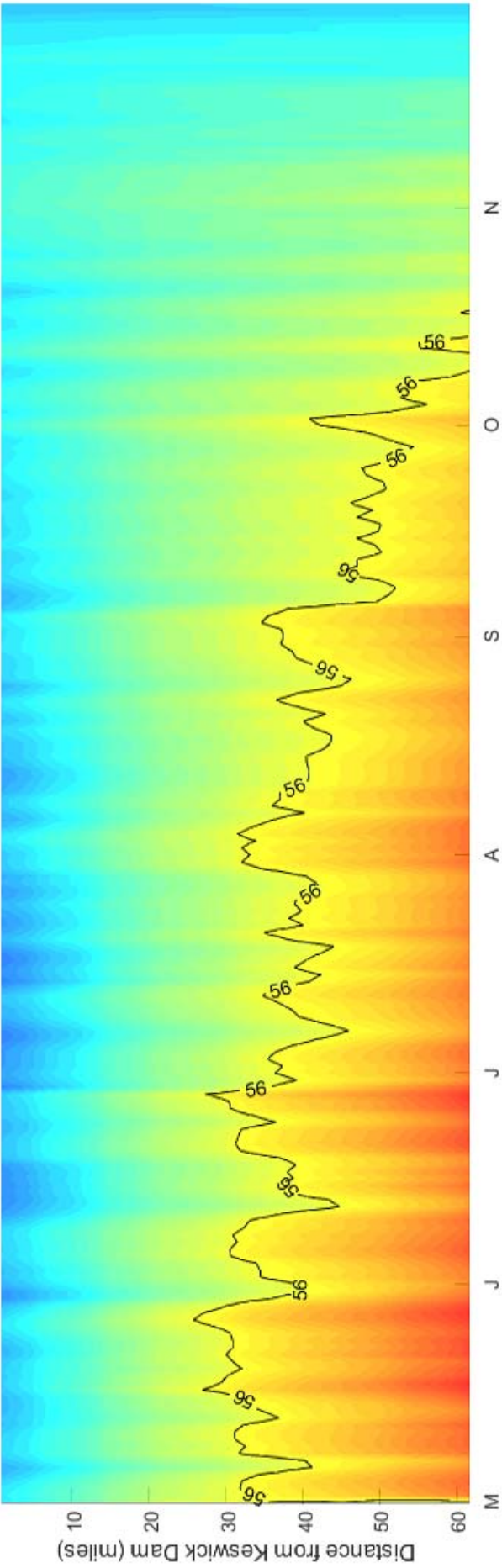
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Kes Releases: April at 5,200, May at 8,500, June at 9,000, July at 10,500, Aug at 10,000, Sept at 9,000,
Oct - Nov at 7,500
EOM April storage: 4.4 MAF & EOM Sept storage: 3.4 MAF
Trinity profile date : 2/11/2016
Whiskeytown profile date: 3/16/2016
Shasta profile date: 3/15/2016
10% Met - Exceedance: May '66, June '73, July '00, Aug '88, Sept '22, Oct '52 and Nov '62
Temp Run date: March 29, 2016

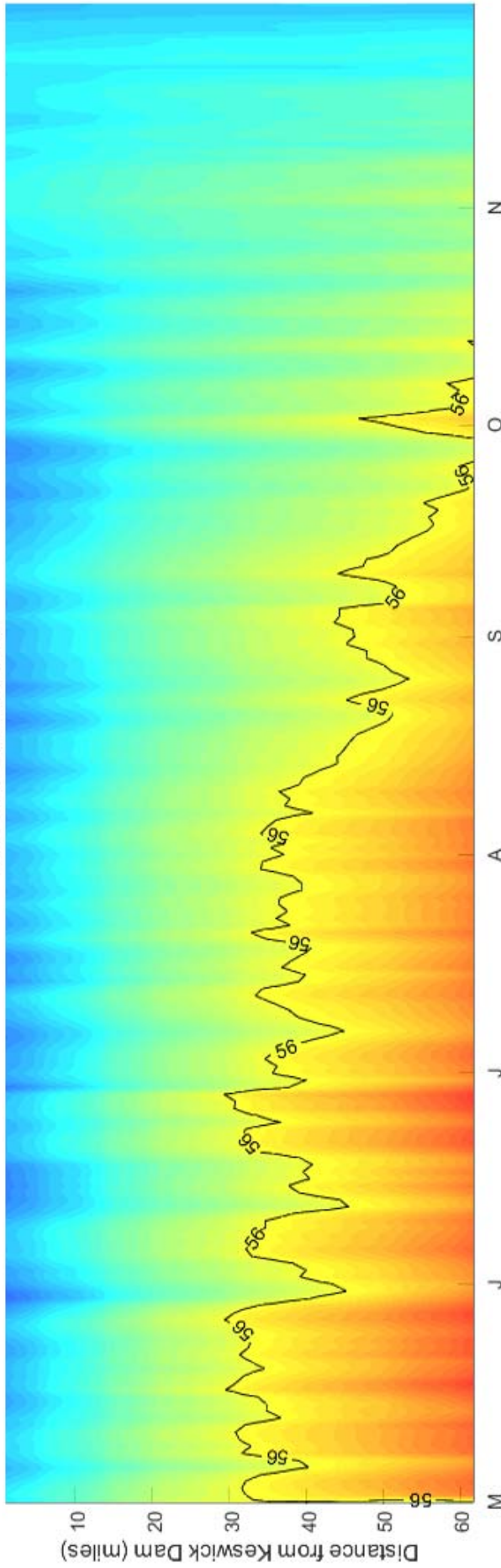




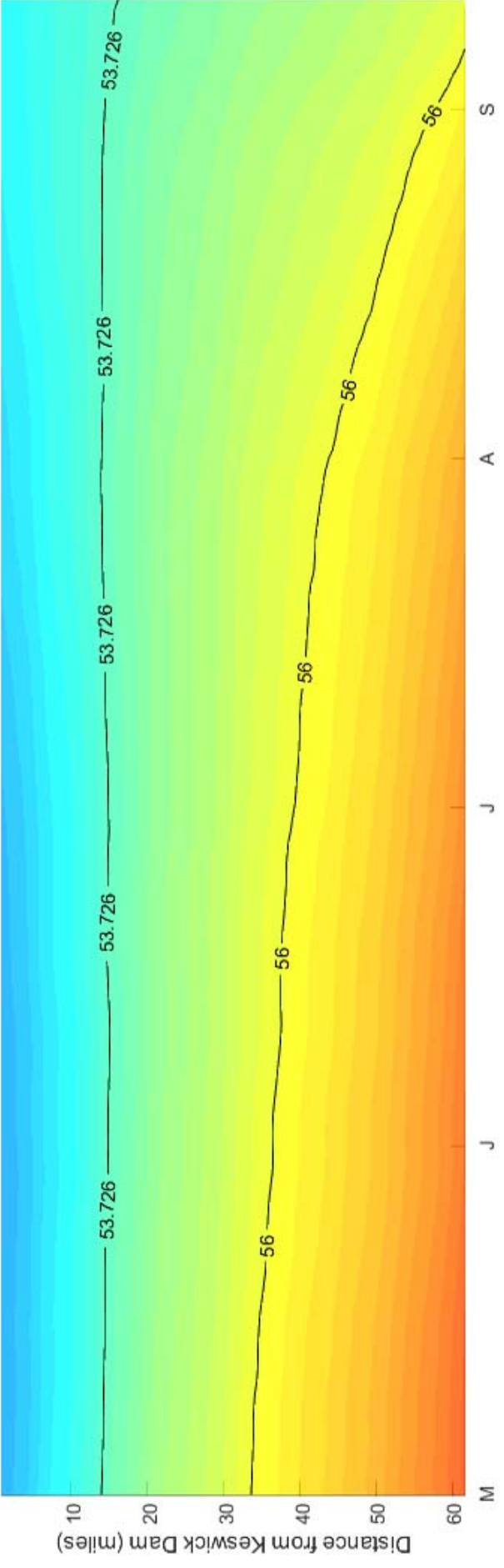
Scenario = March, 50%



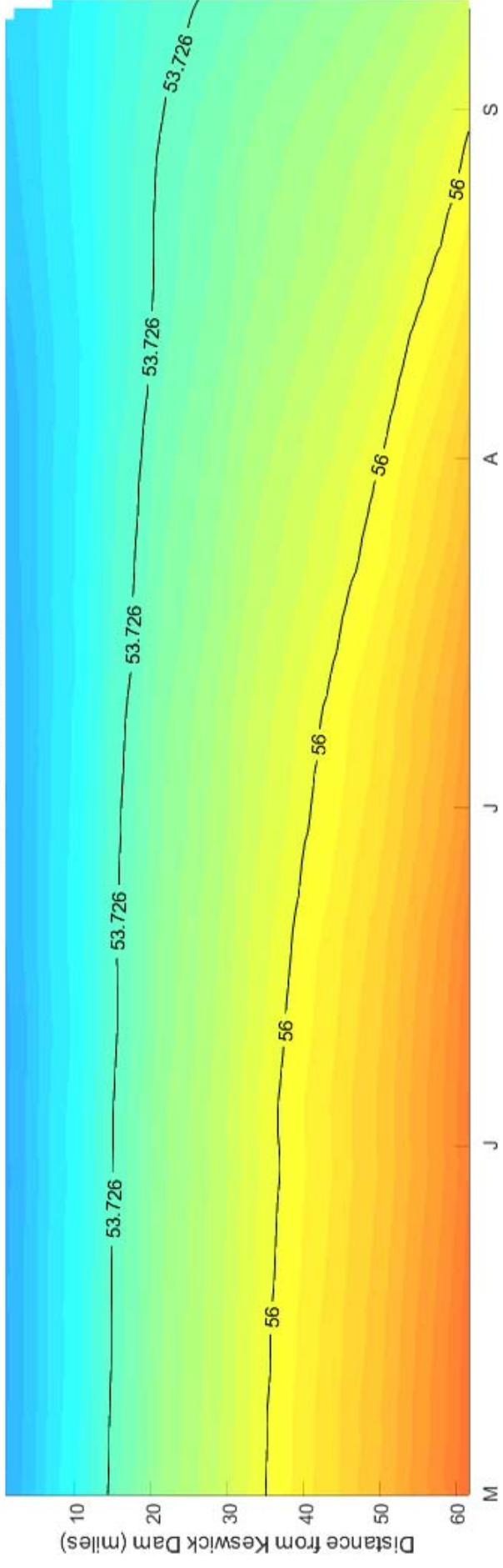
Scenario = March, 90%

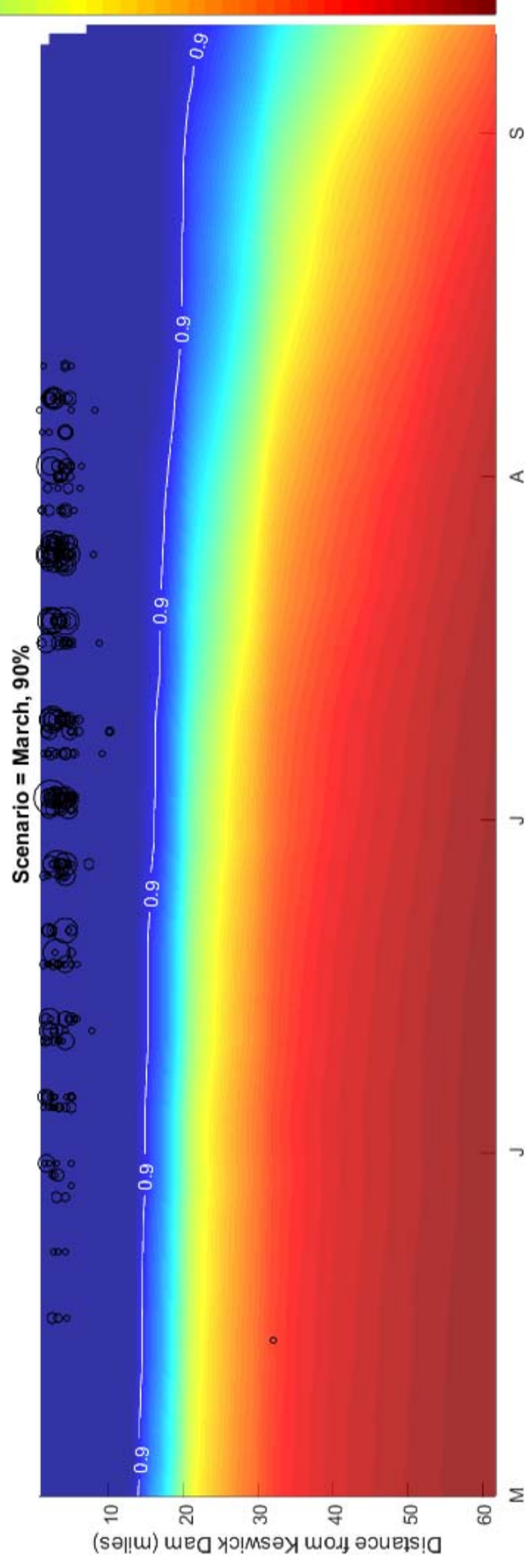
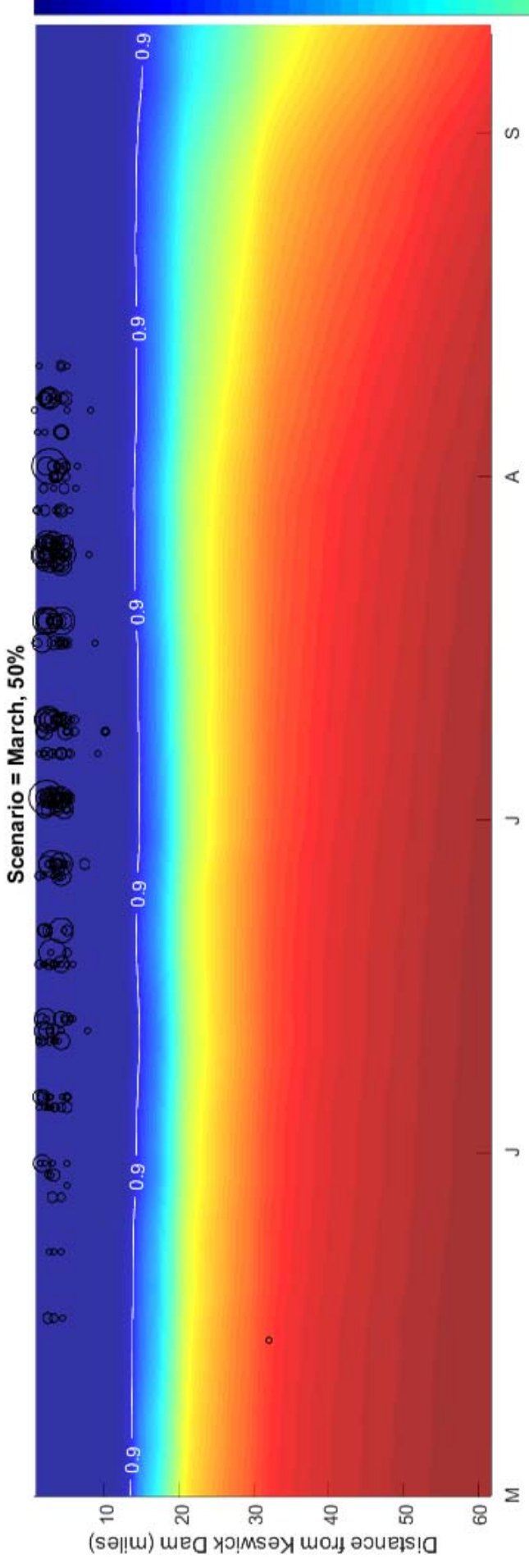


Scenario = March, 50%

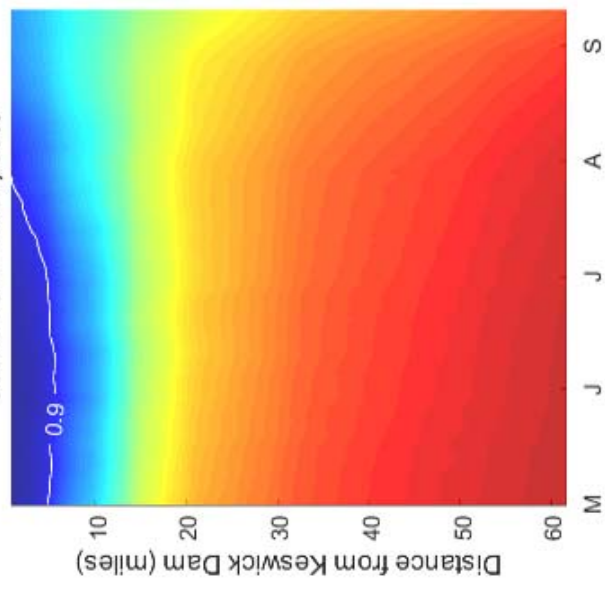


Scenario = March, 90%

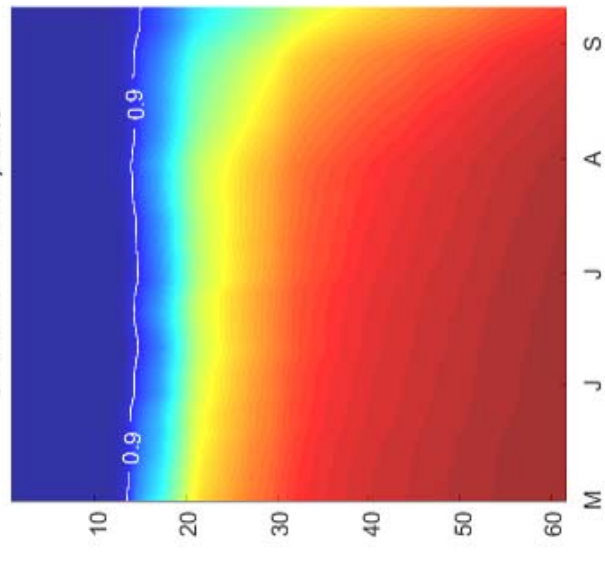




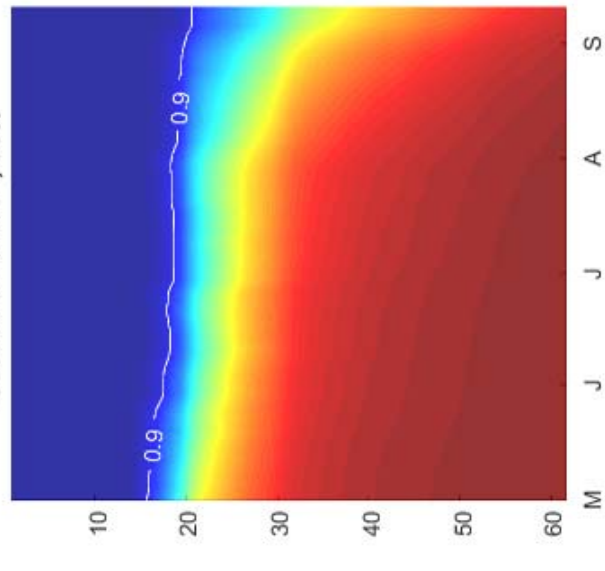
10% CI of Survival Parameters,
Scenario = March, 50%



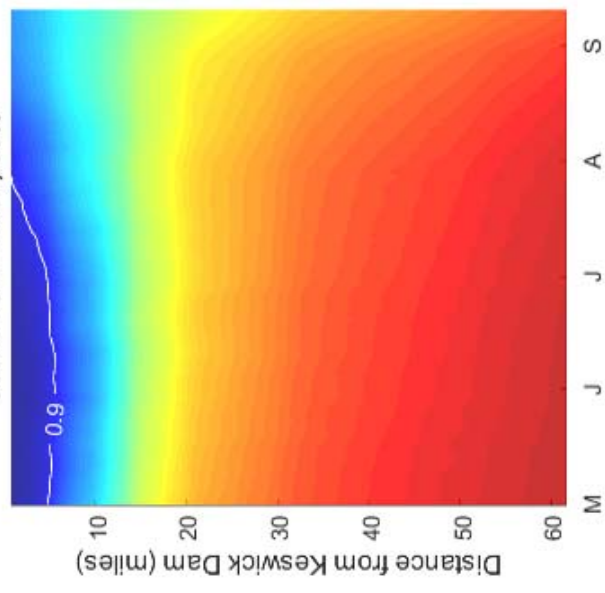
50% CI of Survival Parameters,
Scenario = March, 50%



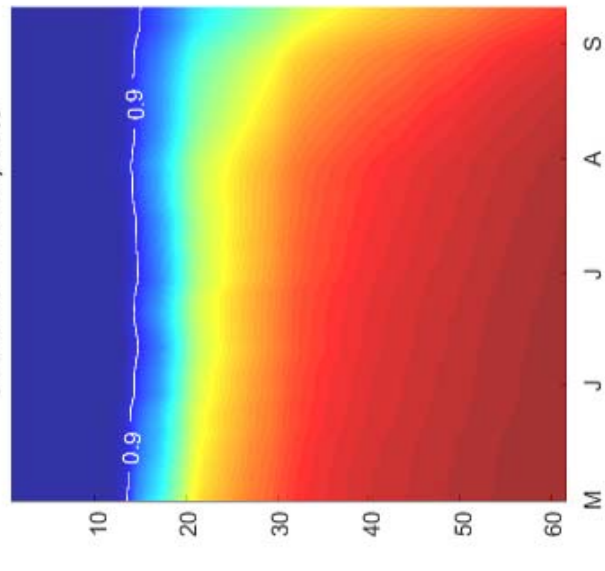
90% CI of Survival Parameters,
Scenario = March, 50%



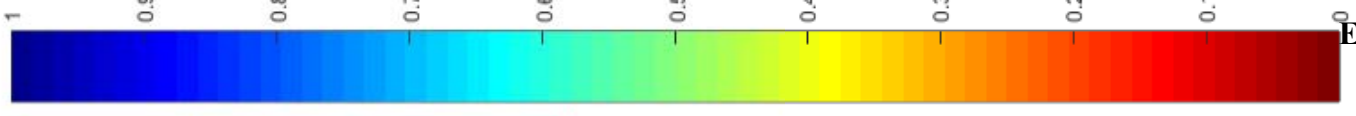
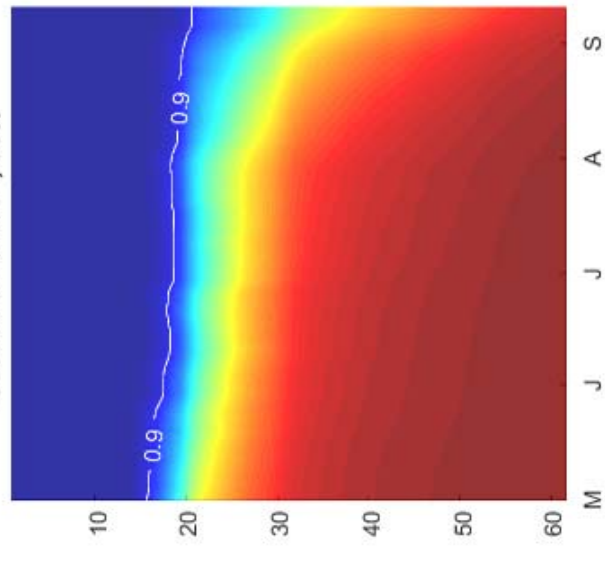
10% CI of Survival Parameters,
Scenario = March, 90%



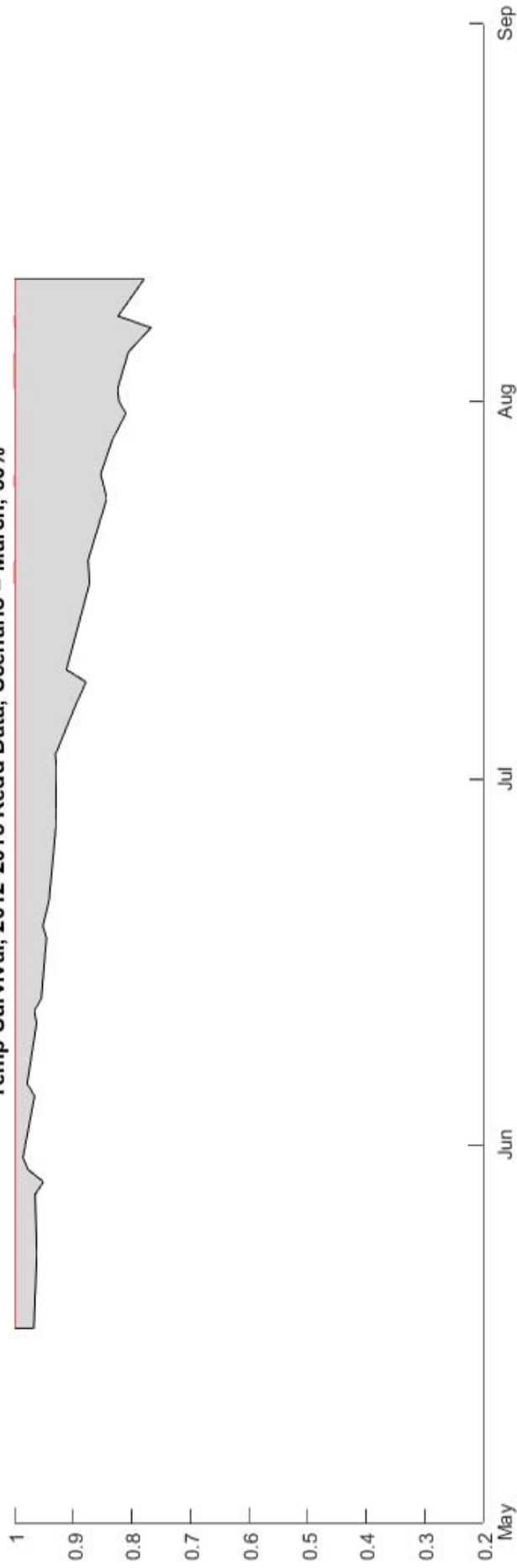
50% CI of Survival Parameters,
Scenario = March, 90%



90% CI of Survival Parameters,
Scenario = March, 90%

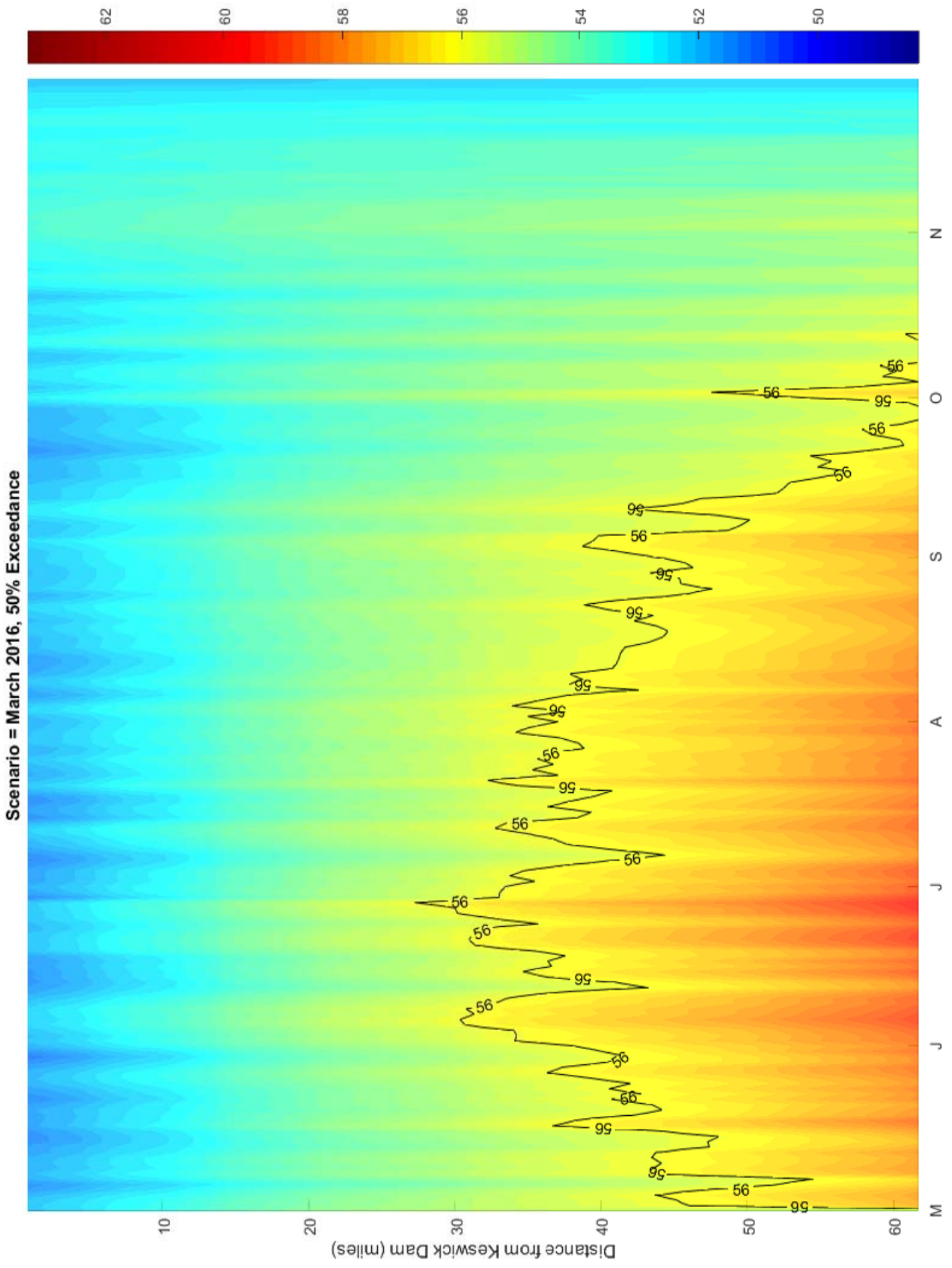


Temp Survival, 2012-2015 Redd Data, Scenario = March, 50%

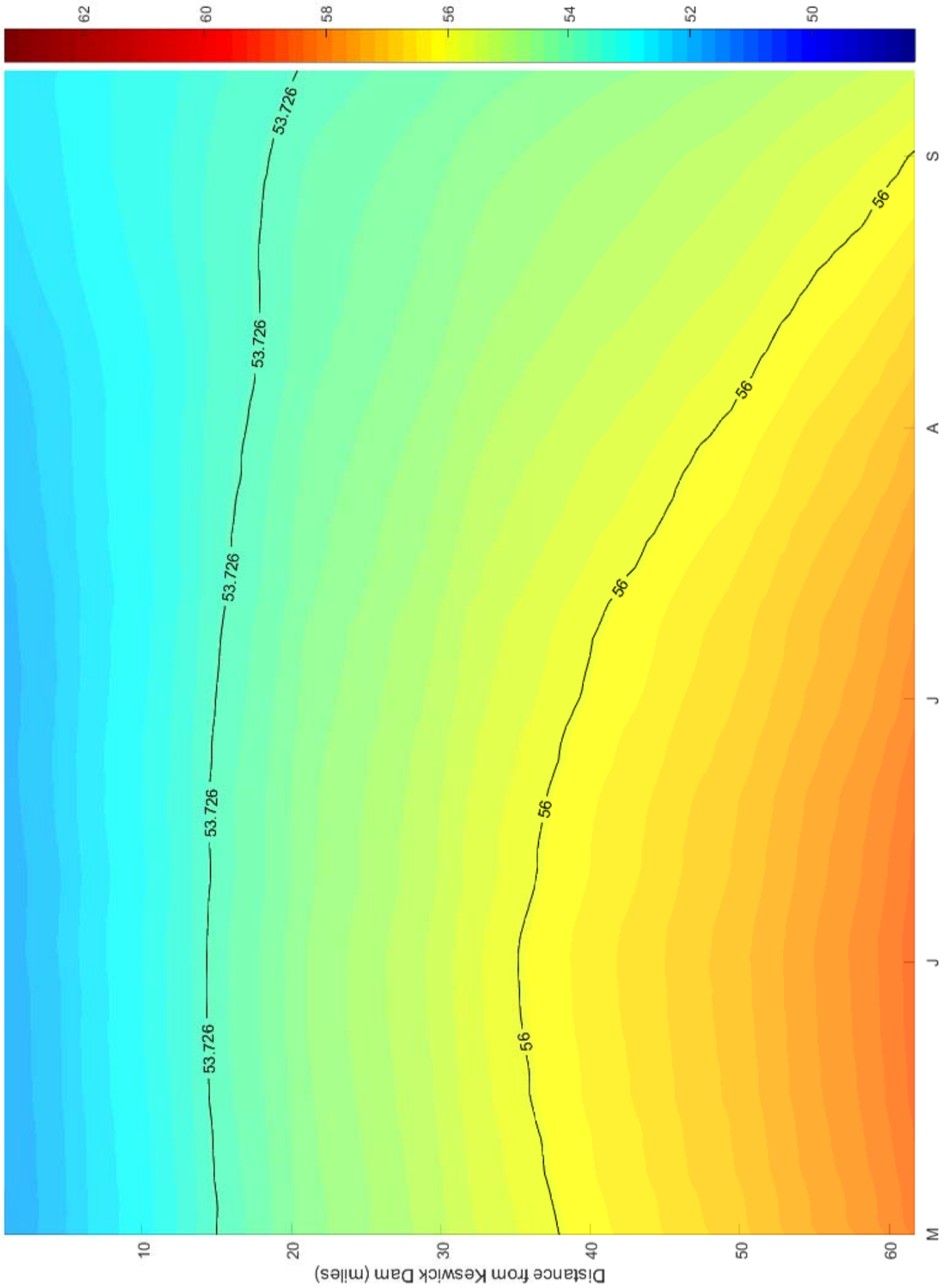


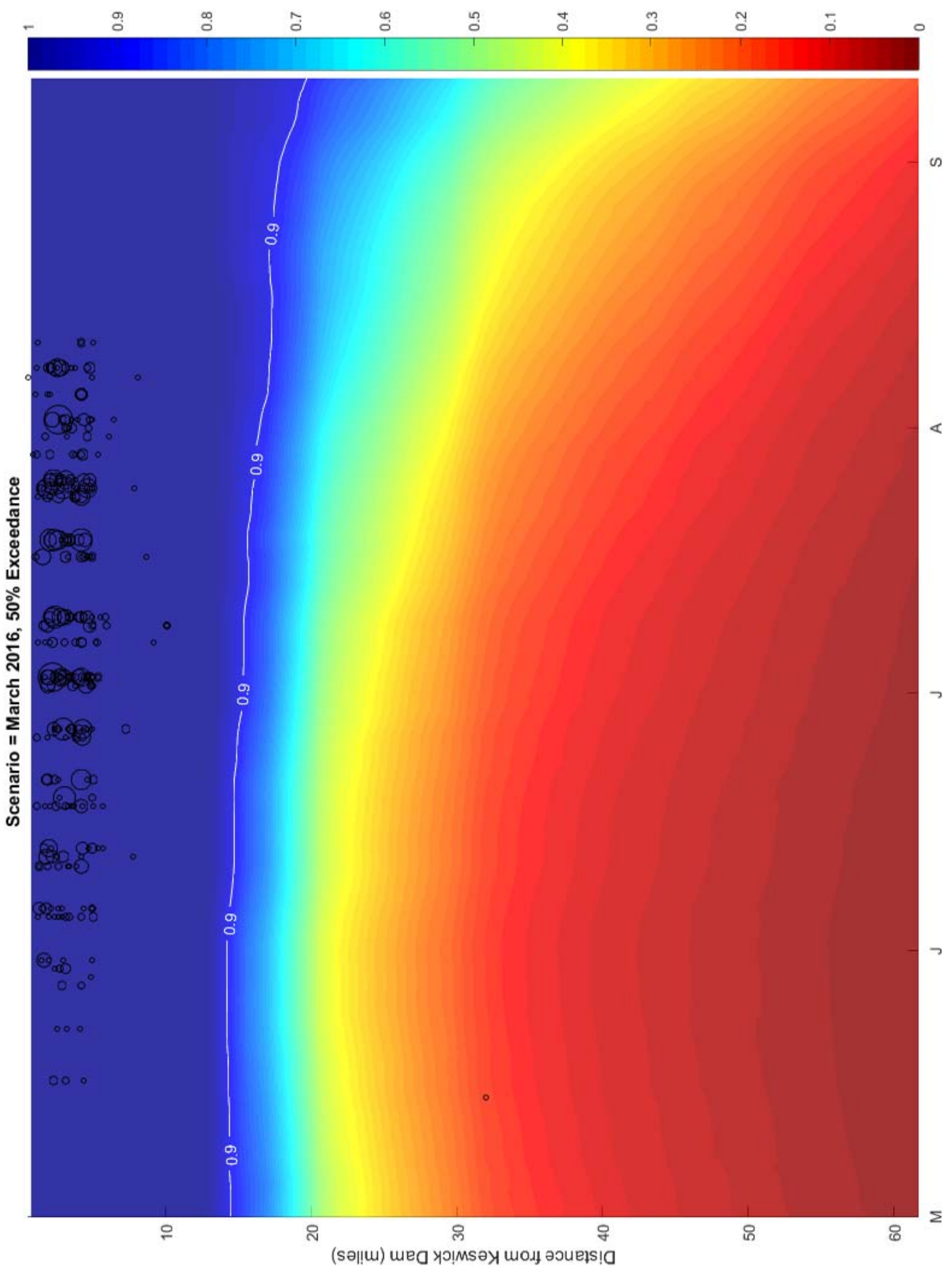
Temp Survival, 2012-2015 Redd Data, Scenario = March, 90%



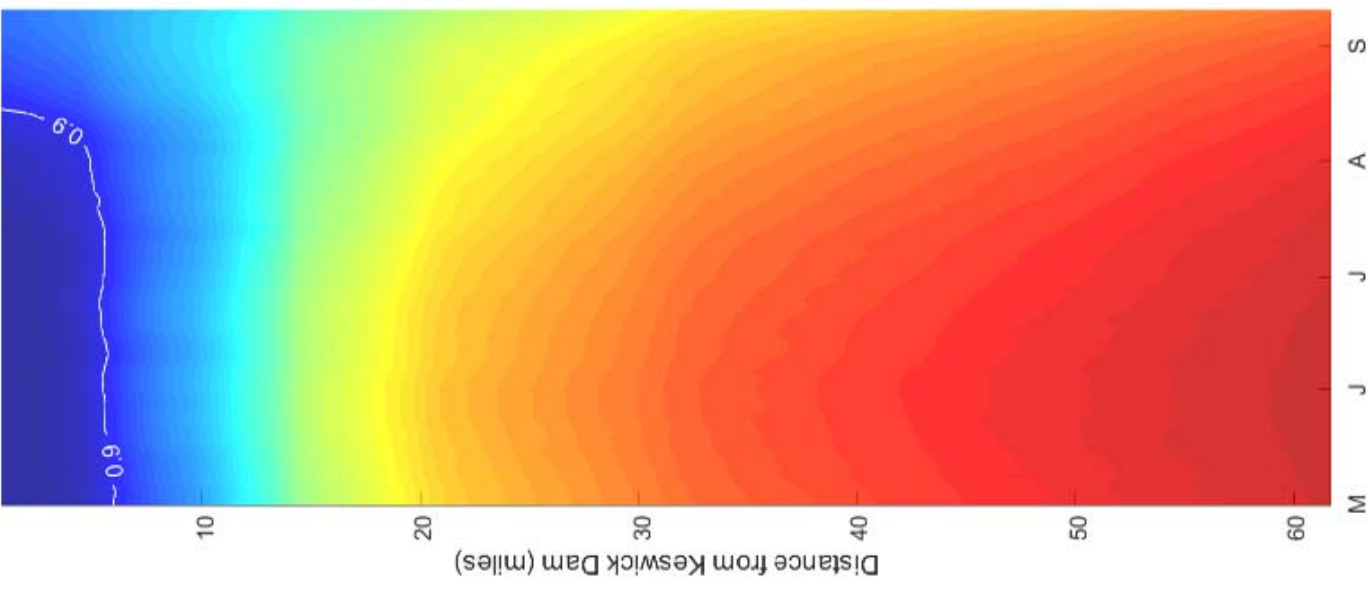


Scenario = March 2016, 50% Exceedance

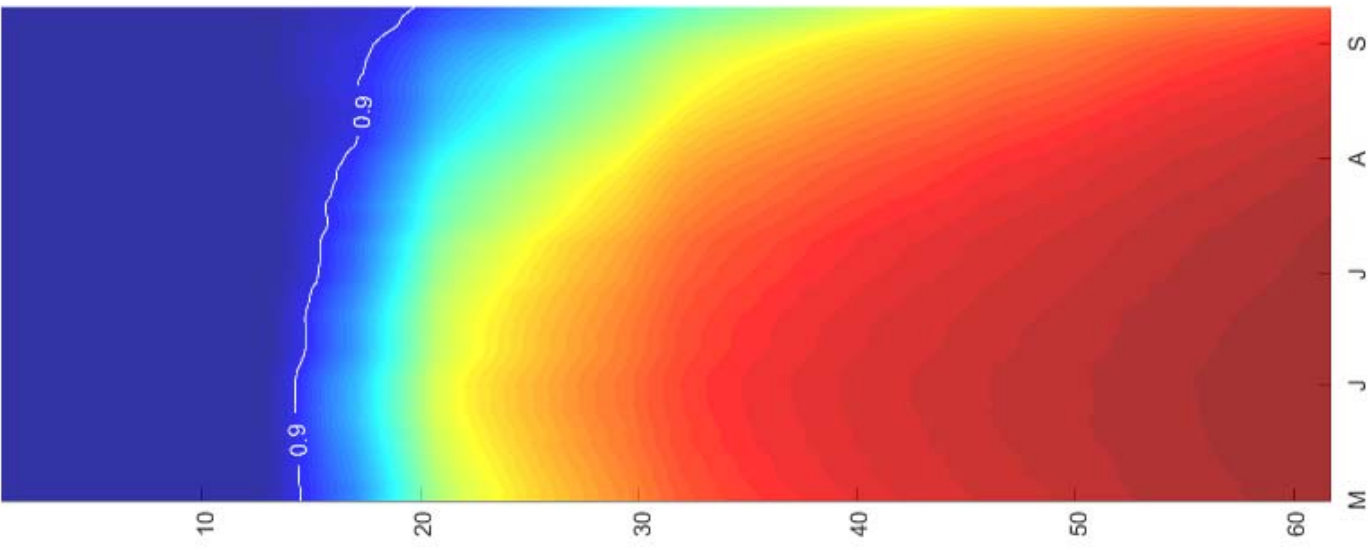




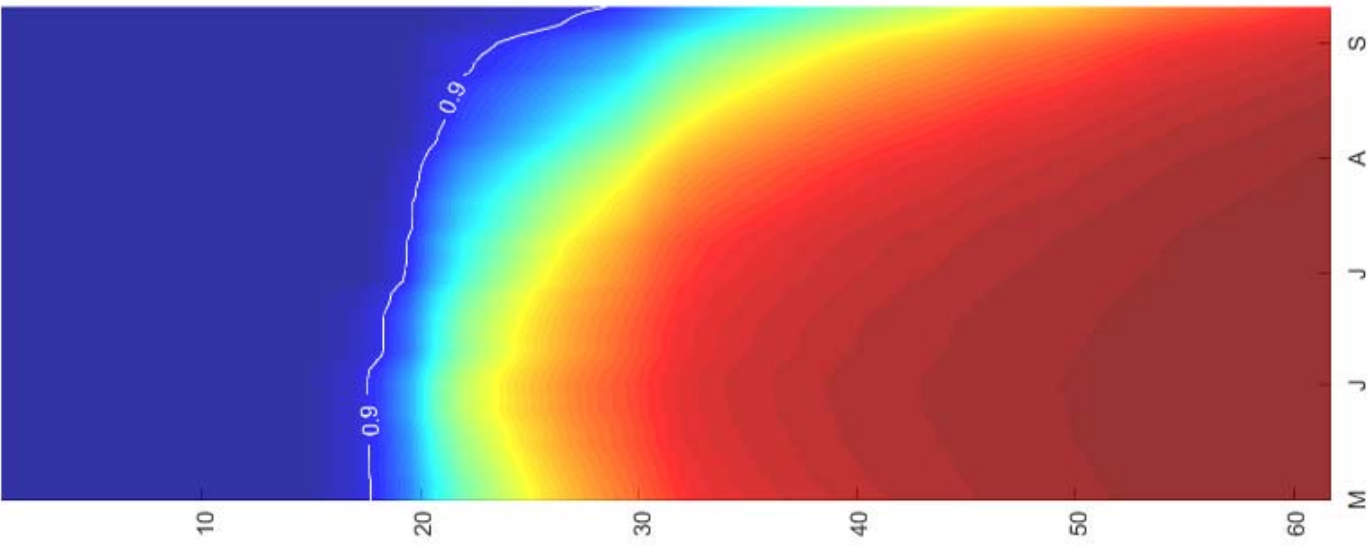
10% CI of Survival Parameters,
Scenario = March 2016, 50% Exceedance



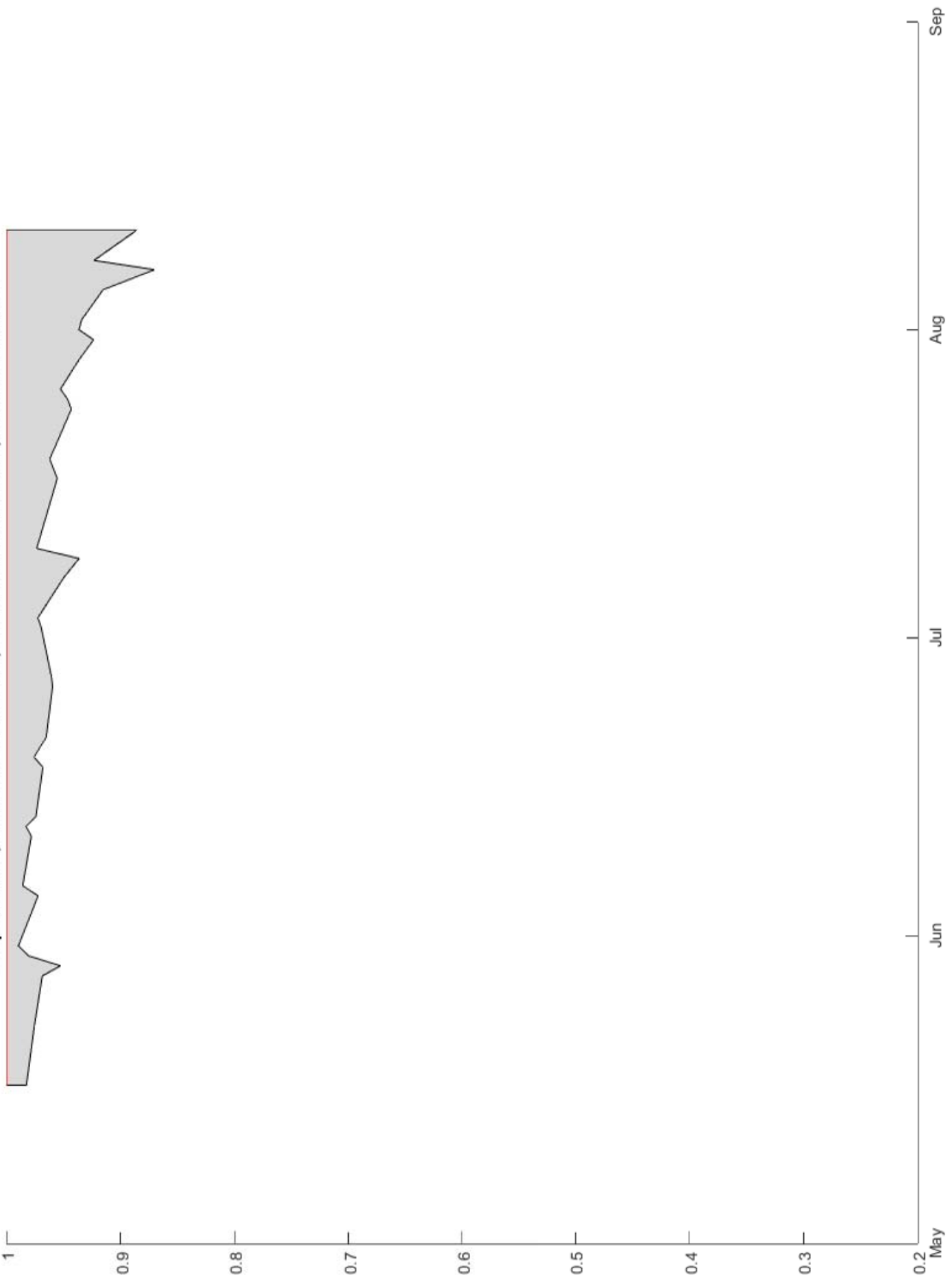
50% CI of Survival Parameters,
Scenario = March 2016, 50% Exceedance



90% CI of Survival Parameters,
Scenario = March 2016, 50% Exceedance

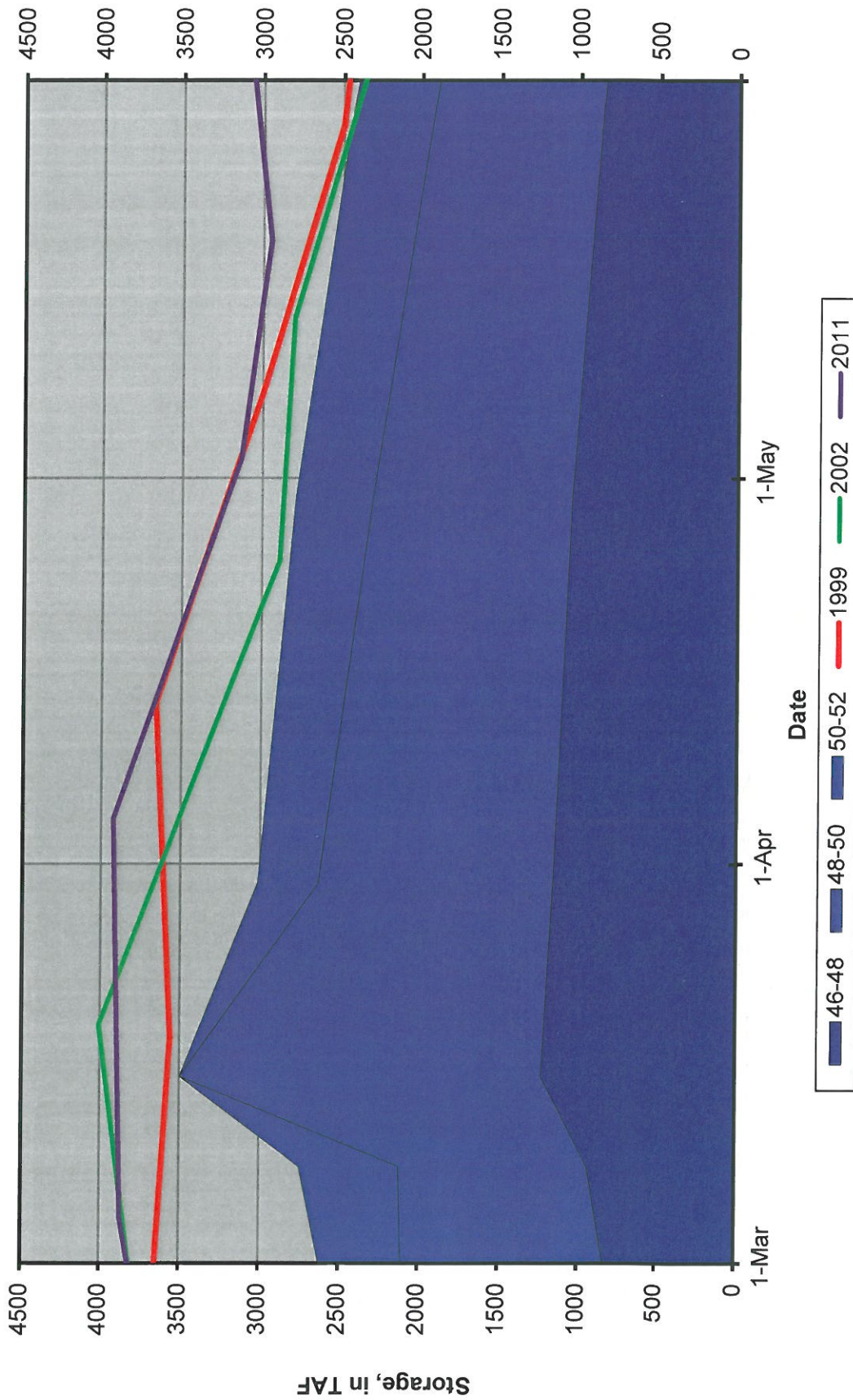


Temp Survival, 2012-2015 Redd Data, Scenario = March 2016, 50% Exceedance



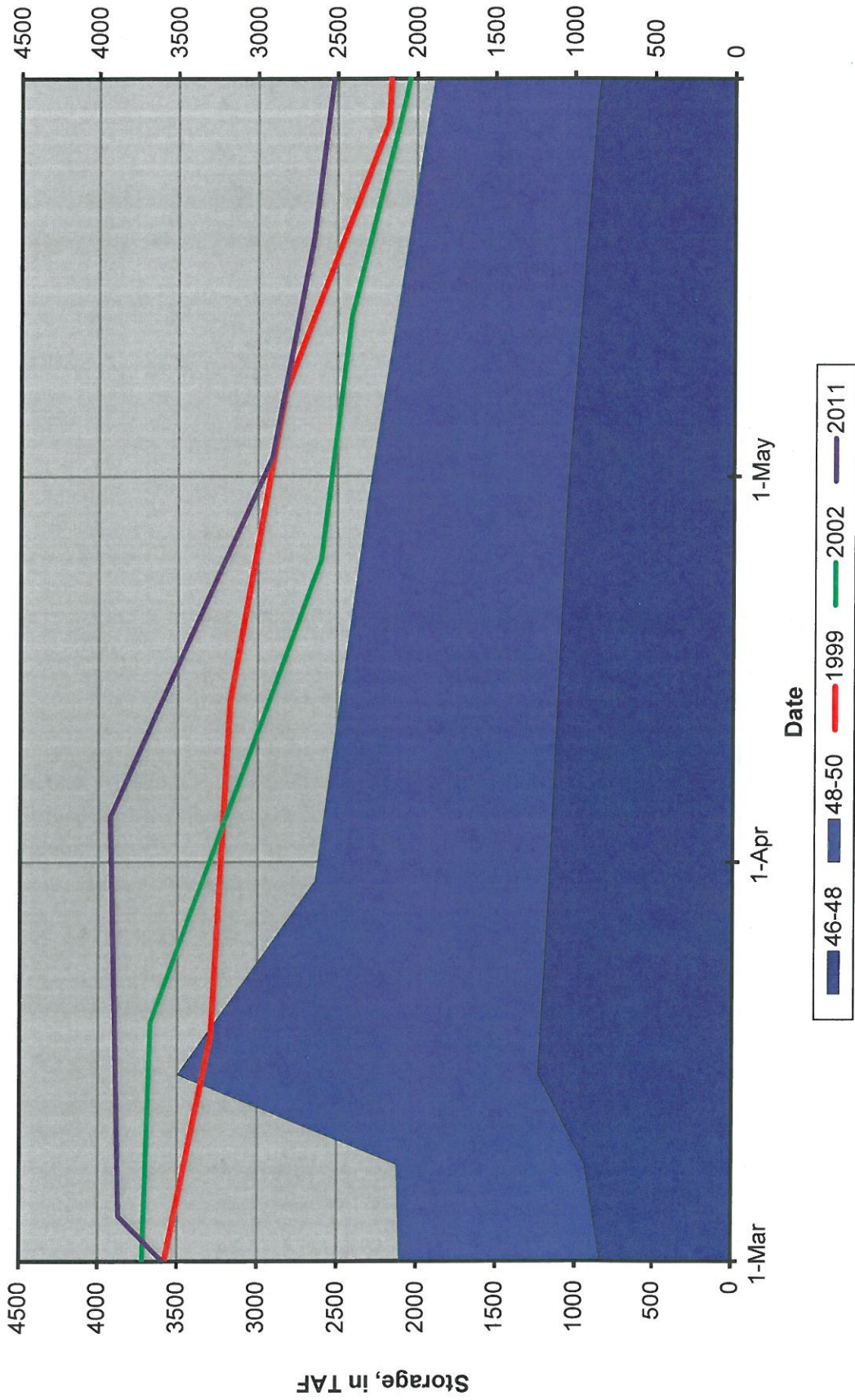
March 15th Model Run Vs Historic Data

Spring Cold Water Storage less than or equal to 52 °F



March 15th Model Run Vs Historic Data

Spring Cold Water Storage less than or equal to 50 °F



March 15th Model Run Vs Historic Data

Spring Cold Water Storage less than or equal to 48 °F

