Lake Earl Western Grebe
Annual Monitoring Report 2010

Prepared for Ducks Unlimited

And the American Trader/Kure Stuyvesant Trustee Councils

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Contents

SUMMARY

2010 was the first of a 3-year project to monitor breeding Western Grebes at Lake Earl as part of a new grebe 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 were present but failed to initiate breeding at Lake Earl in 2010. Up to 148 birds were observed early in the season, but numbers declined to less than 20 by August. The ultimate cause of breeding failure 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. Amount of flooded emergent vegetation available for nesting was minimal and submerged aquatic vegetation was slow to grow to the surface. Prey may have also been inadequate to support nesting birds. Pre-restoration project data regarding cattle effects and human disturbance on nesting grebes could not be gathered, although effects of cattle on the wetland habitat were noted. Cattle fencing is expected to have significant ecosystem benefits at this wetland. Continued monitoring will add valuable management information on effects of annual variation in lagoon water conditions on grebes and associated species.

ACKNOWLEDGEMENTS

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INTRODUCTION

This report covers results of the first year of a three-year Western Grebe (*Aechmophorus occidentalis*) colony monitoring program at Lake Earl in Del Norte County, California. Monitoring in 2010 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 represents 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, potential threats and positive management potential combine to 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, it's 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 will be 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 beds (SAV) 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)

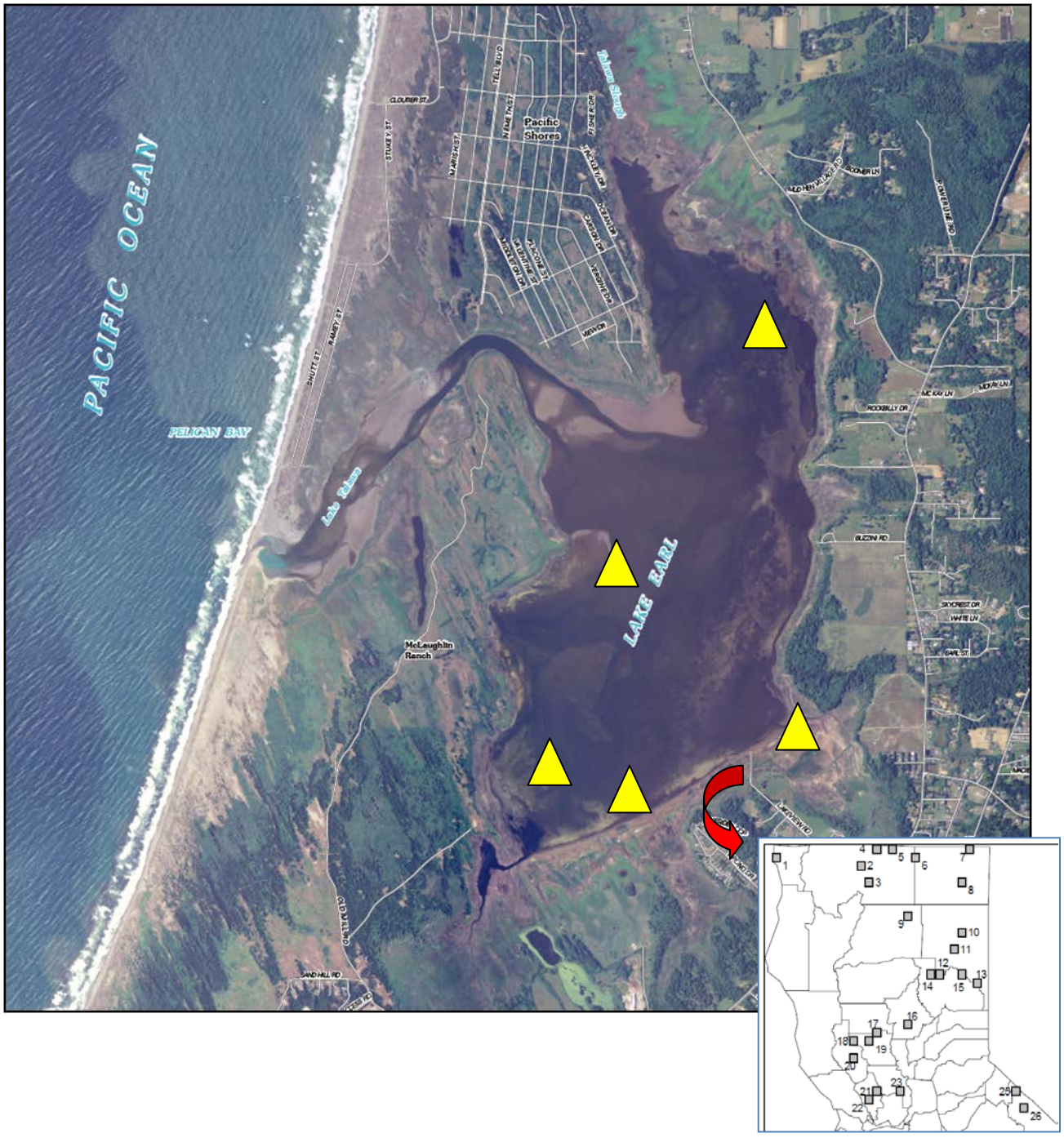


Figure 1. Lake Earl, Del Norte County, California. Photo from USGS taken at a low water level. Yellow triangles indicates areas used by colonial nesting Western Grebes from 1974-2008. Inset shows location of the Lake Earl Western Grebe colony (1) in relation to other breeding areas in northern California. 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 Results section of this report 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 (Tetratech 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 braches 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 (*Potomogeton 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

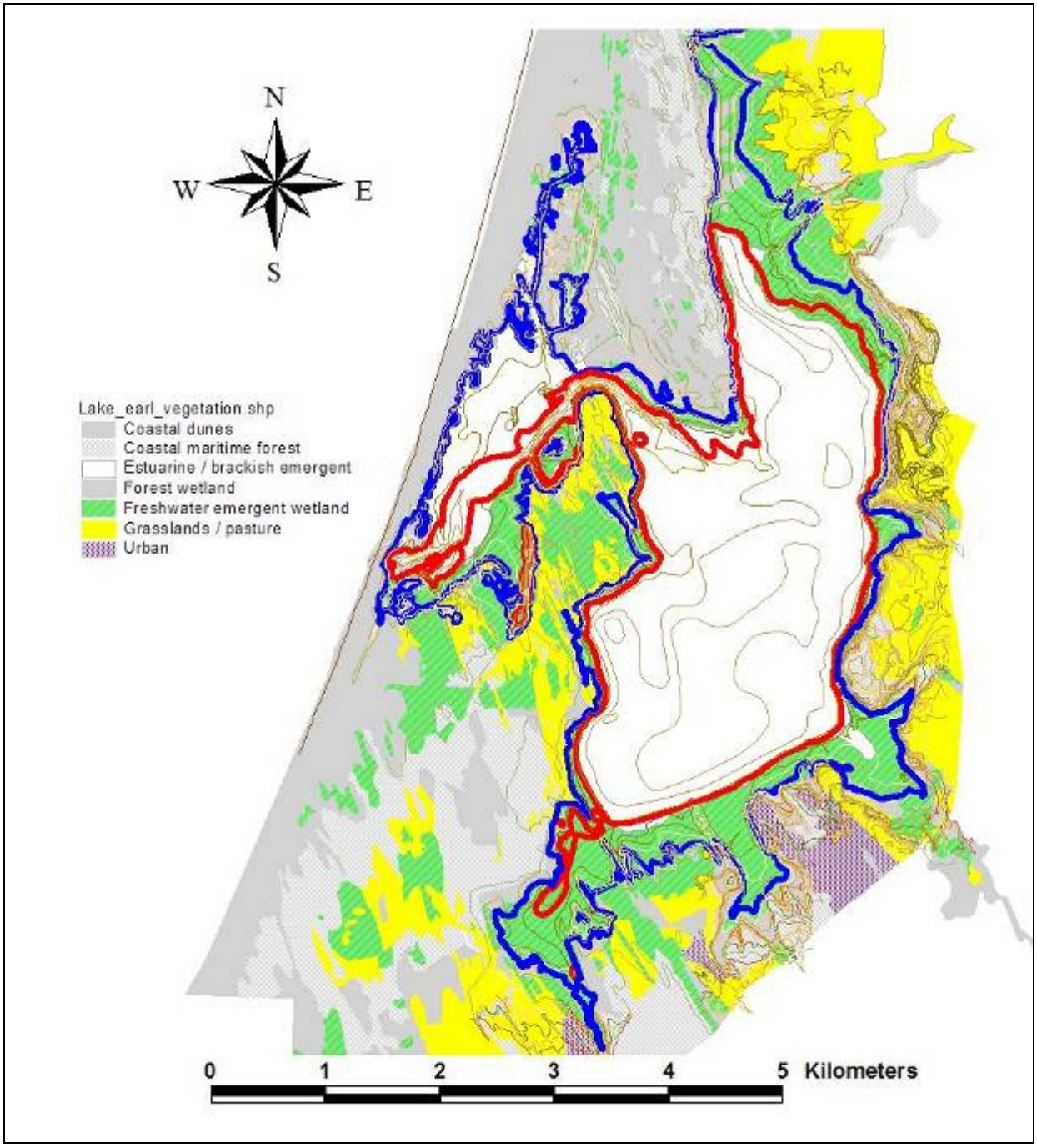


Figure 2. Lake Earl emergent wetland vegetation and relationship to water levels. The inner red line shows the approximate shoreline of the lake during the 2010 western grebe breeding season (2 ft. above msl). The outer blue line approximates the shoreline in summer 2008 (7 ft. above msl). Hydrographic 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

A combination of shore and boat based surveys were used to census and observe Western Grebes at Lake Earl in 2010. Lake Tolowa was not surveyed in this study because there is no historical record of grebes nesting there due to apparently unsuitable breeding habitat. Scope observation points alongshore were similar to those used by Funderburk (1979) and 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, greatly facilitating access to otherwise remote viewpoints. The initial schedule was to conduct observations of nesting grebes and potential disturbance sources 3-4 days a month from June through September 2010. Boat surveys were planned to conduct additional searches for nesting grebes, document broods according to previous protocol (Anderson et al.), and collect supplemental information on nesting habitat.

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 numbers of grebes were estimated based on peak count of grebes observed from a single observation point or a collation of counts from a variety of locations if it seemed unlikely that double-counting could have taken place. General behavior of grebes was noted. Type of boat and numbers of people in the water were documented during general census procedures.

Water level data was taken from the automated California DWR gauge located at the Narrows. Qualitative assessment of wetland vegetation took place from shore (emergent zone) and by boat (SAV). Water depth measurements in historic colony areas were taken with a meter stick during boat surveys.

Historic data on western grebe colony attendance and breeding chronology were gleaned from the unpublished reports and field notes of S. Funderburk, D. Jaques, and B. Depee.

Figure 3. Scope survey points and wetland divisions used during Western Grebe Surveys at Lake Earl in 2010. Map of Lake Earl exerpted 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 10 dates, April-August 2010. Peak numbers of grebes were present prior to the breeding season, when 148 birds were counted rafting in the middle of the lagoon, 18 April (Fig. 4, Table 1). Numbers of grebes declined through the season. By August, the peak count of grebes was only 17.

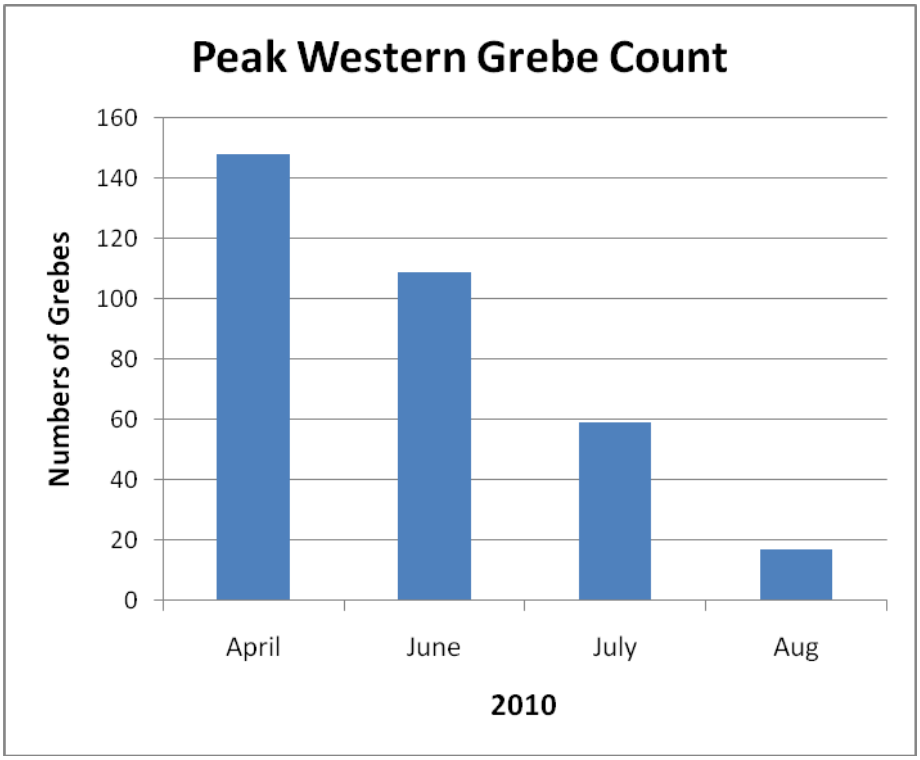


Figure 4. Peak total numbers of Western Grebes counted at Lake Earl in 2010.

Throughout the survey period, Western Grebes were primarily seen rafting in a group in the central and deepest region of Lake Earl in association with small numbers of Pied-billed Grebes (*Podilymbus podiceps*), scaup, Rudy Ducks (*Oxyura jamaicensis*) and Bufflehead (*Bucephala albeola*). Western Grebes were occasionally seen in smaller groups in historic nesting areas along the western side of the lagoon (Table 1). Census results suggested that grebes may have been periodically moving in and out of Lake Earl, using central portions of the lagoon largely to rest. The open ocean was approximately 2.5 km from the primary rafting groups in the center of the lagoon and was accessible by swimming.

Table 1. Western Grebes counted at Lake Earl in 2010. Highest count each day by viewpoint and area are shown.

Date	Method	Observation Point	Lake Area	No. Grebes	Notes
4/18	Scope	Lakeview Drive Boat Ramp	D-E-F-G	148	Grebes rafting in center of lagoon
6/13	Scope	Cadra Point	H	2	Floating separately
6/13	Scope	East Bliss	F	1	Feeding
6/13	Scope	Buzzini Road	E	12	Feed, call, not in obvious pairs
6/13	Scope	The Narrows	J	1	
6/13	Scope	Alder Point	C	8	
6/14	Scope	Lakeview	D-E-F-G	109	Grebes scattered, going in and out of emergent on west side, some rushing
7/8	Scope	Buzzini Road	G-I	24	Distant view
7/8	Scope	Lakeview	G	15	Raft/sleep, possible overlap with Buzzini view
7/8	Scope	Cadra Point	H	1	
7/9	Scope	Lakeview	D-E-F-G	59	Difficult viewing conditions

7/10	Scope	Lakeview	D-E-F-G-H	56	Resting, preening in 3 loose groups
7/9	Boat	Paddled entire shoreline		10	Birds avoided boat; Water depth in southern nesting areas=14-35”
8/13	Shore	Lakeview	D-E-F-G	17	Not paired, but some bill dip, head throw
8/14	Shore	Cadra Point	H	15	Swimming around
8/14	Shore	Lakeview	D-E-F-G	7	Raft in center
8/15	Shore	Lakeview	D-E-F-G	9	Raft in center
8/16	Shore	Lakeview	D-F	17	Inactive, resting
8/16	Boat	Paddled entire shoreline		8	

No evidence of Western Grebe nesting was detected at Lake Earl in 2010. A few weak courtship behaviors were observed but no major displays were seen. Grebes did not appear to be paired, and no nests were found. Grebes were seldom seen carrying vegetation and were never observed building nests. A one-day water based survey of the Lake Earl shoreline was conducted by kayak with binoculars during both July and August and confirmed lack of nesting within emergent fringe habitat. Following discussion with grebe specialist K. Robison, plans for September surveys were cancelled due to failure of grebes to initiate nesting by mid-August.

Groups of grebes foraged in the ocean at the mouth of the lagoon, but foraging in the lagoon was rarely observed. Other avian piscivores were notably absent at Lake Earl compared to previous summers. Numbers of Double-crested Cormorants (*Phalacrocorax auritus*) were low compared to 1997-1998 (Jaques 1999) and Brown Pelicans were entirely absent. More than 300 Brown Pelicans (*Pelecanus occidentalis*) have been observed foraging and roosting in Lake Earl in other summers (Jaques et al 2008, unpubl. field notes).

Method Evaluation

Most of the wetland could be observed from the end of the Lakeview Drive boat launch under the low water conditions in ideal lighting. However light inversions, fog and waves often obscured views from shore, making it impossible to determine if grebes were present in the distance or not. The grebes were so far out in the wetland, that other birders encountered in the field at Lakeview had not noticed them. Cadra Point and the end of Buzzini Road were the only other locations where groups of grebes were consistently seen during the summer. Boat based surveys were necessary for close inspection of all potential nesting areas, but shore-based scope surveys resulted in higher counts of grebes. Kayak surveys using binoculars yielded total counts of 10 and 8 birds respectively in July and August, compared to shore-based scope counts of 59 and 17 on the same dates. Birds clearly avoided the slow moving boat and may have moved prior to detection. Also, the low platform and binoculars were not adequate to see across the entire wetland; boat surveys took place around the inner shoreline rather than the central open waters. Due to low water levels, it was necessary to get out of the kayak and drag it through areas 1-3 inches deep in order to circumnavigate the lagoon shoreline.

Best methods and vantage points for observing grebes at Lake Earl will vary with water levels. For example, in high water years, the Lakeview Drive Boat Launch viewpoint used in 2010 will be underwater and sweeping views from the remainder of that shoreline area will be obscured by emergent vegetation. Grebe nesting colonies are expected to be closer to shore, so viewing of colonies should not be as problematic as observing the birds when they were primarily rafting in the center of the lagoon.

Disturbance/Boats

All boats seen in Lake Earl during the summer 2010 occurred near the boat launch in the deepest portion of the lagoon at the "Narrows." Shore-based fishing was only seen at the Narrows as well. The total number of boats observed during grebe surveys in 2010 was 4. Two kayakers and 1 motorized fishing boat on 9 July, and 1 motorized fishing boat on 16 August. Summer fishermen were reportedly targeting cutthroat trout in the Narrows with limited success. A group of fishermen trailing a boat were observed at the Buzzini Road boat launch, but departed after seeing how low the water was.

Cattle

Cattle herds escaped from at least two pastures at the LEWA during the 2010 breeding season due to inadequate fencing. In both cases, cattle escaped into regions with emergent zone wetlands. Cows escaped from the lower pasture at Lake Tolowa in July and trampled a coastal dune restoration area that contained sensitive native dune mat plants (S. Jerabek, TDS and C. Bartollotta, CDFG, pers. comm.). Cattle also escaped from Brown's pasture on the southeastern shore of Lake Earl, near an historic Western Grebe nesting area (F. Kemp, CDFG). Severe shoreline trampling and a gap in emergent fringe in this area was observed during paddle surveys in August (Fig 5a). A remaining incapacitated cow was seen in the mud during the boat-based grebe survey on 16 August (Fig 5b). The animal was reported to the CDFG. The RCD in charge of overseeing grazing leases for the LEWA responded to the report. Waters off the Brown's pasture were more turbid and laden with flocculent algae than elsewhere in the lagoon.

Figure 5. Condition of shoreline at Brown's pasture, Lake Earl Wildlife Area in August 2010 after cattle escaped from fenced pasture (A, upper). Incapacitated escaped cow south of Brown's pasture August 16, 2010 (B, lower).

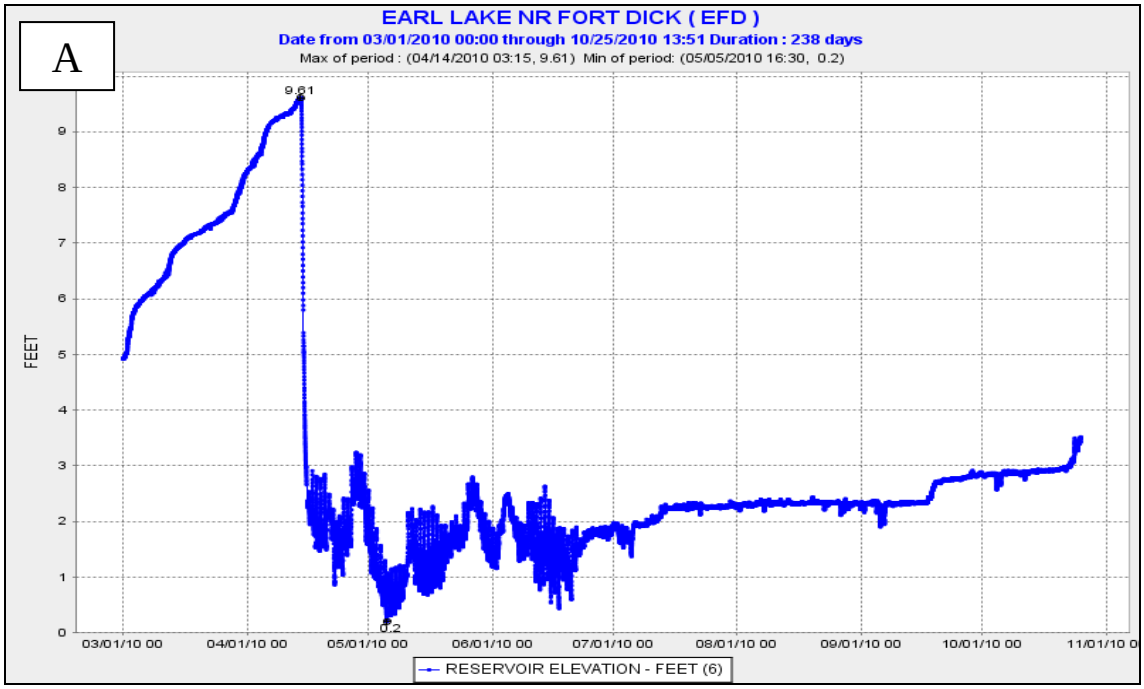
2010 Breach Pattern, Water Levels, and Aquatic Vegetation

A late spring breach occurred at Lake Earl in 2010 and was probably ultimately responsible for the failure of grebes to nest. The lagoon was artificially breached twice in the winter, and then breached a third time in the spring. It is unknown whether the spring breach occurred naturally or was an illegal artificial breach. The result was that lagoon waters remained estuarine and unusually low during the grebe breeding season.

The first manual breach of the 2009-2010 rainy season was conducted 1 December at a gauge level of 8.6' above msl (CA DWR data http://cdec.water.ca.gov/). The lagoon resealed after about 2 weeks. The second manual breach was 27 January at 8.8' msl. The lagoon closed after about 4 weeks. Due to heavy rains, water level subsequently rose to 9.6'msl and the barrier sandbar breached again on 14 April (Fig 6a). The lagoon remained open to the ocean for an extended period of about 4 months before closing. Tidal flux at the Narrows in 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. The DWR gauge indicates that water levels stabilized with breach closure in early-mid July.

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 2010, most of the emergent fringe in the lagoon was on moist or dry land, rather than emerged in water (Figure 2). At 2 ft above msl, the lagoon is largely comprised of open water. A narrow band of flooded emergent habitat occurred along the western shoreline in August (Fig. 7a).

Qualitative assessment of SAV conducted during paddle surveys in July and August indicated that Sago pondweed and Wigeon Grass were growing throughout much of the outer perimeter of the Lake Earl, but growth had not reached the surface in most places. There was no dense mat structure floating on the water. Growth of both species had progressed by August when fruiting strands occurred on the surface over the SAV beds (Fig. 7b). Wigeon grass was widely distributed in Lake Earl, but Sago Pondweed predominated only in the southern end of the wetland. All SAV beds were readily penetrated with a kayak. Water depth in historic nesting areas ranged from 0 cm (Jordon Cove) to about 1 m (off Cadra Point).



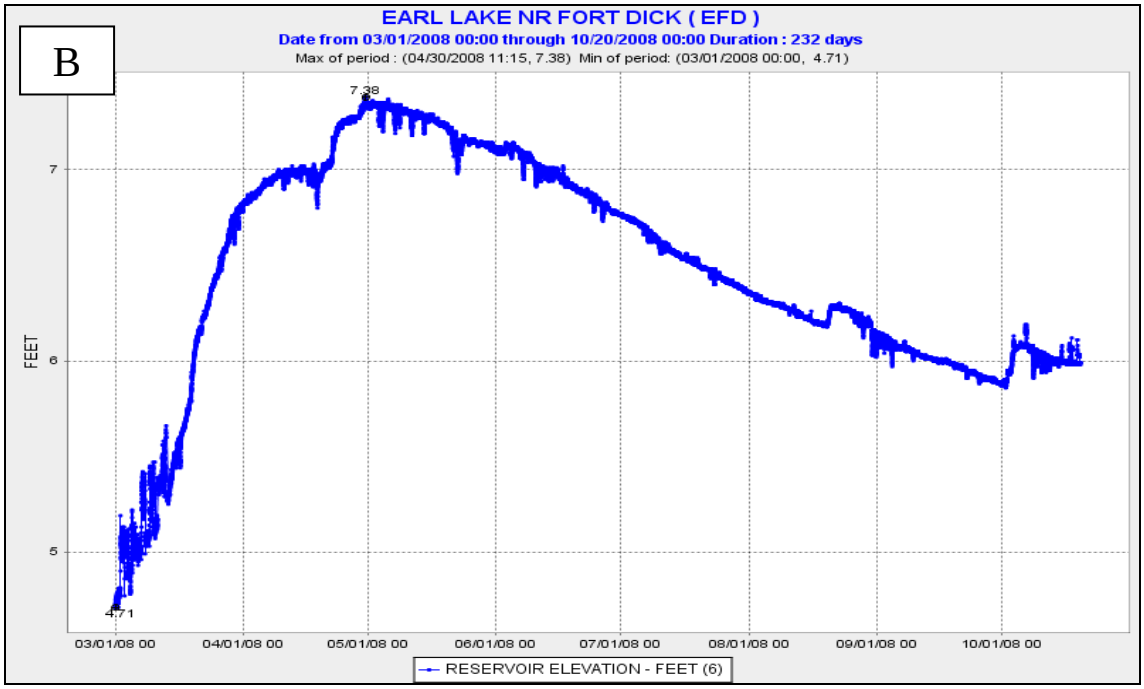


Figure 6. Lake Earl water levels during the 2010 (A) and 2008 (B) Western Grebe breeding seasons. Graphs are generated from data on the California Division of Water Resources website.

Figure 7. Narrow band of flooded emergent vegetation at Lake Earl along west shore, August 2010 (A, upper). Mixed submerged aquatic vegetation along western shore; sago pondweed on right and wigeon grass on the left (B, lower).

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).

Two other species that rely on similar habitat were conspicuously absent at Lake Earl during the 2010 breeding season. Pied-billed grebes also breed in the lagoon on floating nests (Funderburk 1979). In 1997, 39 Pied-billed grebe broods were observed in summer (Jaques 1999), but in 2010, no broods or nests of this species were observed. American Bittern (*Botaurus lentiginosus*) nest in emergent vegetation over water at Lake Earl. 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.

Historic Review

Dedicated studies of Western Grebes at Lake Earl have never been conducted. The following historical data from broader waterbird surveys summarizes much of what is known about grebe use of this site during the breeding season.

Western Grebes were first documented breeding in Lake Earl in 1974 by Humboldt State University graduate student Stephen Funderburk (1979). Prior investigators did not report nesting grebes at the site (Johnson and Yocum 1966, Hehnke 1969, or Peters 1971), although there is an unconfirmed earlier nesting report by the USFWS (1961). A grebe colony occurred in the northeastern section of Lake Earl in both 1974-1975 and was apparently quite productive. The nesting area was discovered on 12 July by boat and routine censuses were conducted from a private waterfowl hunting blind (Clark blind). Clutch sizes were recorded on 12 July as follows: 1-egg (3), 2-egg (5), 3-egg (5), 4-egg (3), 5-egg (1). Funderburk documented 58 Western grebe brood sightings in 1974, and 48 in 1975; although some were "probably recorded more than once." The breeding season population in the lagoon averaged about 114 birds and up to 43 nests were counted (Table 2).

No data on colony size or productivity appear to be available again until 1997-98 (Jaques 1998, 1999). Jaques conducted ground based bi-weekly surveys of waterfowl and other waterbirds for the CDFG from April-July 1997 and April-August 1998. Total counts of Western Grebes in the lagoon averaged 49 and 35 in 1997 and 1998 respectively. The peak count was 65 birds staging in the Jordon Cove nesting area during April 1997. Nests initiated in early June 1997 were apparently unsuccessful and grebes moved to the southern end of the lagoon (off Brown's pasture and Cadra Point) to re-nest in mid-July. Fifteen nests were attended in the first breeding attempt and 11 in the second (26 total nest attempts). Western Grebes had produced at least 5 broods by the time surveys ended in July 1997. Nesting was initiated in the Jordon Cove area again in June 1998, but the area was abandoned by June 23 and nesting effort again shifted to the south end of the lagoon. Fourteen nests and 12 broods were confirmed in 1998, with most chicks seen on the final survey date, 20 August. Grebes

nested in association with both the southeast and southwest shorelines of Lake Earl during these years (off Brown's pasture, in Jordon Cove, and off Cadra Point.)

Table 2. 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.
2010	April 14	Mid July	1-2 feet	0	This report

Western Grebes were detected nesting in Lake Earl in 1999 and 2001 (B. Depee, CDFG unpubl.data). In 1999, at least 6 nests were attended in the northeast section of Lake Earl off the 'Barnfield.' This area is the same proximity as the colony observed by Funderburk in 1974-75. In 2001, 7 grebes were observed incubating, while others were engaged in nest building and courting in southeast Lake Earl, off the Brown's pasture.

During statewide surveys of Western Grebe nesting areas, K. Robison and R. Weems visited Lake Earl on 27-28 July 2008. Robison et. al counted 200 adults, 44 nests, and 1 brood at Lake Earl (K. Robison unpubl. field notes). An estimate of 75 nest attempts was reported (Robison et al. 2009). Two colony locations were documented, one at the southern end of the lagoon and the other along the western edge of the lagoon off Goose Point. Nesting had not been previously recorded at the northwesterly site.

Western grebes have therefore nested in at least 5 different locations at Lake Earl over the past 35 years. Breeding populations and nesting effort have apparently fluctuated, with the greatest numbers reported in 2008. The intermittent record of nesting seems to be most closely related to intermittent survey effort at this site, and the difficulty that typical birders would have viewing colonies from roadside locations.

The year 2010 was the first time that grebes have been surveyed when Lake Earl was open to the sea during June (Table 2). It was also the first year where a failure to breed was documented. Successful nesting by grebes has occurred at water levels of 6-7 ft msl in most recent years. During 2008, when peak numbers of grebes were documented, the lagoon gradually declined from 7 to 6 ft during the breeding season (Fig. 6b) and most of the emergent fringe would have been flooded (Fig. 2).

Breeding Chronology

Date from field notes indicates that 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). Sighting of first chicks has taken place during the last 2 weeks of July in each survey recorded to date (Table 3).

Table 3. Historic records pertaining timing of breeding by Western Grebes at Lake Earl, during waterbird surveys, 1974- 2001.

	First date observed	Last date observed	Source
Courtship	June 8, 1998	June 23, 1998	Jaques 1999
Nest building	June 8, 1998 July 11, 2001	July 15, 1997 July 11, 2001	Jaques 1998, 1999 Depee, field notes
Incubation	July 12, 1974 July 12, 1975 June 5, 1997 June 24, 1998 July 12, 1999	Sep 2, 1974 August 1, 1975 July 29, 1997 July 20, 1998 August 10, 1999	Funderburk field notes Funderburk field notes Jaques 1998 field notes Jaques 1999 Depee, field notes
Chicks	July 29, 1974 July 25, 1975 July 15, 1997 July 20, 1998	Sep 9, 1974 Sep 3, 1975 July 29, 1997 August 19, 1998	Funderburk field notes[1] Funderburk field notes Jaques 1998 field notes Jaques 1999

1 Described as 5 immature and 4 adults attending nests

DISCUSSION

Western Grebe Breeding Parameters and Lake Earl Habitat Conditions

Western Grebes present at Lake Earl during June, and perhaps April, probably represented prospecting breeders. This species tends to move from coastal environments to freshwater breeding grounds from late April to early May, although some populations are resident near their breeding colonies (Poole et al. 1992). The June count of over 100 birds only about half that observed in 2008 (Robison et al. 2009), but was greater than peak counts obtained in June 1997-98 (Jaques 1999). The birds that remained at Lake Earl into July and August may have been traditional breeders that lingered and would have nested if conditions became suitable.

Western Grebe colony locations are somewhat traditional but vary with water conditions (Poole et al. 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), suggesting low fidelity to breeding sites. 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.). It was not unusual for the species, therefore, to have skipped a year of breeding at Lake Earl. Many grebes apparently departed Lake Earl by July and may have moved to another breeding location to nest. Because the colony is relatively geographically isolated, however, birds using this site may not exhibit as much flexibility to shift to other nest sites compared to other areas in the breeding range.

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 was likely unsuitable for nesting by Western Grebes at Lake Earl in 2010 and this was probably directly attributable to the open estuarine conditions. The shoreline emergent vegetation zone was present but not flooded during the 2010 breeding season. The apparent absence of American Bittern nesting at LEWA in 2010 also reflected this condition. Although nesting in the emergent zone was not an option for grebes, nesting in open water over SAV beds was a second option at Lake Earl. Observations during paddle surveys suggested that the condition of the SAV beds may also have been inadequate. SAV did not reach the surface of the lagoon throughout most of the wetland in July, and in areas where it did reach the surface, stem density or strength may not have been great enough to support nests. When SAV did finally reach the surface, forming fairly dense beds in August, it may have been too late in the season to initiate nesting by the remaining diminished population.

Geographic distribution of SAV in the lagoon also appeared to differ from past accounts. Wigeon Grass seemed most widespread and dominant SAV in Lake Earl in 2010, rather than Sago Pondweed. Sago Pondweed has been considered the dominant species in Lake Earl (Wood 1972, Funderburk 1979) but in 2010 it only dominated at the far southern end of the lagoon, where freshest waters would be expected. Western Grebes are known to nest in many species of pondweed, including sago (Ivey 2004), but not Wigeon Grass. Wigeon grass has finer stalks and may not have suitable strength to support these birds. Wigeon grass is the primary SAV species in Lake Tolowa, presumably because it is more salt tolerant (Wood 1972). Differences in salinity tolerance may affect the affect the relative distribution of sago pondweed and Wigeon grass within Lake Earl.

In addition to habitat structure, the typical prey species at Lake Earl may have been affected by the open estuarine conditions of 2010. The diet of Western Grebes nesting at Lake Earl is unknown. 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 few observations of Western Grebes foraging in Lake Earl in 2010, coupled with the apparent movements in and out of the lagoon and relative lack of other piscivorous waterbirds present, suggests that grebes rafting in the lagoon may have relied largely on the ocean for foraging. Use of the ocean for foraging may not be a viable strategy for grebes attempting to nest within Lake Earl. The open ocean would represent a flight of about 2-3 km from traditional nesting areas in the lagoon. Storer and Neutchterlein (1992) state that Western Grebes rarely fly except during migration, and birds may become flightless due to molt of remiges during the breeding season. During incubation, adults may forage several kilometers from colony if water connection is available (Storer and Neutchterlein 1992). Access to the ocean solely by swimming from colony sites at Lake Earl would require

traveling about 6 km and would not be possible in most years because the sand berm at Lake Tolowa blocks the passage. Use of the ocean for foraging would also reduce communication between pairs tending chicks during the brood rearing phase.

Cattle Effects

At Clear Lake in 1999, low water levels combined with disturbance from fishermen resulted in high rates of abandonment and nest predation, and also allowed nest-trampling cattle into the colony (D. Anderson, pers. comm. *In* Ivey 2004). Cattle trampling could have been a problem for grebes at Lake Earl if the birds had nested off the Brown's pasture in 2010. A lack of nesting effort, however, made it impossible to evaluate direct effects of cattle on the grebes.

Cattle grazing may also result in degraded emergent nesting habitat (Gould and Koplin 1971, Burger 1997). Additional habitat threats to grebes include altered functioning of wetlands because of eutrophication and siltation (O'Donnel and Fjesda 1997). Cattle access to the wetlands in historic grebe nesting areas at the southeast end of Lake Earl appeared to be having a negative effect on shoreline vegetation and water quality. Nutrient run off from cattle pastures and direct input of manure into wetlands exacerbates eutrophication and is a wetland conservation issue of national concern (EPA 2008).

Because nutrients from Lake Earl spill out into the ocean each time the lagoon is breached, waters from the lagoon also affect the marine environment. Excess nutrient input to the ocean has been associated with harmful algal blooms (Anderson et al. 2002). Harmful algal blooms have cause plumage fouling and Western Grebe mortality events in coastal regions of California, Oregon and Washington, and are of growing conservation concern (Jessup et al. 2009). The effort to minimize impacts of cattle on Western Grebe nesting habitat at Lake Earl will have positive ecosystem benefits beyond the primary objectives of the project.

Boater Disturbance

Recreational boating disturbance has been implicated in loss of historic nesting areas in B.C. (Burger 1997), and reduced productivity at several sites in California (Ivey 2004, Gericke 2006). Grebe failure to nest and inadequate water for recreational boating also made it impossible to evaluate the impacts of boaters on grebes at Lake Earl in 2010. Out of area boaters that had planned trips to Lake Earl in 2010 probably turned away, and no local kayak events were scheduled due to low waters (S. Jerabek, pers. comm.).

Area Context and Water Level Management

Lake Earl supports a unique, isolated coastal Western Grebe nesting area that has persisted over at least the past 35 years. Historical records indicating what the breeding population might have been prior to human manipulation of the lagoon have not been found to date. The nearest grebe colonies in California are 140-220 km to the east, and these have declined severely over the past century. The best known of these colonies are at Lower Klamath Lake and Tule Lake, described below by Ivey (2004):

> *"The once vast Lower Klamath Lake on the Oregon border formerly supported "several thousand" nesting Aechmophorus grebes (Finley 1911), but habitat today has been reduced to a series of managed wetlands on Lower Klamath NWR on the California side of the border, supporting only 37 nests*

in 2003 (Shuford et al. 2003). A critical water shortage in recent years has further limited the available habitat. Similarly, nearby Tule Lake NWR persists as only a remnant of what once was an immense marsh and supports relatively few grebes compared to the "many thousands" reported there in 1899 (Bailey 1902)."

Water level management is an issue that affects the Western Grebe at many breeding sites in the west (Ivey 2004). The primary goal of water level management at the LEWA is to manage for wildlife resource values, including several listed species, within the constraints of local flooding issues (CDFG 2003). Natural and manual breaches of bar-built lagoons hold consequences for all species inhabiting or transiting these habitats (Krauss et al. 2008). Ideal lagoon management for Western Grebes may be different that for other species at LEWA. Expansion of the LEWA property holdings and the changes in lagoon level management have resulted in significantly increased palustrine emergent seasonally flooded wetlands acreage overall (Tetra Tech 2000).

CONCLUSIONS AND RECOMMENDATIONS

The ultimate cause of failure to breed by Western Grebes at Lake Earl in 2010 appeared to be the late spring breach and associated environmental conditions that persisted through the summer. The unusual breach regime and lack of breeding in 2010 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; specifically, how lagoon management may affect their productivity. To further document breeding season needs and separate confounding variables, quantitative assessment of relevant wetland vegetation characteristics and water quality parameters are recommended concurrent with grebe monitoring. This type of information will help clarify interpretation of effects of restoration actions and other potential management for grebes at Lake Earl.

Restoration project actions to minimize harm from cattle impacts and human disturbance, along with development of management recommendations regarding artificial breach timing, or measures to help grebes cope with variable breach scenarios, will ideally help contribute to population increase of this species in northern California.

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