***Aechmophorus* Grebe Conservation Project**
Almanor, Eagle, Davis, and Antelope Lakes

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Summary

We had a huge impact with grebe outreach and education this year. Our inaugural grebe festival was a great success reaching a larger, more focused audience with our grebe conservation message than ever before. The festival attracted over 200 participants, with more than 50 attending the grebe research symposium, and more than half of the 25 field trips and events selling out.

Teresa Arrate, our Outreach and Education Coordinator, with the help of other staff, interns, and volunteers, conducted a variety of outreach and education efforts in 2016 including tabling at numerous events, giving school classroom presentations, and leading youth field trips. The information provided at these events included grebe brochures, pictures of and general information about Western and Clark's Grebes, a wooden sculpture of a Western Grebe, and a Birds and Climate Change display with information on the predicted range changes for *Aechmophorus* Grebes. David Arsenault, our Executive Director, gave 2 presentations on grebes, 1 in Reno March 30 and the other to Quincy Rotary on May 9. Additional presentations are planned for the fall, winter, and spring.

We have been updating our comprehensive grebe monitoring report for Almanor, Eagle, Davis, and Antelope Lakes to include the 2016 season. The report is forthcoming. With the help of Garry George, we continued our dialogue with the Pacific Gas and Electric Company to manage water in Lake Almanor for nesting grebes. We hope to make more progress on this collaborative effort in 2017.

Outreach and Education

Outreach and education efforts are a priority for the remainder of the grebe conservation project (through 2019). Teresa Arrate, our Outreach and Education Coordinator, with the help of Plumas Audubon Society (PAS) interns and staff, as well as community volunteers, conducted a variety of grebe outreach and education efforts in 2016 including tabling, classroom presentations, and youth field trips.

Grebe Art Contest

We held the Grebe Festival Art Contest during the spring 2016 semester in order to educate local youth about Western and Clark's Grebes and to encourage and promote community involvement in the 2016 Grebe Festival. Students from 11 schools in our region participated in the art contest and we were very excited to receive a total of 231 submissions from 222 youth—a sizeable number of K-12 students to have introduced to grebes and to have educated about their conservation! All submitted artwork were displayed for the entire duration of the Grebe Festival in the entrance to the Almanor Recreation Center, which was the Grebe Festival Headquarters. Participants of the Grebe Festival were greeted with these hundreds of depictions of grebes and many festival-goers commented on what a beautiful, special, and enjoyable welcoming these art pieces offered as they entered the event.

Grebe art displayed at the entrance to our inaugural grebe festival held August 91-21, 2016.

Grebe Festival

Our Inaugural Grebe Festival was held on August 19-21, 2016 in Chester, CA. We had over 200 participants (178 registrants plus non-registered volunteers, trip leaders, walk-ins) and we received excellent feedback with many people reporting great satisfaction with the fieldtrips and overall festival experience. We offered 25 activities and trips which were mostly very well attended (13 of which sold out). Approximately 50 people attended the Grebe Research Symposium which kicked off the festival with presentations from 11 researchers throughout the state. All of the boat trips to get a closer view of the grebe colonies sold out, getting over 100 people great views of the

grebes. We also had free scoping from shore from a vantage point that offered folks a chance to see nesting grebes, which had relocated to this area after the large colony had been abandoned only a couple weeks prior.

Grebe Research Symposium

Grebe Festival Headquarters

The Grebe Festival Art Contest and the Grebe Festival were both great successes that introduced grebes to many youth and adults who didn't previously know much (or anything) about them and educated both groups on their unique behaviors, habitat, and issues affecting their breeding success. The Grebe Festival also brought tourism dollars to the local communities around Lake Almanor and introduced visitors to the area. Plumas Audubon Society hopes to continue to educate on and promote the diversity, health, and beauty of the upper Feather River region through annual Grebe Festival events. The following pictures highlight events at the 2016 Grebe Festival:

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Grebe Festival Research Symposium

We kicked off our inaugural Grebe Festival with a research symposium. Eleven researchers studying grebes all over California gave presentations, which covered many aspects of grebe biology and conservation. The presentations included:

Dan Anderson, UC Davis
History of Western and Clark's Grebe Status and Conservation in California

David Arsenault, Plumas Audubon Society
Aechmophorus Grebes Nesting on Reservoirs in Plumas County

Becky Duerr, International Bird Rescue
Grebes in Captive Care at International Bird Rescue, 2002-2016: Causes of Stranding

Alex Hartman, USGS Western Ecological Research Center
Mercury Contamination of Grebes in California Lakes

Floyd Hayes, Redbud Audubon Society
Breeding of *Aechmophorus* Grebes at Clear Lake, California, 2010-2016

Ryan Martin and Byron Stone, CA Dept. of Water Resources and CA Dept. of Fish & Wildlife
Western and Clark's Grebe Monitoring and Management on the Thermalito Afterbay

Kyra Mills-Parker, Oiled Wildlife Care Network
Post-release Monitoring of Western Grebes using Implanted Satellite Transmitters

Kris Robison, Colibri Ecological Consulting
Brood Size and Nesting Phenology in Western and Clark's Grebes in Northern California

Renee Robison, Colibri Ecological Consulting
Change in Wetland Extent and its Effect on a Breeding Western and Clark's Grebe Population: Eagle Lake, CA 1998-2010

Dan Shaw, California State Parks:
Changes in Population Size and Colony Location of Breeding Waterbirds at Eagle Lake: 1990-1997

Surveys and monitoring

We have been compiling our survey and monitoring results and adding this year's results to the comprehensive grebe monitoring report. The updated report that includes results from 2010-17 is forthcoming.

2017 survey results

Table 1. Summary of adult counts, nests, and young on each lake.

Lake	Peak # nests	Ave. adult census	Peak ratio juv:adults	Est. # young
Almanor	1254	3008	0.30	906
Antelope	9	56	0.12	9
Eagle	Unk	2272	0.68	1556

No complete census surveys were conducted on Lake Davis in 2017

Eagle Lake had breeding for the first time since 2011. This breeding season was the most productive on Eagle Lake since the beginning of the study (Table 1). The numbers of adult and juvenile grebes on Eagle Lake are estimated to be higher due to not completing a full lake census when this data was collected. Reproduction on Lake Davis was confirmed, but a full lake census was not attempted so an estimate of the scale of reproduction could not be produced. Antelope Lake produced fewer young then any of the previous reproductive years during this study (Table 1).

Reproductive Success on Lake Almanor

Table 2. Nest counts at Lake Almanor grebe colonies in 2017

Colony	6-Jun	13-Jun	21-Jun	26-Jun	5-Jul	11-Jul	18-Jul	25-Jul	1-Aug	10-Aug	17-Aug	19-Aug	30-Aug	18-Sep	Peak
Chester Meadows S	0	25	183	218	149	220	147	208	236	112	248		133	1	**236**
Chester Meadows N							496		80	60	165			5	**496**
Causeway									5	6	338	520	430	0	**520**
North of Causeway												2			**2**
Totals	**0**	**25**	**183**	**218**	**149**	**220**	**643**	**208**	**321**	**178**	**751**	**522**	**563**	**6**	**1254**

The total number of adults on Almanor was much lower than previous years, average 4,499 average adult census in 2015-16 (Table 1). There was also a significantly smaller number of peak nests at Lake Almanor again this year (Table 2) compared to 2013-15 (average 2,766 nests/year). The water level at Lake Almanor dropped quickly at times during the breeding

season, though water holding events in mid-July and early August may have prevented the colonies from being abandoned as in previous years (Figure 1). The smaller number of peak nests seems to be linked to the combination of successful nesting grebes and failed nests throughout the breeding season as opposed to colony abandonment.

Waves of successful reproduction at Lake Almanor were accounted during full lake surveys. With 30 days passing between the first two Almanor full lake surveys, it is expected that the young that were observed on the first survey would have grown to 3/4 or 7/8 size by the second survey (Table 3 and 4 – highlighted in blue). From the second survey to the third survey, it is expected that the 1/3 size and larger young observed from the second survey would be Full size and the 1/8 and 1/4 size young would be 7/8 size by the third survey with 45 days passing between the last two surveys (Table 3 and 4 – highlighted in red and green). Due to a complete full lake census not being completed on October 1, we assume the numbers of both juvenile and adult grebes to be higher. We also assume that by the October 1st survey many of the young that were observed earlier in the season were counted as adults or have already begun migrating, reducing totals. Regardless, it can be concluded that *aechmorphous* grebes had a successful reproductive season on Lake Almanor.

Table. 3 Juvenile Grebe Size Class distribution from Almanor full lake surveys.

	1/8 Size	1/4 Size	1/3 Size	1/2 Size	2/3 Size	3/4 Size	7/8 Size	Full Size
Survey 1 - 7/18	14							
Survey 2 - 8/17	27	7	55	504	41	5	9	1
Survey 3 - 10/1*	6	9	6	90	72	41	73	45

*Not a complete census.

Table 4. Estimated days since hatch and associated Size Class of young.

Young Size Class	Estimated Days since Hatch
One-eighth	1-7
One-fourth	3-12
One-third	13-18
One-half	19-23
Two-thirds	24-33
Three-quarters	30-40
Seven-eighths	34-50
Full	51-70

Water Management and Nest Success at Lake Almanor

The water holding activities that potentially saved nesting colonies from abandonment are being investigated to evaluate the likelihood that these events did ensure colonies completed a full incubation period before water levels dropped low enough to trigger abandonment of colonies. The periods between water holding events had water surface elevation drop rates greater than what PAS has recommended to PG&E as the maximum rate of -0.72 in/day (Figure 1). With the water holding events the rate of drop for the period of time analyzed was still higher than the maximum recommended rate of drop (-0.83 in/day July 6 to Sept 3), though the water holding events significantly decreased the rate compared to the periods of time between the events (Table 5).

Figure 1. Lake Almanor water levels with water holding events highlighted

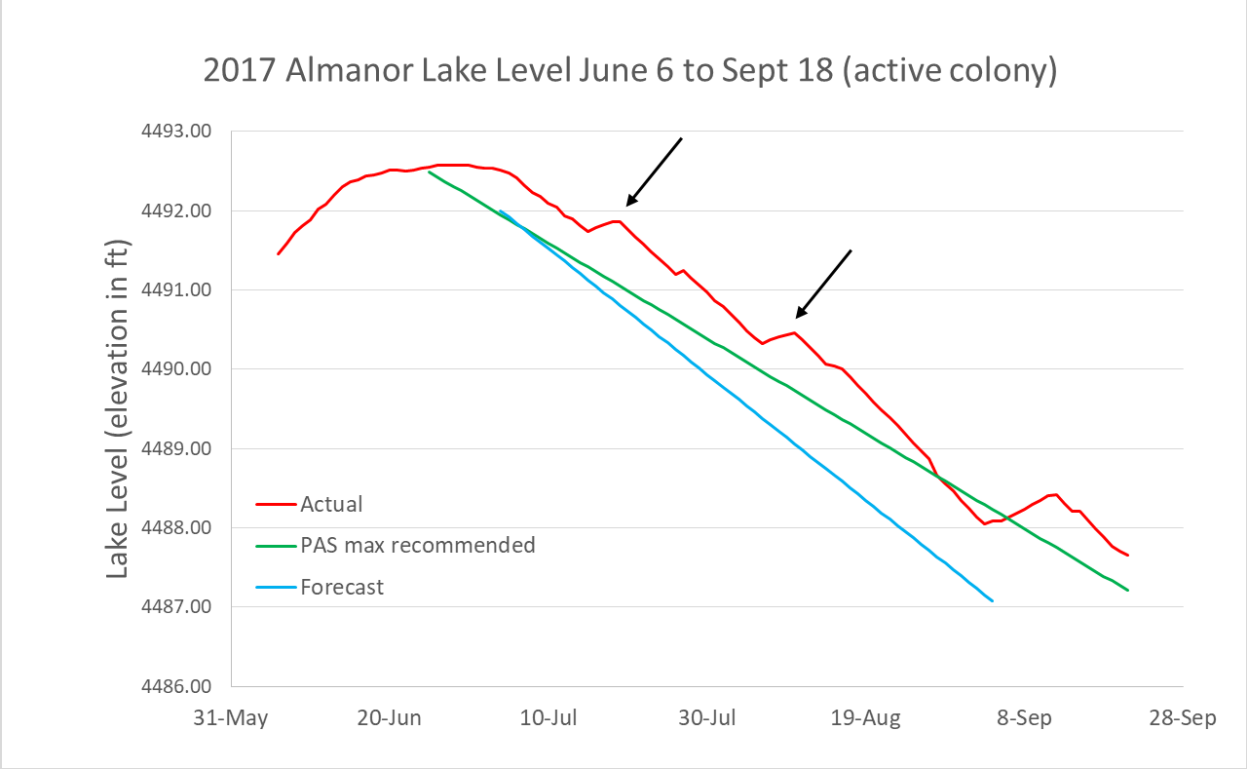


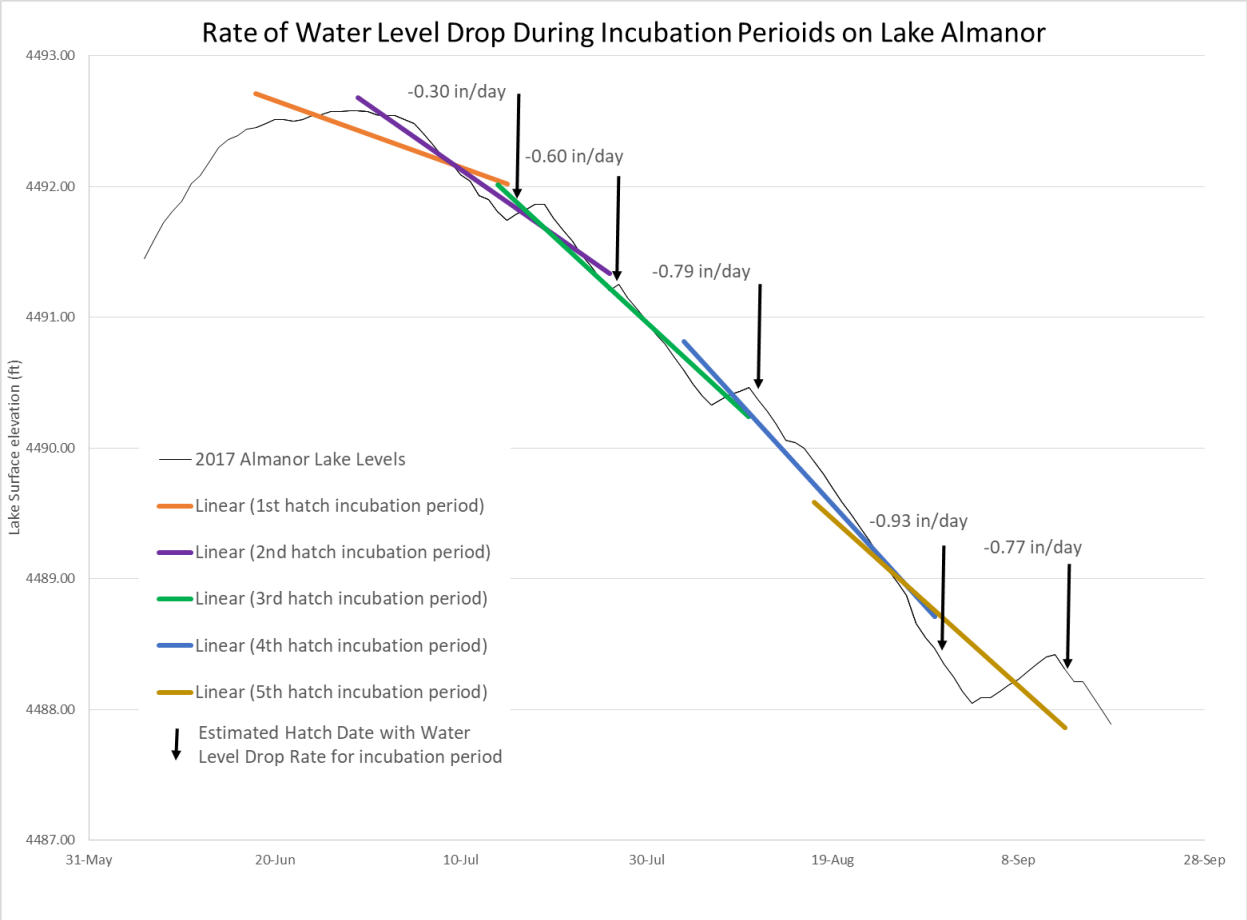
Table 5. Lake Almanor rate of water surface elevation drop between water holding events.

Dates of Water Level Drop	Rate of Surface Elevation Drop (in/day)
July 6 to July 15	-0.88
July 15 to July 20	Water Holding (5 days)
*July 20 to August 6	-0.99
August 6 to August 11	Water Holding (5 days)
August 11 to September 3	-1.24
**July 6 to September 3	**-0.83**

*includes 2 day water holding event **includes all 12 days of evaluated water holding events

In 2016, the rate of water level drop was high enough to trigger colonies of nesting grebes to be abandoned, which also had a consistent rate of drop through the breeding season. The water holding events during the 2017 breeding season were 5 to 10 days long and in 3 to 5 week intervals, and may have extended the timeline for potential nest success (within a 23 day incubation period) by a week or more. In Figure 2, hatch dates were estimated based on the size class of young observed during full lake surveys (Table 3 and 4). A hatch date within the possible range of dates was selected and the rate of water level drop calculated for the associated incubation period. All of the incubation period water level drop rates are lower than the rate of the majority of the nesting season (Table 5), with the exception of the 4th hatch (-0.93in/day). If the estimated 4th hatch date is moved back one week the rate drops to -0.76 in/day, which is another possible scenario since grebes within a nest and colony hatch asynchronously. It should be pointed out that due to the asynchronous hatching of grebes it is likely that there were dozens of actual hatch dates throughout the breeding season. Figure 2 is illustrating 5 examples of how the water holding events affected the average water level drop rate during potential incubation periods.

Figure 2. Estimated hatch dates with water level drop rates for associated incubation periods.



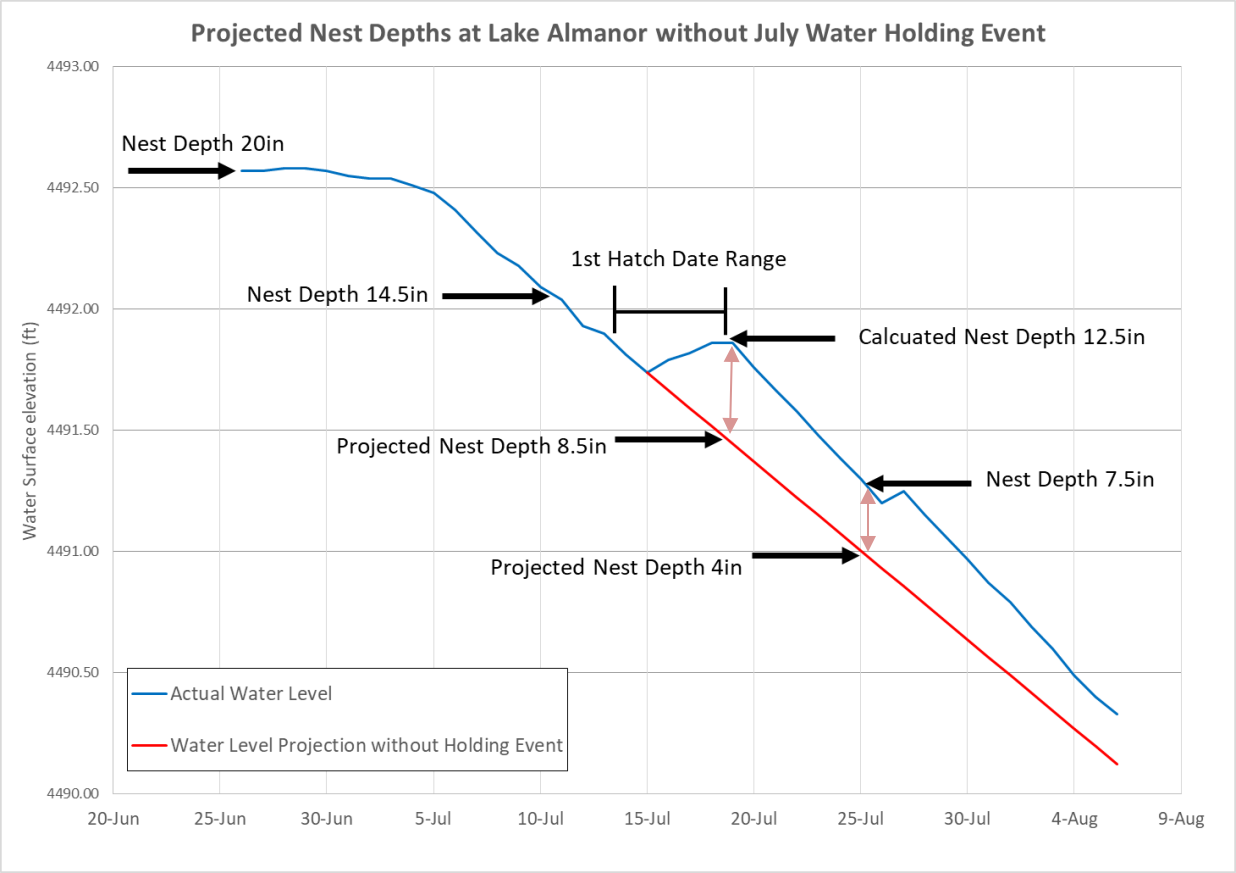
The hatch dates in Figure 3 are not known, though the hatch dates and incubation periods used in Figure 3 is one likely scenario. Incubation period has been extended in this graph to 28 days for the purpose of accounting for nest-building, courtship, breeding, and egg laying prior to incubation.

Nest depths for the Chester Meadows colonies were monitored throughout the initial wave of nesting (Table 6). Based on the size of young observed on July 18, the young hatched sometime in the 7 days prior to that survey. With the rapid rate of water level drop, the nests could have been abandoned just days before the chicks were due to hatch had the water level not begun to increase on July 15 (Figure 3). It is more likely that the later hatches benefited more from the water holding events, though Figure 3 illustrates the potential these events have for aiding the success of nests.

Table 6. Nest depth in inches

Chester Meadows Colonies	21-Jun	26-Jun	11-Jul	25-Jul	1-Aug
South Colony 1	20	20	14.5	7.5	1.5
South Colony 2	20	21	14	7	1
South Colony 3			17.3	8.5	2.5
North Colony				9	1

Figure 3. Projected nest depths at Chester Meadows South colony at Lake Almanor during July water holding event.



PG&E finds the strategy of keeping water level drop rates below -0.72 in/day nearly impossible with obligations of high water and energy supply during the grebe nesting season, though if the strategy could be amended to include water holding events such as these at a similar intervals we may see more consistent reproductive success on Almanor in the future. This strategy will not maximize the potential success of grebe reproduction on Lake Almanor as effectively as holding the water level drop rate at or below the recommended maximum rate of -0.72in/day, though waves of breeding colonies are more likely to succeed with water holding events decreasing the average water level drop rate during incubation periods. It is likely that grebes that attempt nesting between these water holding events will fail, but the nests that are incubating during a period of time that includes water holding events are more likely to succeed. We recommend holding the water surface elevation drop rate as low as operationally possible, and facilitate water holding events between June 25 and September 15 at 3-5 week intervals for periods of 3-5 days. If it is feasible for PG&E to implement this type of water management strategy in the coming years, the increase in grebe conservation efforts on Lake Almanor could become apparent in the populations of these declining species.