

# **Lake Earl Western Grebe Annual Monitoring Report 2011**

Prepared for Ducks Unlimited  
And the American Trader/Kure Stuyvesant Trustee Councils



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November 2011

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## **SUMMARY**

2011 was the second of a 3-year effort to monitor Western Grebes breeding at Lake Earl, California. The project is part of a grebe nesting habitat restoration project. The restoration actions slated to occur in 2011 and 2012 include fencing cattle out of emergent wetlands and initiating boater education to minimize disturbance to grebe colonies on the lagoon. Western Grebes bred at Lake Earl in 2011, but with low success, after failing to breed entirely in 2010. At a minimum, 10 nests were constructed in 2011, hatching took place at 2 nests, and one chick survived to near fledging.

The ultimate cause of breeding failure in 2010 was considered to be a late spring breach of the bar built lagoon, that caused the normally freshwaters of Lake Earl to remain estuarine and low during the breeding season. A similar scenario occurred in 2011, although the breach sealed a month earlier, prior to the breeding season, and water was 2 feet higher. Amount of flooded emergent vegetation available for nesting in both years was minimal. Aquatic prey may have also been limited by unusually shallow, warm water conditions. In addition to suspected deficiencies in nesting substrate and prey, predation by river otters was introduced as a potential negative factor affecting this small, isolated breeding population.

Fencing around most grazed tracts of the Lake Earl Wildlife Area was completed prior to the 2011 breeding season. Cattle exclusion from the wetland is expected to have significant ecosystem benefits on the lagoon. The boater education portion of the restoration project had not been implemented by 2011, but public awareness of the colony increased in other ways due to demonstrated nesting effort by the birds and increased visibility of the project. Continued monitoring will add valuable management information on effects of annual variation in lagoon water conditions on Western Grebes and associated species, particularly if additional parameters are quantified.

## **ACKNOWLEDGEMENTS**

This project was proposed by Ducks Unlimited and funded by Kure/Stuyvesant and Luckenbach Trustee Councils Trustee Agencies, with support from the National Fish and Wildlife Foundation. The project is a cooperative effort between DU and the California Dept. of Fish and Game (CDFG). J. McCreary (DU) administered the monitoring subcontract with Pacific Eco Logic. C. Bartollotta (CDFG) provided logistical support for monitoring and arranged access to the Lake Earl Wildlife Area. F. Kemp and Kiera Freeman (CDFG) provided direct assistance with facilities at the wildlife area and information on cattle management and fencing. S. Jerabek and S. Calla (Tolowa Dunes Stewards) shared their independent observations of grebes at Lake Earl and helped raise local awareness of the project.

## INTRODUCTION

This report describes results of the second year of a three-year Western Grebe (*Aechmophorus occidentalis*) colony monitoring program at Lake Earl in Del Norte County, California. Monitoring in 2010-11 was conducted by Pacific Eco Logic in conjunction with a cooperative restoration project initiated by Ducks Unlimited (DU) and the California Dept. of Fish and Wildlife (CDFG), and funded by the National Fish and Wildlife Foundation, NOAA, USFWS, and CDFG. The restoration action addresses the developing conflict between public recreation functions and wildlife habitat values of Lake Earl. Habitat enhancement, public education, and monitoring are the three primary project components. Ultimately, this work will improve the body of knowledge that forms the basis for annual water level management activities at Lake Earl.

Lake Earl supports the only coastal Western Grebe breeding colony between Santa Barbara, California and British Columbia, Canada, and is the sole estuarine lagoon used for nesting on the U.S. Pacific Coast (Ivey 2004). Western Grebes have received little research or management attention at the site. The wetland and most of the surrounding lands are part of the CDFG Lake Earl Wildlife Area (LEWA). Water levels at the lagoon are regulated by a combination of artificial and natural processes. Annual mechanical lagoon breaching for flood control takes place under review from multiple government agencies and permitting by the U.S. Army Corps of Engineers (USAC). While the lagoon supports a smaller grebe breeding population than many other locations in California, its geographic isolation, vulnerability, and management potential, increase its statewide and ecological significance.

The Lake Earl project goals are to 1) increase public awareness, particularly the fishing and boating communities, about the grebe nesting colony, its sensitivity to disturbance, and how the public can help to promote nest success and population growth; 2) enhance western grebe nesting habitat quality; and 3) monitor the success of public education, habitat enhancement and near term population trends of the nesting colony. These goals are consistent with the concerns and proposed actions outlined in the conservation assessment and management plan for breeding Western and Clark's Grebes in California (Ivey 2004). Monitoring in 2010 was intended to represent the pre-restoration or baseline condition for this project. Objectives for years 2 and 3 were to 1) erect adequate cattle fencing along the upland edge of Lake Earl emergent marsh to reduce habitat degradation and direct disturbance to grebes, and 2) construct public education kiosks at the two Lake Earl boat/kayak launches in an effort to reduce disturbance to nesting colonies by boaters, and 3) continue monitoring.

### Background

Western grebes have been observed nesting in submerged aquatic vegetation (SAV) beds at Lake Earl both in open water and within emergent vegetation zones since at least 1974 (Fig. 1). Historical accounts of grebe nesting have come primarily from a master's thesis project that included year round monitoring of waterbirds at Lake Earl in 1974-75 (Funderburk 1979)

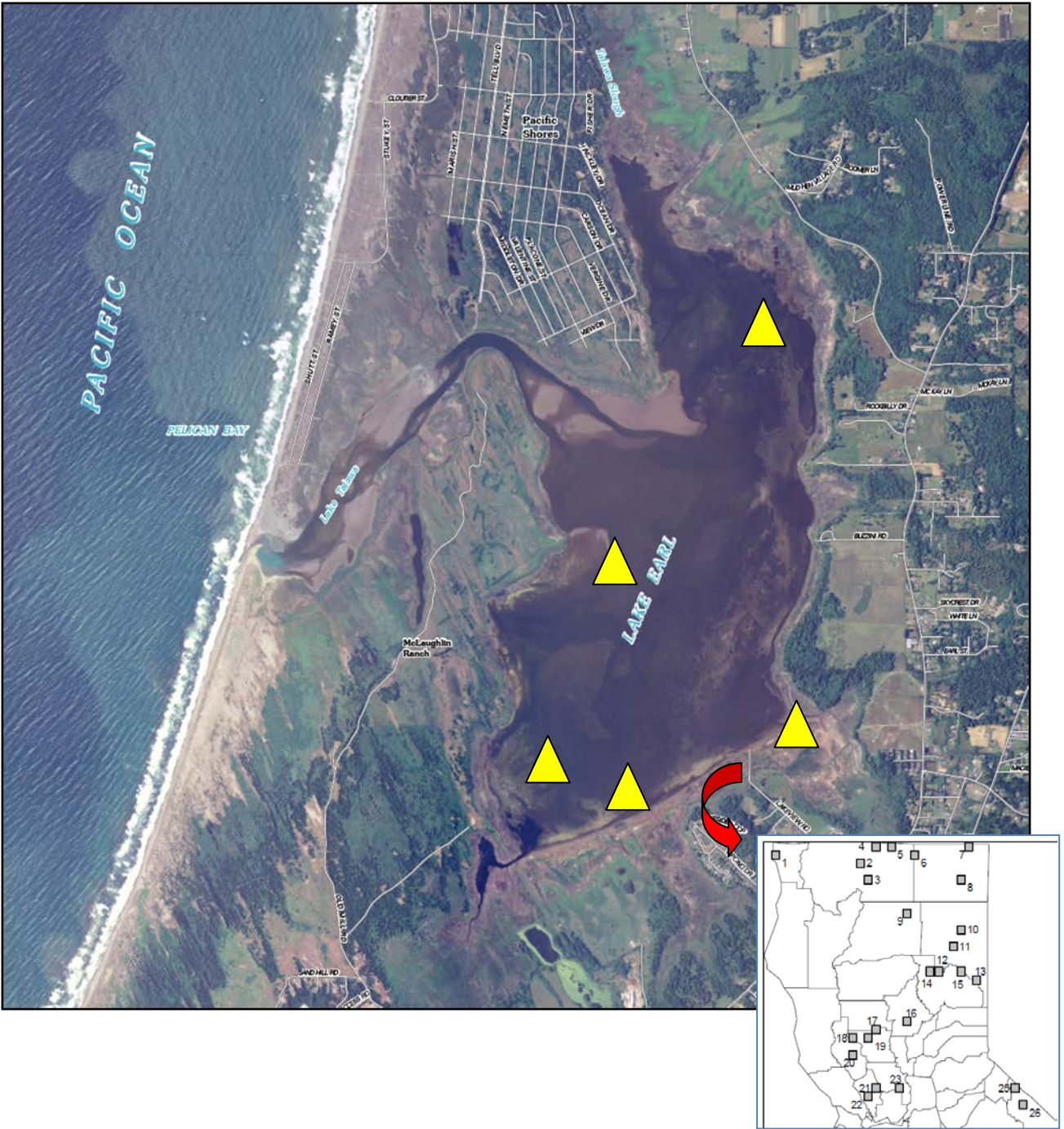


Figure 1. Lake Earl, Del Norte County, California. Photo from USGS taken at a low water level. Yellow triangles indicates areas used by colonial nesting Western Grebes from 1974-2008. Inset shows location of the Lake Earl Western Grebe colony (1) in relation to other breeding areas in northern California. Inset graphic is excerpted from Ivey (2004).



and an unpublished report that provided data on nongame waterbirds in conjunction with waterfowl productivity surveys at LEWA in 1987-88 (Jaques 1999). More recently, Western Grebe specialists from U.C. Davis, K. Robison and R. Weems, visited Lake Earl for 2 days during a 2008 statewide survey of breeding areas and found the colony to be larger than previously reported (Robison et al. 2009). The historical review included in the first year progress report (Jaques 2010) details these findings.

Changes in socio-economic conditions, water level management strategy and LEWA property holdings over the past few decades have presented new scenarios and conservation concerns related to the little known Western Grebe colony at Lake Earl. As timber and fishing industries have declined, eco-tourism and non-consumptive recreational activities have been promoted and increased in rural Del Norte County. These activities include hiking, kayaking, and birding at the LEWA and adjacent Tolowa Dunes State Park. Although boating can be an important source of disturbance to grebes (Gericke 2006, Robison et al. 2009), most user groups at Lake Earl are likely to be receptive to education and willing to cooperate in efforts to preserve the ecological values of the wetland, including its nesting waterbirds.

Lake Earl is a bar-built estuarine lagoon (Krauss et al. 2008). The lagoon breaches naturally in some years when water levels in the lagoon reach levels above about 3m (9ft) mean sea level (msl). However, since at least the 1870's, the lagoon has been manipulated by periodic manual breaches of the sand bar at the southwest end of Lake Tolowa at lower levels (Del Norte County Historical Society Records, Tetra Tech 2000). For most of the last century the lagoon was breached multiple times each rainy season to increase the amount of pasture land available to dairy ranchers and protect rural county roads from flooding. The lagoon fluctuated around a level of 4 feet above msl. Increased concern about the negative ecological effects of diminishing the wetland resulted in a new plan to attempt to more closely approximate the expected natural breach pattern, and breach only at high levels in winter. Beginning in the mid-1980's the strategy has been to limit breaching to winter, at about the 8-10 foot levels (Tetrattech 2000, CDFG 2003).

To compensate ranchers for their loss of lower pasture use, DFG purchased additional lands around the lagoon that would be flooded at these higher levels. In order to maintain short grass pasture for the Aleutian Cackling Goose (*Branta hutchinsii leucopareia*) and other waterfowl species, many of the pastures on LEWA have been maintained and are grazed by tenants under the supervision of the Del Norte Resources Conservation District (RCD). Some of the fencing on these lands was installed during the period when water levels were held lower, which has resulted in a current situation of rusted broken fences and cows escaping into wetlands (F. Kemp, CDFG, R. Galea, RCD pers. comm).

Disturbance issues and shoreline habitat management are directly addressed in the DU restoration action plan. The ecological effects of various annual lagoon breach scenarios are likely to have important implications for nesting Western Grebes at Lake Earl both in terms of nesting structure and forage base. This project is expected to contribute to knowledge of

these relationships and possibly result in additional management recommendations that could help make the unique coastal colony more robust.

## STUDY AREA

Lake Earl is the largest estuarine lagoon on the U.S. Pacific coast. It is comprised of two distinct water bodies, known as Lakes Earl and Tolowa, connected by a relatively narrow channel referred to as “The Narrows.” The lagoon environment varies significantly depending on status of the sand berm at the mouth of Lake Tolowa. When the berm is closed, Lake Earl is a freshwater wetland fed by streams and rainwater, while Lake Tolowa remains relatively brackish due to saltwater seepage and ocean overwash. When the bar opens to the ocean, the lagoon rapidly drains to less than 1 m (3 ft) msl and both waterbodies become intertidal. Total water surface of the lagoon at high water levels (10 ft msl) is about 4,826 acres, compared to 2,191 acres when the lagoon is open to the sea (2ft msl; Tetra Tech 2000). There is a salinity gradient in Lake Earl emanating from the narrows during open estuary conditions (Tetra Tech 2000). Waters with the least salinity occur at the north and south extremes of Lake Earl.

The lagoon system is breached artificially 1-3 times each winter under a joint County of Del Norte, CDFG permit from USAC. After February 15, artificial breaching requires an emergency permit from USAC. During winter, storm waves and onshore transport typically builds the opened beach berm back up within a few weeks, the lagoon reseals, and water levels gradually rise until the next breach or the end of the rainy season. Natural lagoon breaches are rare, but seem to typically occur most often in spring. When breaching occurs in spring, marine conditions favoring offshore sediment transport prevent the barrier bar from rebuilding and the lagoon may remain open and low for months. Artificial closure of the bar was attempted, but failed, in at least one year (May 1992).

The shoreline of Lake Earl is largely undeveloped and rimmed with emergent vegetation, comprised predominantly of Hardstem Bulrush (*Scirpus acutus*) and Three Square Bulrush (*Scirpus americanus*) (Fig. 2). The predominant SAV species in the system are Sago Pondweed (*Potamogeton pectinatus*) and Wigeon Grass (*Ruppia maritima*). Wigeon Grass has been associated with the higher salinity waters in Lakes Earl and Talawa (Wood 1972) and is often intermingled with Sago Pondweed.

Recreational uses of Lake Earl include waterfowl hunting, fishing, boating, birding, and windsurfing. There is a 15 mph speed limit on power boats, restricted to electric only motors. Dense SAV typically prevents widespread use of an outboard motor during the summer in Lake Earl, but kayaking and windsurfing have become increasingly popular over the last few decades. Several groups, including the non-profit Tolowa Dunes Stewards (TDS), have organized kayak trips in conjunction with naturalists and commercial operators

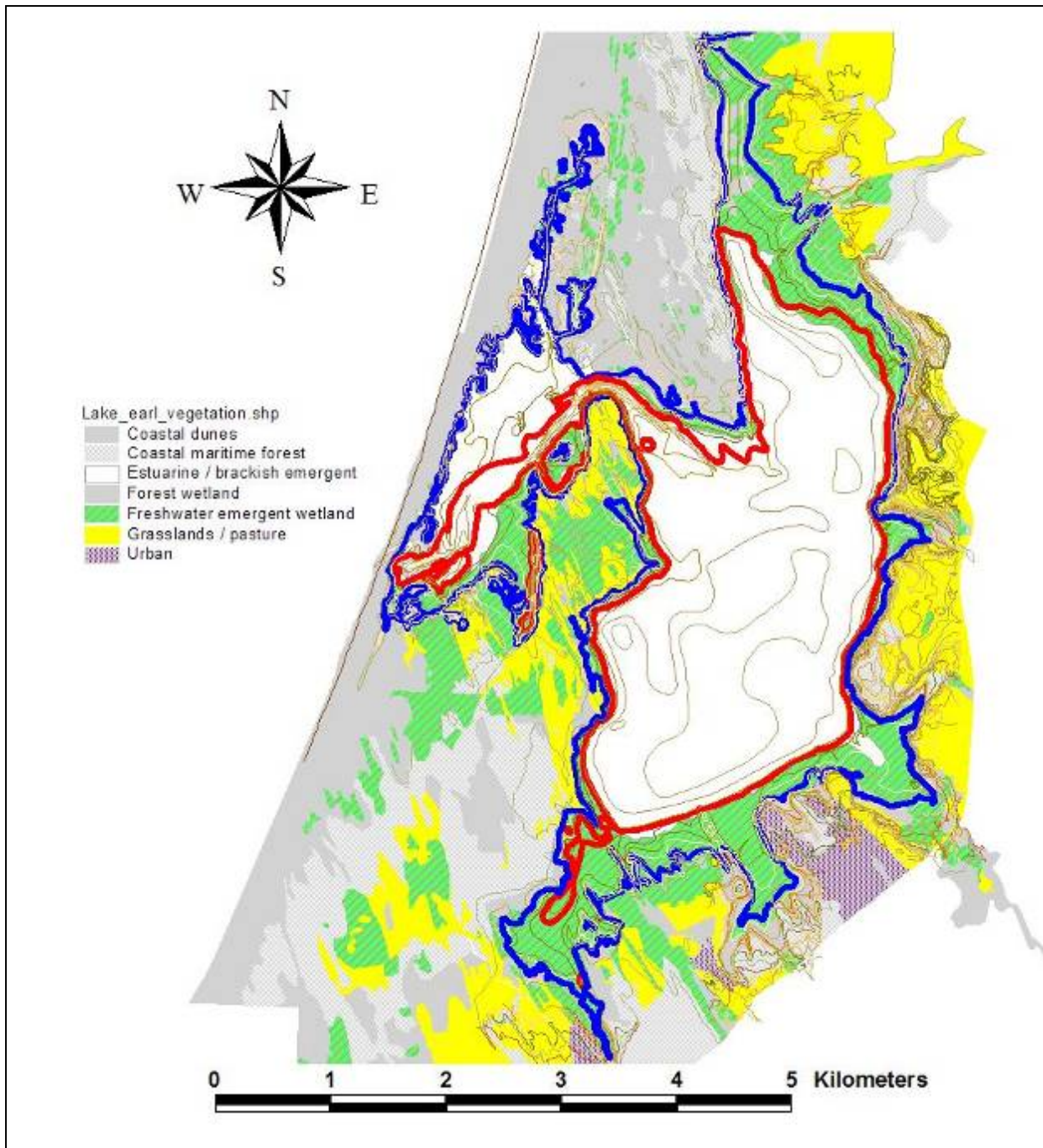


Figure 2. Lake Earl emergent wetland vegetation and relationship to water levels. The inner red line shows the approximate shoreline of the lake during the 2010 western grebe breeding season (2 ft. above msl). The outer blue line approximates the shoreline in summer 2008 (7 ft. above msl). Hydrographic layers are from the California Division of Water Resources; vegetation layers are derived from Nyoka (2003), California State Parks.

to allow the general public to explore the lagoon from the water. Most forms of boating are limited to periods when the lagoon is closed to the ocean, due to the very shallow waters that occur when the estuary is intertidal.



## METHODS

Shore and boat-based surveys were used to census and observe Western Grebes at Lake Earl in 2011, as in 2010. Scope observation points alongshore were similar to those used by others, (Funderburk 1979; Jaques 1999) to conduct waterbird surveys in Lake Earl (Fig. 3). A key to locked gates and permission to drive on closed portions of the wildlife area was provided by CDFG, facilitating access to essential shoreline viewpoints.

Observations of nesting grebes and potential disturbance sources occurred 3-4 days a month from June through September 2010. Boat surveys were used to conduct additional searches for nesting grebes, search for broods (as in Robison et al. 2008), and collect supplemental information on nesting habitat. Both a kayak and a rowboat with a small electric trolling motor were used for surveys in 2011.

The waters of Lake Earl were divided into 10 regions (Fig 3). All sightings of grebes and boaters were ascribed to one or more regions. Total estimates of grebes were based on 1) peak counts of grebes observed from a single observation point or 2) a collation of counts from a variety of locations if double-counting was very unlikely. General grebe behavior was noted. Boat type and numbers of boaters in the water were documented during census procedures and nest site observations.

All nests observed in 2011 were numbered and activity on the nest was tracked at intervals from the shore during the incubation period. Total numbers of grebes in the colony area were counted at the same intervals during each observation period. Nest attendance was used as a method to evaluate status of nest, i.e., whether eggs had been laid or not. No boat based observations took place during the incubation phase as a precaution against potential disturbance to the colony.

Water level and temperature data were downloaded online from the automated California DWR gauge located at the Narrows (<http://cdec.water.ca.gov/>). Qualitative assessment of wetland vegetation took place from shore (emergent zone) and by boat (SAV). Water depth measurements in colony areas were taken with a meter stick during boat surveys in September.





Figure 3. Scope survey points and wetland divisions used during Western Grebe Surveys at Lake Earl in 2010. Map of Lake Earl excerpted from 7.5" USGS Topographic map. Survey route and divisions adapted from Funderburk (1979) and Jaques (1999).

## RESULTS

### Grebe Census

Surveys of Western Grebes at Lake Earl took place on 14 dates, June-September 2011 (Table 1). The peak number of grebes observed during the breeding season was 43 birds. The population appeared to be fairly stable through June and July. Grebe counts dropped to less than 20 birds in August and September. Compared to 2010, numbers of grebes in June and July were lower, but similar in August (Fig. 4).

Table 1. Western Grebes and boats counted at Lake Earl in 2011. Highest grebe count each day by viewpoint and area are shown. Areas checked but with no grebes are not included in the table. <sup>1</sup> Rafting Grebes avoided boat, moved out of view ahead of observer's ability to accurately census.

Date	Method	Observation Point	Lake Area	No. Grebes	No. Boats	Notes
6/24/11	G	Lakeview	G	16	0	Some courting, most resting
"		Buzzini	E	26	0	Courting, fishing, resting
6/25/11	G	Lakeview	G	27	0	Court, fish, rest
"	B	Central basin	G,F,D, E,H,I	2+ <sup>1</sup>	0	Nest search, Kayak paddle survey
6/26/11	B	South and central basin	G,F,H,I	7	0	Nest search, Rowboat w. troll motor
6/27/11	G	Lakeview	G	21	0	
"	G	Cadra Point	H	4	0	2 pair in Sago mat, prospecting, courting
7/20/11	G	Cadra Point	H	35	0	10 nests, incubate, build,
7/21/11	G	Cadra Point	H	43	0	10 nests, incubate, build, court
7/22/11	G	Cadra Point	H	39	0	10 nests, 3 incubate, others build, raft
"	G	Buzzini	E	4	0	Dive, fishing
7/22/11	G	Cadra Point	H	39	0	10 nests but not all occupied, 3 incubate
7/23/11	G	Cadra Point	H	41	1	Kayak in distance (Area G)
8/18/11	G	Cadra Point	H	19	0	2 pair with broods, others rafting vestigial nests, river otter in area
8/19/11	G	Cadra Point	H	19	0	2 pair feeding back-brooded chicks, some birds flight capable, river otter alarms
8/20/11	G	Cadra Point	H	19	0	2 pair chick-feeding, 2 chicks
9/7/11	G	Cadra Point	H	11	0	Raft in former nesting area, no chicks
9/8/11	B	Central basin and south end	H,F,G,I	2 adult 1 chick	2	Found 1 chick swimming, escorted by both parents, 2 duck hunters in skull boats scoping out south lagoon
9/9/11	G	The Narrows and north end of lake	J,D	0	1	Kayaker paddling in narrows

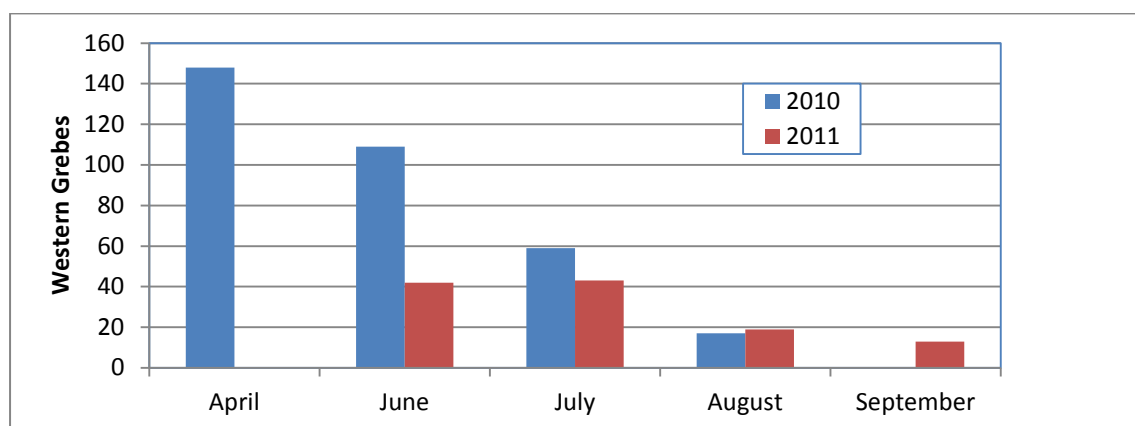


Figure 4. Peak Western Grebe counts by month at Lake Earl, 2010-2011.

## Pre-Nesting

During June, Western Grebes were primarily seen rafting and fishing in loose groups in the central basin of Lake Earl in association with small numbers of Pied-billed Grebes (*Podilymbus podiceps*), Rudy Ducks (*Oxyura jamaicensis*) and scaup. Most of the grebes in the central basin were grouped in two's within the larger groups, and appeared to have already established pair bonds. Pair bonding behaviors including rushing and courtship feeding were observed. None of these behaviors were observed at Lake Earl in 2010. On 6/27, 4 birds that were clearly paired were observed prospecting for nest sites off Cadra Point in open water habitat subtended by submerged aquatic vegetation beds. Behaviors included diving and courting just outside the edge of the dense pondweed bed, entering it and staring down at the prospective sites. About 100 ducks, both dabblers and divers also congregated in this area.

## Nesting

Western Grebe nesting was initiated during early to mid-July. Nearly all grebe use of Lake Earl had shifted to the southwest end of the lagoon by this time. On 20 July, there were 10 nests in various stages of development on the SAV beds off Cadra Point. All nests were constructed with SAV in open water, presumably anchored by roots. Nest building and supplementation was observed at all nests. Pairs defended their nest areas vigorously from other grebes. Up to 43 birds were present, thus only about half of the potential pairs present had constructed nests at this point.

Observations of nest site attendance (Table 2) indicated that incubation was taking place at 3 nests (#2,#4,and #9). Birds at these sites had consistent attendance, incubating posture, and were seen rolling eggs with their beaks. A fourth pair (nest #1) may have initiated incubation on the 22nd. Other nests were left unoccupied at times. All nests but one (#2) were temporarily vacated in response to a river otter swimming through the colony on 23 July (see Potential Predators, below).

Grebe colony attendance was greatest during the morning and evening hours, and lowest in the afternoon (avg. 39.6 and 37 birds respectively vs. 30.8 birds; N= 19). Grebes were seen swimming away from the nest area and were detected foraging from Buzzini Road in July (Table 1). A wide variety of waterfowl species also concentrated in the southwest portion of the lagoon. In addition to feeding and loafing, some of them were molting and others rearing chicks. Gadwall broods used temporarily empty nest platforms for resting each day, using 4 different nests. The intruders were sometimes chased off by grebes returning to the nest, but other times grebes were deterred by threats from the mother duck and waited to take back their nest until after the broods departed.

Observations at the colony from shore were difficult due to distance to nearest nests, low elevation viewpoint, and various environmental conditions. Afternoon light inversions and wind driven wave chop often made grebe viewing nearly impossible at most locations in Lake Earl. Heavy fog also entirely precluded some early morning and evening observations.

Table 2. Western Grebe nest attendance at Lake Earl during period scans of the colony, July 20-23 2011. Shaded squares indicate single bird or pair on the nest or actively building nest. Empty squares indicate an empty nest, but possibly attended by a bird on the water nearby. Numbers under the date indicate time period; 1=morning, 2=afternoon, 3=evening. \* River otter disturbance.

Nest	20			21						22						23						
#	3	1	1	1	2	2	3	3	3	1	1	1	2	2	3	3	3	1	1*	1	1	1
1																						
2																						
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						
Total	35	4		4	2	3	3		3	3	3	3	3	3	3	4		4	4	4	3	3
		3		0	8	1	5		0	8	7	3	4	0	9	1		2	1	1	7	7

### Chick-Rearing

Chicks had hatched from at least 2 nests by the August surveys and all other nests had evidently failed. On 18 August, there were only 2 vestigial nests remaining at Lake Earl and 2 pair packing 1-chick broods. This was 30 days after the earliest known date of onset of incubation (July 20). Based in an average incubation period of 24 days, hatching may have taken place around August 12. Both chick's size and behavior were consistent with a 1 week-old grebe; they were small, at times barely visible, and only left their parent's back when moving over to the other parent. They were fed by the brooding parent, who received fish from the foraging parent.

In addition to the four parents, another 15 Western Grebes were present in the colony area during the mornings in a loose flock, separate from the brood-packing grebes. Some members of the flock moved about as pairs but were not associated with either of the deteriorated nests. These grebes were capable of short flights. The two successful pair were aggressive towards these conspecifics when they approached too closely.

Chick-feeding bouts by the successful pair were sampled during experimental observation sessions 18-20 August. The two pair off Cadra Point, arbitrarily designated as Pair 1 and Pair 2, could not be distinguished on separate days, but could be tracked during the course of a focused observation session by tracking their location. The chicks were fed infrequently during mid-morning hours; fishing was more successful in the evening (Table 3). The pairs were not necessarily actively feeding during an entire observation session. The successful dive (SD) interval was recorded only when one member of the pair was constantly diving and



the other member was tracking it's mate, preparing to receive the prey. Grebe chicks were provisioned with very small silvery fish, possibly stickleback or goby.

Data on unsuccessful dives was not quantified overall, but for example, on 19 August, the male of Pair 1 returned to the female with fish for the chick at 1035 then proceeded to fish some more. Each time the male came up from a dive, the female advanced toward him. From 1047-1128 the male emerged 6 times with an empty beak. The pair came together and did a chick exchange at 1132 and the female immediately began to dive. No prey were delivered to the chick by the end of the observation session at 1200. During this same time period, the other pair did not attempt to feed their chick and all birds had been responding to multiple predator alerts.

Table 3. Chick provisioning rates by two pair of Western Grebes in Lake Earl. One member of each pair was back-brooding a chick while it's mate foraged. Pair 1 and Pair 2 may have been different birds on different days (see text). Total fish; the number of fish delivered to the chick, Fish/hr; number of fish divided by total time, SD interval; successful dive interval (minutes) when a bird was seen provisioning the chick with more than one fish during continuous feeding effort.

Date	Time	Total Time	Pair 1			Pair 2		
			Total fish	Fish/hr	SD interval	Total fish	Fish/hr	SD Interval
2011								
18 August	1820-1920	1.0	2	2	25 min	2	2	20 min
19 August	0900-1200	3.0	1	0.33	--	0	0	--
20 August	1015-1230	2.25	1	0.44	--	2	0.88	8 min

Few other large piscivorous birds were seen off Cadra Point, however, two Double-crested cormorants were present in the colony area each day during the August surveys. They may have been attracted to the area by a submerged fence post that was used for roosting. On 20 August, there was a prolonged chase and fight over a fish that one of the birds had caught and not yet swallowed.

In early September, at least one of the Western Grebe chicks was confirmed to have survived to near fledging. The bird was located on 8 September and estimated to be about 28 days old. It was swimming independent from its parents, but escorted by two adults, presumably the parents. The brood was found in the southwestern portion of Lake Earl by boat, away from the colony. Shore based observations at Cadra Point did not result in any chick sightings, but 11 adult birds were still rafting in the colony area. There was no sign of re-nesting or pair-bonding behavior.

### Predators

The most threatening potential predator to Western Grebes nesting at Lake Earl River was the river otter (*Lontra canadensis*). Otters are resident to Lake Earl and have been observed

stalking and killing waterbirds in the past (D. Jaques, unpubl.). Otters disrupted the behavior of grebes at the colony in July and August 2011. On 23 July a lone otter approached the nesting colony off Cadra Point and caused all (42) Western Grebes to alert. As the otter swam closer, the flightless birds fled by running across the water and diving. All grebes attending nests departed their nests except for an incubation bird at #2. The otter purposefully approached Nest #4 (one of the 3 nests that contained eggs), inspected the contents and then continued on. Two otter were later seen diving outside the colony area, presumably feeding on fish or crustaceans, alerting only the nearest grebes and waterfowl.

During the brood-rearing period otters were seen in the colony multiple times on 2 dates. On 18 August, it was clear the an otter was actively stalking the waterbirds that were concentrated off Cadra Point. The two pair of grebes with chicks on their backs swam away, presumably unable to dive or run without displacing their chicks. Other grebes were able to make short flights by this time. On 19 August, an otter was observed to take a Pied-billed Grebe from the water and swim with it back towards the southwestern shore of the lagoon.

Other potential predators noted were Bald Eagles and Peregrine Falcons. Western Grebes responded to Peregrine Falcons by diving, but displayed no alert behaviors to eagles passing high over head or Northern Harriers cruising low over the marsh edge.

### **Disturbance/Boats**

Few boats were seen in Lake Earl during the summer 2011 as in 2010, presumably due to shallow water, muddy launch points, and poor fishing conditions. Two kayakers and 2 prospective waterfowl hunters in skull boats were observed during censuses of various parts of the lagoon. None of these vessels were detected within 1 km of the grebe breeding colony. Grebes responded negatively to the observer boat during the pre-breeding and chick-rearing phase. The birds swam away from the kayak upon paddling approach at distances greater than about 30 meters, making accurate counts from the low platform difficult. Grebes seemed to allow closer approach by the rowboat powered by a quiet trolling motor. No boat excursions into the nesting colony were made during the incubation phase.

### **Public Awareness**

Public awareness of the Lake Earl Western Grebe colony increased in 2011 due to excitement about successful nesting at the lagoon. Coordinators of the Tolowa Dunes Stewards (TDS) group were the first to detect the nests off Cadra Point (S. Calla pers. comm), the day prior to scheduled surveys for this project. This sparked the interest of Redwood Audubon Society members from Humboldt and Del Norte County, some of whom did not realize that Western Grebes nested on the North Coast. The TDS requested an interpretive talk about the project and offered to help monitor the colony if a volunteer effort were developed. The local newspaper, *The Triplicate*, also became interested in the project and wrote a front-page article about it (Appendix A). The *Triplicate* environmental reporter requested an update during the 2012 breeding season. Local birders, boaters, hikers, etc. typically inquired what

the observer was doing during surveys; the observer's spotting scope views were often shared, and word spread further due to this inadvertent outreach.

## **Cattle**

No cattle were observed on the wetland margin in 2011. Newly installed sturdy fences were located well away from sensitive wetlands. This was in contrast to 2010, prior to restoration action, when multiple incidents of escaped cattle were reported at the lagoon (Jaques 2010).

## **Breach Patterns, Water Levels, and Aquatic Vegetation**

For the second year in a row, Lake Earl breached unusually late in the spring and did not seal and stabilize until summer (Fig. 6c). This was in contrast to the more typical winter breach, spring sealing, and high summer water levels of recent years (e.g., 2008). The lagoon opened, apparently naturally, the afternoon of 30 March 2011. Water level was 10.2 feet above mean sea level (msl) when the breach occurred, and dropped 9 feet in a day. The lagoon was intertidal for nearly 2 months, until the beach berm built up enough to seal the freshwater into the lagoon on 20 May. Lagoon water level rose gradually with rainfall, stabilizing at about 4.0 feet by the second week of June (6/9).

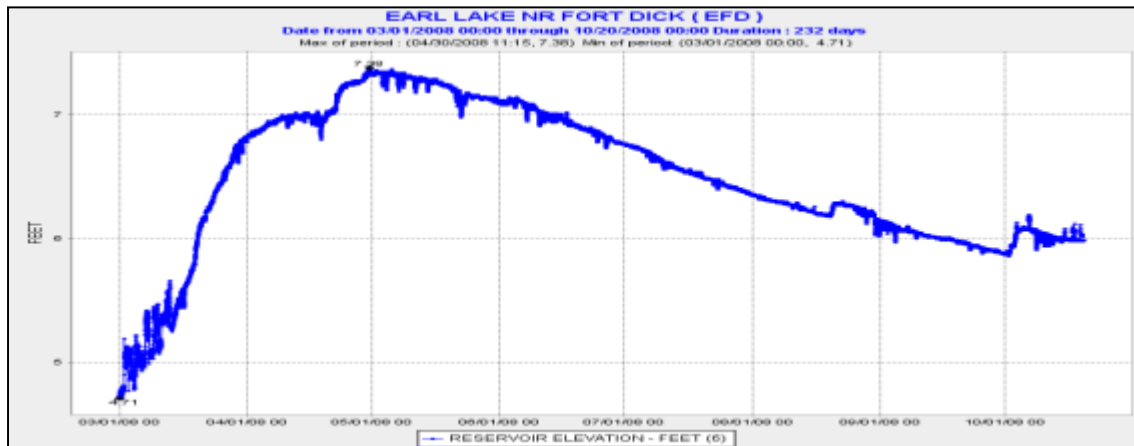
In Spring 2010, the barrier sandbar breached 2 weeks later than 2011, on 14 April at 9.6' msl (Fig 6b). The lagoon remained open to the ocean for more than 2 months before closing in on 23 June, 1 month later than in 2011. Tidal flux at the Narrows in early June was as great as 2 feet (0.5-2.5ft) but tidal attenuation in historic grebe nesting areas would have been somewhat less than that. Water levels increased slightly and stabilized at about 2.0 ft msl in late summer.

The year 2008 contrasts with 2010-11 (Fig 6a). In that year the lagoon closed by 14 Feb, there was no spring breach, and water levels gradually fell, due to evaporation, from 7-6 feet during the breeding season.

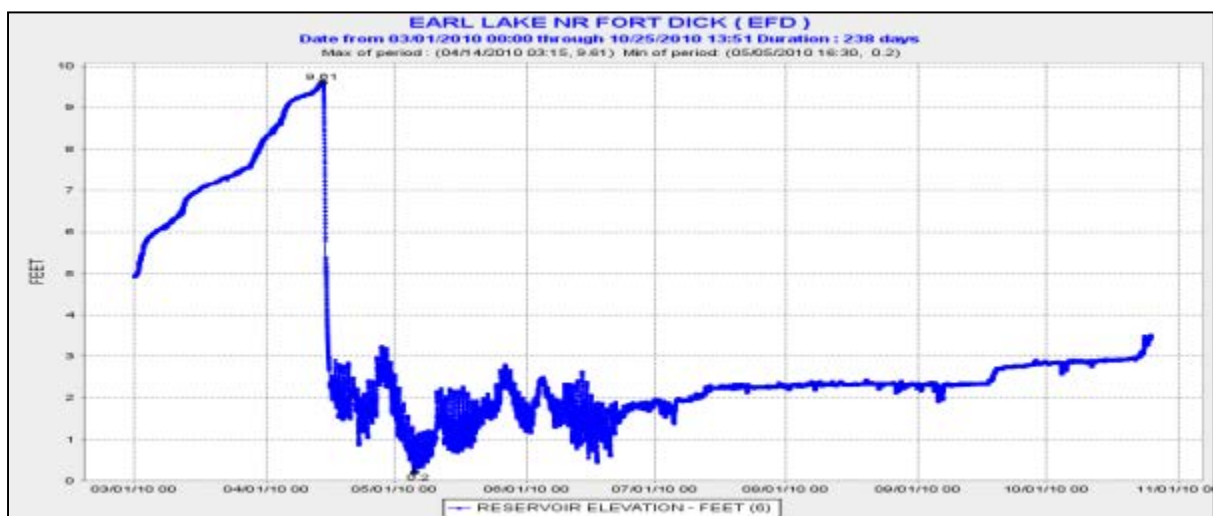
There appears to be a positive relationship between early spring closure (higher water levels) and grebe nesting effort. Data collected during 5 years from 1997-2011 suggests that the later the breach seals in the season, the fewer grebe nest attempts there are (Table 4). The lagoon was under a different management regime in the 1970's when there was a June closure and substantial number of nests. More data are needed to test the hypothesis that grebe nesting effort and success is correlated with breach regime and associated environmental factors.

Water depth in the nesting area off Cadra Point was 1.5 m (60") when measured in September 2011. Water depth in the same area off Cadra Point in 2010 was about 1.0 m, while other historic nesting areas, such as Jordon Cove had no water cover.

A.



B.



C.

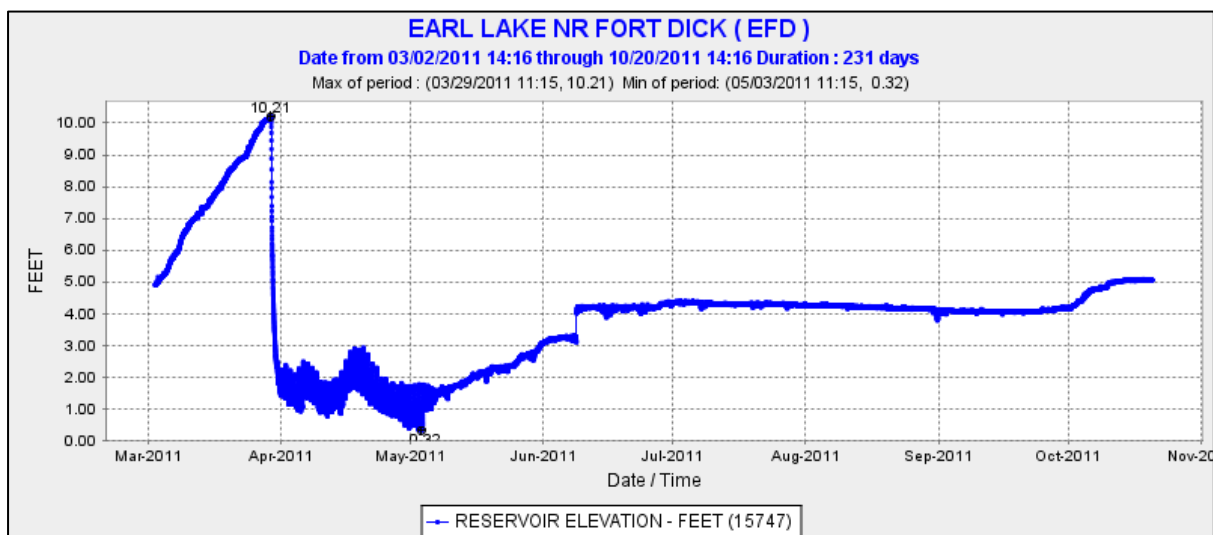


Figure 6. Lake Earl water levels during the 2008 (A) and 2010 (B), and 2011 (C) Western Grebe breeding seasons. Data are from the California Division of Water Resources website <http://cdec.water.ca.gov/>

Table 4. Western Grebe breeding records at Lake Earl in relation to lagoon breach regime, and breeding season water level, 1974-2010. ND= data not yet found.

Breeding Season Year	Last Breach of season	Lagoon Closing Date	Breeding Season level (Jun-Aug)	No. Western Grebe Nest Attempts	Source
1974	ND	ND	4 feet	18	Funderburk 1979
1975	May 15	Early June	3 feet	43	Funderburk 1979
1997	December 3 1996	1st week of March	6 feet	26	Jaques 1999
1998	March 5	March 22	6-7 feet	14	Jaques 1999
2008	Jan 22	Feb 14	6-7 feet	75	Robison et al. 2008
2010	April 14	June 23	1-2 feet	0	Jaques 2010
2011	March 30	May 20	3-4 feet	10	This report

The submerged aquatic vegetation in the colony area (Area H) was comprised of both Sago Pondweed and Wigeon Grass in 2011. Nearest emergent vegetation was greater than 100 meters away from the nearest nest. Condition of both emergent and submergent vegetation did not appear to provide adequate over-water anchoring substrate for nesting Western Grebes in 2010, although water was within the depth range known to be used by grebes (Storer and Neutchterlein 1992).

Aquatic vegetation growth zones at Lake Earl are based on the higher water levels that have occurred at the lagoon system over the past decade. Because the lagoon perimeter was inside the more typical shoreline contours in both 2010 and 2011, most of the emergent fringe in the lagoon was on moist or dry land, rather than emerged in water. At 2 ft above msl, the lagoon is largely comprised of open water (Fig. 2). In 2011, at the 4ft level, more of the emergent habitat was flooded, but the extent was much less than in a more typical 6-8ft water level year.

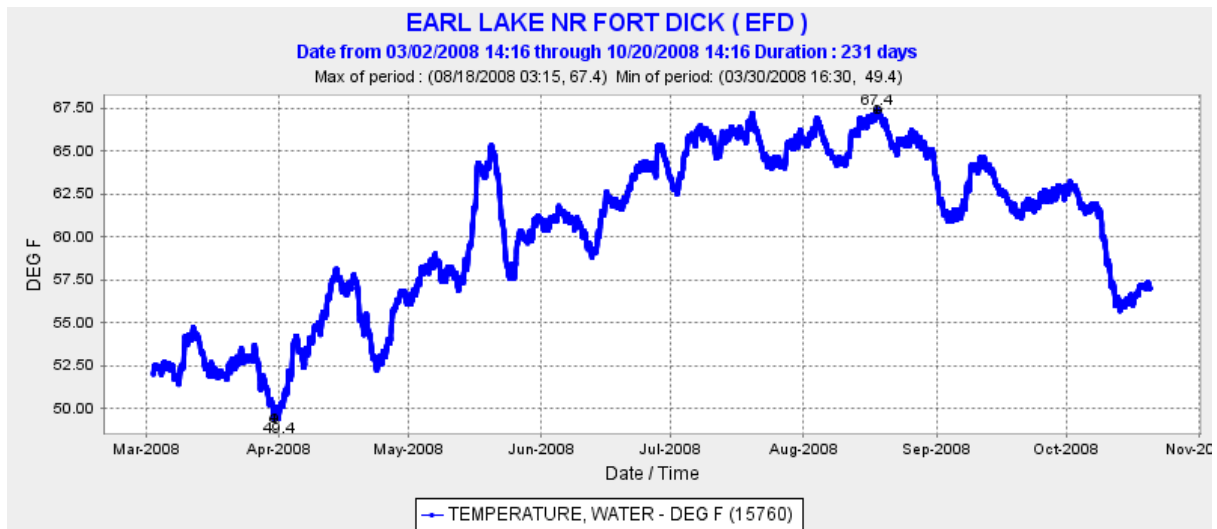
In addition to wetland plant zonation, water depth in the lagoon also affects water temperatures. Shallower water results in warmer temperatures and greater temperature variation. In 2010 and 2011, water temperatures peaked at 77-75 F during July, with large diurnal variation. In 2008, water temps at the narrows peaked at 67 F in August with little diurnal fluctuation (Fig. 7).

### Associated Waterbirds

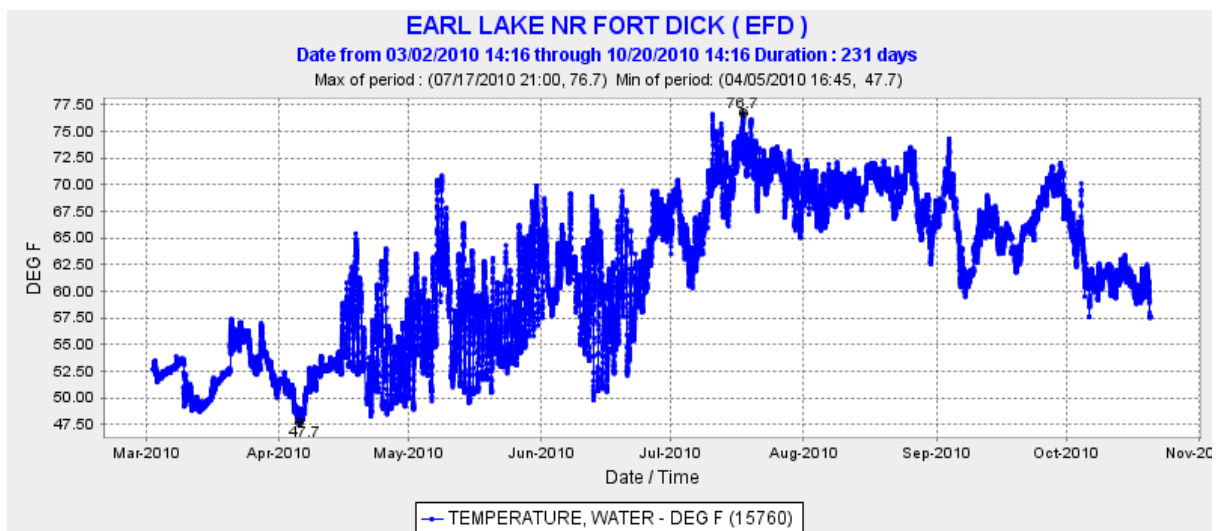
The Pied-billed Grebe (*Podilymbus podiceps*) and American Bittern (*Botaurus lentiginosus*) are species whose breeding habitat requirements overlap with the Western Grebe at Lake Earl. Pied-billed grebes also breed in Lake Earl on floating nests (Funderburk 1979). American Bittern nest in emergent vegetation over water at Lake Earl. Both species were notable breeders in 1997-1999, but not in 2010-2011. In 1997, 39 Pied-billed grebe broods were observed in summer (Jaques 1999). In 2010 there was no evidence of nesting by this species (Jaques 2010). Pied billed grebes were however, consistently present in the Cadra



A.



B.



C.

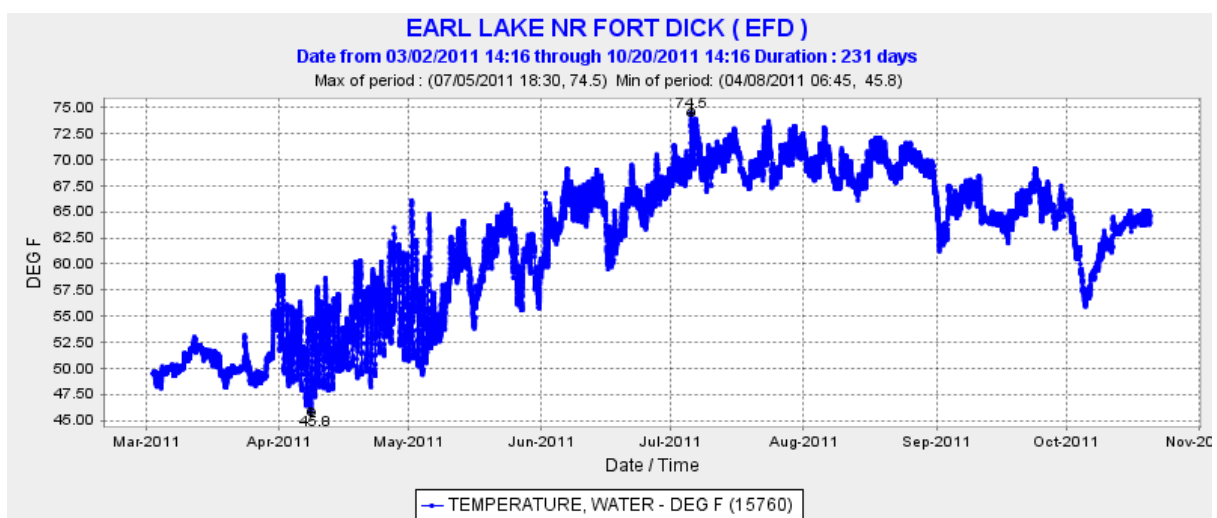


Figure 6. Lake Earl water temperatures at the narrows during the 2008 (A) and 2010 (B), and 2011 (C) Western Grebe breeding seasons. Data from the California Division of Water Resources website <http://cdec.water.ca.gov/>

Point colony area in 2011, and 3 hatch-year birds were observed at the north end of the Lake indicating some successful breeding. Nine bittern territories were mapped at Lake Earl based on booming and visual observations in June 1998 (Jaques 1999). No bitterns were heard or seen during censuses in these same areas in June 2010, however one bittern was seen flying over the marsh at Cadra Point in 2011. Both of these birds may be valuable indicator species for reflecting suitability of habitat structure for Western Grebes. Incidental observations and systematically collected data, suggest that habitat conditions for Pied-billed grebes, bitterns and Western Grebes were better in 2011 than 2010, but not as good as 1997-98 at Lake Earl.

Double-crested Cormorants (*Phalacrocorax auritus*) and Brown Pelicans (*Pelecanus occidentalis*) are piscivorous birds that may most closely fit into the same foraging as Western Grebes at Lake Earl. Hundreds of Brown Pelicans and cormorants forage within Lake Earl in some years (D. Jaques, field notes), although they do not nest there. There were few cormorants and no pelicans observed during grebe surveys at Lake Earl in 2010 or 2011, suggesting low availability of suitable fish prey for these species compared to other years, and possibly Western Grebes as well.

## DISCUSSION

Western Grebe colony locations are somewhat traditional but vary with water conditions (Storer and Neuchterlein 1992). Successful breeding on tidewater marshes is rare (Weber and Ireland 1992). Numbers at large breeding colonies such as Eagle Lake and Malheur have fluctuated dramatically between years (Shaw 1998, Ivey 2004). Breeding populations at Malheur NWR ranged from zero to 3,891 pairs from 1980-98, depending on habitat conditions and prey availability (Ivey et al in prep.). At Lake Earl, western grebes came to the colony in typical numbers in 2010 and 2011, and most remained through the breeding season despite the apparently poor environmental conditions. This project has now documented 1 year of failure to attempt to breed, and one year of a mediocre attempt and nearly total lack of success by the population. Because the colony is relatively geographically isolated, birds using this site may not exhibit as much flexibility to shift to other nest sites compared to other areas in the breeding range.

The ultimate cause of poor success at Lake Earl in 2011 and 2010 appeared to be related to the unusual breach regime in both of these years. Observations suggested that the small colony off Cadra Point in 2011 may have also been impacted by river otter predation. Wetland vegetation structure, prey base, and buffers to predation and disturbance are some of the key parameters that need to be considered in relation to Western Grebe breeding success and population viability at Lake Earl.

Flooded emergent vegetation or rooted submergent vegetation which reaches the water surface is needed to anchor the nests of Western Grebes (Ivey 2004). Habitat structure appeared to be unsuitable for nesting by Western Grebes at Lake Earl in 2010 due to low water levels and other interrelated factors (Jaques 2010). In 2011, the SAV beds were structurally adequate for nesting by late July. Although nesting was initiated late, it was not beyond the range of successful chick-rearing at the site. The Western Grebe nesting season at

Lake Earl has extended from at least June 5 (first incubation noted) to September 9 (birds still attending nests and last chicks seen). This suggests that factors other than nest habitat structure were affecting grebe productivity in 2010. Further discussion of breeding chronology and the status of SAV beds at Lake Earl was provided in Jaques (2010).

In addition to habitat structure, prey species at Lake Earl may have been affected by the water conditions in 2010 and 2011. Grebes are primarily piscivores, but also eat a wide variety of invertebrates (Storer and Neuchterlein 1992). Young chicks are fed small items, including insect larvae. Invertebrate and fish species in Lake Earl grebes differ significantly when the lagoon is freshwater compared to brackish (Tetra Tech 2000). Although grebes are stated to feed opportunistically (Storer and Neuchterlein 1992) prey options may be limited in some cases. At Malheur NWR in eastern Oregon, Western Grebes did not nest during years when size classes of fish (primarily carp, *Cyprinus carpio*) were too large to serve as prey (Ivey et al. in prep). The endangered Tidewater Goby (*Eucyclogobius newberryi*) is the only fish species at Lake Earl that has been monitored in recent years. Tidewater Goby sampling at Lake Earl in 2010 resulted in the lowest catches ever recorded at the lagoon (Chamberlain 2011). The relationship between low goby capture and the breach regime has not been discussed in the available reports to date, although unnatural breaching is thought to be harmful to gobies. Water temperatures at Lake Earl in 2010-2011 were as high as the mid to upper 70's during the summer. This is the upper limit of what can be tolerated by the Tidewater Goby.

Water level management is an issue that affects the Western Grebe at many breeding sites in the west (Ivey 2004) and water level variation from both human manipulation and natural forces appears to be an important issue at Lake Earl. With increased understanding of the cause of breeding failures, additional active management measures for grebes could possibly be developed and incorporated into the management plan at the Lake Earl Wildlife Area (CDFG 2003). Low water years since the inception of this monitoring program have also resulted in very diminished levels of water-based activities at the lagoon compared to more typical years, preventing assessment of human disturbance.

## RECOMMENDATIONS

The lack of Western Grebe breeding in 2010, and nearly complete breeding failure in 2011, have pointed to additional questions that may need to be answered to refine understanding of what grebes require in order to be successful at Lake Earl. To further document the breeding season events, important ecological factors associated with nesting structure and forage base, and to help isolate confounding variables, the following measures are recommended:

To evaluate nest habitat structure and water quality conditions affecting forage base:

1. Quantitatively assess relevant wetland vegetation characteristics, both SAV and emergent types, for example species composition, stem density, and height of SAV; depth of water under emergent plants and width of habitat in relation to shoreline.

2. Conduct water quality monitoring concurrent with grebe monitoring, including measurements of temperature, dissolved oxygen, conductivity, and turbidity in sample areas.
3. Expand survey effort to count indicator waterbird species such as Pied-billed grebes, bittern, cormorants and pelicans in sample areas.

To better document the breeding season, in terms of nesting effort, timing and potential causes of mortality. as well as fulfilling major goals of the project:

1. Develop a local volunteer program to monitor grebes throughout the breeding season so that there are not month long gaps in the data and so that monitoring can continue beyond the timeline of this project.
2. Develop an interpretive talk about grebes at Lake Earl, to increase public awareness, reduce potential boat based disturbances, and recruit volunteers for long-term monitoring.

An expanded monitoring program at Lake Earl would help clarify effects of restoration actions and other potential management for grebes. Restoration project actions to minimize harm from cattle and human disturbance along with introduction of possible management to help grebes cope with variable breach scenarios, will ideally contribute to species population increase. Information gathered so far in this project suggests that the Lake Earl colony may more vulnerable to decline or extirpation than previously considered.

## LITERATURE CITED

California Dept. Of Fish and Game. 2003. Lake Earl Wildlife Area Management Plan. SCH No. 1989013110.

Chamberlain, C. D. 2011. Tidewater Goby investigations - 2010 north coast populations. U.S. Fish and Wildlife Service. Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report DS-2011-21, Arcata, California. Environmental Protection Agency. 2008. National coastal condition report III (2008).  
<http://water.epa.gov/type/oceb/assessmonitor/nccr/index.cfm>

Funderburk, S.L. 1979. Assessment and the use of the Lake Earl Area, Del Norte County, California, by waterbirds and raptors. Thesis, Humboldt State University, Arcata, California.

Gericke, S.M. 2006. Exploring the effects of disturbance events on Western and Clark's Grebes (*Aechmophorus occidentalis* and *A. clarkii*) at Clear Lake, California. M.S. Thesis, University of California Davis, Davis, California. 61pp.

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.

Jaques, D. 1998. Breeding waterbirds at Lakes Earl and Talawa, Del Norte County, California. Unpubl. Rep., California Dept. Of Fish and Game, Lake Earl Wildlife Area, Crescent City, CA.

Jaques, D. 2010. Lake Earl Western Grebe Annual Monitoring Report 2010. Prepared for Ducks Unlimited and the American Trader/Kure Stuyvesant Trustee Councils.

Krauss, N.C., K Patch, and S. Munger 2008. Barrier beach breaching from the lagoon side, with reference to Northern California. *Shore and Beach* 33(2): 33-43.

Robison, K.S., R.E. Weems, and D.W. Anderson 2009. Western and Clark's Grebe conservation and management in California. Annual Report for year 2008 to the American Trader and Kure/Stuyvesant Trustee Councils and National Fish and Wildlife Foundation. 54 pp.

Shaw, D.W.H. 1998. Changes in population size and colony location of breeding waterbirds at Eagle Lake, California between 1970 and 1997. Thesis, California State University, Chico, CA.

Storer, R.W. and Nuechterlein, G.L. 1992. *Western Grebe, Clark's Grebe*. The Birds of North America. Ed. A. Poole, P. Slettenheim, and F. Gill. 26 (1992). 21 pp.

Tetra Tech 2000. Intensive habitat study for Lake Earl and Lake Talawa, Del Norte County, California. Final Report to the USACE, San Francisco District.

Weber, W.C. and J. Ireland. 1992. Tidewater breeding records of the Western Grebe near Vancouver, British Columbia. *Western Birds* 23:33-34.

Wood, W. 1972. Muskrat rumble- muskrat origin, distribution, and habitat investigations in the Lake Earl vicinity of Del Norte County, California. Report for B.S. degree. Humboldt State University.

