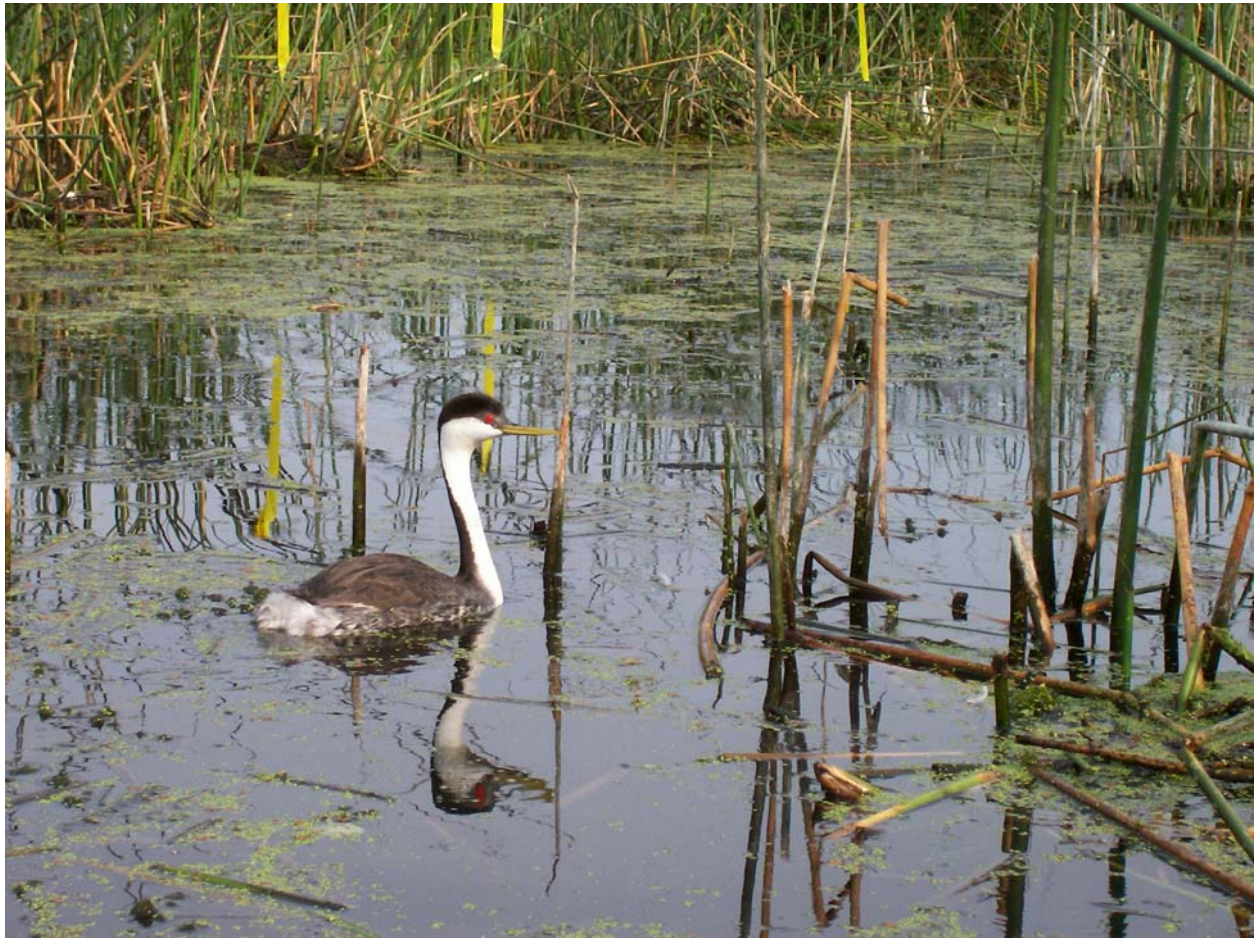


Western & Clark's Grebe Conservation and Management at Clear Lake, California

**Annual Report for Year 2 (2006)
31 December 2007**

Presented to the
National Fish and Wildlife Foundation
and
American Trader Trustee Council



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I. Project Objectives and Results: Continuing to use Ivey (2004) as our principle guideline, our objectives for Year 2 were developed to finalize, continue, and expand some of our original objectives from 2005 (Gericke et al. 2006), and modified accordingly in relation to our experiences of 2005. More specifically, our 2006 goals are outlined below:

A. To re-design and finalize, then manufacture and **produce educational materials** concerning the two grebe species of concern in this project, Western Grebes (*Aechmophorus occidentalis*) and Clark's Grebes (*Aechmophorus clarkii*)(hereafter combined and simply called "grebes").

Under this objective, the following new materials were produced for placement and use in 2007. (Our supplies of previously-produced, first-draft educational brochures were exhausted in 2006).

1. Clear Lake grebe presentation in PDF and PowerPoint, for distribution to and for educational use by agencies and organizations.
2. Text for Clear Lake grebes presentation in Word and WordPerfect.
3. A two-fold brochure about grebes and grebe conservation in PDF, tif, and jpeg.
4. A new design for the information sign to be posted at boat launch sites and other public places with grebes nearby. Metal signs were developed for permanent use, and two types of plastic signs were developed for bulletin-board stapling or permanent postings on walls, fences, etc.

Copies of these 4 items are included on the attached CD (**Clear Lake-1-2006**), and actual samples (minus posts and hardware, of course) of the brochure and information signs are provided along with this report to CDFG and ATTC only (2 sets). If additional samples are desired, please contact dwanderson@ucdavis.edu.

A manufacturer and designer of floating buoys (to be placed near grebe breeding colonies as recommended by Gericke et al. 2006) was also located and contacted, but buoys were not procured due to high cost in relation to unresolved regulatory complications and agency jurisdictional disputes for floating objects in California waterways.

The designs for all these materials were created by a project employee in 2006, **Katharine A. Smith** (kasmithart@hotmail.com) and are intended to be available (through CDFG and ATTC) for use by any non-profit, agencies and public organizations, as well as individuals, at no cost.

B. To continue to **evaluate human disturbances** to grebes on their breeding grounds, emphasizing Clear Lake.

1. Sharon Gericke, co-investigator for years 1 and 2 of this project, completed here M.S. Thesis at UC Davis, utilizing year 1 (2005) in that analysis (Gericke 2006). A second CD (**Clear Lake-2-2006**) includes a copy of her approved thesis. The abstract, summarizing the thesis results, is reprinted below:

Assessing the importance of the effects of human activity on wildlife populations has several important conservation implications. However, disturbance-related studies are often anecdotal or correlative in nature and demonstration of causal relationships is inherently complicated and difficult to demonstrate (Nisbet 2000). From a management perspective, it is important to examine which characteristics (or combination of characteristics) of the disturbance event have the greatest tendencies in eliciting responses. This knowledge may better allow managers to key in on specific management strategies that will offer a population the most appropriate and effective protection.

*Clear Lake in Lake County, California, is an important breeding site for western and Clark's grebes (*Aechmophorus occidentalis* and *A. clarkii*). Previous studies at Clear Lake indicate that the increase in human use of the lake, especially in and around grebe nesting colonies and post-nesting staging areas, has been altering bird behavior and affecting reproductive success. In 2005, I studied the characteristics of disturbance events occurring around or near western and Clark's grebe active nesting colonies and*

post-nesting staging areas and recorded grebe response to recorded events. I analyzed variables associated with each disturbance event using logistic regression and model selection.

Grebe response to disturbance events was significantly associated with the location. The source of disturbance was also significantly associated, but was no longer significant when only human-related sources were included. A source's speed variable and distance to a nesting colony or staging area were highly significant predictors of grebe response. Response was also weakly associated with date and time of observation. A source's speed and duration at a nesting colony or staging area were not significantly associated with grebe response. Model selection indicated that the combination of location with all source characteristics (duration, speed, speed variable, and distance) was the best approximating model for predicting grebe response. Generally, the results indicated the support of management strategies which would mitigate for multiple variables, rather than controlling a single factor.

Disturbance data gathered in 2006 were identical to those collected in 2005 and this second year of data will be incorporated into Gericke's (2006) model analysis eventually, and a manuscript hopefully submitted to an appropriate journal. 2006 disturbance and behavioral data are provided in this report on CD (**Clear Lake-3-2006**), along with additional photos from the 2006 field season.

2. Caroline Thow, an undergraduate researcher in the field class, WFC 101 at UC Davis, collaborated with DWA (co-instructor) during the course and conducted a modest, but controlled disturbance study relating observed, low-intensity boat activities such as seen at Eagle and Clear Lakes (but much less intense than observed on some occasions at both locations). This small study was not supported with funds from this study, but the results were interesting, applicable, and worth presenting in this report. The study was indirectly related to the NFWF/ATTC project reported here. A copy of Caroline's class report (Thow 2006) is included on the CD, **Clear Lake-2-2006** for informative purposes, to add further insights to human/grebe interactions at important breeding sites. It is not for public release. The abstract, summarizing the study's results is reproduced below:

Western and Clark's grebes on Eagle Lake in California are exposed to recreational boating activities throughout their breeding season. I determined the types of reactions grebes produced in response to boats through simulating recreational boat activity by approaching individuals in a canoe or motorboat at different angles and speeds. I observed responses of different age groups and parenting classes to determine if responses varied among these groups and disturbance types. Grebes reacted more vigorously to fast-moving motorboats than canoes. Direct approaches were more disturbing to grebes than oblique approaches. Single adults invested more energy in responses to boat approaches than parenting grebes. There were no differences between the responses of juvenile and adult grebes. Although this was a brief study, its results indicate that boating activity has an influence on the behavior and possibly energy budgets of western and Clark's grebes. Consequently, boat operators should avoid approaching grebes whenever possible.

3. Another related study, not funded by, but also indirectly related to this project was a study by **D. W. Anderson** et al. of mercury contaminants at Clear Lake relating to osprey (*Pandion haliaeetus*) and *Aechmophorus* grebes to be published soon (Anderson et al. 2008). The accepted manuscript for that study (*Ecological Applications*) is attached for the committee's information, because it has pertinent information regarding Clear Lake grebes (see CD, **Clear Lake-2-2006**). It is also not for public release at this time. The abstract is reproduced below:

Mercury (Hg) and reproduction/status of western/Clark's grebes (Aechmophorus sp.) and osprey (Pandion haliaeetus) were studied from 1992 through 2001, and then less intensely through 2006, at Clear Lake, California. Remediation to reduce Hg loading from the Sulphur Bank Mercury Mine was initiated in 1992. Hg in grebe feathers declined monotonically from about 23 mg/kg dw in 1967-69 to 1 mg/kg in 2003, but then increased to 7 mg/kg in 2004-06. Osprey feather Hg varied similarly, with mean values of 20 mg/kg dw in 1992 declining to a low of 2 mg/kg in 1998, but increasing to 23 mg/kg in 2003 and 12 mg/kg in 2006. Osprey feather Hg at our reference site (Eagle Lake, CA) remained low (1-8 ppm) throughout the entire period, 1992-2003. Grebe productivity at Clear Lake improved from about 0.1 to 0.5 fledged young per adult during the latter part of the study when human disturbance was prevented. Then, improved productivity did not differ from our reference site at Eagle Lake, CA. Human disturbance, however, as a co-factor made it impossible to evaluate statistically Hg effects on grebe productivity at

Clear Lake. Osprey reproduced sufficiently to maintain increasing breeding numbers from 1992-2006. Hg in Clear Lake water, sediments, invertebrates, and fish did not decline from 1992-2003, but a shift in trophic structure induced by an introduced planktivorous fish species may have caused significant alterations in Hg concentrations in several species of prey fishes that may have produced concomitant changes in osprey and grebe Hg exposure. The temporary declines observed in grebe and osprey feather residues in the late-1990s, with coincidental improvements in reproductive performance, however, could not be attributed to remediation at the mine site.

C. Another object of the 2006 grebe study was to **evaluate annual reproductive success** and to **estimate the number of active nests** and associated grebes on Clear Lake. These surveys were completed by **Carley Neilson, Harley Winfrey** (field technicians hired in 2006), and DWA for the period 1 June through 31 August. California Department of Fish and Game also provided an aircraft for one early-season aerial survey (Table 1). Additional surveys were conducted at our sometimes-used comparison site, Eagle Lake. In summary, grebe population surveys for 2006, conducted in addition to behavioral studies reported above, are summarized in Table 1.

Table 1. Grebe Population and Productivity Surveys Conducted in 2006.

DATE	LOCATION	SURVEY TYPE	REMARKS/OBSERVERS
12 JULY	Lake Berryessa	Aerial	DWA, F. Gress, R.Morgan (pilot)
12 JULY	Clear Lake	Aerial	Same
10-28 JULY	Clear Lake	Boat	4 transects--HW, CN
31 JULY	Clear Lake (partial)	Boat	DWA, HW, CN
01 AUGUST	Clear Lake (partial)	Boat	Partial survey cancelled (waves)
08 AUGUST	Clear Lake (partial)	Boat	Late-season nest check—DWA, HW, SH
11 AUGUST	Lake Berryessa ¹	Boat	DWA
18 AUGUST	Clear Lake (partial)	Boat	Late-season check, HW and CN
21 AUGUST	Clear Lake (partial)	Boat	Same
08 SEPTEMBER	Lake Almanor ²	Ground	DWA
10-18 SEPTEMBER	Eagle Lake	Ground	DWA

¹Due to the presence of a few begging young, we surmised that there had been <10 active nests at Lake Berryessa in 2006.

²There were only 7 active nests (and no broods seen) at Lake Almanor in 2006; this lake has sporadic grebe nesting that has been on occasion as high as 800 nests in the past.

A summary of reproductive performances for Σ *Aechmophorus* grebes at Clear Lake in 2006 is given in Table 2, below. Additionally, to gain a more long-term perspective, results are also presented that go back to 2000, and a period when a period of significant disturbances again occurred, from 2002 through 2004. Other unexplained changes also occurring during this period: a shift in main colony location, the establishment of an

entirely new [to us] large, major colony on the lake at Anderson Marsh, an unexplained change in phenological pattern of breeding, and an unexplained increase in the proportion of grebes present on the lake as Clark's Grebes. Many other significant changes occurred during that period (2000-2006), as well, including: the development of a major hotel/marina immediately adjacent to the pre-2005 colony location (with associated canal-access through grebe nesting habitat to the lake), and its associated increases in boat and water-sport activities.

Table 2. Nesting Activity and Productivity at Clear Lake in the 2000s.

Year	Est. # Active Nests	Sample-size for Productivity	Productivity: (Young/Adult ¹)	Remarks
2000	2675	1160	0.76	
2001	925	924	0.65	
2002	445	877 ²	>0.01	Very low #s of young were produced in 2002
2003	275	1198	0.19 ³	Pop. estimate is approximate
2004	700	2380	0.16 ⁴	Pop. estimate is approximate
2005	2300	988	0.82	Pop. estimate from Gericke (2006)
2006	800	1002	0.72	

¹Young 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.

²About 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.

³2002 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).

⁴In 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.

It is Interesting that with the continual and very frequent presence of an active research team in the area, enhanced through contacting local residents and groups, our field crews being almost continuously present in and near the breeding colonies, and conducting the distribution of information brochures (starting in 2005) 2005-and 2006 were both years of maximum or near-maximum productivity, such as that of 2000 and 2001, when an interagency conservation "understanding" was still effective.

Aechmophorus grebe nesting is certainly quite variable from year-to-year, with environmental variability apparently superimposed by man-related activities such as disturbances and habitat destruction. It seem obvious from our studies that (1) conspicuous and continual human presence, backed by various agencies involved in

various activities around the lake, along with a public-relations effort seems to help greatly enhance *Aechmophorus* grebe nesting potential, as originally intended by the agencies supporting this project. However, natural variability (and its temporary negative effects on grebe populations and behavior) along with decimating factors elsewhere might still render such efforts ineffective in the long-term. Continual activity and presence during the critical time when grebes are nesting or have vulnerable young, plus outreach activities, seem to be the most important single actions that we can take to protect nesting grebes.

Productivity at Eagle Lake in 2006 was identical to that of Clear Lake, 0.72 YY/AD (n = 1002). Since Eagle Lake has been one of our comparison sites since studies began in 1992 (Anderson et al. 2008), this observation also lends support to the idea that reproduction at Clear Lake in 2006 was adequately protected.

II. Budget Summary: A complete budget summary and final billing will be provided to NFWF and ATTC by UCD Accounting Office, Extramural Grants Office, as a separate report.

III. Acknowledgements: Without cooperation from our many cooperators and contacts (many mentioned in the materials provided, Annual Report Year 1, upcoming 2007 report, and other reports provided herein), ATTC and NFWF contacts and research colleagues, much of this work would not have been possible. Bob Morgen (CDFG pilot), Harley Winfrey, Carley Neilson, and Katharine Smith (our field team for 2006) deserve special mention and thanks. HW and CN recorded most photos of 2006 field activities and DWA recorded the aerial images.

IV. Additional Literature Cited in this Report (If not listed below, references can be found in our 2005 Annual Report, Gericke et al. 2006):

Anderson, D. W., T. H. Suchanek, C. A. Eagles-Smith, and T. M. Cahill, Jr. 2008. Mercury residues and productivity in osprey and grebes from a mine-dominated ecosystem: Clear Lake, California. *Ecological Applications* (in press).

Gericke, S. M. 2006. Western and Clark's Grebe conservation and management at Clear Lake, California. Annual Report to National Fish and Wildlife Foundation and American Trader Trustee Council No. 1:1-31.

Gericke, S. M. 2006. Exploring the effects of disturbance events on Western and Clark's Grebes (*Aechmophorus occidentalis* and *A. clarkia*) at Clear Lake, California. M.S. Thesis, University of California, Davis.

Ivey, G. A. 2004. Conservation assessment and management plan for breeding Western and Clark's Grebes in California. Final Report to the American Trader Trustee Council, June 2004. 80 pp.

Thow, C. M. 2006. Responses of *Aechmophorus* grebes to boat disturbance on Eagle Lake, California. *Eagle Lake Field Biology* (student journal of the Eagle Lake Field Station) 6:15-24.

Materials Attached:

A. Samples of educational materials developed in 2006 (2 sets including items 3 and 4 only):

1. educational brochure,
2. plastic-laminated bulletin board posting sign,
3. permanent plastic posting sign, and
4. permanent metal posting sign.

B. Three compact disks (5 sets):

1. "Clear Lake-1-2006" containing a pdf file of this report plus files for the educational materials developed in 2006,
2. "Clear Lake-2-2006" containing files of scientific reports relating to this project, plus 2006 aerial survey images, and
3. "Clear Lake-3-2006" containing files of disturbance and grebe behavioral raw data and photographs of 2006 field activities.