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Managing Water in the West

Results of Early Temperature Analyses of the Long-Term Experimental and Management Plan EIS

Bureau of Reclamation
Glen Canyon Dam
Adaptive Management Program
Technical Work Group Meeting
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U.S. Department of the Interior
Bureau of Reclamation

Some Advice for the LTEMP EIS

“If you want to know how to operate the dam for humpback chub, look at the last ten years.”

- Bill Pine

Background

Native fish populations have increased since 2000 and humpback chub at the LCR have increased about 100%, also increases observed in the mainstem at the LCR.

Primary hypothesis for this is that there has been an increase in recruitment due to the improvement of conditions for native fish in the mainstem Colorado River.

Fisheries researchers in this program encouraged looking back at the last 10 years to understand what conditions have led to increases in native fish to inform the LTEMP EIS.

Previous studies indicate that at least 12 deg C is bare minimum necessary for humpback chub hatching and growth, and 20-25 deg C for best growth; 16 deg C often cited as target for spawning/good growth.

Argonne is conducting an analysis of historical Colorado River water temperature data to understand water temperature requirements that have resulted in improvement in native fish populations.

Degree-Days and Days Above Critical Water Temperatures Colorado River at the LCR

Year	Deg-Days	> 12 C	> 13	> 14	> 15	> 16	> 17	> 18
1990		0	0	0	0	0	0	0
1992	3196.0	0	0	0	0	0	0	0
1993	2629.0	1	0	0	0	0	0	0
1994	3637.2	9	0	0	0	0	0	0
1995	3819.0	1	0	0	0	0	0	0
1996	3951.0	40	1	0	0	0	0	0
1997	3727.6	2	0	0	0	0	0	0
1998	3731.4	0	0	0	0	0	0	0
1999	3816.4	5	0	0	0	0	0	0
2000	4049.7	120	78	0	0	0	0	0
2001	3834.1	59	1	0	0	0	0	0
2002	3715.9	6	0	0	0	0	0	0
2003	4188.4	170	107	11	0	0	0	0
2004	4311.7	170	119	57	24	0	0	0
2005	4706.0	202	175	153	121	82	6	0
2006	4208.6	179	85	10	0	0	0	0
2007	4047.8	142	14	0	0	0	0	0
2008	4095.6	168	108	0	0	0	0	0
2009	4089.4	148	21	0	0	0	0	0
2010	3953.4	122	12	0	0	0	0	0
2011	4309.0	182	150	114	30	0	0	0

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Historical Temperatures Colorado River at the LCR

Prior to 2002

- Only one year with >100 days above 12 deg C, 2000 (Low Summer Steady Flow)
- < 10 Days above 12 deg C in 8 years

2003 On

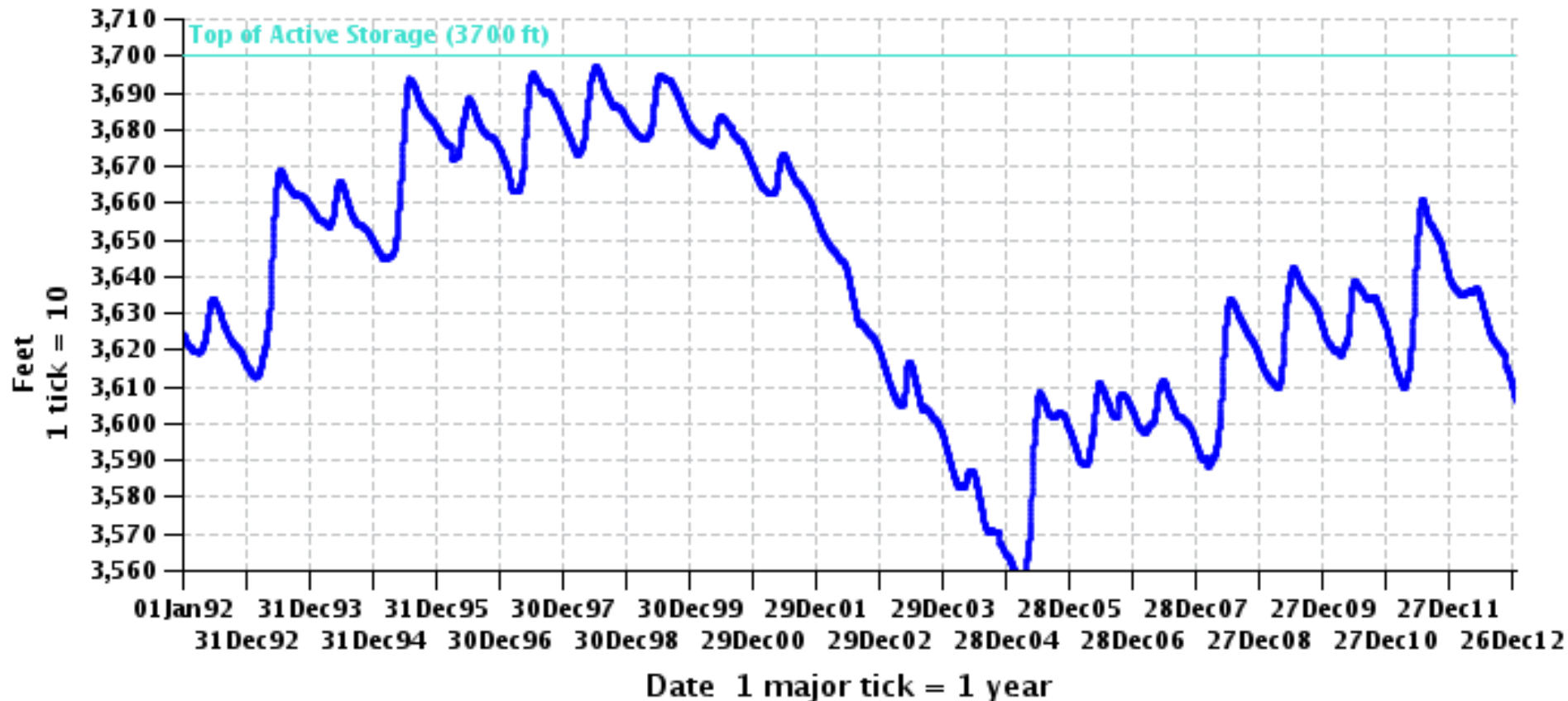
- > 140 days above 12 deg C in every year
- > 100 days above 13 deg C in 5 years, but < 100 days in 4 years and < 25 in 3 years
- 2009-2012, a period of big increases in juvenile humpback chub in the mainstem, 21, 12, and 150 days above 13 deg C respectively

Mean Monthly Temperatures Colorado River at LCR

Year	May	June	July	August	September	October
1990				10.5	11.2	10.0
1992	10.4	11.0	10.7	10.6	10.6	10.5
1993			11.4	11.2	11.5	11.1
1994	10.8	11.8	11.2	11.0	10.8	10.0
1995	10.7	10.8	11.5	11.8	11.6	11.4
1996	10.9	11.6	12.1	12.1	11.7	10.9
1997	10.0	10.3	11.1	11.1	11.2	10.7
1998	10.4	11.0	11.3	11.1	11.2	10.7
1999	10.6	11.4	11.7	11.4	11.2	10.8
2000	11.1	13.3	13.5	13.2	12.0	11.1
2001	11.7	12.3	11.9	11.6	11.9	10.5
2002	11.2	11.6	11.5	11.2	11.6	10.5
2003	11.6	12.3	13.2	13.3	13.9	13.2
2004	11.7	12.1	12.9	13.7	15.0	14.3
2005	12.1	13.7	15.8	16.2	16.7	15.9
2006	12.1	12.5	13.2	13.4	13.7	12.7
2007	11.5	11.8	12.4	12.7	12.9	12.1
2008	10.3	11.8	13.0	13.3	13.6	13.2
2009	11.9	12.3	12.8	12.7	12.9	11.7
2010	10.7	12.1	12.3	12.3	12.8	11.9
2011	10.1	11.4	13.5	14.6	15.0	14.7

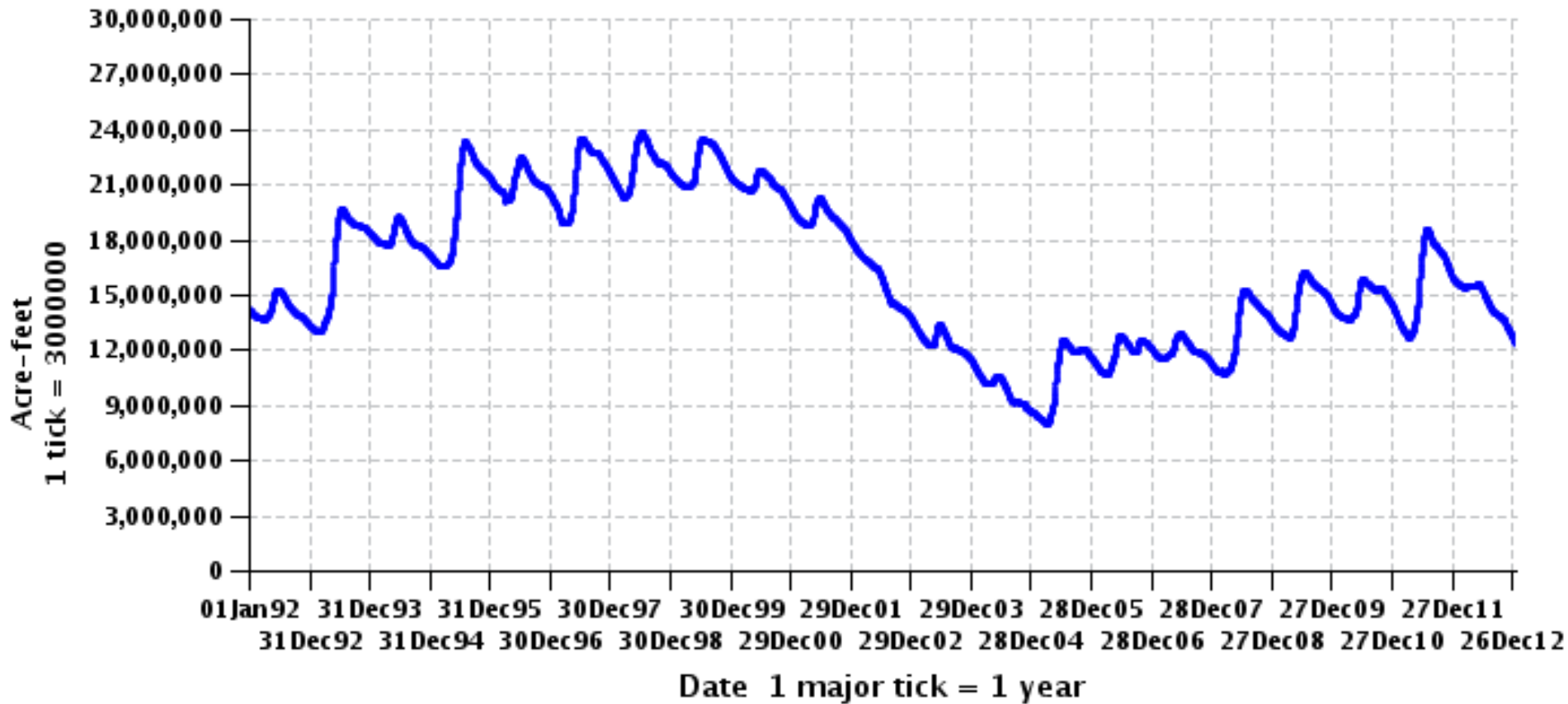
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Lake Powell Elevation



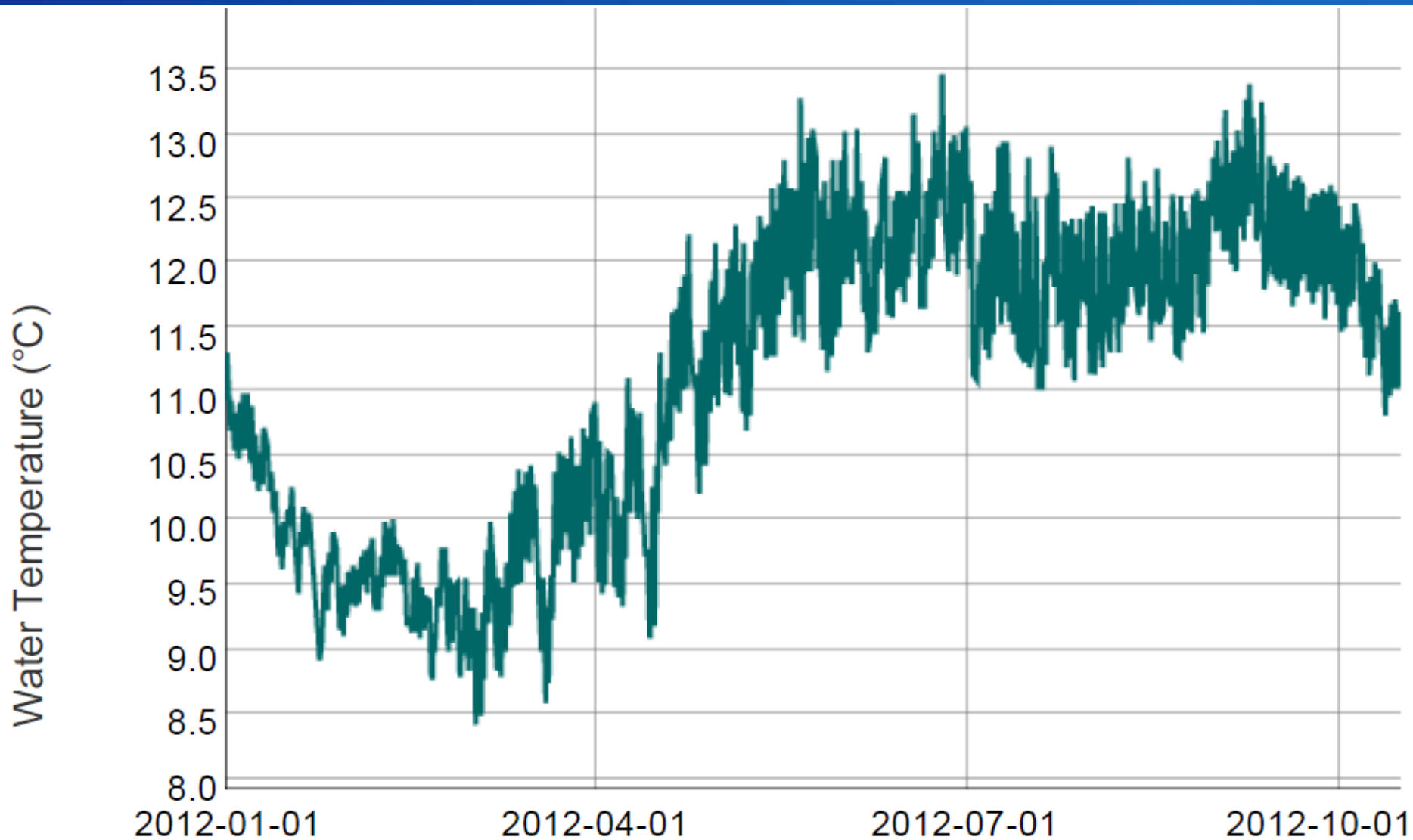
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Colorado River Inflow to Lake Powell



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What about 2012?



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Conclusions

Temperatures in the Colorado River at the LCR have been significantly warmer since 2003 than in the previous 13 years of data, and this is probably a big reason for the improvement in native fish, humpback chub recruitment, and increases in humpback chub in the mainstem.

The most consistent trend is exceeding 12 degrees C in the mainstem at the Little Colorado River, and more specifically exceeding 12 degrees C in the months of July, August and September when small fish leaving the Little Colorado River need conditions that support growth in the mainstem, **much lower than the literature would suggest is needed**. This may be a “sweet spot” providing critical conditions for humpback chub without providing benefits to warm water non-native fishes.

This information will be considered in the LTEMP EIS process and in future consideration of a temperature control device at Glen Canyon Dam.

Hydrologic and temperature modeling will be used to predict how this trend may change over the 20-year life of the LTEMP.