Western & Clark's Grebe Conservation and Management in California

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Cover photo information: A Clark's grebe with chick. Photograph taken 3 August, 2008 at Cachuma Reservoir. *Photo taken by Kris Robison.*

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Figure 1. Clark's Grebe apparently paired with a Western Grebe at Clear Lake, Lake County, California. *Photo taken on 5 July by Kris Robison.*

I. INTRODUCTION

The present project was initiated in 2005 with Clear Lake as the main focus given its many ecological problems plus years of prior experience working with Western (*Aechmophorus occidentalis*) and Clark's Grebes (*A. clarkii*) and other aquatic species at this location (Suchanek et al. 2003; Cahill et al. 1998; Elbert and Anderson 1998; Anderson et al. 2008). Additionally, the current project has provided multiple opportunities for acquiring grebe-related information as well as to conduct monitoring and management activities.

In the past two years (2007 and 2008 breeding seasons), field observations have indicated poor nesting efforts at what have historically been some of the most important sites for grebe productivity not only in California but also in the Intermountain West. In fact, both species are ranked as "High Concern" in the Great Basin and Sierra Nevada regions of the Intermountain West Waterbird Conservation Plan; and are given a ranking of "Moderate Concern" for the Northern and Southern Rockies regions of this same plan (Ivey and Herziger 2006). Additionally, *Aechmophorus* grebes are granted various levels of conservation concern in other areas throughout their range (**Appendix I**). These concerns are shared by organizations such as the Pacific Seabird Group which initiated a Loon/Grebe Technical Committee in 2005 due to conservation needs and concerns and citing population declines and disturbance as a reason to encourage long-term monitoring and behavioral studies of these birds (Pacific Seabird Group; www.pacificseabirdgroup.org/committees; Joel Schmutz, joel_schmutz@usgs.gov, 2009 coordinator). This all raises concern that poor productivity may be a range-wide problem, not solely isolated to California. In light of these concerns, it is important to re-iterate the goals and objectives of this project and to outline the need to continue this and related work.

Both species of *Aechmophorus* grebes are regularly affected by oil pollution on their wintering grounds off the Pacific coast. It is on the wintering grounds where the populations are presumed to be most affected by direct mortality from oil spills. For instance, grebes were the ranked second among bird species affected by the 2007 Cosco Busan oil spill (Hampton et al. 2008). Additionally, both species rank high in number of oiled birds during most oil spills off of the Northern/Central California biogeographic region (NOAA National Centers for Coastal Ocean Science (NCCOS) 2007). Red tide events off of the Pacific coast also have the potential to negatively impact grebes. In the winter of 2007 Western and Clark's grebes were among the various seabird species beached in the Moss Landing, Santa Cruz, and Capitola areas after such an event occurred in Monterey Bay (Jessup et al. 2007). Due to the difficulty of active protection from such threats on the wintering grounds, it was the goal of this project to help overcome and mitigate this mortality by more effective management and protection on the inland breeding grounds. In fact, Ivey (2004) and Gericke (2006) stated that increasing the overall productivity on the breeding grounds may be the only viable way to help compensate for winter-time mortality and to effectively conserve these species; although *complete* seasonal protection will ultimately be necessary to maintain long-term population viability (see **"***Premise***"** in **Appendix II**).

Of particular concern on grebe breeding grounds is the effect of anthropogenic disturbance on survival and nesting success. Because grebe nesting coincides with the busy boating and water-recreation season in California, disturbance continues to be a major obstacle to grebe conservation on all but adequately protected waters. Due to their colonial nesting behavior, fragile-floating nest structures, and flightless-ness while breeding, grebes are extremely susceptible to disturbance and mortality of chicks during the breeding season (Ivey 2004; Gericke 2006). Additionally, if late nesting attempts are disturbed another attempt may not be made, further compromising productivity (Ivey and Herziger 2006). Susceptibility to disturbance does not end after courtship and incubation has ceased. In fact,

grebes and other colonial waterbirds are still at risk in post-breeding staging areas where they come together in large groups, often with young that cannot escape effectively (Rodgers and Smith 1995; Burger 1998). Furthermore, suggestions have been made that long-term increased levels of disturbance may lead to overall reduced nesting success and therefore affect overall long-term population viability and fitness in many species of colonial waterbirds (Burger 1997; Ronconi and St. Clair 2002; Sardella 2002).

It is the continued mortality experienced by grebes off the Pacific coast, ongoing disturbance at important California nesting lakes, and low productivity documented in both the 2007 and 2008 breeding seasons that validate the idea that continued monitoring and more intensive and dimensional management are both essential and necessary. This necessity indicates that more funding in more areas will be required for adequate future grebe conservation.

II. SUMMARY OF 2008 FIELD SEASON

Surveys for *Aechmophorus* grebes (hereafter referred to simply as grebes) were conducted at multiple inland water-bodies throughout the state of California. Particular attention was given to lakes that historically were known as major nesting locations such as Clear Lake, Eagle Lake, and Lake Almanor (see also Feerer and Garrett, 1977). Similar to the 2007 field season, work in 2008 was expanded to surveys of water-bodies throughout the state to obtain a somewhat complete California-wide census of both adult inhabitants and an estimation of reproduction (2007 Annual Report). Lake Earl, Lake Hodges, East Park Reservoir, and Cachuma and Casitas Reservoirs were several locations where both survey and outreach activities were either newly initiated or continued after being initiated in 2007 (as in the case of Lake Hodges).

Through our past experiences and subsequent surveys, we have a reasonably detailed view concerning grebe productivity in California to better asses the potential of more intensive and aggressive management options, to be detailed later in this report. Our continued monitoring and survey work has proven instrumental in gathering data relevant to the determination of grebe trends in California, including specific management information for several sites. A map of colony locations with relative colony sizes for 2008 was produced for future use by managers and researchers alike (**Appendix V**). Also, the maps submitted in 2007 have been revised and re-submitted (**Appendix VI**). We have also observed numerous interesting ecological findings regarding colony sizes and locations, documented disturbance types and relative intensities, and "brainstormed" future potential management options to benefit grebes and other species supported by wetlands and lakes (**Appendices III-IV,** and **Section IX**).

In addition, the previously developed outreach program, with accompanying brochures and interpretive signs, was maintained and moderately expanded in 2008; with new sign locations at three largely productive water bodies in southern California and one additional location in northern California (see **Section VIII**). Outreach efforts were furthered by the publication of an outreach article in the California Department of Fish and Game's Publication, *Outdoor California.* This article was published in the September/October issue of the magazine (**Appendix VII**).

The format of this report is organized by subject, with relevant information for each lake discussed in that respective section, with the exception of Clear Lake which will be addressed independently.

III. SURVEY METHODS

Ground Surveys

Multiple survey types were used in 2008, including ground surveys. This method involved one or more individuals making observations through the use of a spotting scope and/or binoculars from a nearby vantage point. While using a spotting scope, the observer would call out important information about desired parameters (i.e. brood number and age, species ratio, staining ratio, etc.) while another person would be recording these observations. After one observer had finished assessing a given area, they would then take notes while the other person would assess the same area for confirmation. If binoculars were used, then both people would assess the area and record their respective observations. When both observers had completed their assessments, observations would be compared for confirmation. Ground surveys were used at virtually every location and often in combination with other survey methods. At certain locations, this was the only survey-type of practicality. It was determined that this method was inadequate for accurate censuses at several locations including: Mountain Meadows Reservoir, Black Butte Reservoir, Clear Lake, Berryessa Reservoir, Crowley Reservoir, San Antonio Reservoir, Cachuma Reservoir, and Casitas Reservoir. This method is not recommended at these locations due to their sheer size and/or the lack of adequate vantage points.

Boat Surveys

This method is recommended for data collection which gives the observer the ability to view much of a water-body, yielding comprehensive and accurate results. Additionally, weather-permitting, this method provided the ability to thoroughly census an entire water body in a single day. Boat surveys were conducted in one of two ways. If three people were present, two observers looked out on either side of the boat through binoculars and recorded their observations onto the appropriate data forms, while the third person navigated a pre-determined transect. If only two people were present, one person navigated while the other made observations. In this situation the navigator would provide assistance in areas of high density. Four-hundred meter, fixed-width pelagic transects were used for surveys where applicable. After conducting a transect-survey of this type, the data collected for this area was then extrapolated to the area of the entire lake to get an estimate of overall grebe density. Multiple transects are needed at large water-bodies, such as Clear and Eagle Lakes, due to the tendency of grebes to inhabit certain areas of the lake at greater density than others. Lastly, it should be noted that at some southern California locations, renting a boat was required due to quarantine restrictions in place intended to prevent the spread of invasive Quagga (*Dreissena rostriformis bugensis*) and Zebra (*Dreissena polymorpha*) mussels.

Aerial Surveys

An aerial survey (using a California Department of Fish and Game aircraft) of six northern California water bodies was conducted on 1 August 2008. Waterbodies included in this aerial survey were: Lake Berryessa, Clear Lake, East Park Reservoir, Stony Gorge Reservoir, Black Butte Reservoir, and Thermalito Afterbay. This survey provided insight regarding nesting activity and water-level at Clear Lake. Additionally, confirmation between boat and ground surveys conducted earlier in the season at several of these locations was also provided. It is important to note that this method does require ground-truthing as was the case at Thermalito Afterbay where nests were impossible to see due to the structure and density of nesting vegetation. Aircraft should be maintained as an important method for surveying *Aechmophorus* grebes, as funding allows. Due to the vastness of the state of California this method will surely continue to be an efficient and effective way to obtain data at many water bodies.

Kayak/Canoe Surveys

Kayak and canoe surveys consisted of an observer paddling through an area that would otherwise be inaccessible by motorboat. The observer makes observations through binoculars in order to maintain a comfortable distance from nesting birds, so as to avoid disturbance. Observations are then recorded into a field notebook or applicable data sheet (see 2005 Annual Report for protocol). This method provides the advantage of getting close to the birds, gaining access to tight or shallow areas, and is especially important for nesting surveys. There were no nesting surveys conducted in 2008, as we experienced another year of low productivity at places such as Clear Lake, and did not want to place additional stress on the few nesting birds that were present.

IV. CLEAR LAKE, LAKE COUNTY, CA

Clear Lake historically has, and hopefully will continue to be, one of the sites that has contributed significantly to grebe productivity in California as well as to the Inter-Mountain West. It is often home to the "second-highest concentration" of breeding Western and Clark's grebes in the state of California (Cooper 2004). For example, in 2003 it was estimated that grebes at Clear Lake comprised approximately 13% of California's breeding population (Ivey 2004). Unfortunately, the lake has been subjected to a host of ecological and non-ecological problems that include a Superfund Site at the former Sulphur Bank Mercury Mine and intensive DDD applications to extirpate the Clear Lake gnat (*Chaoborus astictopus*) in the late 1940's and throughout the 1950's (Anderson et al. 2008, Gericke 2006, Suchanek et al. 2003, Elbert and Anderson 1998, Feerer and Garrett 1977). Both mercury mining and pesticide application has had detrimental effects on the Clear Lake grebe population for several years, nearly eliminating it entirely in some years (Suchanek et al. 2003, Cahill et al. 1998; Elbert and Anderson 1998, Feerer and Garrett 1977). Although grebe reproduction at this site has nearly recovered in recent years, it has continued to fluctuate greatly. In some years, as few as 500-600 breeding pairs have been established; while in other years as many as 2,700 pairs were observed (Anderson et al. 2008, Gericke 2006).

In addition to the many ecological problems that have directly affected the grebes, anthropogenic disturbances have and continue to threaten grebe nesting success (Anderson et al. 2008, Gericke 2006, Ivey 2004). Gericke (2006) noted that because the grebe breeding season at Clear Lake extends from as early as April through the end of September, the period of time in which these birds are susceptible to human disturbances is especially extended in comparison to other sites. Further compounding this problem is the fact that Clear Lake is a major summer recreation and tourist destination. Feerer and Garrett (1977) recognized increasing levels of human disturbance to grebes at Clear Lake in years past. Their recommendations for grebe management included the protection of Long Tule Point, an important breeding site on the lake, through the formation of a National Wildlife Refuge. More recently, Gericke (2006) stated that "...there remains concern that this consistent increase in human activity is limiting the general recovery of Western and Clark's grebes at Clear Lake."

Unfortunately, our observations for both the 2007 and 2008 field seasons at Clear Lake did not indicate signs of continued recovery (2007 Annual Report). In 2007, the Clear Lake grebes were, in effect, unsuccessful at establishing nesting colonies that could contribute appreciably to the population (2007 Annual Report). Low reproductive output by the grebes has been documented in years past, but not to the same degree as that seen in 2007, with only 0.0026 YY/AD produced. Given that value, we hoped 2008 would be a rebound year for grebe breeding with close to normal productivity of 0.5 YY/AD (Anderson et al. 2008, Elbert and Anderson 1998). This was not so and Clear Lake experienced another very poor reproductive season for the second consecutive year (**Table 1**). Data were collected

via surveys at various times throughout the season (**see Table 2**). We determined that 25 nests was the maximum effort for Clear Lake grebes in 2008, with a productivity estimate of only 0.006 YY/AD (**Table 1** and **Table 3**).

Reasons for this second year of failure are only speculative. Continued disturbance in the forms of consistent, and likely increasing, fishing and boating pressure without adequate buoys and/or closed zones; recreational activity such as reckless personal watercraft operation, waterskiing, wakeboarding, and tubing; and finally airboat and aircraft activity were presumed to play a contributory role in this failure. Disturbances such as these have been documented as having caused either "nest abandonment, increased egg and nestling predation, nest susceptibility to destruction by boat wakes, modified adult behaviors, and even colony failure" (Koplin 1971; Lederer 1976; Burger 1997; Sardella 2002 *in* Gericke 2006). Additionally, historic nesting colony sites such as Long Tule Point (LTP), Rodman Slough and the Oaks Arm lacked buffer zones, closures, or reduced speed limit buoys in 2008, all of which are accepted and recommended management strategies in combating human disturbance (Ivey 2004; Gericke 2006). Furthermore, herbicide application to stop the spread of *Hydrilla* by means of airboat has been documented as a significant proximate cause of complete colony failure at Clear Lake. For example, in 2002 an entire colony was destroyed by airboat-herbicide application (Anderson et al. 2008). *Hydrilla* control via airboat was active again in 2008, due to the discovery of this invasive plant in certain areas of Clear Lake (Kim Clymire, Lake County Public Works, *pers. comm.*). Though we have no direct observations that such activity negatively affected grebe nesting in 2008, it has been well documented as having done so in the past (Anderson et al. 2008).

Habitat availability was not thought to be limiting at Clear Lake in 2008, as we observed presumably sufficient habitat at several historic nesting locations including LTP, McGough Slough, Rumsey Slough, and Rodman Slough. Again, these nesting locations were not adequately protected with very few previously-established restriction buoys and an absence of closed zones. Additionally all are popular fishing locations or see high amounts of boat traffic. Water levels were low in comparison to previous years in 2008 which, if lowered severely enough, could have potentially prevented access by the grebes to historic nest sites ([1] Lake County 2008, and pers. observ.). Anderson Marsh, a relatively less-disturbed and historic colony location, was relatively dry with reduced habitat available for nesting in 2008, as was evident from our 1 August aerial survey. This is unfortunate because Anderson Marsh remains one of the most protected areas at Clear Lake due to various access reductions, as it is a California State Historic Park ([2] California State Parks).

[1] http://www.co.lake.ca.us/Government/Directory/Water_Resources/Clear_Lake_Information/Clear_Lake_Level_Data.htm

[2] http://www.parks.ca.gov/?page_id=483

Food availability was also not presumed to be a significant factor in the prevention of colony formation and nesting success in 2008, but it may have played a role in 2007 (Terry Knight, pers. comm.), although fish abundance data for Clear Lake (particularly for Thread-fin Shad [*Dorosoma petenense*]) for these years has not yet become available. Grebes were observed at each visit to Clear Lake diving and retrieving fishes; sometimes in large feeding flotillas. Our observations of these large feeding flotillas was not characteristic of foraging behavior commonly observed during the breeding season. In fact, both species "usually forage singly or in pairs during period of mate-feeding just prior to egg-laying and in early brood rearing" (Storer and Nuechterlein 1992).

Table 1. Nesting Activity and Productivity at Clear Lake in the 2000's

YEAR	EST. # ACTIVE NESTS	SAMPLE-SIZE FOR PRODUCTIVITY	PRODUCTIVITY: (YY/AD[1])	REMARKS
2000	2675	1,160	0.76	
2001	925	924	0.65	
2002	445	877[2]	>0.01	Very low #s of young were produced in 2002
2003	275	1,198	0.19[3]	Pop. Estimate is approximate
2004	700	2,380	0.16[4]	Pop. Estimate is approximate
2005	2300	988	0.82	Pop. Estimate from Gericke (2006)
2006	800	1,002	0.72	
2007	20	7,646[5]	0.0026	No large-colony nesting effort was initiated.
2008	25	1,420	0.006	Colony initiation at LTP failed

[1]Young per adult ratio includes all adults within standard transects, with or without young. It represents surveys taken during the period after nesting for the season had been finished whilst also independent young were still distinguishable from adults.

[2]About 85% of these nests were directly trampled by air boat activities in the colony at peak-nesting (DWA field notes, page 3765). This required a re-initiation of agency coordination efforts.

[3]2002 and 2003 were also unusual years in that unprecedented high percentages of non-breeding Clark's Grebes were present on Clear Lake, and large numbers of *Aechmophorus* grebes (presumably non-breeders from other areas perhaps affected by an ongoing drought).

[4]In 2004, a major shift in the largest breeding colony location at Clear Lake occurred (to Long Tule Point), likely related to the development of a large marina and associated canal dredged directly through previously-held, traditional nesting habitat of the 1990s and 2000s (although Long Tule Point had been active in the late-1960s). Also, an early-nesting cohort became established at Clear Lake in 2004, in addition to a late-nesting cohort, which had exclusively dominated nesting phenology prior to 2004.

[5] This sample represents a brood survey conducted 14 September 2007, and is an estimate that we are more confident in than the originally reported sample of 7,646 individuals in the 2007 Annual Report. Virtually all adults were non-breeders displaying winter-time feeding behavior; foraging vigorously in very tight "flotillas".

Colony formation was initiated at LTP on 23 July with 3 constructed nests and 50 adults in close association with the surrounding emergent vegetation (**Table 2**). On our next visit to view that same site on 1 August (**Table 2**) there were no active nests and fewer grebes in the general area. Long Tule Point is a popular fishing location subject to continual disturbance in the form of boating pressure due to a lack of buoys (as usual in the past) to alert boaters of speed limits. In fact, only one buoy and one hazard marker were present in the entire area surrounding LTP during our 2008 surveys, when normally, five or six would be expected. Observations of this disturbance pressure lead to the recommendation to protect this area through the formation of a National Wildlife Refuge (Feerer and Garrett 1977). Due to the temporal proximity of our surveys, and because grebes incubate for a period of 24 days, it is unlikely that these nests produced any young (Storer and Nueuchterlein 1992).

Continued disturbance may have caused these grebes to prematurely cease nesting activity at LTP. Other areas of observed but limited nesting were Rodman Slough Interior and Indian Island (**Table 2**).

Table 2. 2008 Clear Lake Surveys.

Survey Date	Method of Survey	Remarks
27 June 2008	Ground	Samples taken of heavily stained grebes. 5 active nests in Rodman Slough. Air quality very smoky. KMR, REW
5-6 July, 2008	Boat	Lake-wide census. Samples taken of stained grebes, species ratios and overall numbers. No nesting/chicks observed. DWA, KMR, REW.
23-24 July, 2008	Boat (23rd), Kayak (24th)	Colony initiation at LTP- 3 nests & much courtship in area. Many stained grebes seen. 3 nests &3YY seen in Rodman Slough by kayak. KMR, REW.
1 August, 2008	Aerial	Nesting observed at: Indian Island. 5 nests, Rodman Slough Interior. 10 nests. DWA, KMR, REW.
20 September, 2008	Boat	Air show observed near Lakeport with many planes on water taking off & landing near grebes. 8 chicks observed 7/8 & full grown. KMR, REW.

In addition, during each visit to Clear Lake, grebes with a deep orange/brown staining were observed (**Figure 2, Table 2**). Plumage staining was first recorded at a much higher frequency in 2007 than recorded in previous years of this project (2007 frequency = 5.3 ± 1.8%, N=585, 95% CI versus not seen previously). Similar staining was again observed in 2008, exceeding frequencies documented for the 2007 breeding season. The number and intensity of stained individuals seemed to lessen as the season progressed, presumably linked to the intensive preening that these birds were observed performing as well as the normal period of major moult. A sample of 567 grebes was examined for such staining over two days of sampling on 5 and 6 July. Of 88, 15.5 ± 0.02%, were clearly stained. The cause(s) for this phenomenon are still unknown, although several hypotheses have been put forth by us and consulted agency personnel including: weathered-oil staining picked up from the Pacific Coast; iron oxide; copper sulfate or Bluestone™ applied at Clear Lake in 2008 to control *Hydrilla* (Kim Clymire, pers. comm.); and/or diatom staining from the marine environment (**Appendix IV**). It is possible that this staining resulted from the winter 2007 red tide event in Monterey Bay, but we believe this possibility to be unlikely since the dinoflagellate associated with that event produced a yellow/green stain and was water-soluble (Jessup et al. 2007). The staining on grebes at Clear Lake was a distinctive orange/brown and did not appear to be water soluble, as observations of stained birds persisted late into the breeding season (**Figure 2**). On 13 August 2008, eight *Aechmophorus* grebes were collected from Clear Lake with permits provided by the U.C. Davis Wildlife, Fish, and Conservation Biology Museum and funds provided by D.W.A. These specimens will be used for later contaminant analysis. It is hoped that this analysis will shed more light on what caused the staining, and studies are continuing.

Figure 2. An example of the high degree of staining observed at Clear Lake, Lake County, CA in 2008. *Photo taken on 27 June by Kris Robison.*

Because the past two seasons have indicated unsuccessful grebe reproduction at Clear Lake, we intensified our surveys to a nearly state-wide level as was proposed in earlier years of the project (Annual Report 2007). Further exploration and outreach to other parts of California began in 2007 and was continued in 2008 (2007 Annual Report). A census of many lakes across the state was conducted in order to assess overall occupancy and productivity at other locations, as attempts at further law-enforcement was beyond our authority. Intensive work at Clear Lake, in any case, would have unfortunately been futile given the low numbers of breeding birds, but will hopefully prove necessary and beneficial in 2009 and beyond.

V. STATEWIDE NESTING EFFORT SUMMARY

At one time not too long ago, respectable grebe experts in California warned of a potential extinction of grebes on California lakes due to pesticide treatment, habitat loss, and food supply reduction (Feerer and Garrett 1977). Currently the status of grebes in California is perhaps less dire because of a 1992-2006 "resurgence" of grebes at Clear Lake (Anderson et al. 2008). To more fully illustrate recent nesting efforts, we generated a map of both the water bodies surveyed in 2007 and 2008, along with the estimated number of nests produced at each location (**Appendices V** and **VI**). From these maps, it is apparent that California grebe nesting is not currently faced with potential extinction; but it is still evident that grebe conservation and management remains necessary, and needs to be expanded.

Northern California Water Bodies

Northern California water bodies have historically made up the majority of the contribution to *Aechmophorus* grebe productivity in California and continue to include some of the most important nesting areas. In fact, the majority of the larger fresh-water lakes north of 35˚ latitude are hosts to grebe nesting colonies as noted many years ago in California by Grinnell and Miller (1944). Specifically, Eagle Lake, Tule Lake, Clear Lake, and Lake Almanor combined made up 91% of the state's 2003 breeding population of the lakes surveyed by Ivey (2004).

In 2008, we visited 35 northern California water bodies, eight of which had nesting grebes (northern California water bodies designated as those that lie north of the 35˚ parallel; **Table 3**; **Appendix V**). These eight water bodies are estimated to have produced between 1,300-1,500 active nests; a number that would have been dramatically better if Clear Lake had had a successful year. Compared to the southern California lakes below that were surveyed, which produced an estimated total of approximately 500 nests, northern California still represented a large majority of the potential grebe productivity in the state, constituting over 70% of our estimated adult numbers in 2008 (**Table 3**). Furthermore, half (n = 4) of the grebe-producing northern California lakes in 2008 had 100 or more nests associated with them (**Table 3**).

Southern California Waterbodies

Of the 47 water bodies surveyed by us in 2008, 12 of them were in the southern half of the state (water bodies south of 35˚ latitude). Of those 12, six had nesting grebes and these lakes contributed significantly to our overall productivity estimates. In fact, southern California produced approximately 35% of the chicks sampled in the state, indicating a sub-optimal breeding year for grebes in northern California in 2008. Two locations, Cachuma Reservoir and Lake Hodges, were each estimated to contain well over 100 nests (**Table 3, Appendix V**). Both sites have been known in the past to have nesting grebes (Ivey 2004); and based on our visits in 2008, both sites were found to have interesting properties that may allow such nesting activity to proliferate in the future, given active restoration. For these reasons, each site is discussed separately below.

Cachuma Reservoir

This is a flood control reservoir that functions as a multi-use water body; serving as a source for Santa Barbara County municipal drinking water, a recreation destination for boating and fishing, and prime grebe and other wetland species habitat (USBR Cachuma 2008). During our visit on 3 August, we noted boat-exclusion booms that were floated across four different channels to restrict boaters (**Figure 9**). It is in these protected channels where grebes were presumed to be successfully nesting due to sufficient habitat and limited human disturbance. This could not be confirmed because our survey of this lake occurred after young and adults had dispersed from nests. However, if these areas are indeed where nesting occurred, the only disturbance that has the potential to negatively impact future grebe nesting under such conditions would be water-level fluctuations. We photographed one of the protected areas at a road-side vantage point where one could observe the excellent mixed-species wetland vegetation that this area contains (**Figure 3**).

Figure 3. Area of wetland protected from boat traffic by booms at Cachuma Reservoir
Photo taken on 4 August, 2008 by Kris Robison.

Lake Hodges

During both visits to this site in 2008, grebes were actively nesting in the willow habitat that dominates the area immediately west of the Interstate 15 overpass. During the first visit on 5-6 August, approximately 50 nests were present. Nesting activity had increased by the second visit on 24 September, with 100-150 nests.

The grebe nesting ecology at Lake Hodges is rather unique for California and perhaps elsewhere. Some of the nests at this location were built at the intersections of branches of dead willow trees at the point where the branches emerge from the water. The actual nest structures consisted of willow branches and detritus material that the birds were observed diving down to retrieve and then adding to the nest. In addition, in 2008 an especially unusual phenomenon was observed at this location. Multiple grebe nests were seen and photographed situated on a floating, but stationary, wooden platform with each nest containing many eggs (**Figure 3**). Some eggs were out of the nests and rolling freely on the platform, likely because the nest-bowls were not sufficiently deep. This was due to the paucity of suitable nest-construction materials such as tule, cattail, and bulrush (*Scirpus spp.*). On our first 2008 visit to Lake Hodges (5-6 August), two nests were observed being incubated on the platform (**Figure 4)**. At the time of our second visit on 24 September, three nests were being incubated on this platform. This situation strongly suggests that grebes might successfully adopt artificial nest structures such as this as viable nesting substrate, provided that adequate surrounding nest-construction materials are available. It suggests a management technique with potentially wide uses (see **Section IX**).

Figure 4. A nest platform that was adopted by three separate nesting Western Grebes at Lake Hodges. Eggs that rolled out of the nests are clearly visible. *Photo taken on 24 September, 2008 by Kris Robison.*

Table 3. 2008 Grebe Nesting Colony Locations and Productivity

Lakes by North Latitude	Est. # of Nest Attempts	Est. Total # of Adults	# of Adults in Sample	# of Young in Sample	Est. Overall Productivity (YY/AD)	Remarks
Tule Lake NWR	175	500	324	104	0.32	September nesting consistent with previous observations by DWA.
Lake Earl	75[1]	200	120	0	--	Great emergent habitat surrounding entire lake.
Eagle Lake	450	2,500	2,013	1,174	0.58	Lowest water level since 1994 (Rathje 2008)
Mountain Meadows Res.	25[1]	150	50	11	0.22	Aerial survey needed to better estimate # of nests.
Lake Almanor	450+	1,350	42	8	0.19	Water level draw-down may have stranded nests and drastically lowered potential productivity.
Thermalito Afterbay	99	300	300	35	0.12	Data collected by R. Martin (DWR)
East Park Reservoir	70[1]	775	738	76	0.10	Approx. 35 nests in colony at any one time.
Clear Lake	≤25	4,500	1,420	8	0.006	Ongoing disturbances & meager nesting effort; no colonies formed.
Mendota Wildlife Area	--	311	311	150	0.48	Data collected by S. Brueggemann (CDFG)
Northern California	***1,370***[2]	***10,600***[2]	***5,318***	***1,566***	***0.29***	***Productivity estimate represented by sample***
Cachuma Reservoir	275+[1]	900	754	500	0.66	Boat-preventative booms in place near presumed colonies.
Casitas Reservoir	≤5	1,000	919	1	0.001	Reports of "hundreds of chicks" in recent years[3].
Skinner Reservoir	20	100	75	12	0.16	
Lake Hodges	150+[1]	550	302	30	0.10	Active colony near active construction site as of 24 September. Great management potential for floating nest platforms.
Lower Otay	10+	250	187	4	0.02	Olympic waterski training courses throughout lake.
Southern California	***460***[2]	***2,800***[2]	***2,237***	***547***	***0.24***	***Productivity estimate represented by sample***

[1] Number of nests greater than previously reported in Ivey (2004).

[2] These estimates have been rounded.

[3]Reported by Rob Weinerth, Park Services Officer, Casitas Reservoir (pers. comm.).

VI. DISTURBANCES

Northern California

Several northern California lakes experience chronic disturbance in various forms. Three of the most important lakes are discussed below.

Eagle Lake

Eagle Lake is a terminal water basin with no outflow (Moyle 2003), and as such, prolonged drought and evaporation have had a substantial and noticeable effect on water level and available nesting habitat, in our experiences, since about 2005 (Lassen Times 2008). In spite of these circumstances, the grebes were still successful at finding limited, adequate nesting areas in 2008. In addition, several chronic, low-level disturbance events were documented in 2008. A severe example was seen when a dead Western Grebe was found entangled in fishing line with a pole still attached. It is presumed that a fisherman accidentally hooked a grebe and the bird dived to escape, pulling the rod and reel down with it and dying later (**Figure 5**).

Figure 5. An entangled Western Grebe with a fishing pole still attached at Eagle Lake, CA.
Photo taken on 9 September, 2008 by Kris Robison.

Clear Lake

Intense boating disturbances were documented in 2008. In particular, during a 5-6 July survey, heavy boat traffic was observed. This traffic was extremely dense and, at times, was difficult for us to navigate through. During this time, grebes were observed having to dive or scatter in order to avoid

nearly being run over by unsuspecting or unconcerned boaters. Due to the number of boats and water-craft that were present on the lake during this time, there was insufficient refuge, in the form of closed or restricted zones, to where these birds could escape. Additionally, during the same survey period, numerous water-skiers, personal water-craft operators, and fisherman were observed traveling directly through large groups of unsuspecting grebes, some apparently intentional. Later in the breeding season, an air-show was held outside of the city of Lakeport on 20 September. Numerous float-planes were observed performing "touch-and-goes" on the water (**Figure 6**). Large groups of grebes had been present in the area before the show began, but quickly scattered and cleared the area. In each case of disturbance, there were no chicks associated with the groups that were forced to either dive or scatter in order to avoid being hit. In a normal productivity year, the effect of such heavy traffic on defenseless chicks could be substantive (Gericke 2006). For these reasons closed or restricted zones would greatly benefit grebes at Clear Lake.

Figure 6. An air-show held in late September was observed to cause disturbances to grebes.
Photo taken on 20 September, 2008 by Kris Robison.

Lake Almanor

This location is unique in that grebes tend to congregate and nest, both historically and presently, in the northern-most part of the reservoir (Ivey 2004). Shallow water depth combined with dense emergent vegetation limit the speed of boat and water-craft traffic through this area. For these reasons, direct boating disturbance is not a major concern as it is at Clear and Eagle Lakes. Instead, water-level manipulation was the major threat to nesting grebes at Lake Almanor.

Lake Almanor is maintained and operated for its hydro-electric capacity by Pacific Gas & Electric (California Hydropower Reform Coalition (CHRC) 2007; Project 2105 2008), and is drawn down between the months of July through October, which directly coincides with the grebe-nesting season (Project 2105 2008). The adverse effects of such water-level manipulation were also documented by Ryan Martin of the Department of Water Resources at Thermalito Afterbay, and are documented in our 2007 Annual Report. Primarily, this type of disturbance can lead to the abandonment and/or stranding of entire colonies if severe enough, as was the case in 2007. In 2008, evidence of another such stranding event was observed on 21 October while conducting a ground survey for broods from the northwest shoreline of Lake Almanor. Dried nest-remains (n = approximately 80), with some of the nests containing broken egg fragments, were observed at that time. Most notably, surrounding the abandoned colony were the scattered remains of grebe eggs which had presumably been preyed-upon from the abandoned nests by Ring-billed and California Gulls (*Larus delawarensis* and *L. californicus*). We estimated, based on the number of egg-fragments seen and documented, that at least 100-150 grebe eggs were lost from these 80 or so nests due to water-level decline and subsequent nest abandonment and stranding.

Boating activity near the colonies was also observed during both our 10 July and 17 August surveys. Boats were seen motoring close to active grebe colonies on both dates. In each instance, the boats remained on the southern deep-water side of the colonies coming within an estimated distance of 50-100 meters. Observations were made from too great a distance to tell whether any casualties had resulted, or to determine the specific level of disruption. In addition, a kayaker was seen on 17 August paddling within 100 meters of a colony. From our observations of the event, the grebes remained sitting on their respective nests in that colony and did not appear to be alarmed or disturbed. In light of a newly placed sign at the boat ramp located closest to the active colonies, we hope to inform prospective boaters about the grebes and their nesting needs (**Appendix VIII**). Additional management options, including placement of buoys and/or artificial nest platforms in slightly deeper water as well as maintaining high water levels later into the season, should be considered for this location to help mitigate the losses of nests due to stranding.

Southern California

Buena Vista Recreation Area (Lake Webb)

This is a highly confined and heavily recreated remnant of a once expansive wetland region known as Buena Vista Lake, located in the southern San Joaquin Valley (Frederickson 1983). In 1850, Buena Vista Lake was recorded as spanning ten miles in length and five miles in width before it was drained for agricultural production (Dasmann 1965). Following this major alteration, *Aechmophorus* grebes were recorded as "nesting abundantly" at this location (Lamb 1922). Although this ecosystem has been drastically altered and despite the fact that there are now intense boating pressures on this lake, grebes continue to inhabit this water-body in relatively low numbers (**Figure 7**).

During a survey of this location, conducted on 10 August, grebes were observed confined to more "remote" portions of this lake due to these extreme boating pressures. Even the more remote portions of the lake were still subject to a high volume of personal water-craft traffic, but boats were prohibited from these areas, providing some protection from disturbance. We believe that with this amount of disturbance occurring throughout the nesting season, grebes would be unable to successfully nest at this location without the implementation of a speed-limit reduction, no-wake zone, or complete nesting-area closure. Regardless, grebes continue to inhabit this water-body in small numbers with

175 adults documented as present on our 10 August survey. It is due to their continued presence and inadequate nesting habitat availability at this location that this site is recommended for consideration in a wetland restoration program (see **Section IX**).

Figure 7. An example of the high volume and intensity of boat and watercraft traffic that is commonplace on Lake Webb, located in the Buena Vista Recreation Area. *Photo taken by Kris Robison on 10 August, 2008.*

Cachuma Reservoir

In spite of a highly productive breeding season (**Table 3**) in 2008, Cachuma Reservoir was observed to have notable disturbances that could potentially have negative effects on the grebes and their accompanying young chicks. During a 3 August boat survey, grebe broods were widespread on this popular reservoir. Unfortunately numerous speed boats were observed traveling across the water at speeds that were likely much higher than the 40mph speed limit (Santa Barbara County Parks 2008). Not surprisingly, grebes were forced to scatter, dive, or seek refuge in the reservoir's speed-restricted coves (**Figure 8**). This type of disturbance may seem unavoidable on a popular fishing lake but such instances reflect the lack of speed limit enforcement on lakes throughout California.

In 2008, outreach work was expanded to this location. Multiple boat ramp signs were given to the on-site naturalists; Melissa Kelly and Liz Mason, who work at Cachuma Lake Recreation Area (**Appendix VIII**). They wished to take it upon themselves to post informational signs to inform boaters of the dangers they pose to vulnerable grebes.

Figure 8. An example of boat-traffic disturbances that occur on the highly recreated Cachuma Reservoir. *Photo taken on 3 August, 2008 by Kris Robison.*

Lake Hodges

Beginning in February of 2007, construction began on a pedestrian footbridge that spans the grebes' willow nesting habitat (**Figure 9**; San Dieguito River Park 2003). Construction was halted in May 2007, resuming again in fall, to mitigate for listed species that inhabit the region including the Coastal California Gnatcatcher (*Polioptila californica*) and the Least Bell's Vireo (*Vireo bellii pusillus*). In 2008, construction was again halted during the summer as a mitigation measure, but was again resumed in mid-September while grebes were observed still on nests in the adjacent waters. The grebes, which rely on the willow habitat that the bridge spans for nesting substrate, were not mentioned in the Mitigated Negative Declaration submitted to the City of San Diego which only included listed species (San Dieguito River Park 2003). It is unknown whether construction activities directly disturbed nesting grebes in the area. Luckily however, the bulk of construction activities are conducted outside of the peak grebe nesting season.

Figure 9. Lake Hodges willow nesting habitat; picture looking north east. Interstate 15 in the background with a view of an ongoing construction project to erect a pedestrian bridge over existing marsh habitat.
Photo taken on 5 August, 2008 by Kris Robison

VII. EAGLE LAKE GREBE WORKSHOP, 19-21 AUGUST, 2008

Meeting attendees

Participants included: Daniel Anderson, Renee Weems, and Kris Robison (UC Davis), Paul Kelly (Retired, California Department of Fish and Game, Office of Spill Prevention and Response), Laird Henkel (California Department of Fish and Game, Office of Spill Prevention and Response), Colleen Moulton (Idaho Fish and Game), Diana Humple (Point Reyes Bird Observatory), Nanette Seto (United States Fish and Wildlife Service-Migratory Bird Division), Ryan Martin (Department of Water Resources), Amedee Brickey (United States Fish and Wildlife Service), Dave Mauser (United States Fish and Wildlife Service, Klamath Basin National Wildlife Refuges), and Frank Gress (California Institute of Environmental Studies).

This workshop was held in order to bring together agency personnel at the location of one of the most important grebe breeding lakes in the Intermountain West. Due to the extremely low productivity observed in 2007, it was important for a summary of anomalous findings to be presented to funding agencies as well as to bolster inter-agency cooperation for grebe conservation and management. Furthermore, this conference provided an atmosphere in which substantive ideas about the future goals and needs of grebe conservation could be communicated and "brainstormed" (**Appendices II-IV**).

Additionally, another goal of this conference was to provide an update of the last two year's work on the project as well as to provide background on the project's commencement and its continued importance in the future. Issues including future expansion of the current project, optimal management and survey techniques, perspectives from funding agencies and trustee councils, and a discussion of a west-wide colonial water-bird census were discussed (**Appendices II-IV**). Several participants accompanied our field team for a demonstration of survey techniques, but similar demonstrations for additional attendees had to be cancelled due to adverse weather conditions, namely high winds.

VIII. NEW BOAT RAMP SIGN LOCATIONS

In an effort to expand outreach efforts to important southern California water bodies, metal boat-ramp signs were distributed and posted at Lake Hodges and Cachuma Reservoir. Additionally, these two locations, along with Casitas Reservoir, received 8½ x 11 U.V. laminated signs as well as informational brochures. Outreach efforts were also expanded in northern California, where a metal boat-ramp sign was posted at a popular campground on the north shore of Lake Almanor. This sign location was important due to its proximity to the active nesting colonies. In addition, laminated signs and informational brochures were given to the camp's general store for posting (**Appendix VIII**).

IX. MORE INTENSIVE OPTIONS FOR FUTURE MANAGEMENT ACTIVITIES

Although a three-year drought (2007-2008) is expected to continue (www.water.ca.gov/drought/), and almost certainly was exacerbated by the chronic disturbance conditions discussed in this report, the need for more intensive and comprehensive grebe management increases. Although disturbance is seen as the most acute threat to nesting grebes, many other factors contribute to grebe productivity. The past two years of work have shown the effect that lack of suitable habitat (through low water-levels or destruction) and limited food-availability, when combined with disturbance pressures, can have on grebe productivity. For certain locations, this resulted in 2008 having some of the lowest productivity documented by D.W.A. for the past 16 years of study. It is for these reasons that outreach and simply monitoring for disturbance may be inadequate to mitigate for losses experienced off of the Pacific Coast. We recommend that other management options be explored and implemented in order to ensure the longevity of these two species as stressed by Ivey (2004). If the trend of low productivity at Clear Lake continues, a lake which formerly comprised 13% of the state's breeding grebe population, significant population-level declines for these species will likely continue. Therefore it is imperative to expand grebe-oriented management in coordination with overall wetland restoration and management now.

Discussed below are some ideas for alternative management methods. Likewise, please refer to Ivey (2004) for a detailed analysis of related potential management options and even their estimated costs. Of course, none of the following activities will be possible without adequate agency interest and cooperation, and most importantly, adequate funding for efforts over a statewide (and larger) area. Additionally, future efforts would likely be most effective if incorporated into the various Joint Ventures throughout the west (Central Valley, San Francisco Bay, Inter-Mountain West, etc.).

Booms, Buoys, and Enforcement

The implementation of closed zones and restricted speed-limit areas were recommended by Gary Ivey in order to decrease wave-action caused by speeding boats and high wind speeds and also to isolate grebe nesting activities (Ivey 2004). The installation of booms or buoys would aid in this

implementation. Booms are particularly effective in accomplishing these goals because they restrict boat and water-craft access to an area while allowing grebes to dive under to reach isolated nesting habitat (pers. observ.). Another added benefit of booms is wave control, as booms in place at Cachuma Reservoir were observed to calm the water (**Figure 10**). Additionally, buoys with solar-powered light installations are another option in implementing a restricted speed-limit area that would serve as an effective alert for boaters both day and night. Ivey (2004) suggested placing informational signs on the buoys alerting boaters to reasons for closure or speed reduction (see Appendix 3 in Ivey 2004). These buoys have the potential to alert boaters to grebe conservation issues as well as limit boat wakes to avoid swamping grebe nests. Both of these options can be expensive, but may be nonetheless necessary in many areas to minimize disturbance-related pressures on breeding grebes.

Crucial to the success of implementing both breeding-area closure and speed-limit reduction is proper enforcement, which can only be accomplished by persons with adequate delegated authority. With an enforcement presence out on the water, observing grebe harassment taking place and informing responsible parties about the Migratory Bird Treaty Act, disturbance-related issues regarding grebes will be lessened. Such activities at most areas will benefit all marshland wildlife in general, and not just grebes. We believe that outreach materials in the form of brochures and boat-ramp signs, although important, will not prevent all boaters from continued disturbance of grebe nesting colonies. More effectively, an active, uniformed agency enforcement official can bring the topic of grebe (and overall marsh wildlife) awareness to the forefront of a boater's consciousness and allow them to realize that their actions are subject to penalty under state and federal law.

Additionally, restoration of "Species of Special Concern" status for Western and Clark's Grebes in California will be an important, necessary step for the adequate conservation of these two species. At our grebe workshop, many participants wondered why these two species were removed from that list in the first-place. Stated concerns from states and provinces surrounding California should have been enough justification for keeping A-grebes in that category. Such status would improve enforcement and reduce disturbances. Unfortunately, the most recent assessment report of California Bird Species of Special Concern (Shuford and Gardali 2008) makes no mention of Western and Clark's grebes, a decision that should be re-evaluated in light of our recent findings and those of the Intermountain West Waterbird Conservation Plan (Ivey and Herziger 2006).

Cost— These measures, although expensive, will prove beneficial to grebe conservation. Ivey (2004) estimated the cost of buoys at both Eagle and Clear Lakes would be approximately $70,000 each; a total of $140,000 to protect both lake's important nesting colonies. This estimate included installation, maintenance, and 120 days of enforcement for both locations. Boom installation would be more expensive for Clear and Eagle Lakes. For example, the combined estimated cost of wave barrier research, construction, and installation was approximately $114,000 at Clear Lake's Long Tule Point alone (Ivey 2004). Additionally, an estimate for the same brand of boom in place at Cachuma Reservoir was $500,000 for a length of 2 kilometers; the length recommended by Ivey to protect both Clear and Eagle Lake. Included in this cost are anchoring and shipping expenses for both lakes (Worthington Products Tuff-Boom™ 2008).

Collaboration—Although these efforts are somewhat costly, they would have positive ecological benefits, and should be implemented on a collaborative basis. See Ivey (2004) *Recommendations for Selected Sites* for lists of potential participants and funding options. It is essential for the proper agency affiliates to work with lake managers to execute described management tools. Without collaboration amongst the agencies such management activities likely will never be implemented.

Figure 10. An example of booms restricting boat and watercraft traffic to certain channels at Cachuma Reservoir. *Photo taken on 3 August, 2008 by Kris Robison.*

Efforts to Stabilize Water Levels at Managed Reservoirs

The ongoing issue of managed-reservoir water level fluctuation and its negative effects on nesting grebes is a contentious and highly political topic. One example lies in the case of Thermalito Afterbay. At this location we were unable to post signs due to a water-ski course that is situated in the midst of a grebe breeding colony. Other conflicts originate when water managers, such as Pacific Gas and Electric, control the elevation of many of their reservoirs for power generation; or water management agencies control irrigation and other releases from lake-originating reservoirs (ex. Clear Lake, Lake Almanor, the East Park Reservoir system, and Thermalito Afterbay Reservoir). However, with recently observed reductions in the number of nesting grebes in California, continued nesting failures at historically important breeding lakes, compounded by losses from the Cosco Busan oil spill; collaboration and dialogue between agency affiliates and water managers must be initiated. The importance of this recommendation is further illustrated at Lake Almanor. For the past two years, Lake Almanor has been the largest single nesting-attempt lake for grebes in California, and both years have resulted in nest-strandings and failures (2007 Annual Report). Because of the ecological importance of Lake Almanor to nesting grebes and the continued futility of nesting attempts at this location, we recommend that discussions between appropriate agency affiliates and water managers take place in order to help lessen the negative effects of the mid-summer draw-down, at least until grebe young have a chance to leave the nests for deeper water.

Artificial Nest Platforms

Floating nest platforms have been highly successful for Common Loon (*Gavia immer*) management (Piper et al. 2002) and they are beginning to be used in grebe management through the East Bay Regional Parks District (Riensche 2007). Additionally, our recent observations further indicate that they may be a viable management technique for grebes as well. As mentioned above, during a 5-6 August survey of the Lake Hodges grebe nesting colony, two active grebe nests were observed situated on a floating wood structure amongst the willow nesting habitat. We observed numerous eggs scattered on the platform that had presumably rolled out of the two nests (**Figure 4**). The grebes constructed these nests out of willow branches and detritus material. Nest bowls were shallow, the presumable reason why the eggs were able to roll out of them since the area where the birds were nesting is well protected from waves and is inaccessible to boat traffic. In this instance, nesting could be enhanced by the intentional introduction of species such as bulrush or through the transplantation of such materials from other areas of the lake. On our second visit to the colony on 24 September the platform was still present and an additional active grebe nest was situated between the two that had been recorded earlier in the season (**Figure 4**).

The expense of artificial nest platforms has been outlined for structures that are more complex and expensive than what grebes may readily choose to adopt or even need (Piper et al. 2002, DeSorbo et al. 2008). For example, the simple wooden structure at Lake Hodges was readily accepted as a grebe nesting platform. In order to determine what platforms work best for different water-levels, research and prototypes will have to be developed and tested. This finding is promising as a cheaper or supplemental management technique to help increase grebe productivity at lakes where water-level manipulation is an issue. Potential sites of testing and implementation include Lake Almanor, East Park Reservoir, Thermalito Afterbay, and Cachuma Reservoir.

Wetland restoration

Ivey (2004) recommended the transplantation of hardstem bulrush rootstalks to grebe colony areas in order to enhance available nesting materials and to aid in the restoration of important wetlands. Below are more intensive, possible restoration projects that have the potential to have numerous positive effects for nesting grebes and, importantly, other wetland species and even recreational hunting sites for later in the season.

Lake Webb

Lake Webb, located in the Buena Vista Recreation Area (BVRA), is the site of a potential wetland restoration project. The potential site lies to the east of the actual water-body but within the boundaries of the recreation area. This site shows the potential to be converted into a multiple-use wetland to benefit grebe nesting, as well as other bird and fish species (**Figure 11**). Additionally, this site holds the potential of becoming a possible water-fowl hunting and fishing location, potentially providing further revenue for the BVRA in the off-season. Such a project would likely initially be very expensive and would require the coordination and funding of multiple agencies and organizations. Potential supporters of such a project may include Kern County, Ducks Unlimited, California Waterfowl Association, California Department of Fish and Game, U.S. Fish and Wildlife Service, and other independent wetland restoration organizations.

Figure 11. Google™ Earth image of a potential restoration site (seen here in bright green) at Buena Vista Recreation Area, located just east of Lake Webb.

Eagle Lake

Availability of undisturbed habitat is thought by us to be an important limiting factor for grebe reproduction at Eagle Lake. Water-levels at this lake have been declining due to low levels of precipitation, an extended drought, and the continued seepage of lake water through the Bly Tunnel (Lassen Times 2008). Furthermore, during our surveys of this location, much existing wetland habitat was observed stranded on the shore, well above the water-line; currently leaving the grebes with fewer locations to establish nesting colonies. A study conducted at Eagle Lake found that water-level fluctuations are positively correlated with the amount of available emergent vegetation and also affect the time for vegetation to return to a level of suitability conditions (Lederer 1978). This may have negative implications for the now stranded vegetation's return to a state that is suitable for grebe nesting. One possible solution to such limited habitat availability can be seen in the restoration of Lederer Marsh.

Lederer Marsh is an ephemeral wetland on Eagle Lake's eastern shoreline that has the potential to be converted into a permanently flooded wetland (**Figures 12 & 13**). This marsh was documented as formed in 1968 as a result of a rising water table (Lederer 1978). Currently, the marsh is only capable of being watered naturally by Eagle Lake during very high-water years because of natural barriers that prevent this area from flooding. Today the water level at Eagle Lake is approaching an elevation of 5,097 feet above sea level. This elevation stands in stark contrast to the estimated highest-high water elevation of 5,125 feet above sea level before the construction of the Bly tunnel in the 1920's (Rathje 2008; Moyle 2003). According to Google™ Earth, the elevation of the highest barrier into the marsh is 5,117 feet above sea level. For this marsh to naturally become a potential grebe breeding ground, the lake would have to surpass the 5,117 ft. elevation. Based on historical data from Lassen County Public Works and Planning (Rathje 2008), Eagle Lake has not been at an elevation which would allow water to enter Lederer Marsh since the 1920's, making natural flooding a rather unlikely possibility any time in the near future.

Our proposed restoration suggestion would involve creating a channel that would allow water to flow into Lederer Marsh from Eagle Lake proper. The tailings from the excavation of the channel could be used to build a levee road on the south end of the marsh to prevent flooding of the Lassen County Youth Camp. This new permanent marsh would allow tule and cattail (*Scirpus sp.* and *Typha sp.*, respectively) to become established and serve as nesting substrate for grebes and many other wetland species. Additionally, this site would provide a potential duck hunting marsh for recreation in the fall and winter. Again, a project of this magnitude would be extremely expensive. Because of this, the cooperation of agencies and organizations alike would be necessary in order for this restoration come to fruition.

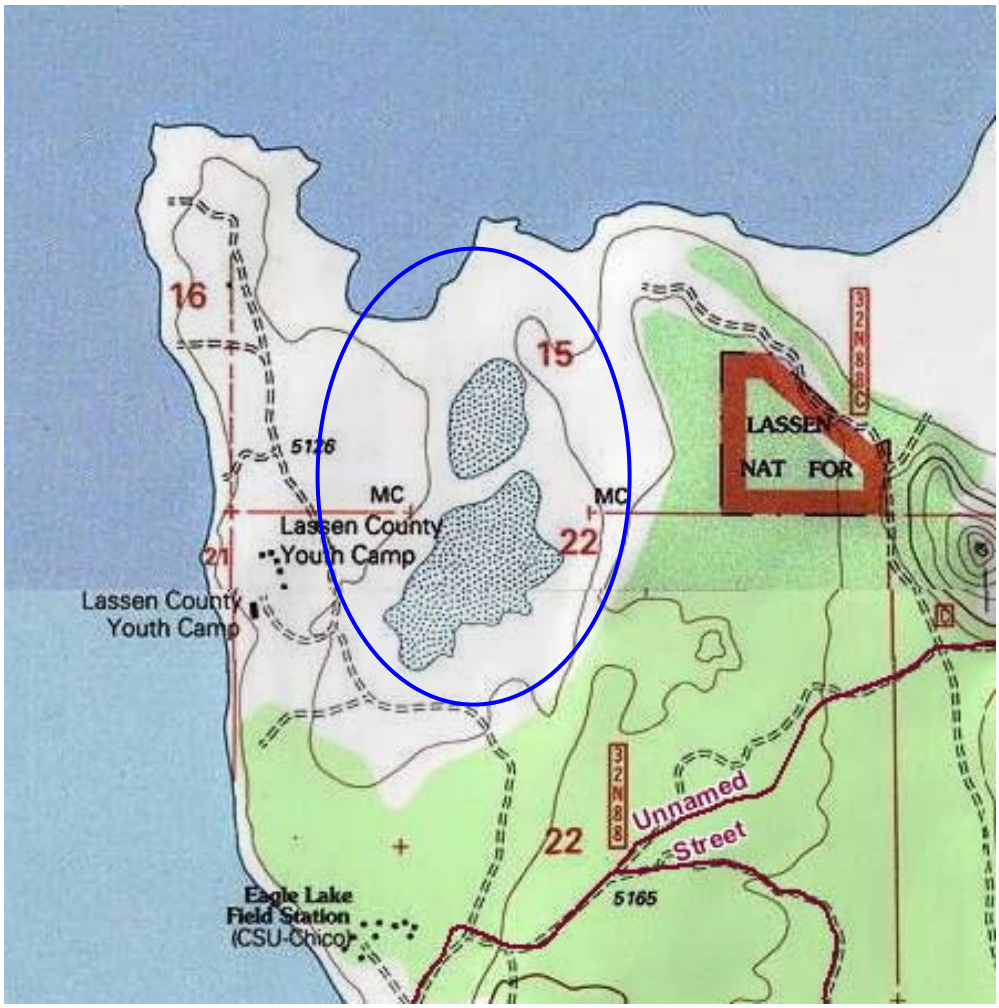

Figure 12. A topographical map of a potential restoration site (outlined in blue) at Lederer Marsh, Eagle Lake, California.

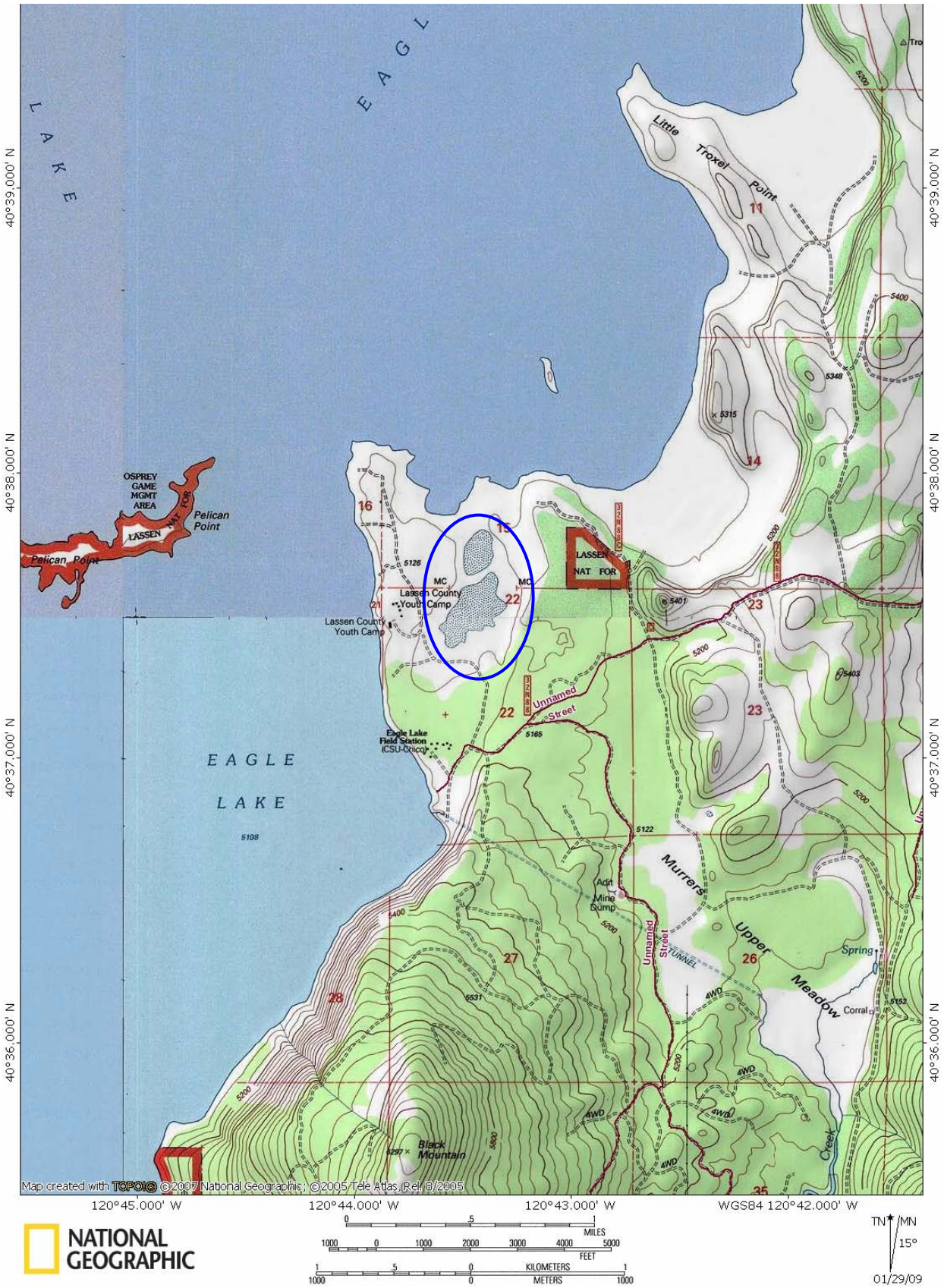

Figure 13. A wider view of the potential restoration site (also outlined in blue) at Lederer Marsh, Eagle Lake, California.

Fishing Line Disposal Receptacles with Accompanying Conservation Stickers

Due to the documentation of numerous grebes entangled in fishing line, the need for easy and proper disposal of fishing line would also serve to benefit these birds on their breeding grounds; as well as providing the added benefit of clean waterways. This simple measure would also protect other wildlife species from ingesting littered fishing tackle which has been shown to contribute to lead poisoning in many waterbird species (Rattner et al. 2008). Containers placed at boat ramps for the collection and recycling of fishing line are a possible way to deal with such entanglements and to encourage proper disposal of not only fishing line but also lead fishing weights (**Figure 14**). This type of measure can be immediately implemented at the marinas of all grebe breeding lakes in California to help mitigate the losses of grebes due to entanglements. Also for our purposes, a conservation-oriented sticker can be designed and placed on the disposal canister to inform fishermen about the importance of properly discarding old line and tackle.

Figure 14. An example of a possible design for a fishing line receptacle; a potential management technique to prevent entanglements of numerous wildlife species. *Photo courtesy of Liz Weems.*

X. CONCLUSION

Through our 2008 survey of forty-seven lakes throughout the state of California, we have again documented a year of decreased *Aechmophorus* grebe productivity. Like the 2007 breeding season, this trend was more severe at northern California lakes such as Clear Lake, Lake Almanor, Mountain Meadows, and Thermalito Afterbay. Some of these lakes have historically been home to the larger grebe breeding colonies of California. Clear Lake in particular experienced major declines in successful nesting attempts and for the second consecutive year had a productivity estimate of below 0.01YY/AD, well below the normal productivity level of 0.5YY/AD. In addition, continued disruptive or anomalous events have been documented by us and others as directly affecting *A.* grebes including: a high frequency of staining; a red tide event in Monterey Bay resulting in *A.* grebes being stranded or beached; fishing-line entanglements; winter-time foraging strategies at breeding lakes; the Cosco Busan oil spill; extreme disturbances through boat, water-craft, and air-show traffic; and intense water-level manipulations, and continuing drought conditions. These events have heightened our sense of concern over the conservation status of *A*-grebes in California. This concern is echoed throughout the Intermountain West, Washington State, British Columbia, and many other locations within these two species' ranges where they are currently granted various levels of conservation concern. Special concern is also shared by organizations such as the Pacific Seabird Group, which itself initiated a Loon/Grebe Technical Committee in 2005.

Despite these less-than-encouraging findings, there were some positive notes to the 2008 breeding season. For instance, Eagle Lake displayed a rebound in nesting and productivity, up from the 92% reduction in productivity documented in 2007 (2007 Final Report). In fact, in 2008 the productivity for grebes at this location was slightly above the normal level of 0.5 YY/AD, and was estimated at 0.58 YY/AD. Additionally, several southern California waterbodies displayed great promise for nesting grebes in the future, especially through management. Cachuma Reservoir had high levels of productivity, estimated at 0.66YY/AD, and contained large areas of water closed to boat traffic. In comparison Lake Hodges, did not produce as many young, but did show the potential given future management activities. Also, because Clear Lake had another disappointing year, our outreach efforts were further expanded to include more southern California lakes. In addition, the publication of an article in *Outdoor California* will also aid in informing the public about grebe nesting needs. Lastly, a 2008 Eagle Lake Grebe Workshop allowed agency personnel to come together to discuss and brainstorm grebe-related issues.

Although *A*-grebes in California have recovered somewhat from historically-reduced population levels (claimed by some as teetering on the brink of extinction), and most likely this was related to large-scale wetland destruction following water-management projects in the first part of the 1900s, expanding human populations and their outdoor activities on small, limited wetland areas dictates that much more conservation work needs to be done. Public outreach is an essential and relatively inexpensive tool to help aid in the conservation of these species; but with continued high levels of disturbance, oil spills, habitat loss, and water-level fluctuation, more intensive management options will be necessary in the future to maintain healthy grebe (and other wetland) populations. Restricted speed-limits or boating exclusions near known nesting colonies would provide much needed protection from disturbance to nesting efforts. To combat habitat loss, water-level stabilization at managed reservoirs during peak nesting times would be a necessary step to stop nest abandonment. Grebe-specific artificial nest platforms, already in use in some areas, are promising as a management technique with wide-spread uses. A more expensive alternative to combating habitat loss is wetland restoration at sites such as Eagle Lake and Lake Almanor. Lastly, fishing line receptacles at marinas

have the potential to benefit grebes and numerous other wildlife species in a cost-effective manner. Accompanying these management options is the need for more funding and inter-agency cooperation.

In conclusion, 2008 was a year of decreased nesting efforts and productivity at lakes that have historically been important contributors to the *Aechmophorus* grebe population of the American West. Although several locations were documented as having above normal productivity estimates, it is clear that most former highly productive locations are in a current, perhaps temporary, state of decline. For these reasons, however, more intensive action will be still benefit these stressed populations. Most importantly, more widespread monitoring is necessary in the short-term in order to determine if this is a continuing trend, and to provide a more complete inventory of just how much of this resource we still have.

XI. ACKNOWLEDGEMENTS

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Diana Humple. Biologist. Point Reyes Bird Observatory. Conservation Science.

Terry Knight. Outdoor Columnist. Lake County *Record Bee*.

Ryan Martin. Staff Environmental Scientist. Department of Water Resources.

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Rob Weinerth. Park Services Officer. Casitas Municipal Water District.

Appendix I Recent conservation listings in both Canada and the United States

Location of Listing	WEGR	CLGR	Status of Listing	Reason for Concern	Information Obtained From
Canadian Provinces					
Alberta	X		-Listed as Sensitive in *The General Status of Alberta Wild Species 2000*	- Lack of data - Sensitivity to human disturbance - Habitat degradation	Alberta Sustainable Resource Development & Alberta Conservation Association (2006)
British Columbia (B.C.)	X		- Listed in B.C.'s Wildlife Branch's ***Red List*** for species that have or are being considered for Endangered or Threatened Status - Provincial rank: **S1B,** extremely rare in breeding season	- Human disturbance - Water-level fluctuations - Extinction of important breeding colonies	Burger (1997) & Fraser et al. (1999)
Manitoba	X		- Listed as **Rare** in the Manitoba *State of the Environment Annual Report* - A rare species is defined as one that has a restricted range, occurs sparsely over a wide area, or is declining in numbers	- The cumulative effect of pesticides in the environment - Disturbance	Manitoba Conservation Department (2009)
Saskatchewan	X		- Listed as **S1B**; extremely rare in breeding season, critically imperiled; may be especially susceptible to extirpation or very few remaining individuals due to some factor of its biology.	- Not provided	Saskatchewan Environment (2003)
United States					
Arizona		X	- Classified as **Wildlife of Special Concern** (WESC) in Arizona 2008 - Listed as a **State Candidate** in 2003	- Occurrence is or may be in jeopardy, or with known perceived threats or population declines.	Arizona Game and Fish Department (2003)
California	X		- Not considered in 2008 - Listed as possibly declining, candidate species in 1978	- More information needed	J.V. Remsen, Jr.(1978) and Shuford & Gardali (2008)
Colorado	X	X	- Not listed as of 2007	- Not applicable	Colorado Division of Wildlife (2007)
Idaho	X	X	- WEGR listed as a **Rare** animal species in 5 out of 10 wetland areas in 2005 - CLGR listed as **Rare** animals species in 2 out of 10 wetland areas in 2005 - Breeding populations of both species listed as an **Imperiled** - Both listed as **Protected Nongame Species**	- Water quality - Water fluctuation - Disturbance - Pesticides	Hahn et al. (2005) & Idaho Department of Fish and Game (2005)

Appendix I Continued

Location of Listing	WEGR	CLGR	Status of Listing	Reason For Concern	Information Obtained From
Kansas	X		- Listed as a species of **Greatest Conservation Concern**	- Rare within the state - Population decline over the past 40 years	Wasson T.L et al. (2005)
Minnesota	X		- Listed as a species in **Greatest Conservation Need** in both the Prairie Parkland and Eastern Broadleaf provinces - Not listed on a state-wide level, but suggestions for listing have been made	- Declining Minnesota population - Declining habitat - Nesting failures	Minnesota Department of Natural Resources (2006)
Montana	X	X	- Not listed as of 2006	- Not applicable	United States Fish and Wildlife Service (2006)
Nebraska	X		-Listed as a **Tier II State Vulnerable** species	- Not provided	Schneider et al. (2005)
New Mexico	X	X	- Not listed as of 2006	- Not applicable	New Mexico Department of Game and Fish (2006)
Nevada	X	X	- Both species listed as **Species of Conservation Priority** - Both species listed as **S4b** which indicates that their breeding populations are apparently secure but there is some cause for long-term concern due to declines and other factors	- Only 200 WEGR breeding pairs; 300 CLGR breeding pairs - Disturbance - Water level fluctuation	Wildlife Action Plan Team (2006)
North Dakota	X	X	- Not listed as of 2005	- Not applicable	Hagen et al. (2005)
Oregon	X	X	- Not listed as of 2006	- Not applicable	Oregon Department of Fish and Wildlife (2006).
South Dakota	X		-Listed as a **Priority III,** moderate conservation priority	- Habitat loss/fragmentation - Human disturbance -Water level fluctuations -Botulism outbreaks	Bakker (2005)
Texas	X	X	- Not listed as of 2003	- Not applicable	Campbell (2003)
Utah	X	X	- Not listed as of 2007	- Not applicable	Utah Department of Natural Resources (2007)
Washington	X		- Listed as a species of **Greatest Conservation Need**	- Oil spills - By catch in gill net fishery - Human disturbance - Loss of prey base	Washington Department of Fish and Wildlife (2005)
Wyoming	X	X	- Listed as a species of **Greatest Conservation Need**	- Water level fluctuation - Human disturbance	Wyoming Game and Fish Department(2006)

Appendix II

Prepared: 13 August 2008

AECHMOPHORUS GREBE CONSERVATION: 2008 AND BEYOND

MEETING AGENDA, 19-21 AUGUST 2008

EAGLE LAKE FIELD STATION

19 AUGUST:

1100-1800	Arrival day, tour Eagle Lake by boat and car, settle-in at ELFS
1830-	Dinner at the dining hall Evening Social hour, informal discussions, PowerPoints

20 AUGUST:

0600-0800	Bird-watching, fishing
0800	Breakfast in dining hall
0900	Convene in lecture hall
0900-0910	Introductions, goals and objectives--Anderson, participants
0910-0925	History of the grebe conservation project--Kelly
0925-1010	Review grebes in CA, 2007-2008--Weems/Robison/Anderson
1010-1020	Grebes at Thermalito Afterbay, 2007-2008--Martin
1020-1030	Break
1030-1100	Grebe restoration from ATTC viewpoint, accomplishments-Gorbics/Hampton
1100-1140	Grebe restoration from K/S viewpoint, future goals--Henkel/Brickey
1140-1200	General discussion--all participants
1200-1300	Lunch in the dining hall
1300-1400	Brainstorming and discussion of future goals--Anderson, all participants
1500-1600	Future goals and strategies to conserve A-grebes--Henkel, all participants
1600-1610	Break
1610-1630	Summary and conclusions/recommendations--Brickey, all participants
1630-1730	Visit a field site representing potential wetland restoration
1730-1800	Break, relax
1800	Dinner in the dining hall
1900-	Evening discussions, social hour, osprey nest at sunset

21 AUGUST:

0600-0800	Birding, fishing, early departures, shucks--sleep-in
0700	Breakfast in dining hall (early so people can leave if they want)
0800-1200	Departures, tour Eagle Lake by boat and car, chance to visit Mountain Meadows
1200-1300	Lunch in the dining hall
1300-1630+	Discussions of post-listing monitoring, CABRPE--Brickey, Seto, Burkett, Comrack, Gress, Anderson, and anyone else who is interested

22-27+ AUGUST:

Get to work on grebe surveys, monitoring, and sign maintenance activities--Robison, Weems, Anderson

Additional Ideas: On evenings of 19 or 20 August, we might add a discussion of A-grebe status on the wintering grounds led by Kelly, Davis, Shuford, and Humple; also include a discussion of A-grebes in the Klamath area led by Shuford and Mauser; a discussion of needs for genetic studies led by Humple.

Appendix III

Prepared: 20 August 2008

AECHMOPHORUS GREBE CONSERVATION: 2008 AND BEYOND.
IDEAS FOR FUTURE WORK AND ACTIVITIES—A LIST OF PROPOSED ACTIVITIES TO ENHANCE A-GREBE ECOLOGY AND CONSERVATION:

PREMISE: Not enough is being done on their breeding grounds to conserve, protect, and enhance A-grebes. And if grebes are protected and monitored/studied just on their breeding grounds only to migrate to the coastal areas to become oiled and die, why bother?

- Conduct state-wide (better region-wide) population surveys, continue to monitor populations through adverse and optimal breeding conditions.
- Intensify CA/OR/WA coastal monitoring programs to include A-grebes, continue to monitor causes of mortality on the wintering grounds (including beach-bird surveys).
- Conduct movement studies (satellite telemetry) to determine sources and migration routes of wintering populations.
- Conduct detailed genetic analysis and PVA of A-grebe breeding populations throughout western North America.
- Refine and update habitat suitability analysis throughout western North America and define habitats in need of protection and enhancement (ex. USFES 1984, FWS OBS-82/10.69).
- Complete AIC analysis of disturbance studies on the breeding grounds (Gericke 2006).
- Develop an artificial floating-nest system to help compensate for changing water-levels at breeding sites (WEGR/CLGR in much of the West have become reservoir-dependent).
- Develop/practice bulrush (and other key emergent types of vegetation) vegetation management techniques.
- Develop light-buoy (required by safety regulations) and other buoy systems for protection of critical nesting areas (ex. bay west of Long Tule Point).
- Develop wave-barrier systems at critical nesting areas (Ivey 2004), for example, booms used in reservoirs to control boat traffic.
- Re-introduce, enhance, and manage native grebe food species such as tui chub (*Gila bicolor*) in historical habitats and reservoirs where grebes nest (sportfish plus grebe food).
- Consider land acquisition and protection of areas not currently protected, mitigation lands and easements (ex. Lake County Land Trust in unprotected areas around Clear Lake; UC Davis carbon-trap project).
- Consider wetland restoration and creation (example Lederer Marsh at Eagle Lake and Buena Vista Lake in Central California).
- Determine how much of this fits the North American Waterfowl and Waterbird Management Plans and Joint-Venture activities already underway or planned.
- Participate in general wetland acquisition, restoration, and creation activities—do not re-invent the wheel; how might current activities need to be modified?

ADDITIONAL IDEAS—added to the list during the meetings:

- Establish survey protocols for *Aechmophorus* grebes on the breeding grounds.
- Conduct meta-analysis of all the coastal survey data to date, also beach-count data.
- Re-incorporate A-grebes into California's species of special concern.
- Make A-grebes part of priority criteria in wetland restoration programs.
- Continue to assess factors limiting A-grebe populations.
- At PSG meeting in Long Beach, CA, in January of 2010, conduct and publish symposium on conservation and ecology of A-grebes.

Appendix IV

Aechmophorus Grebe Conference 2008
Meeting Minutes
Eagle Lake Field Station
August 19-21

Attendees:
Daniel W. Anderson (U.C. Davis)
Amedee Brickey (United States Fish & Wildlife Service)
Frank Gress (California Institute of Environmental Studies)
Laird Henkel (California Department of Fish and Game- Office of Spill Prevention & Response)
Diana Humple (Point Reyes Bird Observatory)
Paul Kelly (*Retired* California Department of Fish and Game- Office of Spill Prevention & Response)
Ryan Martin (Department of Water Resources)
Dave Mauser (United States Fish and Wildlife Service)
Kris Robison (U.C. Davis)
Nanette Seto (United States Fish and Wildlife Service)
Renée Weems (U.C. Davis)

0900- 0910 PDT **Introduction of project from UC Davis perspective** (Dan Anderson)

- Data collection began in 1992 with methyl mercury study
- Clear Lake methyl mercury study and publication
  - No overt effects on grebes
  - Wolfe and Norman (1998) study came to same conclusion
  - Study observed numerous other problems affecting grebes
- American Trader Trustee Council (ATTC) Project
  - Paul Kelly initiated and secured the funding
  - Project concentrated on outreach and disturbance- monitoring mainly at Clear and Eagle Lakes
- Kure/Stuyvesant Trustee Council Project
  - Laird Henkel and Amedee Brickey
  - Continuation of project objectives from the American Trader project

0910- 0915 PDT **Conference attendee introductions and affiliations**

0915- 0925 PDT **History of the grebe conservation project** (Paul Kelly)

- Conflicts between lakebed management and grebes
  - *Hydrilla* control devastated nesting colony with airboat
- Found a need for funding to get insights
  - Sharon Gericke disturbance study (2006)
  - Sharon provided a presence working with managers to increase awareness of problems affecting grebes on the nesting grounds
- Grebes species hit hard by oil spills
  - ATTC restoration plan introduces grebe problems
  - Need more specificity for restoration projects
  - Gary Ivey report
- NFWF to UC with low overhead costs

- Similar opportunities in other states?
- Expansion with future funding
  - Marsh restoration
  - Disturbance barriers
  - Etc…

0925- 0935 PDT **Discussion**

- Grebe conservation in the future
- Clear Lake local working with grebes on a consistent basis
  - Volunteer basis
  - Reliable presence as voice for grebe conservation (ex. a local Audubon society)
  - Lower funding needs for management and monitoring at key sites

0935-1030PDT **Review of 2007-2008 grebe breeding seasons**

(Kris Robison & Renee Weems)

- Background and Importance
  - Current threats on breeding and wintering grounds
  - Focus on breeding grounds to offset oil spill mortality
- 2007 Project Objectives
  1. Surveys and monitoring
  2. Implementation of management activities
  3. Continuation of agency cooperation for further outreach and management
  4. Expansion of goals and management activities to other nesting locations
  5. Exploration of further outreach opportunities
- Summary of events 2007
  - Surveys began focusing at Clear and Eagle Lakes
  - Expansion to 25 lakes throughout California
- Series of anomalous events
  1. Failure to initiate breeding efforts
  2. Abandonment of established nests
  3. Unprecedented frequency of plumage-staining
  4. Water-level fluctuations
  5. Nesting habitat dry at many locations
  6. Winter-time feeding behavior observed in summer
- Clear Lake Summary 2007
  1. Adult numbers
     - Late June: 2,000 adult individuals
     - Thread-fin shad (*Dorosoma penetense*) die-off
     - Exodus of many bird spp. from lake (incl. grebes)
     - "Tens of thousands of *A.* grebes between Bolinas and Golden Gate" Steve Hampton OSPR
     - Late July: 8,000 adult individuals
     - Nearly all displayed winter-time feeding behavior
     - No "interest" in nesting
  2. Stained Plumage
     - Data collected in July survey
     - N= 585

- 5.3 ± 1.8% (95%CI)

3.Observed Disturbance
- Majority were recreation-based
- Management-based disturbance includes:
- Trampled vegetation consistent with *Hydrilla* control method
- Low-lake level

NOTE: Apparently suitable nesting habitat was still present in many locations

4. Nesting Failure
- **No colonial** nesting effort observed
- 10 scattered nests seen, 20 chicks estimated as produced
- No complete nesting surveys conducted to avoid possible disturbance to meager effort
- Productivity: 0.0026 YY/AD
- Possible explanations
  a. Short term food-supply declines
  b. Long-term drought and low water levels
  c. Possible point-source & chronic pollution problems
  d. Chronic disturbances at this high-use lake

• Eagle Lake Summary 2007
- 2 complete lake surveys

1. Adult numbers
- 3,400 adult individuals estimated
- 3,400 is 22.1% of D.W.A. 2002 estimate
- 33.3% of D.W.A. 2003 estimate

Substantial reduction in adult #s

2. Nesting

a. Nesting surveys
- No complete nesting survey conducted
- No conspicuous nesting colony could be located

b. Brood surveys
- 145 chicks observed
- Productivity: 0.04 YY/AD
- Normal year productivity: 0.5YY/AD
- 92% reduction in productivity
- Multiple adults tending a single brood

3. Stained Plumage
- Data collected in mid-July survey
- N= 455
- 1.5± 1.1% (95%CI)
- Possible oiling, iron-oxide, copper sulfate?
- Consistent with bird and mammal staining in South Bay
- Suggestion of diatom analysis

4. Observed Disturbance
- No recreational disturbances observed
- Very limited time spent at this location

5. Subsequent surveys- post meeting

- Estimated 400-500 nests
- Productivity of 0.58 $YYAD^{-1}$
- May indicate 2008 as a year following a severe reduction in breeding population size (2007)

- Other lakes visited
  - A. Data collected for 25 lakes during the 2007 field season
    - Decisions for which lakes to visit were based on Ivey (2004)
    - 20 of the lakes visited had grebes present

  - B. 2 previously un-documented nesting locations
    - Tinemaha Reservoir
    - Lake Skinner
- Outreach
  - A. Informational signs (boat ramps & bulletin boards)
    - Boat ramps targeted
    - Posted at campgrounds, courthouses, chambers of commerce, local businesses, etc.
    - 131 signs were posted
      - a. Clear Lake: 38
      - b. Eagle Lake: 36
      - c. Mountain Meadows: 3
  - B. Informational brochures
    - Distributed to numerous locations
    - 7,330 brochures handed out
  - C. Buoys
    - Unable to place
    - See Final Report 2005, same conclusion reached
- 2008 Updates
  - A. Clear Lake
    - 4,150 grebes on lake as of early July
  - B. Aerial surveys
    - 6 lakes surveyed (Berryessa, Clear Lake, East Park, Stony Gorge, Black Butte, and Thermalito Afterbay)
    - <50 nests total visible from air (all lakes included)
    - Nesting only seen at Clear Lake (n=25) & East Park (n=25)
  - C. Other lakes surveyed
    - 43 lakes and reservoirs visited thus far
  - D. Grebe specimens collected at Clear Lake
    - Exploration of stained plumage upon seeing high frequency in 2007
    - Collected with WFCB museum permit
      - a. 6 stained & 2 clean collected
      - b. Specimens to be archived at UC Davis
- Notable Findings 2008
  - 1. Lake Cachuma
    - Booms fencing off nesting habitat
    - Protection from boating disturbance

- Approximately 500 broods observed

2. Lake Hodges
   - Numerous nesting pairs observed
   - Observation of grebe using nesting platform
   - Possible future grebe conservation effort
   - Piper et al. 2002 found increased reproductive success in common loons (*Gavia immer*)

- The future of grebe conservation

A. Restoration
   - Several sites show potential
   - Buena Vista Recreation Area & Eagle Lake

B. Buoy placement
   - The need already exists for buoy placement
   - Protect exposed colonies from boat wake disturbance (ie. Lake Almanor)
   - To keep boaters, etc. out of sensitive areas

C. Further expansion
   -Low productivity observed
   - More lakes must be managed and surveyed especially in years following low productivity
   - Interest in grebes must be sparked among boaters at high disturbance lakes

D. Continued management
   - Low productivity in 2007
   - Management on breeding grounds essential to offset winter mortality (latest is *Cosco Busan*)

E. Continued Agency Cooperation
   - Collaboration needed to continue management after this project is over

1030- 1045 PDT **Break**

1045- 1105 PDT **Grebes at Thermalito Afterbay** (Ryan Martin)

- Grebes surveys on Afterbay began in 2003 with Ivey
  - Department of Water Resources continued in 2004
    - Surveys conducted once a month (nonbreeding)
    - Surveys conducted once a week (nesting)
- Afterbay operation
  - Warm the water in Afterbay for rice-agriculture irrigation
  - Wildlife area for fishing, hunting & everyone else
  - Pump-back to Forebay & Lake Oroville for power generation
- Competing interests for water depth
  - Nesting waterfowl (March 15- June 1) 134.0ft
  - Brood ponds (April 15)
  - Grebes (July 10- Sept. 15) 132.6 -125.6ft
    - Minimum fluctuation they'll allow at afterbay--5ft
    - Requested only a 4ft fluctuation,
    - D.W.R. loses $$$

- Grebe management at the Afterbay
    - 134ft saw peak grebe nesting
    - 2007 at the Afterbay:
        - 40 or 50 nesting attempts
        - 0 young produced
    - Management sees grebe conservation as "good faith" measure
        - No status for grebes in this region
        - Trying to keep FERC people happy
    - No nesting in Forebay
        - Water temperature too cold to allow growth of submergent vegetation (Pondweed, *Potamogeton spp.*)

1105- 1145 PDT **Discussion**

- How to monitor grebes in this habitat
    - Monitor population itself?
        - Wintering bird/ grebe surveys
        - Would it be outside of scope of CA populations?
        - 95% of grebe #s reduced in WA
            - Special status
            - Are grebes just moving around?
- Attrition rates of grebes
    - What are the rates?
        - More stable than for mallards?
        - Shallower mortality for grebes?
        - More work needed on this subject
- Monitoring approach
    - When to do aerial surveys? (at peak nesting)
    - Questions of nesting synchronicity between lakes
    - Do second year grebes forego nesting?

1145- 1205 PDT **Kure/Stuyvesant perspective**

- Humbolt Bay oil spill
    - Just settled (couple-$100,000)
- Leuchenbach settlement
    - In process of settling
    - $965,000
- Kure/ Stuyvesant
    - Provide further funding for current project
- Cosco Busan spill
    - Grebes were #2 species types affected by spill
- Needs for further management:
    - What are the major sites for grebes region wide?
    - At these sites, what are the major factors are affecting survival?
    - Region-wide numbers?
    - Set up protocol to follow

1205- 1220 PDT **Discussion**

- Future of grebe conservation
    - Restoration

- Tule Lake expansion of wetlands:
-9,500 acres of permanent wetland to be established in Upper Sump in current plan for 2010

1220- 1320 PDT **Lunch Break**

1320- 1400 PDT **Brainstorming and discussion of future goals**

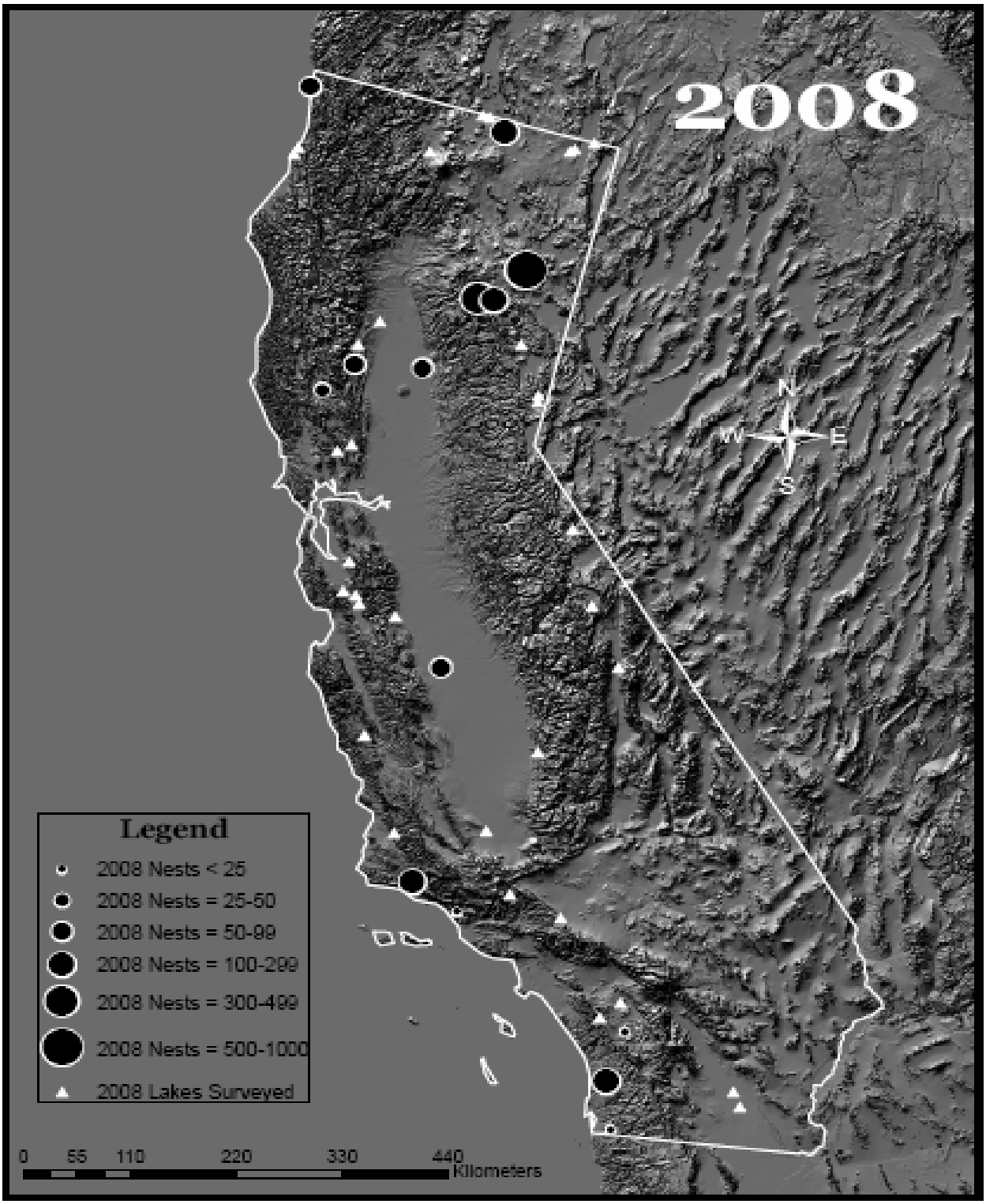
- State-wide/region-wide population surveys
  - Consecutive year blocks
  - 3yrs on 2 yrs off, potentially
    - Based on grebe lifespan?
    - Need continuous data to determine regional causes of decline
    - Region-wide surveys would provide baseline data
    - Following region-wide surveys, select particular sites for more intensive monitoring
- Intensify CA/OR/WA coastal monitoring programs to emphasize *A.*grebes
  - P.R.B.O. beachcomber surveys
  - O.S.P.R.→ S.S.E.P. funding 2yrs of coastal surveys
- Conduct movement-studies to determine sources and migration routes of wintering population
  - Studies have been conducted with transmitters
    1. 100% mortality in 3 days in WA studies using abdominal implants (W.A. Department of Fish and Wildlife)
    2. Other studies have shown more success when birds are kept captive during healing process (U.C. Davis Wildlife Health Center)
    3. V.H.F. may be challenging due to night migration
    4. Small satellite tags for murrelets weighing 2g may be better for grebes than bigger, more invasive, transmitters
    5. Cell phone technology for studying movement patterns in development (Rompre et. al *In Press)*
       - Data loggers
       - Presented at the AOU 2008 Conference
- Conduct detailed genetic analyses
  - Assess population structures to determine the regional association of birds
  - Guiding NRDA towards focusing restoration at specific colonies
- Conduct habitat suitability analysis
  - Funding is limited
- Complete AIC analysis of disturbance studies on breeding grounds (Gericke 2006)
  - Have data, Gericke needs to publish it
- Develop an artificial floating-nest system to compensate for water-level fluctuations at reservoir-breeding sites
  - Expensive
  - Maintenance-intensive

- Develop/practice bulrush (and other key emergent vegetation types) vegetation management techniques
    - Expansion of marshes
    - Tule Lake
- Develop light-buoy and other buoy systems for protection of critical nesting areas
    - Clear Lake is an excellent area for this
- Develop wave-barrier systems at critical nesting areas (Ivey 2004)
    - Lake Cachuma booms
    - Aesthetically unpleasing & restrictive to boaters?
- Reintroduce, enhance, and manage native grebe food species such as tui chub in historical habitats and reservoirs where grebes nest
    - Does a precedent exist?
- Consider land acquisition and protection of area not currently protected (ex. Land County Land Trust in unprotected areas around Clear Lake)
    - Out of scope of specific grebe conservation?
    - Conservation easement
    - Carbon banks and wetlands
- Determine how much it fits the North American Waterfowl and Waterbird Management Plans and Joint-Venture activities already underway or planned.

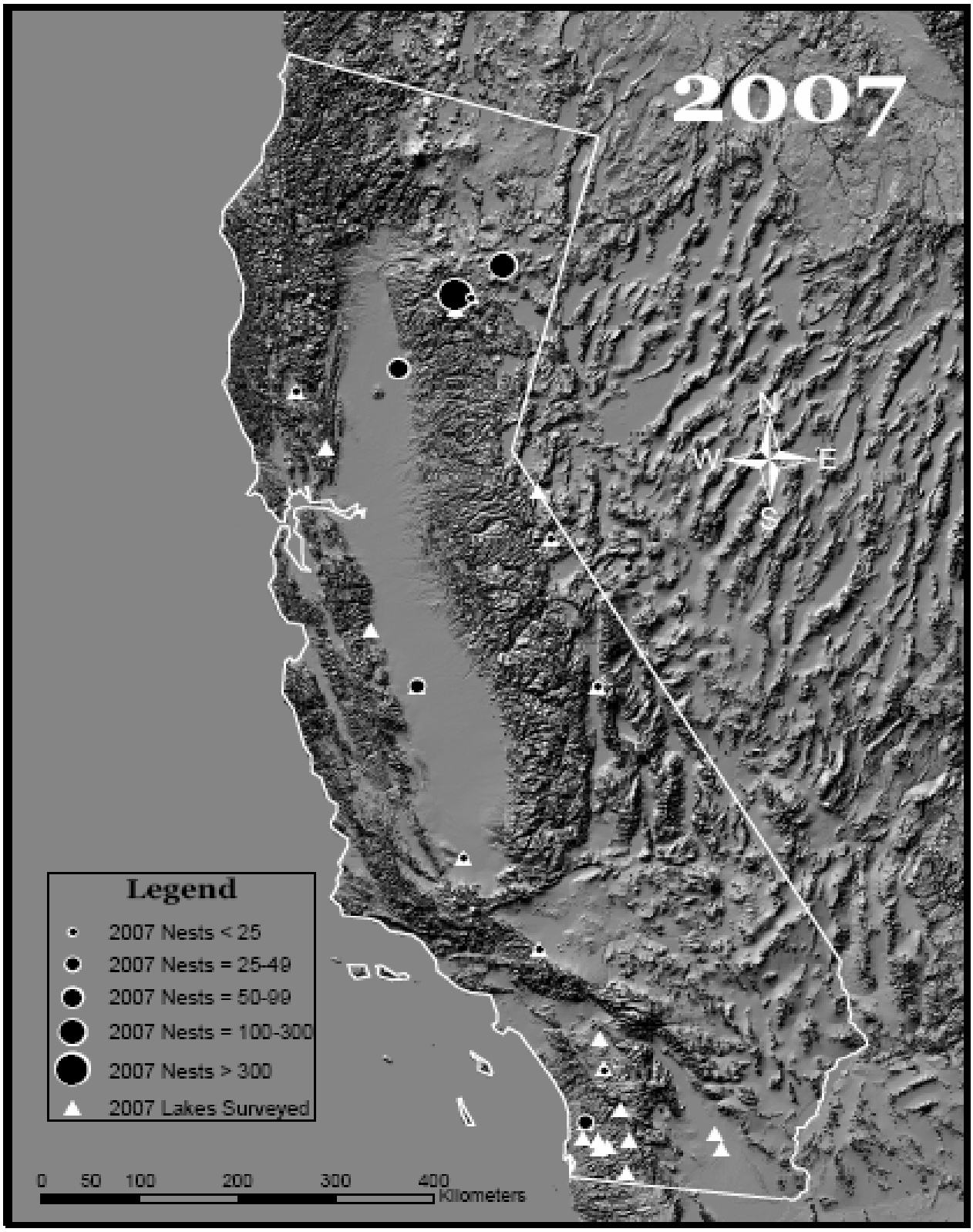
1400- 1530 PDT **Future goals and strategies to conserve *A.* grebes**

- Identifying top threats:
    - Is disturbance the #1 issue?
        - The Trustee Councils address only disturbance in their own restoration plan
        - Disturbance is the most acute threat
    - How big a role does water-level play?
        - R. Martin with peak nesting at 134ft
        -Lake Almanor in 2007 (stranded nests photo)
    - Oil?
        - May be most significant chronic threat
- Research and monitoring needs:
    - Population Viability Analysis
        - Need to know adult mortality (currently unknown)
        - Use big-bodied grebe data
    - Mark recapture studies
        - Picric acid at different lakes for marking
        - Considered a pollutant?
    - Could we also survey eared grebes?
        - Congregate when migrating
        - Count at congregation sites and survey there to determine overall trends
        - Protocols already exist for eared grebes

Appendix V Locations of California's 2008 grebe breeding colonies with relative sizes displayed.



Appendix VI Locations of California's 2007 grebe colonies with relative size displayed.



Appendix VII Copy of the article published in California Department of Fish and Game's publication *Outdoor California.*

California's western and Clark's grebes are

Under Pressure

Historically, these two look-alikes have enjoyed prosperity. But conflicts with people are leading to habitat loss

Photo courtesy of UC Davis

Story by Renee Weems and Kris Robison

On any hot summer day at lakes around California, the shrill calls and splashing dives of western and Clark's grebes can be heard amidst the hum of boat traffic and vacationers enjoying the summer sun. Western and Clark's grebes are conspicuous black and white waterbirds typically inhabiting inland lakes in the summer, and coastal ocean waters in the winter. The two species are difficult to differentiate between at times, but occur together year-round. In the spring, they complete a nocturnal migration from the marine Pacific coast to inland lakes and reservoirs. In fact, many Californian lake-shore residents are surprised at the sudden arrival and departure of these birds, commenting on how they seem to either appear or vanish overnight. It is at these inland bodies of water, however, where the grebes settle down to court and nest. And to spectators of the ritualistic courtships, the grebes are described as no less than amazing. Unfortunately, the effects of human activities have had serious consequences for the populations of both species.

Until late in the 20th century, scientists described Clark's grebes as a color variant of western grebes, and did not identify the two as separate species. Although both birds are somewhat similar in appearance, western grebes are distinguished from Clark's by the presence of black feathering reaching below their red eyes. Clark's grebes, on the other hand, have white feathering surrounding their eyes.

A subtler difference lies with the birds' vocalization patterns. Clark's have a one-note call while westerns employ

Previous pages, a Clark's grebe (Page 20) packs her chick on her back for its first two to four weeks of its life because it hasn't learned how yet to dive. Previous pages, a pair of western grebes (Page 21) attends their floating nest for the season. This page, although populations have been historically strong for both western and Clark's grebes, loss of habitat, combined with persistant human disturbance, can cause a drastic drop in their numbers. The nests can easily flood in the wake of speeding powerboats, and with a nesting season from May through September, when most people become excited about outdoor summer activities, the possibility of conflicts increases dramatically.

a two-note call. In addition, bill color can be used for identification. Clark's have a yellow-orange bill; westerns have a yellow-green bill. It is difficult to differentiate between the sexes of both species, but subtle differences do exist. Females of both species are smaller with a shorter, thinner bill that is slightly upturned in comparison to males.

Although challenging for the human eye, grebes have no problem differentiating one another, and after arriving at their nesting grounds, the birds quickly initiate courtship behavior. The most captivating of these displays is known as the rushing ceremony, which includes two or more grebes rising up in synchrony, and skirting across the water for as far as 20 yards.

Marilyn Waits, president of the Redbud Audubon Society, describes the spectacular display between grebes as a highlight to Lake County's annual heron celebration at Clear Lake. "When a grebe pair begins rhythmic head bobbing, then rears up on their feet and hydroplane together across the water surface, it is a spectacular sight that leaves our festival guests awed and amazed at the beautiful, complex behaviors these birds display," she says.

Another display is the weed ceremony, a complex ritual involving a pair of grebes. The birds begin a posturing display followed by intense vocalization. The pair then dives underwater and returns with vegetation in their bills to face each other and present the weeds.

After these courtship rituals are completed, colonial nest building is initiated. The grebes construct floating nests out of emergent or submergent vegetation that is anchored to the substrate. As such, wetland habitat and stable water levels are vital to the success of a grebe nesting colony. Colonies composed of thousands of nests can be common at important breeding lakes such as Lake County's Clear Lake, and Eagle Lake in Lassen County. Nesting occurs between May and September. After hatching, chicks are fed and carried on the backs of parents for several weeks.

By the end of summer, the chicks are full grown, and able to fly to their wintering grounds along the Pacific coast. Migration back to the wintering grounds usually occurs between September and November, though some populations are thought to remain resident at lakes that do not freeze.

California is especially vital to western and Clark's grebes because it makes up a large portion of their range with high numbers of breeders. Western and Clark's grebes can be seen throughout the western part of North America stretching from as far north as British Columbia, Canada, and southward to Sonora, Mexico. The birds are found as far east as Minnesota. Historically, grebe numbers have remained healthy throughout their range, but in recent years these elegant birds have endured population-level threats largely due to conflicts with humans.

Some of the earliest human related threats to western and Clark's grebe populations were market hunting and egg collecting. Throughout the late 19th and early 20th centuries, these birds were sought after for their ventral white "fur," as it was called, which was used to make coats and hats.

In 1899, an unknown writer described the extent to which the grebes were hunted while

Photo courtesy of UC Davis

writing about Tule Lake in Siskiyou County. The writer states, "... many thousand grebe skins have been shipped from this one lake ..." In addition, profit estimates of grebe harvest from the Klamath Basin in 1904 reached into the $30,000 range. Egg collecting was also popular during this time, and served to compound population declines that had resulted from market hunting. With the passage of the federal Migratory Bird Treaty Act of 1918, western and Clark's grebes became protected from such disturbances. The statute forbids the "take" of any migratory bird or migratory bird nest, making market hunting and egg collecting of both western and Clark's grebes illegal.

Today, issues are a bit more complex. Late in the 20th century, pesticide applications exerted negative effects on grebe populations. Pesticides became widespread after World War II as an all-purpose solution for eliminating pest species throughout the United States. For example, the synthetic pesticide Dichloro-Diphenyl-Trichloroethane, most commonly known as DDT, was heavily applied from 1949 to 1963 in the Klamath Basin, which lies on the Pacific Flyway for many migratory bird species. The flyway is used by western and Clark's grebes. Another toxic pesticide, toxaphene, was applied to the same area from 1956 to 1963. Both chemicals were linked to direct mortality in fish-eating birds, including the grebes. Dichlorodiphenyldichloroethane, a breakdown product of DDT under anaerobic conditions, was itself applied to Clear Lake in the 1940s as an attempt to exterminate a non-biting gnat. Grebe populations were severely affected, and breeding failures ensued. Another of DDT's breakdown products, Dichlorodiphenyldichloroethylene was linked later to eggshell thinning in many avian species. This news helped break the story to the world of DDT's toxic effects on animals, including the bald eagle and other bird species. In 1972, the U.S. banned use of DDT and its byproducts.

Even though the threat of breeding failure due to these toxic chemicals has lessened, ongoing risks affecting western and Clark's grebes persist in the form of habitat loss. Other wetland species feel the pressure from that failure as well. Because of the specific habitat type required for construction of grebes' nests, damage to such areas adds stress on breeding grounds, and has a disproportionate effect on the breeding population. Because grebes often construct nests from emergent or submergent vegetation, availability of wetland habitat remains crucial. California has lost 90 percent of its historic wetlands, due in large part to an increasing human population, which limits the number of adequate nesting locations that still exist.

Associated with habitat loss is human disturbance. The nesting season for the western and Clark's grebes coincides with the state's popular boating season, which leads to a threat—in most cases unintentional—of particular importance. For example, the floating nests constructed by these birds can be flooded by boat wakes. In addition, water level manipulation at reservoirs can leave nests stranded on dry ground causing nest abandonment by the birds, and exposure to terrestrial predators. Alternatively, flooding of nests can occur when water levels are raised at reservoirs. Even with successful nesting, the chicks are still vulnerable to direct boat strikes, and hypothermia

'When a grebe pair begins rhythmic head bobbing, and then rear up on their feet and hydroplane together across the water surface, it is a spectacular sight that leaves our festival guests awed and amazed at the beautiful, complex behaviors these birds display.'

Marilyn Waits, president of the Redbud Audubon Society, describing the rushing ceremony between grebes during Lake County's annual heron celebration at Clear Lake.

Photo courtesy of UC Davis

Skirting across the surface of Clear Lake in Lake County, a pair of Clark's grebes perform the rushing ceremony, part of the bird's courtship behavior. The ritual, sometimes done by three or more birds at a time, involves the birds rising together and scurrying along for as much as 20 yards.

Tips on enjoying grebes without disturbing them

So what can California residents do to help protect grebes, their nests and their vulnerable chicks? Because the grebe nesting season coincides with the busy boating and fishing seasons, there are several tips, that when followed, can help these birds, and allow boaters to enjoy the water.

Avoid Nesting Areas: Stay at least 300 feet away from colonies, and avoid prolonged presence near them.

Watch the Wake: When moving near colonies, go slowly and quietly to avoid swamping nests and minimize disturbance.

Take a Scenic Detour: Motor, sail, or paddle around flocks and colonies instead of through them.

Avoid Boat Strikes: Watch for grebes in open water, especially between May and September, to avoid lethal collisions.

Respect Buoys and Limits: Obey buoy markers and posted speed limits for the safety of all.

Pack Out Trash: Adults and young grebes can become tangled in fishing line and other plastic trash, and drown.

Educate Others: With everyone's help, we can ensure the survival of these beautiful, valuable birds.

when left at the surface by their diving parents. This is due to the chick's inability to dive within the first two to four weeks of life. Threats to these birds, however, are not isolated to their breeding grounds.

Oil spills comprise the main threat faced by grebes on their wintering grounds off the Pacific coast. Spills come without warning, and, depending on the size, usually kill thousands of birds; a significant portion of which can be grebes.

"Western and Clark's grebes are among the most frequent victims of oil spills along the California coast, with an estimated 8,000 killed in the last 20 years," says Steve Hampton, a Department of Fish and Game resource economist with the Office of Spill Prevention and Response, known as OSPR.

These oiling events can be human-caused or natural, and can lead to significant losses of many species of marine birds. These losses have been attributed to direct death from plumage

Photo courtesy of Frank Gress

A tight raft of grebes mix at Clear Lake. Although both species appear similar, western grebes have black feathers reaching below their red eyes, and have a yellow-green bill. Clark's grebes have white feathering surrounding their eyes, and they have a yellow-orange bill. Females of both are smaller with a shorter and thinner bill that is slightly upturned in comparison to males.

fouling and loss of thermoregulatory abilities, or indirect effects caused by oil ingestion and stress. In November 2007, the oil spill from the container ship Cosco Busan affected approximately 3,000 birds, 19 percent of which were western and Clark's grebes.

Fortunately, specialists are working to conserve these two beautiful species of grebe. The University of California, Davis, in cooperation with DFG and other state, as well as federal agencies, has launched a long-term project. Specialists from DFG's OSPR have provided exceptional support, and have been intimately involved in the project. UC Davis professor and principal investigator on the project, Dan Anderson, sees promise in the efforts being taken to conserve these birds. "This multi-agency project is hopefully just what California's western and Clark's grebes need," Anderson says. "It is meant to engender a long-term conservation program, which will permanently conserve these wonderful birds. We want to leave something behind that is lasting."

The project includes population and nesting surveys, as well as disturbance monitoring at grebe breeding grounds. It focuses on educating boaters and residents at lakes around California about what they can do to prevent negative impacts on nesting colonies while enjoying popular recreational lakes. Additionally, signs are posted, and informational materials are distributed to inform the public about grebe conservation.

"Part of OSPR's mission is to restore natural resources injured in oil spills," says Hampton. "Concentrating our attention at grebe breeding grounds is the most effective way to accomplish this goal for these species. With this project, we hope to protect the colonies, and educate lake users how to coexist with the grebes. Most people are more than happy to do so, as they're beautiful birds. We hope this project will prevent some of the accidents that have occurred in the past in which major disturbance events have inadvertently decimated grebe nesting colonies."

Renee Weems and Kris Robison are recent graduates from the University of California, Davis in the Department of Wildlife, Fish, and Conservation Biology. They are experienced field technicians working on a long-term university study on the management and ecology of western and Clark's grebes in California.

Appendix VIII Updated table of 2007 and 2008 sign posting locations.

LAKE	LOCATION	CONTACT	SIGN MATERIAL		
			Lam[1]	Metal	Plastic
Eagle Lake	Aspen Campground	Eagle Lake Ranger Station	4		
	BLM North Campground	Bureau of Land Mgmt.	4		
	Christie Campground	Eagle Lake Ranger Station			1
	Eagle Campground	Eagle Lake Ranger Station	4		
	Eagle Lake Amphitheatre	Eagle Lake Ranger Station	1		
	Gallatin Marina	Sheriff & Store Staff		1	2
	Lahontan Heights	Ted Andresen		1	
	Lassen County Visitor Center	Staff	5		
	Mariner's Resort	Resort Staff	2		1
	Merrill Campground	Eagle Lake Ranger Station	3		
	Rocky Point Campground	Camp Host	3		
	Stone's Landing	Sheriff		1	
	Spaulding General Store	Store staff		1	
	Spaulding Marina	Pat Horan		2	
Mountain Meadows	Boat Ramp	Mark Sanford, PG&E		2	
	Water access north of boat ramp	Mark Sanford		1	
Clear Lake	Anderson Marsh State Park	Jay Sherman		1	
	Borenbega Boat Storage	Steve Gomez		1	
	Clear Lake Chamber of Commerce	Bob Aguirre	2		
	Clear Lake Drive, Lakeport	Doug Grider		1	
	Clearlake Oaks County Park	Kim Clymire		1	
	Crystal Lake Drive	Kim Clymire			1
	Clear Lake State Park	Jay Sherman	15	1	1
	Disney's Water Sport Rental	Roy & Charlotte Disney	1		
	Ferndale Resort & Marina	Bill (Co-owner)	2		1
	Glenhaven Beach Campground	Greg (Manager)			2
	Holiday Harbor R.V. Park	Joan (Manager)			1
	Indian Beach Resort	Anthony Benevento	2		1
	Keeling County Park	Kim Clymire		1	
	Konocti Vista Casino	Sarah Ryan		1	
	Lake County Courthouse	Debra Sommerfield	6		
	Lakeside County Park	Kim Clymire		2	
	Lucerne Harbor County Park	Kim Clymire			1
	M&M Campground	Percy Oved		1	
	Redbud Park	Julie Burrow		3	
	Rodman Slough	Kim Clymire		1	
	3rd St., Lakeport, Boat Ramp	Doug Grider		1	
	5th St., Lakeport, Boat Ramp	Doug Grider		1	
Cachuma Reservoir	Cachuma Lake Recreation Area	Melissa Fulton	35	5	
Lake Hodges	Lake Hodges Recreation Area		10	1	
Casitas Reservoir	Lake Casitas Recreation Area	Rob Weinerth	13		
Lake Almanor	North Shore Campground		5	1	

Additional Notes:

Art, courtesy of Ava Renee Anderson, Davis Waldorf School, CA