Conservation of *Aechmophorus* Grebe Colonies at Six Northern California Lakes

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Final Report

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Public Outreach, Breeding Colony Protection, Monitoring and Evaluation

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Summary

For the past three years, the Audubon network has been engaged in a multi-faceted conservation campaign focused on the protection and proliferation of nesting Western (*Aechmophorus occidentalis*) and Clark's (*A. clarkii*) Grebes on six northern California lakes. Three Audubon chapters have been responsible for coordinating outreach to local communities and lake users, monitoring nesting colonies, and identifying key conservation actions to protect nesting grebes on their respective lakes. These efforts have resulted in better informed and enthusiastic communities that support grebes on their lakes, a thoroughly surveyed population that likely comprises over 70% of the breeding grebes in California, and major conservation progress setting the groundwork for long-term management changes that will positively influence nesting success and favorable nesting conditions. The number of adult grebes on the four major lakes (Clear Lake, Eagle Lake, Lake Almanor, and Thermalito Afterbay) has increased 58% and nest attempt save increased 60% since the start of our monitoring and outreach efforts.

The outreach effort by the four partners has been highly effective at delivering a consistent conservation and educational message that has had significant penetration into diverse lake communities in the Sierra Nevada and Coastal Range. Altogether, we have directly presented our message of sharing the lake with grebes and the need to protect the birds to 13,125 people using a diverse media, outreach and education campaign, each group catering to the different communities that use the lakes. We have had 43 newspaper, radio, and TV stories highlighting our efforts, and Audubon Magazine is currently developing a feature story on our work.

We have also made some large steps towards long-term management changes that will have a positive influence on grebe nesting efforts. To increase public awareness of sensitive areas for grebe colonies, 12 large interpretative signs have been installed at strategic locations such as boat ramps and public lakeside parks, putting grebes front and center as people enter and exit the lakes. Additionally, 21 warning signs have been installed on the shoreline near perennial grebe colonies as well as in the middle of a key boat channel at Clear Lake. Over 30 warning buoys have been purchased and are now part of the annual lake management activities of the Department of Water Resources, a key partner at Clear Lake and Thermalito Afterbay. Plumas Audubon has also played a key role in the closing of the Bly Tunnel that has been leaking water from Eagle Lake for decades, and Redbud Audubon has integrated itself into several of the community planning committees such as the Clear Lake Advisory Committee, the citizen body designated by the Board of Supervisors to provide input and recommendations on matters affecting Clear Lake.. The past three years of work and partnership have yielded strong allies in all of the lake communities, and our project has been involved with or partnered with over 100 different organizations, community groups, state and federal agencies, business, and school groups. This project has made the local Audubon chapters conservation mainstays in their respective regions with long-term benefits to nesting grebes as well as other wildlife species that depend on these lakes.

Introduction

Western and Clark's grebes (*Aechmophorus*) are important and iconic members of California's diverse array of migratory waterbirds. Moreover, these two species uniquely link California's open sea, bay, and estuary habitats with inland montane lakes through their fascinating life history cycle (Gaykos et al. 2011). These grebes also link the human communities where they are found creating a web of conservation between rural mountain and urban coastal communities in ways that few other charismatic species can do. Grebes are also important bio-indicators of environmental health as they are sensitive to both bio-magnification of heavy metals in the food sources as well as being directly affected by human-induced disturbance (Anderson et al. 2008). In short, when grebes are thriving it is indicative of a healthy environment for wildlife and people. Audubon California and a consortium of Audubon chapters including Redbud, Altacal, and Plumas, have been conducting a multi-faceted conservation project that integrates science, education and conservation efforts to benefit breeding grebes on six inland lakes. These lakes, which include Eagle Lake, Lake Almanor, Clear Lake, Thermalito Afterbay, as well as Lake Davis and Antelope Lake, serve as nesting sites for 76% or more of the total number of all nesting *Aechmophorus* grebes in California (Ivey 2004). Northern California supports approximately 5.6% of the global population of Western (*Aechmophorus occidentalis*) and Clark's grebes (*A. clarkii*).

Within this region, three lakes (Eagle Lake, Clear Lake, and Lake Almanor have stood out as major nodes of breeding grebes and that together supported more than 13,000 grebes in 2012 (Kyle 2012). If the Intermountain West population of *Aechmophorus* grebes remained stable at 17,000 individuals since the last estimate in 2004, these three lakes could represent 86% of the western population. These sites rank first, third and fourth in importance to breeding *Aechmophorus* grebes among select California Lakes (Ivey 2004). At Eagle Lake, recent impediments to grebe populations have been extremely low water levels due to a series of dry winters that have resulted in grebes not being able to access traditional breeding sites. At Lake Almanor, the most important conservation need is protecting nests from declining water levels brought about in part from drawdown associated with power generation.

Clear Lake ranks as the third most important breeding site in California (Ivey 2004), supporting an estimated 470 breeding pairs of Western and Clark's grebes in 2004. Our recent surveys have counted over 2,700 active nests and 8,000 adult birds suggesting a shift in importance for Clear Lake as a grebe breeding site (Kyle 2012). The lake has the potential to become even more important through continued conservation efforts. Recent hurdles to nesting success seem to stem primarily from natural events and water quality including low lake levels from California's prolonged drought and die-offs of threadfin shad and silversides in 2011, the grebes' primary food at this lake. Additionally, nutrient loading and heavy metals may be adversely affecting nesting success indirectly and directly although more work needs to be conducted to measure these effects. Uncontrollable natural events make it even more important to reduce human-caused impacts on breeding success. Fishing and boating activities although potentially a human factor limiting recovery in the past seems to have declined as a threat in recent years.

Thermalito Afterbay is part of the Oroville Dam Complex and ranks as the fifth most important breeding site in California, supporting an estimated 212 breeding pairs of Western and Clark's grebes in 2012. *Aechmophorus* grebes have nested at Thermalito Afterbay for at least 20 years but no efforts have been made to consistently count them or monitor breeding success until the Department of Water Resources in 2004 and now in partnership with Altacal Audubon and Audubon's Grebe Conservation Project. Human disturbance from waterskiing and dramatic fluctuations in water levels appear to be the main threats causing nest abandonment and reduced breeding success.

By combining efforts of science and outreach staff from Audubon California with local knowledge and an ongoing presence from three local chapters and partners, we have built public awareness and support, reduced human disturbance, and monitored nests and productivity each year since 2010. This report presents the results of the monitoring and outreach efforts for 2010-2013 for most of the important grebe nesting lakes in northern California as well as highlights some of the major conservation wins and products that have been accomplished by our team. Additionally, we have developed some recommendations for better protection of grebes on the six lakes that have been surveyed as well as establishing future research and outreach needs for the project lakes.

METHODS

Surveying and Monitoring Colonies

This *Aechmophorus* grebe survey protocol was used by the Grebe Conservation Project to study and monitor grebes nesting in northern California on Clear, Eagle, Almanor, Davis, and Antelope Lakes as well as the Thermalito Afterbay. The protocol was based on Gericke et al. (2006) and has been modified based on our experiences on the lakes during the last four breeding seasons.

Most of the breeding grebes began arriving in April-May and left the lakes in November-December. It would be useful information to monitor the wintering and migrating grebe population; however our study focused on breeding grebes; our surveys were consolidated the breeding and post-breeding seasons.
Monitoring and survey efforts were categorized as follows: nest initiation surveys, nest monitoring surveys, abandoned nest surveys, disturbance surveys, population surveys, and brood surveys. Survey protocols were designed to maintain a buffer of >100 meters from active nests to avoid flushing grebes from their nests and exposing eggs to predators (Gould 1974; Kury and Gochfeld 1975; Lindvall 1975; Ellison and Cleary 1979; Safina and Burger 1985; Shaw 1998) Predators such as gulls and corvids wait for disturbances in colonies to push grebes off nests, and then they move in to try to rob nests of eggs (Sardella 2002). Every effort was made to maintain the 100m buffer although grebe reactions to approach varied and at times, especially on Clear Lake, it was difficult to impossible to maintain the 100m buffer given the location and size of some colonies. At those colonies where the buffer could not be maintained a slow approach by canoe or kayak limited stress on the birds, allowing for natural nesting

behavior to occur. Only one observed predation was seen during closer approaches, and we do not attribute any nest failure or abandonment to our surveying efforts.

Nest Initiation Surveys

Weekly nest initiation surveys were conducted from shore using binoculars and spotting scopes and by canoe and kayak in known historic breeding colonies starting June 1 (Appendix A). Nest initiation varies by lake and ranged from the beginning of May through the beginning of August on our study lakes. Weekly surveys up until nest initiation were not possible every year, thus nest initiation surveys began on each lake based on historic nest initiation dates. If nest initiation was missed, it was estimated based on the first chicks seen hatching or based on the size of the oldest chicks observed during the first brood survey.

Nest Monitoring Surveys

Although most nesting occurs in historic breeding colonies, full lake surveys were also conducted to determine if there were any new nesting areas not previously documented. Once nesting began, discrete nesting areas were considered colonies, defined as a group of grebe nests at least 400m from other grebe nests. Colony size was tracked using the Nest Monitoring Survey Form (Appendix B). Colonies were mapped from shore and from canoe and kayak as accurately as possible while attempting to keep a >100m buffer from active nests. Compass bearings to the right and left edge and other reference points in colonies were taken from observation points and the distance to the reference points estimated. Doing this from multiple points around the colony, both by boat and by shoreline if possible, increased colony mapping accuracy and also allowed observers to get an accurate count of nests and adults. Sometimes colonies were mapped by kayaking around the perimeter of the colony. A solo kayaker maintaining a >10m buffer and a steady speed, minimized disturbance to the colony and provided an accurate colony boundary. This type of survey is only conducted for nest colonies in open water and not for colonies in dense vegetation such as willows or tules.

On Clear Lake, each nest was classified as either a “shore nest” if placed among emergent macrophytic vegetation near the shore (e.g., tules, water primrose, willows) or an “open water nest” if placed in open water > 1 m from emergent vegetation. For colonies located in open water, the Redbud team measured the maximum distances of nests from the shore or emergent vegetation, usually based on measurements from a laser range finder or, in the case of more distant nests, a GPS unit

Nest counts on Lake Almanor were conducted from strategic observation points around colonies, including on-water points while Clear Lake, Eagle Lake, and Thermalito Afterbay monitoring relied on boat surveys. Nest monitoring was conducted before noon, whenever possible, as this was when adults were more likely to be on their nests (Miller and Johnson 1978, Bogiatto 1998). At each site we counted the number of all obvious nests of *Aechmophorus* grebes. Nests that appeared to be actively maintained or being built were noted but not included in our final estimates of active nests. Because our counts were conducted on

average only once per week, we decided to count all nests that appeared to be well constructed even if no eggs were present, because those without eggs may well have had eggs at some point within a few days before or after observation and thus should be included in any measurement of reproductive effort.

Tallying the total number of grebe nests on a lake during one breeding season was also challenging since the number of nests in a colony is constantly changing and grebes will abandon nests and then start new nests in a different area. Our nest counts are the additive sum of the peak number of nests in each colony. For example, a colony may peak with 150 nests and then a new colony will form and may peak at 200 nests, thus our total additive nest count would be 350. This method of estimation reflects the reproductive effort of the birds and indicates potential number of young that could have been produced on each lake. Our estimates of nesting effort were conservatively derived with full understanding that to accurately count each active nest throughout the season would be incredibly difficult with our current capacity and visitation frequency.

Nest monitoring surveys were repeated once or twice a week for each colony for the duration of the nesting season because grebes continue initiating nests throughout the summer months (Ivey 2004) and the location and size of nesting colonies can change continuously. On some lakes such as Lake Almanor and Thermalito Afterbay, as the water levels dropped submerged vegetation increases and grebes can nest in deeper water. Mapping the nest colony during each visit provided important data that documented the changes in colony location. Changes varied from very slight to major shifts between visits. Colony extents changed constantly because nests can be constructed in 1-3 days (Ivey 2004) and abandoned at any time.

Abandoned Nest Surveys

At Lake Almanor grebes have nested in onshore thickets so that nests in thick vegetation such as willows and tules often could not be counted until after nesting had finished without significant disturbance to nesting grebes. In these areas, nest counts were completed after nesting had finished, when surveyors can walk and/or boat through the abandoned nest colony and count old nests.

Disturbance Surveys

Once nesting began, disturbance surveys were conducted, generally June-September (Appendix D). Disturbance surveys were conducted weekly, but during different days of the week (weekdays, weekends, and holidays) and during different times of the day including crepuscular hours. Colonies should be observed when possible for >1 hour to quantify types of disturbance to grebe colonies and grebe responses. In certain circumstances at Clear Lake where distance between colonies was great, disturbance surveys took place in 15-minute intervals with multiple intervals occurring at several colonies in one day. These surveys should be done from shore at a distance >100 m to avoid observer disturbance to nesting grebes during surveys. Where boat surveys were necessary, observation buffer distances were smaller but observer disturbance was kept at a minimum by being on the edge of the colony and remaining

stationary for the duration of the survey. Disturbance surveys are generally done in conjunction with other surveys such as nest or brood counts to maximize efficiency of the survey effort.

A disturbance is defined as an action causing the grebes to noticeably alter their behavior, while a potential disturbance was anything we thought might cause a disturbance within the colony. During timed periods at each site, all disturbances and potential disturbances within 100 m of the colony were counted (except for boats, which were counted out to 200 m if a noticeable wake reached the colony).

Disturbances and potential disturbances were divided into the following categories based on their cause: motorboats (including airboats), kayaks, low-flying aircraft, mammals, and birds (large possible predators). These categories were then subdivided further to better represent the extent of the disturbances (e.g., predation and presence in colony for mammals). Moving subjects were categorized according to their closest point of approach to the colony.

Population and Brood Surveys

Population counts and brood surveys are conducted by motor boat on larger lakes or by kayak on small lakes such as Thermalito Afterbay, Lake Davis, and Antelope Lake and started around mid-July. Population surveys (counts) are conducted prior to the presence of young and/or during brood surveys. A mid-summer population survey may more accurately estimate the potential adult breeding population on lakes because grebes begin migrating away from and to lakes starting in August. On Plumas Audubon's study lakes, grebe numbers steadily rise from August through September.

Brood surveys start after young are first observed on a lake and are repeated 1-2 times a month until the beginning of October, except on Clear Lake where a single brood survey is conducted around the perimeter of the lake in September. Good weather is important for accurate population counts and brood surveys; even light winds can create choppy water that can significantly reduce grebe detectability and survey accuracy. Survey considerations include boat size and speed and observer ability. A faster boat can help complete a survey more quickly on larger lakes. Completing surveys more quickly helps reduce the likelihood of double-counting because grebes will not have moved as far in a shorter period of time. Population counts require at least 2 surveyors, 1 data recorder, and 1 boat driver, while population/brood counts should be conducted with 4 observers, 2 recorders, and 1 boat driver.

Population counts involve one observer watching each side of the boat and tallying all of the *Aechmophorus* grebes observed while the boat completes a systematic route covering the entire lake or, in the case of Clear Lake, its perimeter. The route should be optimized to avoid double-counting or missing any grebes and observers should be aware of areas where grebes have or have not been counted already during the survey. Clark's and Western Grebes should be distinguished when possible and otherwise counted as *Aechmophorus* grebes.

Brood surveys target groups of grebes to maximize the sample size along transects. Brood survey transects are 1,000 meters in length and in as straight a line as possible. One observer records grebes on one side of the boat as far as can be clearly distinguished by species (Clark's

or Western) and age (adult or juvenile), which is generally 100-250m depending on visibility due to wind, waves, and the sun's direction. Grebe young are categorized by size as: ⅛, ¼, ⅓, ½, ⅔, ¾, ⅞ or full size compared to adults. Optimally, 10 transects per brood survey are conducted if enough large groups of grebes are encountered. The route around the lake should be tracked with GPS and the start and end points of transects marked as GPS waypoints. The ratio of young to adults is calculated per transect and averaged across transects to determine an average young:adult ratio for a lake. Additionally, at Clear Lake, due to its size and number of birds, we did a single transect and counted adults and young within 100 m. We also counted adults beyond 100 m and estimated the number of young by extrapolating the ratio of young to adults within 100 m. It is important to have data recorders so that observers do not have to look away from the grebes they are counting to record their observations.

On smaller bodies of water that can be thoroughly surveyed and all grebes accurately identified to species and age, transects are not necessary (eg. Lake Davis). These lakes should be systematically circumnavigated and all grebes counted by species and age.

Population counts should be conducted during brood surveys to obtain a census of the entire grebe population on the lake. Transect surveyors should count grebes in between transects. To obtain a population estimate, a second set of observers should count all grebes observed on their side of the boat including those outside of the transect distance. Thus, two estimates of the total grebe population can be obtained per survey to determine the accuracy of those estimates, one based on transect extrapolation and one based on a full count. The two estimates can be averaged to reduce survey error due to over- or under-counting. Double counting grebes can be avoided by travelling a systematic route tracked by GPS and noting locations where grebes have already been counted.

Other Monitoring Methods

Water Level Monitoring

An important component of both the Plumas and Altacal Audubon's (PAS and AAS, respectively) study of nesting grebes in northeastern California was determining how the management of water surface elevation on artificial reservoirs affects nesting grebes. Thus, water level monitoring is critical to our study. PAS and AAS monitor water levels with online resources such as the California Data Exchange Center (http://cdec.water.ca.gov/cgi-progs/mapper). Water monitoring can also be accomplished by measuring water depths at a consistent location throughout the season.

Wildlife Cameras

In 2012, Plumas Audubon began using wildlife cameras (Bushnell Trophy Cams) to monitor individual grebe nests and determine nest success and disturbances such as predators. After completing a second year of nest monitoring with wildlife cameras in 2013, we have determined that it is the only effective way to monitor individual nest success, disturbance, and predation. In 2014, Plumas plans to increase the sample size of nests monitored with wildlife

cameras, and the other Audubon chapters are interested in adding cameras to their nest monitoring efforts.

Aerial Surveys
Aerial surveys make it possible for Plumas Audubon to visit several water bodies in one day to determine the presence/absence of grebes and nests. However, aerial surveys have limitations including the fact that grebes dive when a plane flies too close so aerial flights must be low enough to distinguish grebes from other water birds, and high enough to reduce grebes diving. In addition, it can be difficult to distinguish nests in tules, willows, and other dense vegetation and if large numbers of nests are present, they can be difficult to accurately count while flying over. Thus, more accurate nest counts can be made from high resolution photos taken by an observer or aircraft-mounted equipment. Another limitation to aerial surveys and high-resolution photos is that they are expensive. Aerial surveys were not widely used by our project and likely will only be used to obtain regional estimates of birds rather than accurate counts on any particular lake.

Data Management
Data sheets are scanned as pdfs for archival. Microsoft Excel is used to tabulate data. ArcGIS is used for mapping, including spatial data such as colony locations and associated attribute data such as number of nests in colonies.

RESULTS

The three chapters have many accomplishments for the past four breeding seasons. Audubon California has helped support the chapters by providing technical assistance with messaging, outreach, and data collection. Additionally, Audubon California staff has been responsible for budget tracking assistance, reporting, and requesting funds to the National Fish and Wildlife Foundation. Since much of the work completed has been accomplished by the Audubon chapters, we have highlighted some of their significant work with community outreach, conservation projects, and surveying and monitoring breeding colonies.

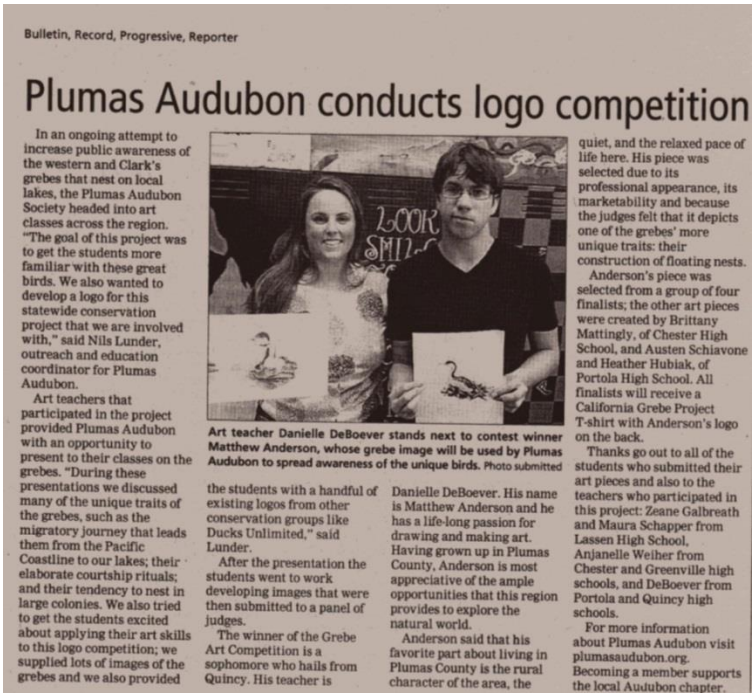
Public Outreach and Education

Plumas Audubon

The Plumas Audubon Society (PAS) has worked diligently to engage citizens of northeastern California with the California Grebe Conservation Project. Drawing from our extensive grass-roots community, which covers Plumas, Lassen, and Sierra Counties, we have conducted many successful outreach and education events. We believe that these events have contributed to a greater awareness and appreciation for the grebes that rely on the lakes of our region in order to forage, court, reproduce, and raise their young.

PAS has successfully partnered with local school districts, teachers, and administrators to provide exciting opportunities for students and instructors to learn about the grebes on their local lakes. Schools near grebe nesting lakes were prioritized; each of those schools was presented with opportunities to participate in our outreach and education programs (Figure 1). Many schools have been engaged by our programs; some of those schools have enjoyed multiple events with the Plumas Audubon Society Grebe project including taking part in the 2013 art contest where students were able to help develop a new grebe logo for Plumas Audubon (Figures 2 and 3).

Figure 1 Students from the Indian Valley Academy observe grebes along the shore of Chester Meadows on Lake Almanor



Bulletin, Record, Progressive, Reporter

Plumas Audubon conducts logo competition

In an ongoing attempt to increase public awareness of the western and Clark's grebes that nest on local lakes, the Plumas Audubon Society headed into art classes across the region. "The goal of this project was to get the students more familiar with these great birds. We also wanted to develop a logo for this statewide conservation project that we are involved with," said Nils Lunder, outreach and education coordinator for Plumas Audubon.

Art teachers that participated in the project provided Plumas Audubon with an opportunity to present to their classes on the grebes. "During these presentations we discussed many of the unique traits of the grebes, such as the migratory journey that leads them from the Pacific Coastline to our lakes; their elaborate courtship rituals; and their tendency to nest in large colonies. We also tried to get the students excited about applying their art skills to this logo competition; we supplied lots of images of the grebes and we also provided the students with a handful of existing logos from other conservation groups like Ducks Unlimited," said Lunder.

Art teacher Danielle DeBoever stands next to contest winner Matthew Anderson, whose grebe image will be used by Plumas Audubon to spread awareness of the unique birds. Photo submitted

After the presentation the students went to work developing images that were then submitted to a panel of judges.

The winner of the Grebe Art Competition is a sophomore who hails from Quincy. His teacher is Danielle DeBoever. His name is Matthew Anderson and he has a life-long passion for drawing and making art. Having grown up in Plumas County, Anderson is most appreciative of the ample opportunities that this region provides to explore the natural world.

Anderson said that his favorite part about living in Plumas County is the rural character of the area, the quiet, and the relaxed pace of life here. His piece was selected due to its professional appearance, its marketability and because the judges felt that it depicts one of the grebes' more unique traits: their construction of floating nests.

Anderson's piece was selected from a group of four finalists; the other art pieces were created by Brittany Mattingly, of Chester High School, and Austen Schiavone and Heather Hubiak, of Portola High School. All finalists will receive a California Grebe Project T-shirt with Anderson's logo on the back.

Thanks go out to all of the students who submitted their art pieces and also to the teachers who participated in this project: Zeane Galbreath and Maura Schapper from Lassen High School, Anjanelle Weiher from Chester and Greenville high schools, and DeBoever from Portola and Quincy high schools.

For more information about Plumas Audubon visit plumasaudubon.org. Becoming a member supports the local Audubon chapter.

Figure 3 Plumas News press release announcing winner of grebe art competition

In addition to the schools, we have connected with a wide range of local organizations that have helped us to get the word out on the nesting grebes to a diverse audience. By collaborating with established civic organizations we have amplified our efforts. We feel that the

Figure 2 Winning art piece

relationships that have been developed during the first four years of the California Grebe Conservation Project will have long term positive impacts on the breeding success of the grebes on our local lakes.

The following information is an example of the outreach and education activities that Plumas Audubon coordinated in 2012.

In May 2012, Plumas Audubon spent a lot of their time engaging with local community students at several schools about grebe conservation and protection at Eagle Lake and Lake Almanor. Fifty-five students at Quincy Jr. High School and another 175 students at Lassen High school learned about the *Aechmophorus* grebes that nest in the region. Also they presented to approximately 80 students at Chester Jr. High School on the grebes that nest on Lake Almanor.

Nils Lunder presented to the Almanor Basin Watershed Advisory Committee at their State of the Lake Forum in June where the colony monitoring and student outreach efforts were highlighted.

In 2012, Plumas Audubon developed a Summer Youth Outing Program for their region in Northeastern California that brought over 100 local youth on day trips to learn about and observe grebes on Lake Almanor, Eagle Lake, Lake Davis, and Antelope Lake. This program has served the communities of Loyalton in Sierra County; Portola, Quincy, Greenville and Chester in Plumas County; and Westwood and Susanville in Lassen County. Also they presented at campgrounds located on the grebe nesting lakes and connected with over 100 campers with their grebe talks. These campers were typically boating, kayaking, or using the lakes during the day and learning about grebes at night. Campground presentations have been an effective outreach strategy for Plumas for the past two years.

Presenting to local community groups such as the Chester and Susanville Rotary, and the Lake Almanor West board of directors has informed groups involved with potential management and development changes at the lake. During the summer of 2012 approximately 220 people have been introduced to grebe natural history and conservation at Lake Almanor and Eagle Lake.

Table 1 Summary of Plumas Audubon's outreach efforts and impact

Education

Number of events:	**Number of people reached:**
36 Classroom Presentations	**891 students and staff**
14 Field Tours	**293 local residents (primarily youth)**
25 Public Presentations	**366 local residents**
7 Campground Presentations	**105 lake users at Eagle and Almanor**
81 Total events	**1,642 Total people directly engaged**

Outreach

14 Newspaper/Newsletter articles	**94,800--total circulation[1]**
5 Radio Public Service Announcements	**100,000—total potential listeners**
Plumas Audubon Website	**67,500--Approximately 150 visits per day beginning June 1 2012[2]**
Total outreach	**262,300--Total people exposed to outreach efforts**

Outreach Materials

20 Nest colony warning signs designed and installed near active nesting colonies
4 Grebe interpretive signs installed at high traffic grebe observation locations on Lake Almanor and Eagle Lake
400 Grebe Brochures distributed in the Lake Almanor and Eagle Lake basins

Redbud Audubon

The Clear Lake group has developed a different strategy for outreach along the 100 miles of shoreline. There are six major communities that interact with and use the lake, and a number of them host a variety of community festivals each year. Redbud Audubon has become a frequent booth exhibitor at many of these festivals, with a visual presentation about grebe behavior and colony protection. Heron Days, Redbud's own annual festival, has highlighted the grebe project with speakers, boat tours, children's activities, and an exhibit booth where grebe conservation and the health of Clear Lake is a major message. These festivals attract thousands of residents, giving Redbud Audubon a large platform to reach multiple communities and age groups at the same time. Over the four years of outreach effort, Marilyn Waits and the Redbud team has set up 18 information booths at 8 festivals and interacted with 3,737 participants (Figure 4). Overall, using a variety of outreach approaches and grant-funded materials, Redbud volunteers have directly reached 4,533 people and produced print media exposures to 68,264 people, based on media circulation figures. Most importantly, the project has made permanent grebe education contributions to Lake County that will last many years beyond this project. The grant has significantly strengthened the chapter's ongoing grebe education tools and produced new

[1] Feather River Publishing, Lake Almanor Country Club, Lake Almanor Fishing Association, Bailey Creek Babble, Lassen Land and Trails Trust supplied PAS with this information

[2] According to data supplied by the PAS web host

and valuable working relationships with local organizations and agencies that will continue to support grebe conservation efforts in the future (See Appendix C for full details).

In addition to the festival circuit and schoolchildren outreach, Redbud Audubon has made a significant partnership with the Department of Water Resources (DWR) who has been a major supporter of grebe conservation since the beginning of our project. Each year DWR installed more than warning 20 buoys purchased by Redbud Audubon to notify boaters of the locations of grebe colonies (Figure 5).

Figure 4 Marilyn Waits and Redbud Audubon table at one of several Clear Lake festivals that take place throughout the year.

Figure 5 Over 20 buoys were deployed every year to warning boaters on Clear Lake about nearby grebe colonies. Buoys usually protected 7 major colonies.

There have been several presentations to the Lake County Board of Supervisors to inform them of the importance of Clear Lake to breeding grebes. Marilyn Waits has also made presentations to the Clear Lake Advisory Committee, the official citizen committee appointed by the Board of Supervisors to deal with issues regarding Clear Lake. Redbud has continued to engage with the advisory committee to make grebe colonies on Clear Lake a topic of discussion and priority for the lake communities.

Redbud has also been a leader in developing innovative outreach material to link online users to breeding grebes on Clear Lake. During the 2012 breeding season, a video was produced by Floyd Hayes documenting the Grebe conservation project at Clear Lake as well as describing the natural history and behaviors of *Aechmorphorus* grebes, and ways the public can help avoid disturbing colonies. This has been a valuable asset for the chapters to incorporate into their school and community presentations. Redbud Audubon plans to continue using it at school presentations into the future. Redbud also developed the GrebeCam, a live streaming video feed of grebe nests that drew viewers to Redbud's webpage and was a great education

platform to show viewers the activities that go on at a grebe nest. The chapter was able to host the GrebeCam during the 2011 and 2012 breeding seasons. Audubon California and local news outlets highlighted the story encouraging people to view the grebe nest from the Redbud Audubon website where they developed educational material on the various spring rituals that can be seen in a grebe colony on Clear Lake. The chapter received numerous emails from Lake County residents that viewed the camera and wanted to connect with the Grebe team. The 2012 webcam nest remained active for one week and then was abandoned by the birds.

In 2013, Redbud Audubon partnered with the Sea Scouts troop of teenagers in Lake County to help with fishing line recycle bins the chapter installed for grebe protection. Redbud gave several presentations at the Sea Scout meetings on the importance of Clear Lake for grebes and trained the Scouts on safety procedures for cleaning the recycle bins.

Altacal Audubon

The Thermalito Afterbay is a heavily used water body for boats, jet skis, and water skiers. Most of the users tend to be local boat owners that frequent the Afterbay consistently throughout the summer. Altacal Audubon has taken advantage of their return to build an educational relationship with these return users by setting up a grebe booth at the major boat ramps on the weekends during the spring and summer months (Figure 6). Their consistent presence has led to a greater acceptance of our grebe conservation message that is conveyed using large, engaging visuals of grebes walking on water or rushing (Figure 7), and providing useful handouts such a floating key chains for boat keys with a picture of a grebe on them. Additionally, hundreds of "Baby on Board" stickers (Figure 7) have been distributed to children and adults at the boat ramps and at school presentations. During the course of the grebe project 1200 boaters per year have been exposed to our messaging at boat ramps.

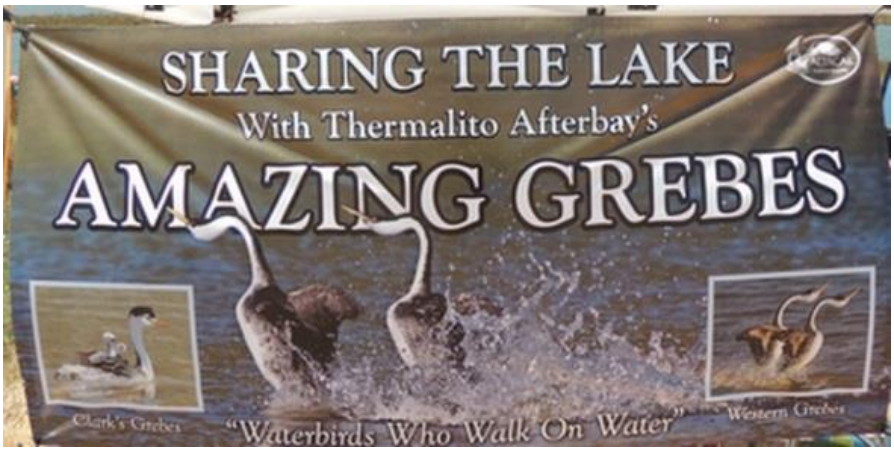


Figure 6 Large banner produced by Altacal Audubon for outreach efforts at Thermalito Afterbay boat ramps showing two Grebes rushing.

Figure 7 Sticker promoting grebe conservation and awareness and two of the many winners of the Grebe Game at Thermalito Afterbay.

Altacal Audubon has also been active in providing presentations and games for elementary and middle school students that engage kids both in the classroom and at the Afterbay (Figure 7). During the 70 school presentations, over 2,150 students and teachers have been engaged (Table 2)with some productive results including numerous drawings from elementary school children of grebes on the Afterbay explaining the importance of protecting them (Figure 8).

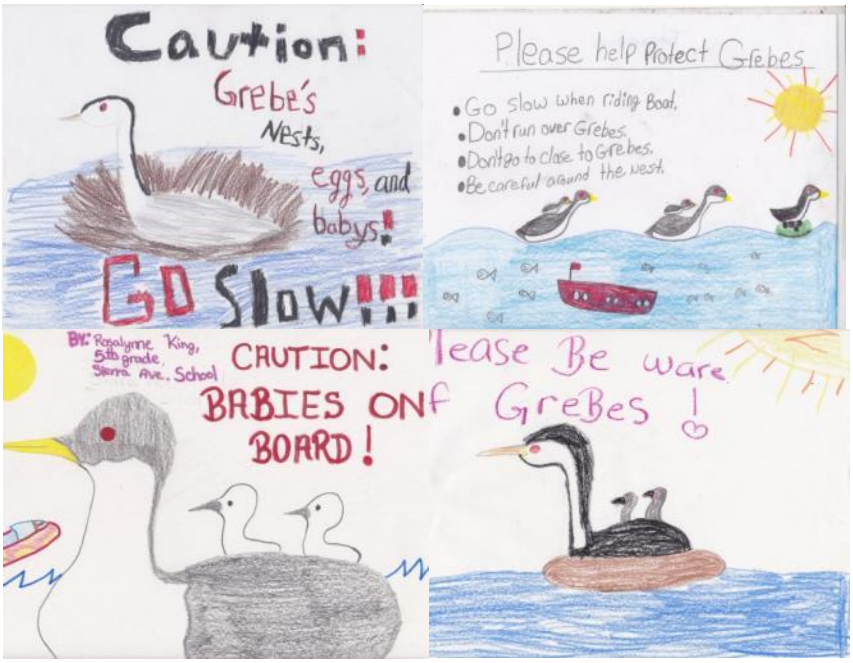


Figure 8 Examples of pictures created by elementary students explaining grebe conservation after an Altacal presentation

Table 2 Number of students attending classroom presentations on grebe natural history and conservation for 2011-2013

YEAR	NUMBER OF STUDENTS
2011	650
2012	700
2013	800

BREEDING COLONY PROTECTION

Plumas Audubon

Plumas Audubon worked with PG&E, Collins Pine Company, Mount Hough Ranger District of the Plumas National Forest, Eagle Lake Ranger District of Lassen National Forest, Lassen County, and the Five Dot Cattle Company to install signs (Figure 9) alerting the public and workers of nesting grebes in specified areas of Eagle Lake and Lake Almanor (Figure 11). A total of 11 signs have been installed on the lakes – 4 on Lake Almanor, 6 on Eagle Lake, one on Antelope Lake.

Figure 9 Grebe warning sign developed by Plumas Audubon and Audubon California

During the 2013 season they also installed four interpretive signs on the two lakes at major access points to prominently display grebe natural history and conservation information to boaters, fishermen, and families going out on the lakes. This sign production effort has been coordinated with the two other Audubon chapters so the signs installed at each of the four lakes will be the same, conveying the same message and information (see Figure 15 below).

Redbud Audubon

Each year beginning in 2011 warning buoys purchased by Redbud for the grebe project have been placed around several Clear Lake colonies where boating activities could disturb the nesting birds. All 20 buoys that Redbud bought have been deployed in this way since 2011. Additionally, a large 5 mph warning sign was placed prominently at the north end of the lake (Figure 11), near Rodman Slough where over half of the nesting grebes were located in 2012 and 2013.

Redbud Audubon has also identified the need to remove excess fishing line from the lake. This effort began at the 2012 Grebe conference where, during a visit to Eagle Lake, a grebe was spotted entangled with fishing line (Figure 12). After coming back from the conference several members of the Redbud Audubon grebe team developed a recycling bin (Figure 13), found guidance from the California Coastal Commission, which even identified a company, Berkley Conservation Coalition, doing monofilament recycling. Over the summer of 2013, 15 recycling bins have been placed at boat ramps on Clear Lake (Figure 14). The success of the recycling effort has been demonstrated by the amount of fishing line deposited in the bins and measured during clean out. The goal of the program is to reduce the amount of monofilament line in the lake that grebes and other wildlife can potentially become entangled in.

Figure 11 Sign warning boaters to slow down near the Rodman Slough grebe colonies on Clear Lake

Figure 12 Grebe entangled in fishing line seen at Eagle Lake in 2012

Figure 13 Recycling bin developed by Redbud for monofilament line

Figure 14 Placement of 9 fishing line recycling bins at boat ramps on Clear Lake

Redbud also coordinated their efforts with Plumas and Altacal Audubon to purchase five interpretive signs were installed this fall at five prominent community parks and boat launches around Clear Lake (Figure 15).

Figure 15 Twelve Interpretative signs have been installed at Clear Lake, Lake Almanor, Eagle Lake, and Thermalito Afterbay in prominent locations to educate the public about grebes.

Altacal Audubon

Altacal Audubon has been able to purchase a shallow-hulled Excel boat and trailer that will dramatically improve the surveying effort at the Thermalito Afterbay. Until this point, the surveys were completed by kayaks that resulted in surveys taking multiple hours. The boat reduces the amount of travel time and maximizes the time spent at the colonies. The boat will be stored and operated by the Department of Water Resources, which has an excellent storage facility and easy launch to the lake. We are pleased to be expanding the capacity of conservation monitoring at the Afterbay and anticipate the boat being a crucial part of ongoing monitoring at the Afterbay for years to come.

Figure 16 Example of the buoys placed at the waterski course on Thermalito Afterbay

Additionally, the chapter has responded to some of the early recommendations of Ivey (2004) that buoys and other warning signs should be placed on the waterski course to alert boaters of the nearby grebe colonies and that boat wake can have a major impact on nest success. Seven buoys were purchased and have been on the water since 2012 (Figure 16).

COLONY MONITORING AND EVALUATION

Surveys of Adults, Nests, and Young

The three chapters averaged 65 surveys per year on the six lakes monitoring the maximum population of adult grebes, number of nest attempts, number of young produced, and calculated the reproductive rate as a ratio of young:adult populations (Table 3).

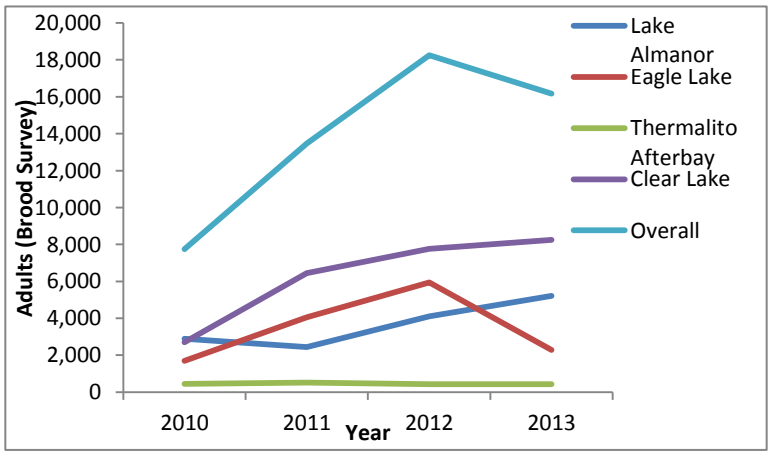


Figure 17 Estimated number of adults at each target lake as well as the population estimate

Number of Adults. The number of adults observed on each of the study lakes showed a steady increase until 2013 when low water levels at Eagle Lake likely caused fewer birds to select the lake as a breeding site (Figure 17).

Number of Active Nests. The number of nests is related to the effort the grebes are investing in offspring production and likely is dictated by nesting substrate availability, food resources, and level of predation pressure and disturbance. During the study period, the number of observed active nests continued to increase despite a complete collapse of nesting at Eagle Lake (Figure 18). Clear Lake consistently supported large numbers of nests. Lake Almanor has seen a steady increase in nesting activity with more nests seen in 2013 than any other breeding season during the study period. Thermalito Afterbay has maintained a consistent number of nests, which may be

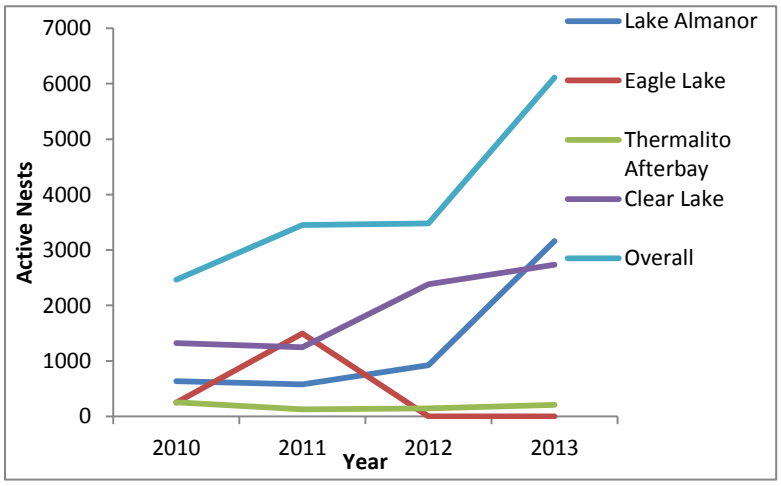


Figure 18 Estimate of active nests at study lakes throughout the breeding season 2010-13. Active nests estimates represent the reproductive effort the birds are investing in producing young. This number represents the cumulative estimate for the entire study

influenced by a stable population and nesting substrate at the Afterbay.

Number of Young. Despite the promising increase in adults and nest attempts, the number of young being produced on these lakes in not keeping pace (Figure 19). The notable drought conditions in 2012 and 2013 may have negatively affected the birds' ability to successfully raise young, particularly at Eagle Lake; however, even in less than ideal conditions, Clear Lake grebes produced more young during the dry years than the wet years of 2010 and 2011. Clearly, many factors besides those measured by our survey network could be influencing breeding success and further refinement of our survey effort and method may be needed to determine the major factors suppressing the production of young.

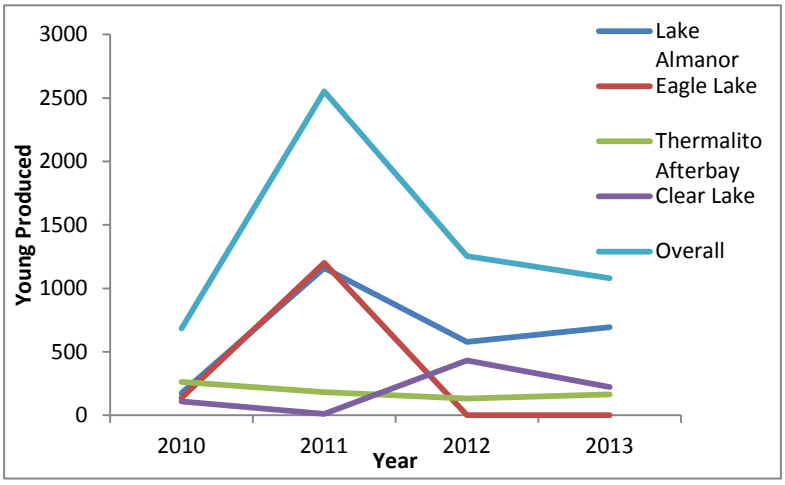


Figure 19 The maximum number of young observed on study lakes for 2010-13 as well the total number of young observed for the study. Young are counted during brood surveys that typically occur in September each year.

Ratio of Young to Adults. The young:adult ratio reflects the rapid increase in adults and the lagging number of young (Figure 20). The estimated average reproductive rate was .19 for all six lakes. If Eagle Lake is excluded from the calculation, the reproductive rate for the five lakes with active nests is .27. The number of young produced for the five active lakes varied from year to year depending on a multitude of factors. More research will need to focus on factors limiting nesting success and identify potential strategies to improve nesting conditions and nesting success. Despite variable reproductive success, the number of grebes coming to the four focal lakes more than doubled since 2010, peaking in 2012 (Figure 17). It is difficult to determine if this increase implies an overall population increase, but it may suggest that habitat conditions at these lakes have improved during our study period.

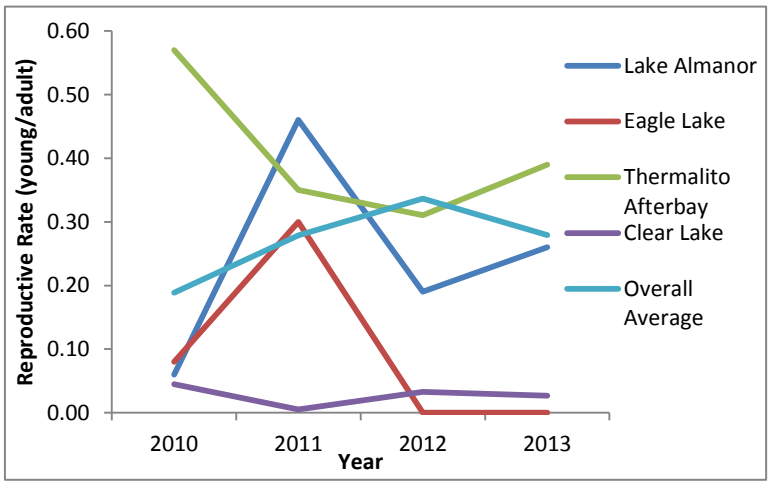


Figure 20 Estimated reproductive rate based on the young:adult ratio for each lake for 2010-13. The overall average reproductive rate for each year was determined using all lakes for 2010-11 and excluding Eagle Lake in 2012-13 due to no breeding being attempted there.

Table 3 Summary of survey efforts of the six project lakes form 2010-2013.

Location	2010[3] Adults	2010 Active Nests	2010 Young	2010 Reproductive Rate (young/adult)	2011 Adults	2011 Active Nests	2011 Young	2011 Reproductive Rate (young/adult)
Lake Almanor	2,900	636	175	0.06	2,446	580	1,160	0.46
Eagle Lake	1,700	250	138	0.08	4,056	1,496	1,200	0.30
Thermalito Afterbay	452	255	262	0.570	520	130	182	0.350
Clear Lake	2,694	1,322	110	0.045	6,443	1,248	29	0.005
Antelope Lake								
Lake Davis								
Total	**7,746**	**2,463**	**685**	**0.189**	**13,465**	**3,454**	**2,571**	**0.279**

Location	2012 Adults	2012 Active Nests	2012 Young	2012 Reproductive Rate (young/adult)	2013 Adults	2013 Active Nests	2013 Young	2013 Reproductive Rate (young/adult)
Lake Almanor	4,108	926	577	0.19	5,209	3,163	695	0.26
Eagle Lake	5,950	0	0	0.00	2,287	0	0	0.00
Thermalito Afterbay	**425**	**142**	**132**	**0.311**	425	210	164	0.390
Clear Lake	7,760	2,382	361	0.033	8,250	2,737	211	0.027
Antelope Lake	82	-	49	0.60	62	20	22	0.37
Lake Davis	138	30	63	0.55	158	35	53	0.35
Total	**18,243**	**3,480**	**1,182**	**0.133**	**16,171**	**6,110**	**1,070**	**0.169**

[3] **The number of "Adults" at Clear Lake during 2010 and 2011 is based on *September* surveys, whereas the number of "Adults" at Clear Lake during 2012 and 2013 is based on our July surveys. All surveys include the grand total of adults counted on the lake, so it is difficult to compare populations between the first and second half of the project. Mid-summer surveys should be done to consistently study variation in the size of the potential breeding population.**

DISTURBANCE

Disturbance Index surveys were conducted by all three chapters in all four years of the study with the intention of documenting potential and actual effects of natural predation pressure and human induced disturbance on the nesting success of grebes on the target lakes. Each lake had unique levels of human and natural disturbance pressure, but to illustrate the potentially devastating effects of predation on Clear Lake, Redbud surveyors observed 27 nests with eggs preyed upon by American Crows during 5 hours of observation, for an average of 5.4 nests per hour, on 10 and 19 July 2012. Given this rate of predation, a potential 75.6 nests with eggs could be preyed upon by crows during a 14-hour day in a single colony. Although the number of nests preyed upon each day was presumably much fewer because the predators would have been satiated after eating a certain number of eggs, a more conservative estimate of 30 nests preyed upon each day over a 30-day period in two colonies would result in 1,800 nests destroyed by predation. More data on rates of predation would be useful to fully understand the potential impact of predation on limiting grebe productivity.

Lake Almanor, Eagle Lake, and Thermalito saw far less explicit pressure on the grebes during their surveys than those at Clear Lake, but disturbance of varying sorts does seem to play an influential role in nest success on each lake. Each of the major disturbances are highlighted below and assessed by each survey group.

Wind Disturbance

Wind disturbance appears to be a major factor adversely affecting the reproductive success of grebes on Clear Lake because of strong wind patterns at the north end of the lake. Each year, those at Clear Lake observed numerous nests that were apparently blown ashore or adrift by wind-generated waves (Figure 21) . The impact of wind-generated waves was difficult to observe and measure. Only once at Clear Lake was a nest directly observed (via webcam) being blown from its anchor, at Corinthian Bay on 15 August 2012, and subsequently abandoned. The fact that one of the few shore nests that Redbud Audubon focused on with a webcam in 2011 and 2012 was blown away suggests that it may happen much more frequently. Open water nests are especially vulnerable to wind-generated waves. On 14 August 2011 surveyors found about 200 nests were blown ashore and subsequently abandoned at Long Tule Point (Figure 21). In 2013, most of the more exposed open water nests along the northwestern shore of the lake disappeared, including about 100 nests blown ashore and subsequently abandoned in a cove at Rumsey Slough East on 6 August.

Figure 21 A grebe colony on 11 and 14 August 2011 at Long Tule Point, Clear Lake, revealing about 200 nests blown into shallow water by wind-generated waves and subsequently abandoned by the grebes. Photos by Floyd Hayes.

In both 2012 and 2013 we observed nests that had obviously drifted into Rodman Slough, including a nest that we observed float underneath the bridge on 6 August 2012. Only once at Clear Lake was a nest directly observed being blown from its anchor, at Corinthian Bay on 15 August 2012, when volunteers operating a webcam reported that the focal Western Grebe nest was blown away and subsequently abandoned.

At Eagle Lake, wind has historically been suggested to cause major disturbance at grebe colonies (Ivey 2004); however, during our study the two active colony locations were situated in cattail beds that provided adequate protection from waves being generated by the wind and boats.

Lake Almanor colonies are located in shallow water and in more protected coves where wind does not seem to have as large an influence as at Clear Lake. However, there was a major wind event in 2012 that destroyed over 250 nests. Wind can be a problem at Lake Almanor, but these isolated events do not seem to have the same degree of effect on nesting success as at Clear and Eagle Lakes. Thermalito Afterbay colonies experience some degree of protection from the orientation of the nesting coves and even though the area around Chico is known to have high winds, the Afterbay nests are not adversely affected.

Figure 22 California Gull preying on grebe eggs at the northwest end of Clear Lake on 31 July 2012, and American Crows preying on grebe eggs at Long Tule Point, Clear Lake, on 10 July 2012. Photos by Floyd Hayes

Avian Predation

Avian predation is a major factor adversely affecting the reproductive success of grebes on all four lakes. Although there were often a variety of large bird species entering grebe colonies, surveyors observed predation by only two species: the California Gull (*Larus californicus*) and American Crow (*Corvus brachyrhynchos*) (Figure 22). Plumas Audubon was able to capture an incidence of a Bald Eagle that attacked an incubating adult on Lake Almanor in 2013; however both the adult and nest survived this particular disturbance (Figure 23). At Lake Almanor, a Northern Harrier was observed feeding on an adult grebe that it may have killed and a Great Horned Owl was photographed on a grebe nest presumably after attempting to kill an adult on a nest. At lake Davis, we observed several dead grebes near nests and we guessed that they may have been killed by Great Horned Owls.

Most disturbances yielded no response from the grebes (Figure 24). Certain types of disturbance caused the grebes to become restless and occasionally leave the colony. Gulls, river otters, bald eagles, corvids, kayakers, ski boats, jet skis, fishing boats, humans on shore, and aircraft were observed in proximity to grebe colonies. Most disturbances were due to avian predators (Figure 25), and most predatory events were observed by gulls (California and ring-

billed) and corvids (American Crow), usually when grebes were away from their nests or after nests had been abandoned. We observed 54 instances of nests with eggs being preyed upon by birds in 2012 and 42 instances in 2013. During 2012 and 2013 combined, an American Crow attacked a grebe nest with one or more eggs 53.5% of the time it entered a colony for a rate of 0.66 attacks per hour. Attacks by the California Gull were much less frequent at Clear Lake, but a constant presence and a major predator on Lake Almanor. During 2012 and 2013 combined, a California Gull attacked a grebe nest with one or more eggs, on average, 19.0% of the time when it entered a colony for an average rate of 0.33 attacks per hour. The crows and gulls usually attacked a nest that was temporarily or permanently abandoned by grebes, and rarely attacked a nest that was defended by a grebe. A few grebes defended their own nests from such attacks, but ignored attacks on neighboring nests.

Figure 243 Bald Eagle attacking a grebe nest on Lake Almanor. Both the nest and adult survived the attack. Photo by Plumas Audubon.

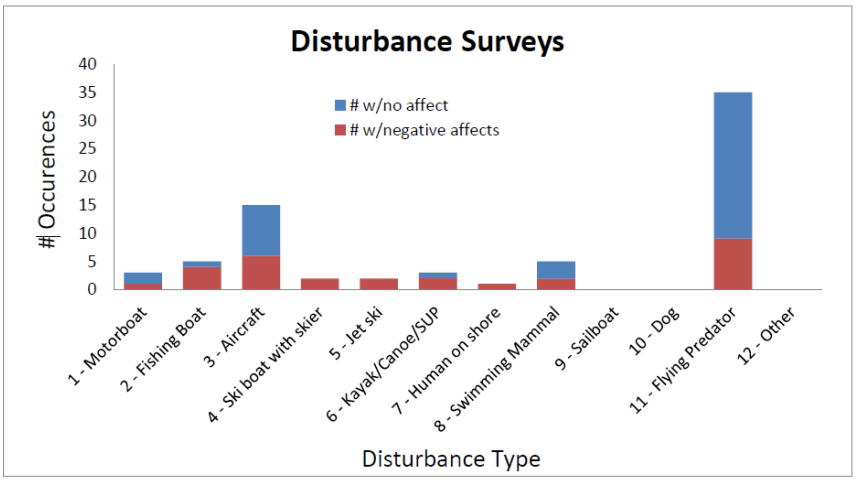


Figure 234 Example of disturbance surveys at Lake Almanor in 2012. Flying predators are the most common disturbance and at times can predate an active nest. Most predated nests were abandoned.

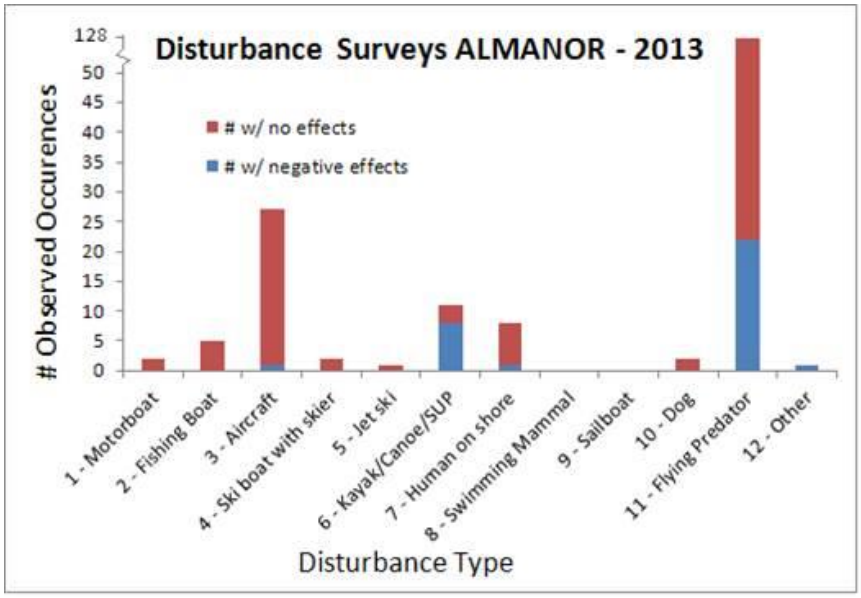


Figure 25 Disturbance survey results for Lake Almanor documenting a dramatic increase in avian predator disturbance with a major increase in predation events.

Mammalian Predation

Mammalian predation may be a significant factor adversely affecting the reproductive success of grebes, but the evidence is indirect. Even when Plumas Audubon placed several wildlife cameras in the colonies in 2012 and 2013, mammalian predation events were difficult to document (Figure 27 However, one adult grebe carcass was attributed to predation by a river otter due to evidence at the carcass and images from a nearby wildlife camera taken the night before. Some nests with broken eggshells were assumed to be preyed upon by raccoon after the nests had been abandoned and the water level dropped enough for the raccoons to reach the nest. During 2010-2013 Redbud observed one or more River Otters (*Lutra canadensis*) enter a colony on ten occasions but never observed any acts of predation, although on one occasion we believe we heard eggs being crunched on a nest hidden in emergent vegetation. Predation by mammalian predators may be more frequent at night although even when mammals are present, eggs seem to remain intact.

Figure 26 Samples of night photos taken by wildlife cameras of potential mammalian disturbance and predation; however nest in photo is assumed to have fledged young. It has been difficult to estimate the magnitude of mammalian predation, especially river otters, which seem to actively hunt in the colonies. All photos were taken on Lake Almanor in 2013 at one nest location.

River otters were confirmed as a predator of adult grebes and were often seen and recorded on camera in and near the grebe colonies on Clear Lake and Lake Almanor. River otters were not documented depredating eggs.

Human Disturbance

Anthropogenic disturbance remained relatively low at all lakes throughout the duration of our study. Although we frequently observed boats entering a breeding colony or passing nearby, we rarely observed incubating grebes departing from the nests or nests being disturbed by humans. The grebes are relatively habituated to watercraft of all forms and simply dove underwater whenever one approaches too closely and at times refused to leave their nest despite the close proximity of humans and boats. On one occasion, in 2010, Redbud surveyors did observe a nest that was adversely affected by a motorboat, when a nest with a single egg was flipped upside down in the water by a boat that passed within 1 m of it at high speed.

Since that event in 2010, all surveyors on all project lakes have seen a very low amount of human disturbance that has had direct negative impacts on nest success. The rate of potential human disturbances at Clear Lake per hour varied greatly, averaging 0.75 per hour with a range of 0.33-1.62 with the highest rates of disturbance coming in 2010 and decreasing to an average

.46 incidents per hour per year, and 3.5-fold drop. Lake Almanor and Eagle Lake also had similar rates of human disturbance at .61 incidents per hour with only 24 of 88 total incidents resulting in birds leaving their nests (Figure 24 and 25). Most the disturbance events involved kayaks or low flying planes on Lake Almanor, and unfortunately some kayak-induced disturbances did lead to gull predation in 2013 when birds were pushed off their nest thus allowing gulls to swoop in and eat the egg. Eagle Lake's shallow water depth meant that grebes nesting in tules did not have any human-related disturbance since most boaters did not have access to the parts of the lake where the birds were breeding. The boat activity near the grebe colonies on the Thermalito Afterbay mirrors that of Eagle Lake with very few boaters using the nesting area and causing little disturbance.

Despite a minimal level of disturbance caused by humans has been observed, the potential impact on grebe breeding colonies can be quite large. Incidents like that seen with speeding watercraft on Clear Lake and that of kayakers on Lake Almanor make it imperative that the kayaking community be made aware of grebe colonies. This will likely reduce these types of occurrences in the future, as will the warning signs installed by Plumas Audubon. It is possible that the increased effort at educating boaters about the grebes has reduced the potential disturbance rate. For now, human disturbance appears to be a minor factor in directly reducing the reproductive success of grebes at our project lakes.

Other Disturbances

Nests within a colony and even entire colonies are often abandoned by the grebes. Insufficient food resources may be a frequent cause of nest and even colony abandonment, although other causes, such as intense predation, may also cause colonies to be abandoned.

Water level Fluctuation

We have been able to document the negative effects of rapid water level fluctuation on nesting grebes on several of our target lakes including Lake Almanor, Thermalito Afterbay, Lake Davis, Antelope Lake, and Eagle Lake. The water level declines at Eagle Lake are mainly caused by the continued drought that has affected overall water availability in California. At Eagle Lake, the water level drop has eliminated suitable grebe breeding habitat in the last two years.

Lake Almanor is part of the "Stairway of Power" and a major forebay for hydroelectric power generation in the Feather River watershed for Pacific Gas & Electric. Plumas Audubon has documented the effects of rapid water level decreases on the success of nesting grebes. Although the relationship is complex, there are negative effects associated with water level drop at Lake Almanor.

Lake surface elevation at Lake Almanor in 2013 decreased rapidly over the summer, especially when compared to 2012 (Figure 28). The average rate of surface elevation decrease during the 2010-2013 breeding seasons was 0.44 feet per week. There were significant lake level drops in 2010 and 2013 due to below average winter precipitation.

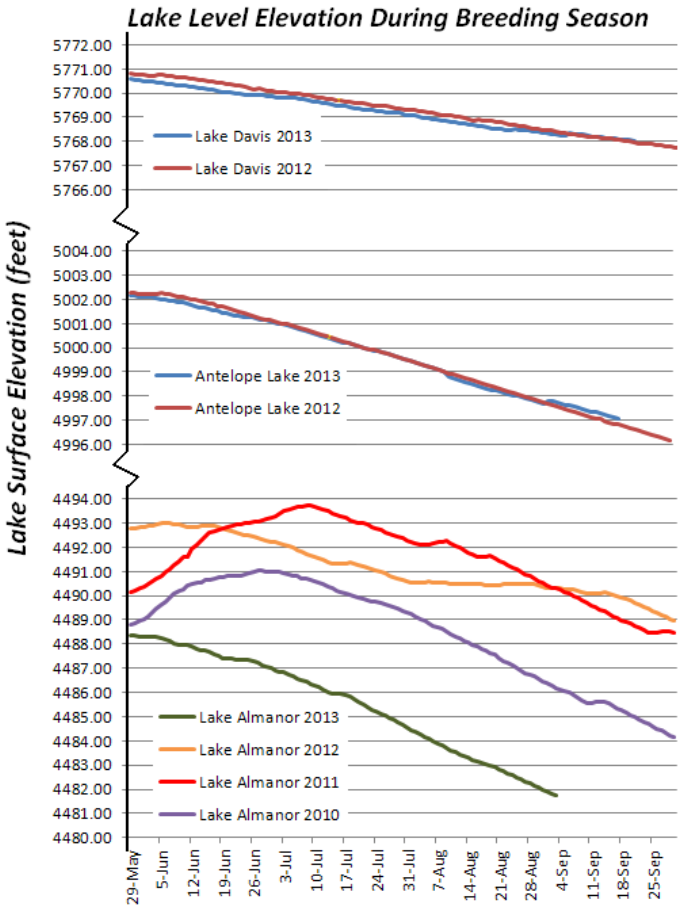


Figure 27 Water level drops at Lake Davis, Antelope Lake, and Lake Almanor through the grebe breeding season for 2010-2013

When water level drops at Lake Almanor are compared to those at Lake Davis and Antelope Lake, which are all dammed reservoirs, it is evident that Lake Almanor water management is more erratic and less predictable, dependent on the electricity production and other water allocation needs, whereas Lake Davis and Antelope Lake water is used primarily for irrigation, thus allowing for more consistent water level management (Figure 27). More consistent water level management appears to facilitate higher reproductive success. The young:adult ratios on Lake Davis averaged 0.45 in 2012 and 2013 and 0.485 on Antelope Lake whereas the young:adult ration on Lake Almanor averaged 0.243 from 2010-2013. Although the larger grebe populations such as at Lake Almanor and Clear Lake, have a lower proportion of the grebe population that breeds each year, which lowers the young:adult ratio, there still appears to be a correlation between water level management and grebe reproductive success. Continued monitoring is crucial to better understand the relationship between water level management and grebe nesting success.

A clear example of rapid water level drop negatively affecting grebe nests was observed at Thermalito Afterbay in 2013 when emergency repairs were being made to the dam and spillway system upstream of the reservoir. In one week, water levels dropped by over 5 feet between July 15 and July 20 before being brought back to normal (Figure 28). Nest counts conducted by the Department of Water Resources show a dramatic negative impact on nesting grebes. The nest count prior to the 5 foot drop was 104 active nests on July 17 and afterwards only 60 nests were observed on July 24. The grebes renested after water levels returned to normal levels and 165 active nests were detected on August 8.

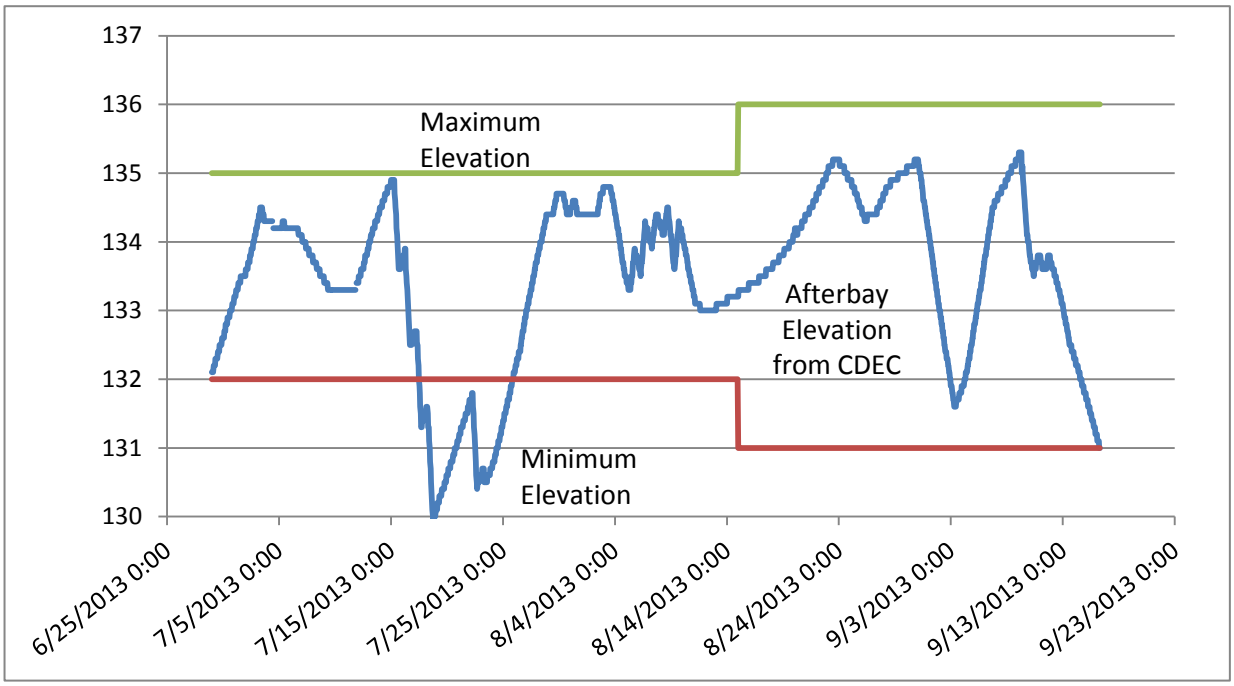


Figure 28 Water level graph the Thermalito Afterbay with designated maximum and minimum water levels that are typically maintained throughout the grebe nesting season. In July 2013 the afterbay experienced a dramatic 5 foot drop in water levels before being brought back to within the threshold. Grebe nests were stranded and abandoned due to this unanticipated drop.

Thermalito Afterbay is a good example of how maintaining stable water levels during the nesting season can improve nesting success. Maximum and minimum water levels were established in 2004 adjusted in 2010 to allow the grebes a predictable environment to construct their nests in deep enough water to avoid being stranded.

DISCUSSION AND RECOMMENDATIONS

Overall, the number of grebes seen on the four focal lakes has been increasing despite reproductive success continuing to be irregular depending on local conditions including food availability, access to nesting substrate, and water levels. There are several major events contributing to reproductive success that our study was able to document that should be mentioned. First, Eagle Lake had a complete collapse of nesting colonies in 2012 and 2013 due to the extremely low water levels in the lake. Additionally, Clear Lake had a collapse of the breeding season in 2011 likely due to a major bait fish die-off that was difficult to document, yet still resulted in almost no young surviving that year. Also, Clear Lake, despite having a large population of grebes on the lake each year and an increase in the number of active nests over the study period, the level of predation by crows and gulls has intensified and the number of nests destroyed by the wind has increased, contributing to low reproductive success. A parallel increase in the proportion of open water nests, probably due to decreasing water levels in the lake, may increase the vulnerability of grebes to nesting failure from avian predation and wind-generated waves.

Besides predation pressure, the annual survey effort of the reservoir lakes, Almanor, Davis, Antelope, and the Thermalito Afterbay, has resulted in excellent data on the impact of water level changes that, at times, can be dramatic and have devastating effects on grebe reproductive success. Plumas Audubon, particularly, is in a strong position to show how Lake Almanor water level changes are directly impacting grebe nesting success that could be defined as the “take” of protected species. A report to PG&E is likely to be completed in 2014.

Additionally, disturbance surveys were conducted at each lake for the entire study period to better understand the various pressures the grebes are facing from natural and human sources, and in most cases and in most years, the chapters conclude that natural predation, water level fluctuation, wind, and food abundance (although not measured) have a greater level of impact on the birds than human disturbance by boaters, kayakers, dog walkers, and planes, which had a minimal effect on nest success.

Our work on six northern California lakes documented and advocated for close to 70% of the known breeding *Aechmophorus* grebes in northern California (Ivey 2004). We have also reached thousands of residents of the lake communities and over 3,000 students who are the future of these communities. Overall we have enacted an effective campaign against human-caused disturbances at the colonies including reducing the effects of boats, boat wakes, kayaks, jet ski and waterski disturbance, and intrusion of fisherman into breeding colonies. Additionally, we are working towards further integration of grebe colony conservation into water level management of two reservoir systems at Lake Almanor and Thermalito Afterbay that protects nests from becoming stranded due to water level drop. We have also helped successfully lobbied for the closure of the Bly Tunnel at Eagle Lake, which has been slowly syphoning off water from this terminal lake since the mid-1950s. Closing the tunnel will help increase water levels at Eagle Lake and contribute to grebe nesting success well into the future.

This project has also helped develop essential partnerships within lake communities that directly affect grebe nesting success. The Department of Water Resources has become a key partner at Clear Lake and Thermalito Afterbay and a major supporter of grebe colony conservation. Rotary Clubs, elementary schools, and community development councils at many of the communities near our study areas have rallied around grebes and the need to protect and appreciate them.

The data we have been able to collect through surveying the grebe colonies has created a regional monitoring network of grebe breeding results. . We now have access to one of the best datasets on breeding grebes in the western states that also couples nesting success with quantified disturbance events. Identifying the threats to

nesting grebes has created the opportunity for Audubon chapters to develop conservation strategies based on their survey data.

Since 2010, we have observed more grebe adult grebes using our project lakes with a peak of over 18,000 birds in 2012. Despite having more adults, we are not seeing a corresponding relative increase in young being produced. From our disturbance surveys, several different factors seem to be affecting different lakes.

At Clear Lake, the limitations seem to be extensive wind-generated waves destroying nests as well as heavy predation pressure from American Crows and California gulls. At Lake Almanor, water level drops as well as predation seem to be the main factors limiting production of young. Other lakes such as Lake Davis, Antelope Lake, and Thermalito Afterbay appear to be able to produce a healthy number of young relative to the number of adults that are present. Eagle Lake is affected by natural water level drops and the availability of nesting substrate. Direct human disturbance appears to remain a minor issue at most colony sites. Other human factors that have not been thoroughly measured may be negatively influencing nesting success. Water level fluctuation has been measured in this study and is a major human-induced disturbance factor affecting nesting success.

The lack of young on these lakes is a concerning trend that requires Continued monitoring is needed to track the number of young produced on each lake. We have been refining the way in which reproductive success is measured because of the large number of non-breeding grebes on the major lakes. Clear Lake is the most evident example of large portions of the adult population not being representative of the breeding population on the lake. Obtaining a young per nest attempt calculation would be a more accurate way of measuring reproductive effort and success. We are developing strategies to count nests, which includes use of wildlife cameras, refined sampling protocols, and modeling.

Despite needing more accurate measurements of reproductive success, it is quite clear that one of the major disturbance factors affecting grebes is water level fluctuations. The data that has already been collected in this study presents a clear picture of these impacts and the development of water level management protocols should not be delayed, particularly on Lake Almanor. Grebes are protected under the Migratory Bird Treaty Act and stranding nests due to human-manipulated water level drop can be defined as the take of nest, eggs, and young. Therefore, we recommend using reproductive data to advocate with power producers to incorporate the needs of grebes into water level management during the summer breeding season. Plumas Audubon will be at the center of these negotiations going forward with support from the rest of project members.

Outreach to the power companies as well as the lake communities has been a major part of this project with thousands of community members being educated about grebes and their conservation importance. Outreach is a long-term investment that is paying short-term dividends with increasing community support of grebes. We are going to need this support to make large-scale changes in behavior if there is an interest in addressing some of the disturbance factors such as water quality improvements, heavy metal reduction, water level fluctuation, and boat disturbance. Already we are seeing a decline in boating disturbance incidences that may be a result of the signage, presentations, and outreach actions conducted by the Audubon chapters. We recommend that outreach efforts continue at these lakes to take advantage of the groundwork and relationships that have been developed with a focus on getting communities to rally around specific conservation actions that will positively influence long-term conditions for nesting grebes (i.e. improving water quality and quantity).

One result from our study is the consistently low rate of reproduction at Clear Lake. Our other study lakes have shown relatively successful reproduction in at least one of the years of the study. This could partially be explained by the large number of non-breeding adults at the lake; however even considering just the number of nesting attempts observed each year, the number of young observed is quite low. Moreover, Clear Lake is hosting a very large proportion of the grebes observed in our study and thus improving the overall success rate of our study population.

In conclusion, we recommend additional years of field work to increase the sample size and accuracy of our conclusions on all study lakes. Strong correlations between water levels and nest success will require additional years of data in order to accurately determine the necessary minimum and maximum water depths that allow for successful nesting and continued use of these lakes a the major breeding lakes for grebes in northern California.

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Acknowledgements

Audubon California and the three participating chapters would like to thank the Luckenbach Trustee Council for funding this project for the past 3-1/2 years, and we look forward to working with the Council into the future. We would also like to thank the numerous volunteers in each of the chapters who have helped with monitoring colonies and outreach to student and lake communities. We have also received a significant amount of support from the Department of Water Resources at Clear Lake and Thermalito Afterbay, for which we are very appreciative. Plumas Audubon would like to thank Pacific Gas and Electric, the United States Forest Service, the Lassen County Planning Department, the Collins Pine Company, the California Department of Fish and Wildlife, the Lassen College Foundation, Friends of Eagle Lake Trout, Eagle Lake Fishing

Appendices

Appendix A: Organizations affiliated with Grebe Conservation Project

Lassen College Foundation
Susan River Watershed Group
Lahontan Basins Integrated Regional Watershed Management Group
Feather River Integrated Regional Watershed Management Group
Feather River Coordinated Resource Management Group
Pacific Gas & Electric
Collins Pine Company
Lassen Land and Trails Trust
United States Forest Service
Bureau of Land Management
Feather River Publishing
4-H
Girl Scouts of America
Boy Scouts of America
Future Farmers of America
Indian Valley Recreation and Parks District
Central Plumas Parks and Recreation
Almanor Parks and Recreation District
Sierra County Wilderness Challenge
Lake Almanor Country Club
Lake Almanor West Community
Sierra Institute for Community and Environment
Pine Creek Coordinated Resource Management Program
Westwood Family Resource Center
Lassen Family Services
Lassen County Office of Education

Plumas County Office of Education
KJDX Radio
Rotary International
Mountain Meadows Conservancy
Feather River Land Trust
Almanor Basin Watershed Advisory Council
Feather River College
Friends of Eagle Lake Trout
Lassen County
Long Valley Charter School
Greenville Outdoor Adventure Learning
Lake County Record-Bee newspaper
Bay Nature magazine
Snow Goose Festival
Heron Festival
Olive Festival
Earth Day
Wild West Days
Middletown Days
Pear Festival
Clearlake Chamber of Commerce
Hidden Valley Garden Club
Clear Lake Advisory Committee
Lake County Land Trust
Sea Scouts Troop Lake County
Clear Lake High School
Pacific Union College
County of Lake Department of Water Resources
Butte College
Chico State University
Gateway Museum
Chico Creek Nature Center
Gridley Elementary School
Sierra View Elementary
Oroville Bird Street School
Oroville/Palermo School
Thermalito Nelson Avenue School
Thermalito School District
Department of Water Resources – Thermalito Afterbay
Sacramento River Preservation Trust

Appendix B: Select Media Pieces on Grebe Conservation Project

Clear Lake article, 2013

Bulletin, Record, Progressive, Reporter

Lassen National Forest firefighters from Engine 16, out of the Almanor Ranger District, install an informational sign near Lake Almanor. The signs are part of Plumas Audubon's efforts to education the public about grebes. Photo courtesy Plumas Audubon

New signs to educate lake users about grebes

The Plumas Audubon Society has been busy installing interpretive signs at selected locations on Eagle Lake and Lake Almanor. These signs are designed to inform lake users about the unique traits of western and Clark's grebes, which are migratory diving birds that come to local lakes during the summer.

They travel from their wintering grounds along the Pacific Coast in search of lakes and marshes where they come to hunt small fish, build their floating nests, mate and raise their young. Plumas Audubon has been contributing to a statewide effort to increase the nesting success of these birds.

To achieve this goal Plumas Audubon has taken a multi-dimensional approach. Workers monitor grebe populations throughout the summer breeding season on Eagle Lake, Lake Almanor, Mountain Meadows Reservoir, Antelope Lake and Lake Davis; study their

birds and increase the total number of young that survive their first year. If this is the case, then there is a good chance that the grebes' total population will also increase over time.

Plumas Audubon has worked with the United States Forest Service and the Collins Pine Co. to select high-visibility locations for these signs. In addition to sites that receive a lot of traffic, they also worked to select sites that provided visitors with a good chance of observing the grebes while in the vicinity of the sign.

Grebes were observed during the installation of each of the four signs. Plumas Audubon encourages everyone to take the time to visit one of the signs, and while there, to look around for a grebe.

On Lake Almanor the signs are located at the causeway near Chester on the south side of Highway 36, at the Canyon Dam boat ramp and the West Almanor boat ramp. On Eagle Lake the sign can be seen at the marina on the south shore.

Plumas Audubon thanks Audubon California, the California Department of Fish and Wildlife Office of Spill Prevention and Response, the United States Forest Service (Ann Carlson, Michelle Ahearn, Soai Talbot, Jim Rust and the guys on Engine 16), the Collins Pine Co. and the Luckenbach Trustee Council Oil Spill Liability Trust Fund for making this project happen.

To learn more about this project or to get to know more about Plumas Audubon, visit plumasaudubon.org. New members are always welcome. Plumas Audubon is involved with a wide array of bird-related projects throughout the upper Feather River watershed and anyone can get involved; contact Nils Lunder, outreach and education coordinator, at nils@plumasaudubon.org.

Plumas County News, 2013

Audubon Society leads outreach program for chil

Jordan Clary
Staff Writer
jclary@lassennews.com

The water has dropped in Eagle Lake and the effects are reverberating around its vicinity. The tule grasses, which grow along the water's edge, have dried and that's a problem for the grebes.

Grebes like to either build floating nests or nests in plants where they can swim up to them. Last year there were 1,500 nests in Eagle Lake. This year, according to Nils Lunder, a biologist and outreach coordinator for the Plumas Audubon Society, there's a good chance there won't be any.

On Aug. 8 Lunder and Liz Hauner, an intern at Plumas Audubon, led a group of local children on an educational tour around Eagle Lake.

The outing was a pilot project Plumas Audubon is hoping to continue year after year.

"We want to develop a program that will offer kids a different perspective on the environment and how the local habitat supports wildlife and birds. Basically, we're trying to get people engaged by doing things outside where they can enjoy and appreciate the outdoors," said Lunder.

The grebes were the focal point of the outing. Oil companies, to help compensate for the damage grebes have suffered due to ocean oil spills, funded the grebe pro-

Erin Nickell, left, Leanndra Harper and Serena Polzak look for raptors in the cliffs behind Eagle Lake. Photo by Jordan Clary

he said. "They're very adaptable. Historically, if the lake is deeper, there is so much more nesting habitat. All this tule grass is just waiting, but it can't thrive without water, so when the water comes up, there will be more nests."

While the purpose of the trip was to learn about

gether here. The Cascades are a huge geological province with its rounded volcanoes. The energy that feeds the volcanoes is from plate tectonics where you have the oceanic plate diving under the continental plate. The Sierra Nevada is another province.

The Diamond Mountains

about ancient Lake Lahotan and some of the geological history of Eagle Lake.

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For more
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plumasaudub

Plumas Audubon launches new summer youth program

James Wilson
Sports Reporter
sports@plumasnews.com

The importance of birds in Plumas County is undeniable. The area is seated in one of California's main reservoir areas, and birds play an important role in deciphering the health of our planet. Due to their long distance of travel and exposure to many different ecosystems, birds act as a barometer for the earth. If birds are in trouble, so are humans.

The Audubon Society recognized the crucial link birds and humans have more than 100 years ago. Conservation and preservation have always been the mainstays of the Audubon Society and Plumas County's chapter is no exception.

Plumas County's chapter focuses extensively on tracking the behavior of birds. When asked what some of the Plumas Audubon Society's greatest achievements were, Nils Lunder, volunteer for the chapter, said, "The main things this chapter is proud of are their monitoring efforts and their different conservation programs. They've been involved with developing nesting habitat for burrowing owls ... and a lot of community outreach programs."

One such outreach program is the new Summer Outings for Youth. The first outing took place July 18 with a trip to Lake Davis. Lunder and fellow volunteer David Hamilton drove out to Lake Davis with Sierra County's Wilderness Challenge group. Wilderness Challenge is an alcohol and other drug abuse prevention program that gives youths ages 8 – 18 healthy activities in which to participate throughout the summer.

Right after arriving at the Lake Davis Dam, the kids participating in the program were treated with the sight of an osprey snatching up a trout from the lake and flying it back to its nest. Lunder and Hamilton talked to the children about the different living habits of osprey: why osprey always nest near water, how they hunt and how long they keep their nests.

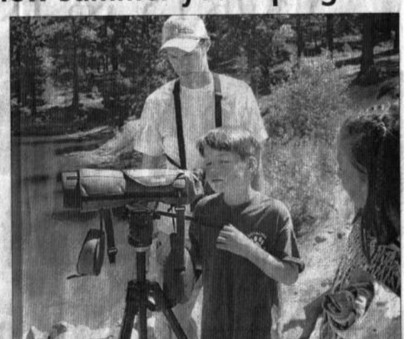
Lunder brought the kids to the shore where he pointed out several species of birds that were viewable with binoculars. After giving the kids a chance to see all the birds, Lunder talked about the importance of observation and record keeping in the field. Later in the day the group enjoyed a free and healthy lunch while exploring the lake and spotting more birds.

"The purpose of the program," Hamilton said, "is just to get more kids out and involved in the natural environment and kind of spark interest. To provide something that's healthy and educational. To get them out in the woods and see some of these things that a lot of them really don't know are here."

There are four more outings listed on the Plumas Audubon website. On Aug. 1, the society will be taking kids out to Eagle Lake. Aug. 13 provides an outing to Lake Almanor, and on Aug. 14 and 15 the outing will be back at Lake Davis. There may be more trips planned this summer, however, so everyone is encouraged to check the website frequently for updates. All trips in the Summer Outings for Youth program are completely free to attend.

The Plumas Audubon society is fully funded through membership. Those who are already members of the National Audubon Society and have a Plumas County address are automatically members of the Plumas chapter. Those interested in joining the Plumas chapter can contact Darla DeRuiter at 283-2939. Membership is $20 per year and includes the Audubon Society's monthly magazine along with the Plumas chapter's monthly newsletter.

Those interested in the Summer Outings for Youth program or volunteering their own time are invited to visit plumasaudubon.org or contact David Arsenault at 283-0455.



Keith Miller checks out a bird through a telescope while Brianna Roen patiently waits for her turn. Roen and Miller both participate in the Wilderness Challenge Group. Photo by James Wilson

Plumas County News, 2012

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LAKE ALMANOR COUNTRY CLUB

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501 Peninsula Drive • Lake Almanor Peninsula • California 96137

VOL. 18 NO. 4 THE OFFICIAL PUBLICATION OF THE LAKE ALMANOR COUNTRY CLUB JULY 2011

HELP SAVE LAKE ALMANOR'S BEAUTIFUL GREBES

By Leslie Larson, LACC & Plumas Audubon member

Did you know that Lake Almanor is home to one of the last sizeable populations of Western and Clark's Grebes in California and the West? You may have heard their gentle call near shore in late afternoon or seen them swimming and diving while out on your boat.

On Friday, July 22, at 10:00AM in the conference room at the LACC office on Peninsula Drive the Plumas Audubon Society is hosting a presentation about our grebes. Come and find out what makes them so special and how you can help this elegant, but vanishing, species survive on our lake.

Grebes have evolved a very unique lifestyle, which is now in jeopardy. In many ways, Lake Almanor, along with several other northern California lakes, is their last stand. Grebes live on Western coastal waters most of the year. But, in spring, they migrate to inland lakes to choose a mate and raise their young. Shortly after they arrive, they lose their ability to fly — instead investing all their energy into the breeding cycle.

If you are out on the water in mid-late summer, you may be fortunate enough to see a highlight of the grebes' complex mate selection ritual called the "Rushing Ceremony." In this dramatic and tenderly affecting show, two or more birds rise up and run across the water in parallel display.

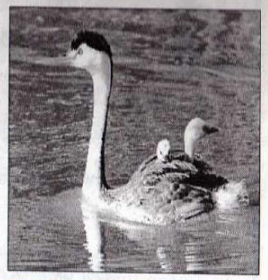
Once pair bonds are established, grebes build a nest from bottom-anchored floating vegetation, well away from onshore predators. The chicks hatch in 24 days and immediately climb onto their parent's backs where they will ride for 2-4 weeks. The water is too cold for nestlings, if they fall in it for more than a few moments.

Western and Clark's grebes are not currently listed as endangered, but their numbers and breeding success are declining sharply. Come and learn more about these beautiful birds that we host on our lake, one of their last preserves. Learn the simple things we can do to help them thrive for years to come.

What: Putting on a Show: The Grebes of Lake Almanor
When: Friday, July 22, 10:00 - 11:00 A.M.
Where: LACC Office Conference Room, 501 Peninsula Drive
Sponsored by: Plumas Audubon Society

What you can do to help the grebes:

Respect nesting marker buoys and give them room - stay 300 feet from colonies
Watch your boat's wake - don't swamp nests or nestlings on parents' backs
Navigate around flocks instead of through them
Avoid boat strikes
Pack out trash like fishing line and plastic



President's Message

Paul Gray

WOW! This year has flown by. Where does the ... three new board members. Welcome to the new ... guides our club on various important ...

LACC Election Results

Barbara MacArthur	751
Tracy Thurber	731
Eileen Kennelly	719

LACC Officers

Plumas County newsletter, 2011

2011 Clear Lake News Article on Grebe Webcam

(printed in full by Lake County's three major news sources)

The story that follows is about an unexpected adventure creating a live-action film whose stars departed while the film was in production!

The stars are Western and Clark's Grebes, birds that breed on Clear Lake in the summer and sometimes stay here year-round. Lake County residents love watching their courtship displays of "rushing" across the water in synchronized pairs. Grebes form large colonies of floating nests made from tule reeds, and babies ride on the parent's back for their first six weeks of life.

Usually the only people who get to see these very unusual bird behaviors are boaters, fishermen, people living along the lakeshore, or attendees who take the annual Heron Festival boat tours conducted by our local Redbud Audubon chapter.

During the past two weeks Redbud Audubon tried to make these sights available to anyone with Internet access, using a web-cam, which is a video camera linked to a computer and then to the Internet. Viewers anywhere in the world could then watch live action of nesting grebes at a grebe colony.

The chapter undertook this experimental web-cam as part of a public outreach grant to educate the public about the need to protect vulnerable nesting colonies during the grebe breeding cycle. This Audubon project is in the second year of a four-year grant. Two other Audubon chapters are doing similar outreach campaigns protecting grebes on nearby lakes. Audubon California obtained the grant from the Luckenbach Trust Council.

The grebe colonies on Clear Lake are usually either in open water or secluded coves without nearby homes. On August 3 Audubon was contacted by John Deiderich about a colony of about 100 nests that happened to be close enough to a row of waterfront homes that a webcam could view the nest areas. There had not been a colony in this location for at least 20 years.

Audubon staff approached the homeowner nearest to the nest area, and Rich Marquez agreed to allow the camera to be set up out on his second-story deck. Audubon learned that this colony had already been nesting for three weeks, which meant that chicks could arrive within days (grebe eggs incubate 28 days). After all the chicks hatch, the grebes desert the nests and move out into the lake to feed. Thus it was urgent to get the web-cam up fast.

Over the next six days, Redbud researched and acquired the needed equipment. Invaluable guidance came from Pete Desimone, Manager of the Starr Ranch Audubon Sanctuary in Orange County. Pete has set up three nest-cams linked to the sanctuary's website (a barn owl nest, hummingbird nest, and black phoebe nest).

DeSimone loaned Redbud a camera, explained exactly what cables and software Redbud needed to buy, advised on uploading the video data with a wireless Internet card, and put us in touch with a firm in Arcata that provides an interface between the uploaded data-stream and our Redbud Audubon website. The streaming firm provides multiple servers so that up to 50 viewers can watch the video simultaneously without crashing the website.

Amazingly, the web-cam went live on August 11, eight days from the starting point! For the first few days, the camera focused on seven nests, and viewers were able to watch grebe parents taking turns sitting on the eggs, bringing food, and adding to the nests with more tules nesting material. Then beginning early this week, Audubon started seeing changes at the web-cam nests. Originally there were seven nests with eggs and sitting grebes on them. Over several days, the grebes began deserting the nests, leaving the eggs unprotected. On Wednesday afternoon, a new pair of grebes appeared, rebuilt a deserted empty nest, deposited new eggs, and began sitting on them..

When the camera was turned on Thursday morning, both the nesting grebe and the eggs were gone. A possible explanation is that an otter family had been seen swimming in the area on Tuesday, so perhaps after the camera was turned off Wednesday night, the grebe parent deserted the eggs, and the otters found and ate the eggs. Audubon birders have seen otters attack grebe nests in the past, so this may be a probable cause for the eggs' disappearance.

But why did the parents desert the eggs before hatching? That question applies not just to the nests being filmed, but throughout the Clear Lake colonies this week. On Monday, Dr. Floyd Hayes discovered that a colony of over 200 nests at Long Tule Point that he monitored last Thursday was now completely deserted. The nests were now pushed together very close to shore, most likely blown there by the winds on the lake this weekend.

Surprisingly, the nests themselves were mostly intact, many with eggs still in them, but no grebes were incubating. The eggs had been deserted by the parent grebes. The grebe project team's sadness and disappointment at this loss was profound. Puzzlement over the cause of this behavior led to a number of email discussions involving Terry Knight and Floyd Hayes. Most probable explanation is that food sources for the imminent babies were insufficient to sustain them. Somehow, Nature senses when this problem occurs, and the birds then do not complete the breeding cycle. However, there may be good news to come.

Terry Knight reports that silverside minnows (a favorite food for grebes) and baby bass are becoming plentiful in the lake, and Audubon has seen a new grebe colony forming at the north end of the lake. It is possible that the grebes will start another breeding cycle that can be completed before migration begins. Last year Audubon saw nesting up into early October, so perhaps all is not lost this year.

But for the moment at least, the web-cam is turned off because there is no activity at that colony area. Redbud Audubon is greatly disappointed because the project team was so excited about being able to share video of newborn chicks being carried on a parent's back while the other parent brought food to the babies.

For now, that is not going to happen. But Redbud Audubon has learned a lot from this experiment, and will try again if nesting returns to the area where the camera was located. And, even though this web-cam had a short life, this was the first time anywhere that a nesting bird web-cam focused on grebes!

Appendix C: Summary of Redbud Audubon Outreach Effort

Summary of Grebe Conservation Four-Year Public Outreach Activities
Clear Lake -- Redbud Audubon chapter

News Media Coverage

Total = 605 column inches

Lake County Record-Bee newspaper Circulation: 5,956

Date	*Page*	*Col.Inches*	*Title of Article*
7/22/2010	pg 1, 3	53	"Don't Rock the Nest"
9/4/2010	pg 1, 2	49	"Babies on Board"
8/20/2011	pg 1	50	"Grebe Webcam Success"
8/24/2011	pg. 7	50	"Grebe Webcam Success" repeat
5/30/2012	pg. 6	18	"Grebe Numbers Down"
7/18/2012	pg. 5	30	"Inadequate Grebe Food"
7/17/2013	pg. 6	29	"Grebes in Short Supply"
8/21/2013	pg. 1	18	"Save Birds: Move a Fishing Line"
10/10/2013	pg. 1	10	"Environmental Update: Grebes"
		307	
	Total exposures		**(9 articles x 5,956 readers)** **53,604**

Bay Nature magazine Circulation: 7,000

April-June 2013	cover and	30	grebe with baby - full page photo
	pg 12-15	120	"Lake County's Hidden Jewels"
		150	
	Total exposures		**(1 article x 7,000 readers)** **7,000**

The Western Grebe
Redbud Audubon chapter newsletter Circulation: 470

Monthly Issue			
November 2010	pg. 1, 3	14	"Grebe Conservation Project is Nov Topic"
	pg. 2	7	"How can YOU get involved with Grebe Project"
February 2011	pg. 3	4.5	"Know Any Teenage Jet-skiers or Water-skiers?"
May 2012	pg. 2	5	"Grebe Conservation Project Begins New Breeding Season"
	pg. 2	3.5	"Educational Signs for County Parks"
	pg. 2	1.5	"Citizen Science Observations"
	pg. 2	2.5	"Need for More Grebe Project Volunteers"
September 2012	pg. 2	7.5	"Progress report on 2012 Breeding Results"
	pg. 2	2	"Grebe Summit Draws Project Teams from Three Chapters"
	pg. 3	7	"Grebe struggles to Escape Fishing Line"
	pg. 3	5	"A Simple Solution to Fishing Line Disposal"
	pg. 5	8	"Grebe Notecards for Sale"
February 2013	pg. 1	14	"Video of Clear Lake Grebes Featured at February Meeting"
	pg 7	18	"Grebe Breeding Results Chart - Four Years, Five Lakes"
		99.5	
	Total exposures		**(14 articles x 470 readers)** **6,580**

Grebe brochure handout

Sept 2010 - Oct 2013	2-sided	48	"Western and Clark's Grebes - Putting on a Show" (360 distributed per year x 3 years) **1,080**

Total exposures in print news media 68,264

Websites and Internet Communications

multiple articles over 3 years		Lake County Online news articles
July 2010 onward	2 minutes	grebe "rushing" video on Heron Festival website
August 2011	3 days	Grebe Nest Webcam streamed online
August 2012	6 days	Grebe Nest Webcam streamed online
August 2012 onward	18 minutes	video of Clear Lake grebes on Y-tube
August 2012 onward		"Amazing Grebes" 4-pg pdf on Redbud website

Summary of Grebe Conservation Four-Year Public Outreach Activities
Clear Lake -- Redbud Audubon chapter

		Year Start Date	July 2010	July 2011	July 2012	July 2013
		Year End Date	June 2011	June 2012	June 2013	Oct 2013
Date(s)	Activity		Year 1	Year 2	Year 3	Year 4
	PUBLIC OUTREACH - TASK 1					
	Grebe Exhibit Booth					
Jan 28-29, 2012	Snow Goose Festival - Redbud exhibit booth			175		
April/May annual	Heron Festival exhibit booth		125	150	100	
April/May annual	Heron Festival guided boat tours		527	515	260	
March annual	Olive Festival		85	100	125	
April annual	Earth Day		100	100	60	
June annual	Wild West Days			75		
March annual	Middletown Days			40		
Sept annual	Pear Festival		400	400	400	
	Total exposures at community festivals		**1237**	**1555**	**945**	
	Presentations to Community Groups					
April/May annual	Heron Days speaker "Those Amazing Grebes"		55	45	65	
2/7/2012	Clearlake Chamber of Commerce			52		
2/13/2012	Hidden Valley Garden Club			37		
4/27/2012	Clear Lake Advisory Committee			21		
7/20/2013	Lake County Land Trust					35
	Total exposures with community groups		**55**	**155**	**65**	**35**
	Chapter Meeting Presentations					
11/18/2010	Meeting topic: Grebe project overview		65			
2/21/2013	Meeting topic: Grebe video and project update					46
	Total exposures at chapter meetings		**65**			**46**
	Regional Meeting Presentations					

March 2011	Hosted first Grebe Summit		25		
August 2012	Presented at second Grebe Summit			28	
Oct annual	NO.CA Regional Council meetings	24	27	25	23
9/28/2013	Audubon CA board members boat tour				10
	Total exposures at regional meetings	**24**	**52**	**53**	**33**
	School Children				
April/May annual	Heron Days kids activities grebe drawing	65	70		
June-Aug 2013	Sea Scouts Troop Lake County			17	17
10/16/2013	Clear Lake High School 9th grade 1:15 class				23
10/16/2013	Clear Lake High School 9th grade 2:25 class				21
	Total interaction with schoolchildren	**65**	**70**	**17**	**61**
	Outreach totals per year	**1,446**	**1,832**	**1,080**	**175**