

BREEDING OF *AECHMOPHORUS* GREBES AT CLEAR LAKE, LAKE COUNTY, CALIFORNIA, DURING JUNE 2015

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ABSTRACT

We estimated a total of 4,993 nests in 17 colonies, of which 69.2% were attended by Western Grebes, 30.3% by Clark's Grebes and 0.5% by mixed pairs ($n = 643$ nests). Most of the nests (79.0%; $n = 3,944$) were in the northern arm (and associated tributaries) of Clear Lake, with fewer in the southwestern arm and associated drainages (21.0%; $n = 1,049$), and only one nest (0.02%) in the southeasteam arm. Nearly all of the nests were in either the northern tributaries of Clear Lake (74.8%; $n = 3,735$) or channels draining the south end of Clear Lake (21.0%; $n = 1,048$), with only 3.7% in Clear Lake ($n = 187$). Most of the nests were shore nests (96.4%; $n = 4,814$) attached to emergent vegetation; the remaining were open water nests (3.6%; $n = 179$) attached to submergent vegetation and placed up to 230 m from shore. Nesting began much earlier than in the previous six breeding seasons, with nests and eggs first reported on 9 May. The timing of nesting activity varied among colonies, with the southwestern colonies peaking during June and the Rodman Slough colonies peaking between mid June and mid July. Breeding ceased earlier than during the previous six breeding season, with only one new nest found after 2 August and no new nests found after 7 August.

A brood survey by motorboat on 30 June recorded 3,236 adult grebes, of which 72.8% were Western Grebes ($n = 1,678$ adults), 27.2% were Clark's Grebes ($n = 628$) and 930 were unidentified. We counted 259 juvenile grebes, of which 90.6% were Western Grebes ($n = 232$), 9.4% were Clark's Grebes ($n = 24$), and three were unidentified, providing the first mid-summer survey in which we recorded juvenile grebes. A brood survey by motorboat on 13 September recorded 6,245 adult grebes, of which 57.3% were Western Grebes ($n = 1,794$), 42.7% were Clark's Grebes ($n = 1,337$) and 3,114 were unidentified. We counted 353 juvenile grebes within the transect area, of which 77.3% were Western Grebes ($n = 273$) and 22.7% were Clark's Grebes ($n = 80$). During both surveys we recorded an overall ratio of 0.11 juveniles per adult within the transect area (unidentified adults excluded), providing our second highest ratio. Extrapolating the ratio of juveniles to adults within the transect area to the total number of adults grebes counted, we estimate a total number of 704 juveniles for the lake, greatly exceeding any all previous years since our study began in 2010.

We recorded only ten disturbances during 33.25 hours of observation, for an average of 0.30 disturbances per hour. Birds accounted for five (50.0%) of the disturbances (Table 3). We confirmed one instance of an American Crow (*Corvus brachyrhynchos*) attempting to prey on an egg until it was chased away by a male Clark's Grebe. Although three Northern River Otters (*Lontra canadensis*) were once observed within 25 m of an active grebe colony, no predation was observed. Humans accounted for five (50%) of the disturbances, including two by a canoe or kayak and three by a motorized boat. In each case the boats were moving slowly and disturbance of the grebes was minimal.

Motion-activated cameras focused on one or more active grebe nests for 3,509 hours. The cameras documented 16 confirmed and six inferred instances of egg predation by a Raccoon (*Procyon lotor*; Fig. 2), one instance of an American Crow flying from a nest with an egg in its beak, one instance of a crow scavenging on eggs smashed by two turtles 15.5 hr earlier, one instance of a Western Pond Turtle (*Actinemys marmorata*) and a Red-eared Slider (*Trachemys scripta*) smashing two eggs, and three apparent instances of ovicide by grebes.

The number of nests and chicks observed were the second highest since our study began in 2010, but the number of estimated chicks on the lake was the highest. Because of the high water levels in 2016, the vast majority of nests were constructed along the shore in protected areas with very few nests exposed far from shore in open water. As a consequence, we did not observe any instances of nest failure due to wind-generated waves or disturbances by boats. However, we recorded an unusually high level of predation on eggs by Raccoons.

INTRODUCTION

The Redbud Audubon Society began monitoring the breeding activities of Western Grebes (*Aechmophorus occidentalis*) and Clark's Grebes (*A. clarkii*) on Clear Lake in July 2010. This report summarizes our data for nest surveys, brood surveys, and disturbance indices on Clear Lake during the 2016 breeding season.

METHODS

NEST SURVEYS

Formal surveys of grebe nesting began on 10 June and continued through 13 September. Most surveys were conducted by canoe; some were conducted from land or a motorboat. All surveys were conducted by two or more observers, including: Floyd Hayes (FH), Marta Hayes (MH), Dylan Turner (DT), and Aimee Wyrick (AW). Kraig Jillson and Faith Rigolosi (FR) provided additional anecdotal information.

We repeatedly visited sites where grebes may be expected to breed and attempted to count all nests present, regardless of whether or not eggs were present. Nests that appeared to be in the incipient stages of construction but were indistinguishable from natural accumulations of vegetation were not counted unless we observed grebes actually constructing them. During subsequent surveys we attempted to identify new nests which were added to the total number of nests for the season. A colony is defined as a single location supporting breeding birds located close enough in distance to interact socially (Gochfield 1980), in this case with a gap no larger than 400 m between nests. However, defining a colony can be difficult and arbitrary. Some colonies begin > 400 m apart but later merge into each other.

We attempted to estimate the proportion of nests of Western and Clark's Grebes within selected colonies by identifying which species attended a given nest. However, our identification was often based on a single parent and may have overlooked nests attended by a mixed pair of Western Grebe and Clark's Grebe, or a hybrid grebe paired with either a Western or a Clark's Grebe.

Each nest was classified as either a "shore nest" if placed among emergent macrophytic vegetation near the shore (e.g., tules, water primrose, willows) or an "open water nest" if placed in open water > 1 m from emergent vegetation. For colonies located in open water, we measured

the maximum distances of nests from the shore or emergent vegetation, usually based on measurements from a laser range finder but sometimes estimated.

During the 1910 breeding season we obtained extensive data sets on the number of eggs, water depth of nests, distances between the nearest nests, and densities of nests, but in an effort to minimize human disturbance of the colonies during subsequent breeding seasons, none of these measurements were taken except for a few counts of eggs while nests were being counted.

BROOD SURVEY

We conducted a midsummer survey of adult grebes to assess the size of the breeding population on 30 June and we conducted a brood survey at the end of the breeding season to evaluate reproductive success on 13 September. Both surveys were conducted from a motorboat, by FH, DT and AW on 30 June and by FH and DT on 13 September. Each survey consisted of a transect with a 200 m width along the entire shoreline of the lake, with occasional deviations to inspect flocks of grebes, for 110.6 km on 30 June and 99.6 km on 13 September. We counted all adult and juvenile grebes within a distance (approximately 100 m) that adults could be confidently identified. Grebes beyond the transect distance were also counted but not identified.

DISTURBANCE INDEX

Disturbance index counts were conducted from 10 June to 9 September at colonies with eggs. A disturbance was defined as an action in which one or more grebes responded by jumping off of a nest or diving underwater, or resulting in the predation of an egg, while a potential disturbance was any human activity potentially causing a disturbance or the close approach of a known avian or mammalian predator. During timed periods at each site, all actual disturbances and potential disturbances within 100 m of the colony were counted during 15 min periods. Disturbances and potential disturbances were divided into the following categories based on their cause: motorized watercraft (including airboats and jet skis), canoes / kayaks, low-flying aircraft, mammals, birds (large possible predators) and mammals. These categories were then subdivided further to better represent the extent of the disturbances (e.g., predation and presence in colony for mammals). Moving subjects were categorized according to their closest point of approach to the colony.

NEST CAMERAS

From 15 June to 16 August we deployed up to six Bushnell 8MP Trophy Cam Bone Collector Trail Cameras at selected nests in relatively shallow water < 1.75 m deep. Each camera was attached to a metal stake and placed within 5 m of one or more nests and left in position for a period of up to 14 days. During each subsequent visit we swapped memory cards and relocated a camera if the nest it was focused on no longer contained eggs or had disappeared.

RESULTS AND DISCUSSION

NEST SURVEYS

We estimated a total of 4,993 nests in 17 colonies, of which 69.2% were attended by Western Grebes, 30.3% by Clark's Grebes and 0.5% by mixed pairs ($n = 643$ nests; Table 1). The colonies, with the number of nests in parentheses, were located at the following sites

arranged from north to south (Fig. 1, Table 1): Rodman Slough: Northwest Channel (2,079), Rodman Slough: Far North Marsh (11), Rodman Slough: Far North (2), Rodman Slough: North (844), Rodman Slough: South (799), Northwest End of Clear Lake (127), Lakeport: Manning Creek (2), Point Between Manning Creek and Rumsey Slough (2), Rumsey Slough: West (2), Long Tule Point (53), Sunrise Shores (253), Southwest End of Clear Lake (85), Anderson Marsh: North (38), Anderson Marsh: Southwest (233), Anderson Marsh: Southeast (432), Cache Creek (7), and Clearlake Oaks (8). Most of the nests (79.0%; $n = 3,944$) were in the northern arm of Clear Lake, with fewer in the southwestern arm (21.0%; $n = 1,049$), and only one nest (0.02%) in the southeastern arm. Nearly all of the nests were in either the northern tributaries of Clear Lake (74.8%; $n = 3,735$) or channels draining the south end of Clear Lake (21.0%; $n = 1,048$), with only 3.7% in Clear Lake ($n = 187$). Most of the nests were shore nests (96.4%; $n = 4,814$); the remaining were open water nests (3.6%; $n = 179$) placed up to 230 m from shore.

Nesting began much earlier than in the previous six breeding seasons. The first nesting activity was detected on 9 May, when KJ reported nests with eggs at Rodman Slough: Northwestern Channel, about a month before we began our surveys on 10 June. FR reported observing the first chicks in the northern arm of Clear Lake during the last week of May. We observed our first chicks in the southwestern arm of Clear Lake on 10 June and in the southeastern arm of Clear Lake on 15 June. The last nests with eggs incubated by grebes were seen at Rodman Slough: Northwestern Channel on 9 September, when just two nests (one with three eggs, the other with two eggs) remained.. The timing of nesting activity varied among colonies. In the southwestern arm of the lake, Anderson Marsh: Southeast and Cache Creek had already peaked by the time we first discovered them on 10 June. Other colonies in Anderson Marsh and in southwestern Clear Lake peaked by late June. In the northern arm of the lake, the Rodman Slough colonies peaked between mid June and mid July. Breeding ceased earlier much earlier than during the previous six breeding season, with only one new nest found after 2 August and no new nests found after 7 August.

Below we provide details for each active colony and former colonies, which are arranged from north to south (Fig. 1). Within each colony the details of breeding activities are arranged chronologically by date. A summary of breeding data for each colony is presented in Table 1.

Rodman Slough: Northwest Channel and Pond

This is a new colony, including a channel extending nearly as far west as Highway 29, a large pond just north of the channel, and a channel just east of the large pond.

23 June: FH and DT searched by canoe and counted 1,000 nests, including 996 between the large pond and the end of the channel near Highway 29 and four in a channel just east of the large pond. Many nests were built in willows; two were built on a man-made wooden structure. Many nests had more than five eggs and many nests were empty. Presumably the grebes first began nesting in this area, accounting for chicks seen by late May at the north end of the lake. We encountered two communal egg dumps of 15 and 12 eggs.

8 July: FH and DT searched by canoe and counted 1,485 nests (all shore), including: 140 in the channel connecting the large pond with Rodman Slough North, all west of the first channel heading north and east of the pond; 905 in the large pond; 406 in the channel between the pond and the end of the channel near Highway 29; and 34 in the channel just east of the large pond (first channel heading north from northwest channel). We counted 227 Western Grebes (77.5%)

and 66 Clark's Grebe (22.5%) on nests. We found three communal egg dumps of 18, 14, 13 and 12 eggs in the northwestern channel; the nests with 14 and 13 eggs were only 4 m apart and the nest with 12 eggs was only 16 m away. Another communal egg dump of 22 eggs was in the large pond. A dead adult grebe was beside a nest.

15 July: FH, DS and DT searched by canoe and did not count nests. However, the communal egg dump of 18 eggs in the large pond was being incubated by a male Clark's Grebe.

2 August: FH and DT searched by canoe and counted 2,045 nests (all shore), including 854 nests (308 new) in the channel and 1,191 (286 new) in the large pond. A new communal egg dump had 16 eggs. We saw three dead grebes, of which two were in the water and one on a nest with seven eggs.

7 August: FH and MH searched by canoe and saw many nests and several tiny chicks, but did not count nests. Nesting activity appeared to have declined. A new communal egg dump with 14 eggs was in the small pond at the end of the channel. Mating was observed.

16 August: FH and DT searched by canoe and saw many nests, but did not count nests. Nesting activity continued to decline.

24 August: FH and DT searched by canoe and saw many nests, but did not count nests. Nesting activity continued to decline.

9 September: FH and DT searched by canoe and found only two active Western Grebe nests with eggs, one with two eggs and the other with three.

Rodman Slough: Far North Marsh

This is a new colony, located north of power lines beside a tule marsh in a channel west of the main channel.

23 June: FH and DT searched by canoe and counted 11 grebe nests (all shore), including five just left of the fork (only 1 egg present) and six beyond the fork (three nests with up to three eggs).

8 July: FH and DT searched by canoe and found one Western Grebe on a nest.

Rodman Slough: Far North

This is a new colony, located 125 m north of power lines in the main channel.

2 August: FH and DT searched by canoe and found two nests (both shore), one with one egg and the other with two eggs. A Western Grebe was on the nest with two eggs.

Rodman Slough North

10 June: FH and DT searched by canoe and failed to find any nests.

23 June: FH and DT searched by canoe and found 228 nests (all shore), including: 42 along the southwest shore; 10 west of the western point; 22 along the west shore; and 154 along the east shore. A communal egg dump had 13 eggs. We counted 41 Western Grebes (65.1%) and 21 Clark's Grebes (33.3%), and a heterospecific pair (1.6%; female Clark's Grebe on nest, male Western Grebe building nest) on nests.

28 June: FH and DT searched by canoe and counted 354 nests (353 shore, 1 open water), including: 71 (29 new) along the southwest shore; 24 (14 new) west of the western point; 45 (23 new) along the west shore; and 214 (60 new) along the east shore. The colony had merged with the Rodman Slough South colony. Communal egg dumps included: 14 eggs in a nest along the

west bank; 13 eggs and 13 eggs in nests only 4 m apart, plus 22 eggs only 12 m away with three nests in between, and 15 eggs only 36 m away from the nest with 22 eggs, all along the east bank at the junction with the eastern channel. Two of the east bank nests were 267 m up the eastern channel, including an open water nest 2 m from shore.

8 July: FH and DT searched by canoe and counted 551 nests (550 shore, 1 open water), including: 79 (8 new) along the southwest shore; 58 (34 new) west of the western point to the first channel heading northward from the main northwest channel; 115 (70 new) along the west shore extending north slightly beyond the first two channels on the left; and 299 (85 new) along the east shore extending north slight beyond the first two channels and east in the eastern channel to a point just west of the rock pile around the sluice gate. A new communal egg dump on the east bank had 13 eggs; it was about 40 m from previous egg dumps. A dead adult grebe was observed.

15 July: FH, DS and DT searched by canoe and found many nests, but did not count nests. A new communal egg dump with 12 eggs was on the northeast bank of the colony, north of the log.

2 August: FH and DT searched by canoe and counted 503 nests (all shore), including: 285 nests (206 new) along the southwest shore; 144 (86 new) west of the western point to the large pond; and 74 (fewer than before but at least one new) along the west shore extending north to the second of two channels). However, we did not count nests along the east shore, which had declined. An estimated 293 nests were new.

7 August: FH and MH searched by canoe and saw many nests, but did not count nests. Nesting activity appeared to have declined.

16 August: FH and DT searched by canoe and saw many nests, but did not count nests. Nesting activity continued to decline.

24 August: FH and DT searched by canoe and saw many nests, but did not count nests. Nesting activity continued to decline. We searched unsuccessfully for nests to the end of the channel east of the main channel.

9 September: FH and DT searched by canoe and failed to find any active grebe nests.

Rodman Slough: South

10 June: FH and DT searched by canoe and counted 37 grebe nests (all shore). One nest had two eggs and about ten nests had one egg.

15 June: FH and AW searched by canoe and counted 170 grebe nests (all shore), with 133 new nests. Approximately 40% of the nests contained eggs, with up to six eggs in a nest.

23 June: FH and DT searched by canoe and counted 377 grebe nests (371 shore, six open water), including nine (eight shore, one open water) in the south subcolony and 368 in the north subcolony. Up to four eggs were present in a nest. We counted 81 Western Grebes (60.9%) on nests and 52 Clark's Grebes (39.1%) on nests.

28 June: FH and DT searched by canoe and counted 690 nests (681 shore, 9 open water), including 61 (52 new) in the south subcolony, 628 (260 new) in the north subcolony and 1 (new) nest on the east shore. Up to 9 eggs were present in a nest.

3 July: FH and DT searched by canoe and counted 799 nests (787 shore, 12 open water), including 99 (38 new) in the south subcolony and 700 (72 new) in the north subcolony. We noted communal egg dumps of 11 eggs and 23 eggs. At 1533 DT observed a Western Grebe 7 m away

throw an egg off a nest into the water; it was the only egg on the nest.

8 July: FH and DT searched by canoe and counted 88 nests (none new) in the south subcolony, but did not count nests in the north colony. Communal egg dumps included 23 eggs in a nest near willows on the east side of the short northwest channel and 11 eggs on the west side of the channel.

15 July: FH, DS and DT searched by canoe and found many nests, but did not count nests.

28 July: FH and DT searched by canoe and saw many nests, but did not count nests. We saw four chicks on nests, including two chicks on one nest and an egg hatching at a nest with a chick present.

2 August: FH and DT searched by canoe and saw many nests, but did not count nests. We photographed a possible hybrid Clark's X Western Grebe with slight black feathering under the eye on a nest, possibly incubating eggs; it gave a single harsh, low call.

7 August: FH and MH searched by canoe and saw many nests and a few tiny chicks, but did not count nests. Nesting activity appeared to have declined.

16 August: FH and DT searched by canoe and saw many nests, but did not count nests. Nesting activity continued to decline.

24 August: FH and DT searched by canoe and saw many nests, but did not count nests. Nesting activity continued to decline. A new communal egg dump had 11 eggs. Mating was heard, we observed one egg being laid and we saw a few eggs hatching.

9 September: FH and DT searched by canoe and failed to find any active grebe nests.

Northwest End of Clear Lake

10 June: FH and DT searched by canoe and counted 38 nests (all open water), including one nest 29 m from shore east of the channel and 37 nests 57-230 m from shore west of the channel. No eggs were observed.

15 June: FH and AW searched by canoe but failed to find any nests.

23 June: FH and DT searched by canoe and found 73 new nests (all open water). Three nests were west of the channel, 12-38 m from shore; one was halfway between Robin Hill and the channel. Two nests were accompanied by Western Grebes and the third by a possible mixed pair of Western and Clark's Grebes. No eggs were present. Seventy nests were east of the channel, 30-284 m from shore. One egg was present in three nests; all other nests were empty. Two half-grown chicks were observed swimming in the water with adults.

28 June: FH and DT searched by canoe and counted 12 new nests (all open water) on the west side of the channel, as close as 3 m from shore. Two older nests, presumably the same observed on 23 June, were a third to a half way to Robin Hill, and were occupied by a Clark's Grebe and a Western Grebe. We counted 26 nests east of the channel, presumably the same as those observed on 23 June. No eggs were present.

30 June: FH, DT and AW searched distantly by motorboat and failed to find any nests.

8 July: FH and DT searched by canoe and failed to find any nests.

15 July: FH, DS and DT searched by canoe and found four new nests (all open water). Three were along the east bank of the lagoon east of the channel, about two-thirds to three-quarters of the way to Tule Island, and one was in the middle of the lagoon. They were not inspected closely and probably lacked eggs.

28 July: FH and DT searched by canoe and found only one old grebe nest east of the channel, probably the same one in the middle of the lagoon on 15 July.

7 August: FH and MH searched by canoe and failed to find any nests.

16 August: FH and DT searched by canoe and failed to find any nests.

24 August: FH and DT searched by canoe and failed to find any nests.

9 September: FH and DT searched by canoe and failed to find any grebe nests.

13 September: FH and DT searched by motorboat and failed to find any grebe nests.

East of Tule Island

23 June: FH and DT searched by canoe and failed to find any nests.

30 June: FH, DT and AW searched by motorboat and failed to find any nests.

28 July: FH and DT searched by canoe and failed to find any nests.

13 September: FH and DT searched by motorboat and failed to find any grebe nests.

South of Tule Island

30 June: FH, DT and AW searched by motorboat and failed to find any nests.

13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Nice: West

10 June: FH and DT searched from land and failed to find any nests.

15 June: FH and AW searched from land and failed to find any nests.

28 June: FH and DT searched from land and failed to find any nests.

30 June: FH, DT and AW searched by motorboat and failed to find any nests.

8 July: FH and DT searched from land and failed to find any nests.

28 July: FH and DT searched from land and failed to find any nests.

7 August: FH and MH searched from land and failed to find any nests.

24 August: FH and DT searched from land and failed to find any nests.

9 September: FH and DT searched from land and failed to find any grebe nests.

13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Nice: East

30 June: FH, DT and AW searched by motorboat and failed to find any nests.

13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Lucerne

30 June: FH, DT and AW searched by motorboat and failed to find any nests.

13 September: FH and DT searched by motorboat and failed to find any grebe nests.

North Lakeport: Lafferty Road

23 June: FH and DT searched by canoe and failed to find any nests.

30 June: FH, DT and AW searched by motorboat and failed to find any nests.

8 July: FH and DT searched by canoe and failed to find any nests.

13 September: FH and DT searched by motorboat and failed to find any grebe nests.

North Lakeport: Rocky Point North

15 June: FH and AW searched from land and failed to find any nests.
 23 June: FH and DT searched from land and failed to find any nests.
 30 June: FH, DT and AW searched by motorboat and failed to find any nests.
 13 September: FH and DT searched by motorboat and failed to find any grebe nests.

North Lakeport: Rocky Point South

15 June: FH and AW searched from land and failed to find any nests.
 23 June: FH and DT searched from land and failed to find any nests.
 30 June: FH, DT and AW searched by motorboat and failed to find any nests.
 13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Lakeport: Rumsey Bay

23 June: FH and DT searched from land and failed to find any nests.
 30 June: FH, DT and AW searched by motorboat and failed to find any nests.
 13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Lakeport: Library Park

15 June: FH and AW searched by canoe but failed to find any nests.
 30 June: FH, DT and AW searched by motorboat and failed to find any nests.
 28 July: FH and DT searched by canoe but failed to find any nests.
 2 August: FH and DT searched by canoe and failed to find any nests.
 16 August: FH and DT searched by canoe and failed to find any nests.
 9 September: FH and DT searched by canoe and failed to find any nests.
 13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Lakeport: Esplanade Street

15 June: FH and AW searched by canoe but failed to find any nests.
 30 June: FH, DT and AW searched by motorboat and failed to find any nests.
 28 July: FH and DT searched by canoe but failed to find any nests.
 2 August: FH and DT searched by canoe and failed to find any nests.
 16 August: FH and DT searched by canoe and failed to find any nests.
 9 September: FH and DT searched by canoe and failed to find any nests.
 13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Lakeport: Shoal

15 June: FH and AW searched by canoe but failed to find any nests.
 30 June: FH, DT and AW searched by motorboat and failed to find any nests.
 28 July: FH and DT searched by canoe but failed to find any nests.
 2 August: FH and DT searched by canoe and failed to find any nests.
 16 August: FH and DT searched by canoe and failed to find any nests.
 9 September: FH and DT searched by canoe and failed to find any nests.
 13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Lakeport: Manning Creek

15 June: FH and AW searched by canoe but failed to find any nests.

30 June: FH, DT and AW searched by motorboat and failed to find any nests.

28 July: FH and DT searched by canoe and found two nests (one shore, one open water).

The shore nest was attached to tules and had one egg; the open water nest, which was empty, was 13 m from shore and 6 m from the shore nest.

2 August: FH and DT searched by canoe and found only one old, empty nest.

16 August: FH and DT searched by canoe and failed to find any nests.

9 September: FH and DT searched by canoe and failed to find any nests.

13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Point Between Manning Creek and Rumsey Slough

15 June: FH and AW searched by canoe but failed to find any nests, but three small grebe chicks were seen with swimming adults.

30 June: FH, DT and AW searched by motorboat and failed to find any nests.

28 July: FH and DT searched by canoe and found two new grebe nests (both shore), one empty and the other with one egg. Two Clark's Grebes and a Western Grebe were in the area, and a Clark's Grebe was sitting on a nearby mat of tules that wasn't a nest.

2 August: FH and DT searched by canoe and failed to find any nests.

16 August: FH and DT searched by canoe and failed to find any nests. However, two Western Grebes and a Clark's Grebe were sitting on tule mats and may not have been well.

9 September: FH and DT searched by canoe and failed to find any nests.

13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Rumsey Slough: West

15 June: FH and AW searched by canoe but failed to find any nests.

30 June: FH, DT and AW searched by motorboat and found two nests (both open water).

3 July: FH and DT searched by canoe and found two old nests (both open water) 105-110 m from shore. No eggs were present.

28 July: FH and DT searched by canoe but failed to find any nests.

2 August: FH and DT searched by canoe and failed to find any nests.

16 August: FH and DT searched by canoe and failed to find any nests.

9 September: FH and DT searched by canoe and failed to find any nests.

13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Rumsey Slough: East

15 June: FH and AW searched by canoe but failed to find any nests.

30 June: FH, DT and AW searched by motorboat and failed to find any nests.

3 July: FH and DT searched by canoe and failed to find any nests.

28 July: FH and DT searched by canoe but failed to find any nests.

2 August: FH and DT searched by canoe and failed to find any nests.

16 August: FH and DT searched by canoe and failed to find any nests.

9 September: FH and DT searched by canoe and failed to find any nests.

13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Point between Rumsey Slough East and Big Valley Rancheria

- 30 June: FH, DT and AW searched by motorboat and failed to find any nests.
- 3 July: FH and DT searched by canoe and failed to find any nests.
- 28 July: FH and DT searched by canoe but failed to find any nests.
- 16 August: FH and DT searched by canoe and failed to find any nests.
- 9 September: FH and DT searched by canoe and failed to find any nests.
- 13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Big Valley Rancheria

- 30 June: FH, DT and AW searched by motorboat and failed to find any nests.
- 3 July: FH and DT searched by canoe and failed to find any nests.
- 28 July: FH and DT searched by canoe but failed to find any nests.
- 16 August: FH and DT searched by canoe and failed to find any nests.
- 9 September: FH and DT searched by canoe and failed to find any nests.
- 13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Land's End

- 30 June: FH, DT and AW searched by motorboat and failed to find any nests.
- 3 July: FH and DT searched by canoe and failed to find any nests.
- 28 July: FH and DT searched by canoe but failed to find any nests.
- 16 August: FH and DT searched by canoe and failed to find any nests.
- 9 September: FH and DT searched by canoe and failed to find any nests.
- 13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Holiday Cove

- 30 June: FH, DT and AW searched by motorboat and failed to find any nests.
- 3 July: FH and DT searched by canoe and failed to find any nests.
- 28 July: FH and DT searched by canoe but failed to find any nests.
- 16 August: FH and DT searched by canoe and failed to find any nests.
- 9 September: FH and DT searched by canoe and failed to find any nests.
- 13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Adobe Creek

- 23 June: FH and DT searched by canoe and failed to find any nests.
- 30 June: FH, DT and AW searched by motorboat and failed to find any nests.
- 3 July: FH and DT searched by canoe and failed to find any nests.
- 28 July: FH and DT searched by canoe but failed to find any nests.
- 16 August: FH and DT searched by canoe and failed to find any nests.
- 9 September: FH and DT searched by canoe and failed to find any nests.
- 13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Between McGaugh Slough and Adobe Creek

- 23 June: FH and DT searched by canoe and failed to find any nests.
- 30 June: FH, DT and AW searched by motorboat and failed to find any nests.

- 3 July: FH and DT searched by canoe and failed to find any nests.
- 28 July: FH and DT searched by canoe but failed to find any nests.
- 16 August: FH and DT searched by canoe and failed to find any nests.
- 9 September: FH and DT searched by canoe and failed to find any nests.
- 13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Long Tule Point

- 23 June: FH and DT searched by canoe and failed to find any nests.
- 30 June: FH, DT and AW searched by motorboat and counted 22 nests.
- 3 July: FH and DT searched by canoe and counted 73 nests (37 shore, 36 open water) of which 51 were new, including 63 in the eastern lagoon subcolony and 10 in the western channel subcolony. We confirmed five homospecific pairs of Clark's Grebe (all mating) and one heterospecific pair of a male Clark's Grebe and female Western Grebe (mating).
- 15 July: FH, DS and DT searched by canoe and failed to find any nests.
- 28 July: FH and DT searched by canoe but failed to find any nests.
- 16 August: FH and DT searched by canoe and failed to find any nests.
- 9 September: FH and DT searched by canoe and failed to find any nests.
- 13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Corinthian Bay

- 23 June: FH and DT searched by canoe and failed to find any nests. However, we observed two Western Grebe chicks and two Clark's Grebes chicks with swimming parents.
- 30 June: FH, DT and AW searched by motorboat and failed to find any nests.
- 3 July: FH and DT searched by canoe and failed to find any nests.
- 15 July: FH, DS and DT searched by canoe and failed to find any nests.
- 13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Quercus Point

- 30 June: FH, DT and AW searched by motorboat and failed to find any nests.
- 13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Sunrise Shores

28 June: FH and DT searched by canoe and counted 237 nests (all shore), with 51 Western Grebes (63.8%) and 29 Clark's Grebes (36.3%) on nests. Approximately 20% of the nests had eggs with up to five eggs in a nest.

30 June: FH, DT and AW searched by motorboat and observed a decline in nesting activity.

3 July: FH and DT searched by canoe and counted 188 nests (all shore), with 16 new nests based on the number of nests mapped within sectors on 28 June. We counted 31 Western Grebes (60.8%), 19 Clark's Grebes (31.1%) and one mixed pair (1.6%) on nests. We confirmed two homospecific pairs of Clark's Grebe (both mating) and one heterospecific pair of a male Western Grebe (nest building) with a female Clark's Grebe (on nest).

8 July: FH and DT searched by canoe and found only one grebe nest with eggs in tules of the southeastern subcolony. No eggs were present elsewhere in the colony. One dead adult was

found on a nest.

24 August: FH and DT searched by canoe and failed to find any nests.

13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Southwest End of Clear Lake

In previous years I identified this area as “Southwest of Indian Island.”

10 June: FH and DT searched by canoe and failed to find any nests.

28 June: FH and DT searched by canoe and found 56 grebe nests (all shore), including three in a northern subunit and 53 in a southern subunit about 50-150 m to the south. Two nests in the northern subunit had one egg each. About ten nests in the southern subunit had up to two eggs. We counted 14 Western Grebes (58.3%) and 10 Clark’s Grebes (41.7%) on nests.

30 June: FH, DT and AW searched by motorboat and observed many nests.

3 July: FH and DT searched by canoe and counted 85 nests (all shore), including nine (six new) in the northern subunit and 76 (23 new) in the southern subunit. We counted 36 Western Grebes (60.0%), 23 Clark’s Grebes (38.3%) and one mixed pair (1.7%) on nests. We confirmed four homospecific pairs of Clark’s Grebes (one on nest, the other nest building for three pairs, both on a nest for one pair) and one heterospecific pair of a male Western Grebe (nest building) and female Clark’s Grebe (on nest).

8 July: FH and DT searched by canoe and found fewer active nests, only 19 with eggs and several with broken eggs.

15 July: FH and DT searched by canoe and failed to find any grebe nests. Only two swimming grebes were present.

24 August: FH and DT searched by canoe and failed to find any nests.

13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Anderson Marsh: North

10 June: FH and DT searched by canoe and failed to find any grebe nests.

15 June: FH and AW searched by canoe and counted six grebe nests (all shore), but only one had a single egg. A dead adult grebe was observed.

28 June: FH and DT searched by canoe and failed to find any grebe nests.

3 July: FH and DT searched by canoe and found 22 nests (all shore), including seven in tules of the northern subunit and 15 in willow saplings in the southern subunit. We assume six were old nests first found on 15 June and 16 were new. A Western Grebe with a half-sized chick was within 5 m of a partially built nest when we arrived and when we passed by again 45 min later, suggesting it may have been reneesting; we did not identify its mate.

8 July: FH and DT searched by canoe and counted 31 nests (all shore), including 21 nests (14 new) in tules of the northern subunit and 10 (none new) in willow saplings in the southern subunit. We counted 38 eggs in 15 nests, with an average of 1.2 eggs per nest (range = 0-8).

15 July: FH and DT searched by canoe and found only four nests (all shore) with eggs, with an average of 2.0 eggs per nest (range = 1-4). Three nests, including one attended by a Clark’s Grebe, were in the northwest corner of the northern subunit; because only one nest had been previously detected in that part of the colony, two nests appeared to be new. The fourth nest was farther south but still in the northern subunit. We counted 23 grebes swimming in the area.

24 August: FH and DT searched by canoe and failed to find any nests.

Anderson Marsh: Southwest

10 June: FH and DT searched by canoe and counted 125 grebe nests (all shore). Nine eggs were counted in five nest, with an average of 0.07 eggs per nest (range = 0-3).

15 June: FH and AW searched by canoe and saw relatively few grebes. Most of the nests, which were not counted, appeared to be abandoned.

3 July: FH and DT searched by canoe and counted 233 grebe nests (all shore), most of which were empty, but with up to four eggs in a nest. We confirmed a homospecific pair of Clark's Grebes mating on a nest.

8 July: FH and DT searched distantly by canoe and saw some grebes within the colony, but did not enter the colony.

15 July: FH and DT searched by canoe and failed to find any grebe nests at the north end of the colony. The colony was entered because no grebes were seen swimming within the colony.

24 August: FH and DT searched by canoe and failed to find any nests.

Anderson Marsh: Southeast

10 June: FH and DT searched by canoe and counted 427 grebe nests (all shore). Most nests had eggs, with up to ten eggs in a nest. Many eggs were smashed with shells carried up into nearby vegetation, suggesting predation.

15 June: FH and AW searched by canoe and counted 305 grebe nests (all shore), including five new nests (but only egg) just inside the entrance to the northwestern channel. Only about 63 nests had eggs. Three dead adults were found.

28 June: FH and DT searched by canoe and failed to find any active grebe nests.

24 August: FH and DT searched by canoe and failed to find any nests.

Cache Creek

This is a new colony.

10 June: FH and DT searched by canoe and found seven grebe nests (all shore) in a channel west of Harbor Lane. Nine eggs were counted in five nests, with an average of 1.3 eggs per nest (range = 0-4). Two nests were attended by Western Grebes (4 eggs, 1 egg) and two nests were attended by homospecific pairs of Clark Grebes (took turns incubating 1 egg; nest building with 0 egg). A Western Grebe with a very small chick on its back was seen swimming nearby.

15 June: FH and AW searched by canoe and counted six grebe nests (all shore). Seven eggs were counted in three nests, averaging 1.2 eggs per nest (range = 0-5).

Clearlake Park

30 June: FH, DT and AW searched by motorboat and failed to find any nests.

13 September: FH and DT searched by motorboat and failed to find any grebe nests.

Clearlake Oaks

10 June: FH and DT searched from land and failed to find any nests.

15 June: FH and AW searched from land but failed to find any nests, although three Western Grebe chicks were seen nearby with swimming adults.

- 15 June: FH and AW searched from land and failed to find any nests.
 28 June: FH and DT searched from land and failed to find any nests.
 30 June: FH, DT and AW searched by motorboat and failed to find any nests.
 8 July: FH and DT searched from land and failed to find any nests.
 28 July: FH and DT searched from land and failed to find any nests.
 7 August: FH and MH searched from land and found a pair of Western Grebes placing nesting material beside an emergent post in a lagoon at Clark Island.
 24 August: FH and DT searched from land and failed to find any nests.
 9 September: FH and DT searched from land and failed to find any grebe nests.
 13 September: FH and DT searched by motorboat and failed to find any grebe nests.

BROOD SURVEYS

A brood survey by motorboat on 30 June recorded 3,236 adult grebes, of which 72.8% were Western Grebes ($n = 1,678$ adults), 27.2% were Clark's Grebes ($n = 628$) and 930 were unidentified. This was the highest proportion of Clark's Grebes recorded during a mid-summer survey. We counted 259 juvenile grebes, of which 90.6% were Western Grebes ($n = 232$), 9.4% were Clark's Grebes ($n = 24$), and three were unidentified. This was the first mid-summer survey in which we recorded juvenile grebes, with an overall ratio of 0.11 juveniles per adult (0.14 for Western Grebe, 0.04 for Clark's Grebe) within the transect area (unidentified adults excluded). However, because more than a thousand grebes were nesting in Rodman Slough at the time of our survey, our data vastly underestimate the number of adult (and presumably juvenile) grebes in the lake and adjacent wetlands combined.

A brood survey by motorboat at the end of the breeding season, on 13 September, recorded 6,245 adult grebes, of which 57.3% were Western Grebes ($n = 1,794$), 42.7% were Clark's Grebes ($n = 1,337$) and 3,114 were unidentified. We counted 353 juvenile grebes within the transect area, of which 77.3% were Western Grebes ($n = 273$) and 22.7% were Clark's Grebes ($n = 80$), for an overall ratio of 0.11 juveniles per adult (0.15 for Western Grebes, 0.06 for Clark's Grebes) within the transect area (unidentified adults excluded). Extrapolating the ratio of juveniles to adults within the transect area to the total number of adults grebes counted, we estimate a total number of 704 juveniles for the lake. Because of the large size of the lake our estimated numbers of adults and juveniles are conservative, representing minimum values. Our ratio of 0.11 juveniles per adult was our second highest, exceeded only by 0.16 in 2014, but our extrapolated estimate of 704 juvenile grebes greatly exceeded previous years (since 2010), with the second highest estimate of 442 in 2014.

DISTURBANCE INDICES

We recorded only ten disturbances during 33.25 hours of observation, for an average of 0.30 disturbances per hour (Table 3).

Birds accounted for five (50.0%) of the disturbances (Table 3). On 16 occasions we observed an American Crow (*Corvus brachyrhynchos*) within 25m of a colony (Anderson Marsh: Southwest and throughout Rodman Slough). Of seven occasions in which an American Crow actually entered a colony, a crow was seen on a nest with one or more eggs on five occasions, but actual predation was observed only once, when a crow pecked twice on an egg but was then successfully chased away by a male Clark's Grebe. On another occasion we observed

two crows perched on a floating log within 5 m of grebe nests; one of the crows was pecking at an object that appeared to be food and it may have been an egg, but we were unable to confirm whether it was actually preying upon an egg.

Mammals did not account for any of the disturbances. On 8 July we observed three Northern River Otters (*Lontra canadensis*) swim within 25 m of an active grebe colony at the Southwest End of Clear Lake, but no predation was observed.

Humans accounted for five (50%) of the disturbances, including two by a canoe or kayak and three by a motorized boat. In each case the boats were moving slowly and disturbance of the grebes was minimal.

NEST CAMERAS

Motion-activated cameras focused on one or more active grebe nests, defined as one or more eggs present in a nest, for a combined total of 3,509 hours. We included temporary time periods in between in which a nest no longer had eggs due to predation or some other event.

The cameras documented 16 confirmed instances of one or more eggs within a nest being preyed upon by a Raccoon (*Procyon lotor*; Fig. 2), plus six inferred instances of predation in which a Raccoon was on or very close to a nest in which eggs were presumably present but not visible. On 11 occasions a Raccoon was either on a nest without eggs or swimming past a nest without eggs. All Raccoons were photographed at night. The cameras documented one instance of an American Crow flying from a nest with an egg in its beak (Fig. 3), one instance of an American Crow scavenging on eggs smashed by two turtles 15.5 hr earlier, one instance of an American Crow on a nest without eggs, and five instances of American Crows flying through a colony. All American Crows were photographed during the day.

We recorded several different species of birds at empty nests, either resting on the nests or foraging from the nests. On one occasion an old, empty nest sank underwater when a Great Blue Heron landed on it, which is unusual because Great Blue Herons often perch on nests without sinking them.

On 30 July a native Western Pond Turtle (*Actinemys marmorata*) and an introduced Red-eared Slider (*Trachemys scripta*) crawled up on a Western Grebe nest to bask and incidentally smashed both of the eggs present (Fig. 4).

In addition to documenting predators and nuisances at nests, the cameras documented some unusual grebe behaviors. We recorded three intentional or unintentional incidents of oviduct, with two occurring at the same nest on 5 July. In the morning at 09:28:31, a Western Grebe in the water and facing a nest while another Western Grebe was swimming away. Only 18 seconds later an egg appeared on the nest while two Western Grebes were in the water and facing the nest and a third Western Grebe was swimming away; presumably the third grebe had just climbed onto the nest, deposited the egg and jumped off the nest. Then 23 seconds later a Western Grebe appears to be grabbing the egg with its beak and 17 minutes later the egg is missing while the Western Grebe is still on the nest and another is arriving in the water (Fig. 5). Later in the afternoon an egg was laid on the nest between 15:59:59 and 16:08:04, with a Clark's Grebe standing beside the egg (as though it had just been laid) on the latter occasion. At 16:58:28 the egg is partially visible underneath a Western Grebe that is sitting on the nest while another Western Grebe is in the water facing the nest. Just 17 seconds later the egg is still partially visible under the Western Grebe but it is clearly smashed, while a Western Grebe is still in the

water facing the nest (Fig. 6).

A third instance of apparent ovicide occurred on 5 August. At 12:45:43 a Clark's Grebe is standing on a nest with its left foot between two eggs. Just 1 min and 43 sec later only one egg is visible on the nest and the grebe's left foot has moved toward the left, suggesting that it kicked the egg off the nest. However, it is uncertain whether the egg was evicted from the nest intentionally or unintentionally (Fig. 7).

We recorded 166 matings of which only three (1.8%) occurred at night, which was much lower than the 12.9% of matings at night in 2015.

CONCLUSIONS

The number of nests and chicks observed were the second highest since our study began in 2010, but the number of estimated chicks on the lake was the highest ever. Because of the high water levels in 2016, the vast majority of nests were constructed in emergent vegetation along the shore in relatively narrow channels of tributaries to the north of Clear Lake and drainages to the south of Clear Lake, with very few nests exposed far from shore in open water. As a consequence, we did not observe any instances of nest failure due to wind-generated waves or disturbances by boats. However, we recorded an unusually high level of predation on eggs by Raccoons. Our results suggest that reproductive success is enhanced by high water levels.

LITERATURE CITED

Gochfeld, M. 1980. Mechanisms and adaptive value of reproductive synchrony in colonial seabirds, Pp. 207-270 in *Behavior of Marine Animals, Vol. 4, Marine Birds* (J. Burger, B. L. Olla, & H. E. Winn, Eds.). Plenum Press, New York.

Fig. 1. Map of *Aechmophorus* grebe colonies indicating the number of estimated nests in each colony during the 2016 breeding season at Clear Lake, Lake County, California.

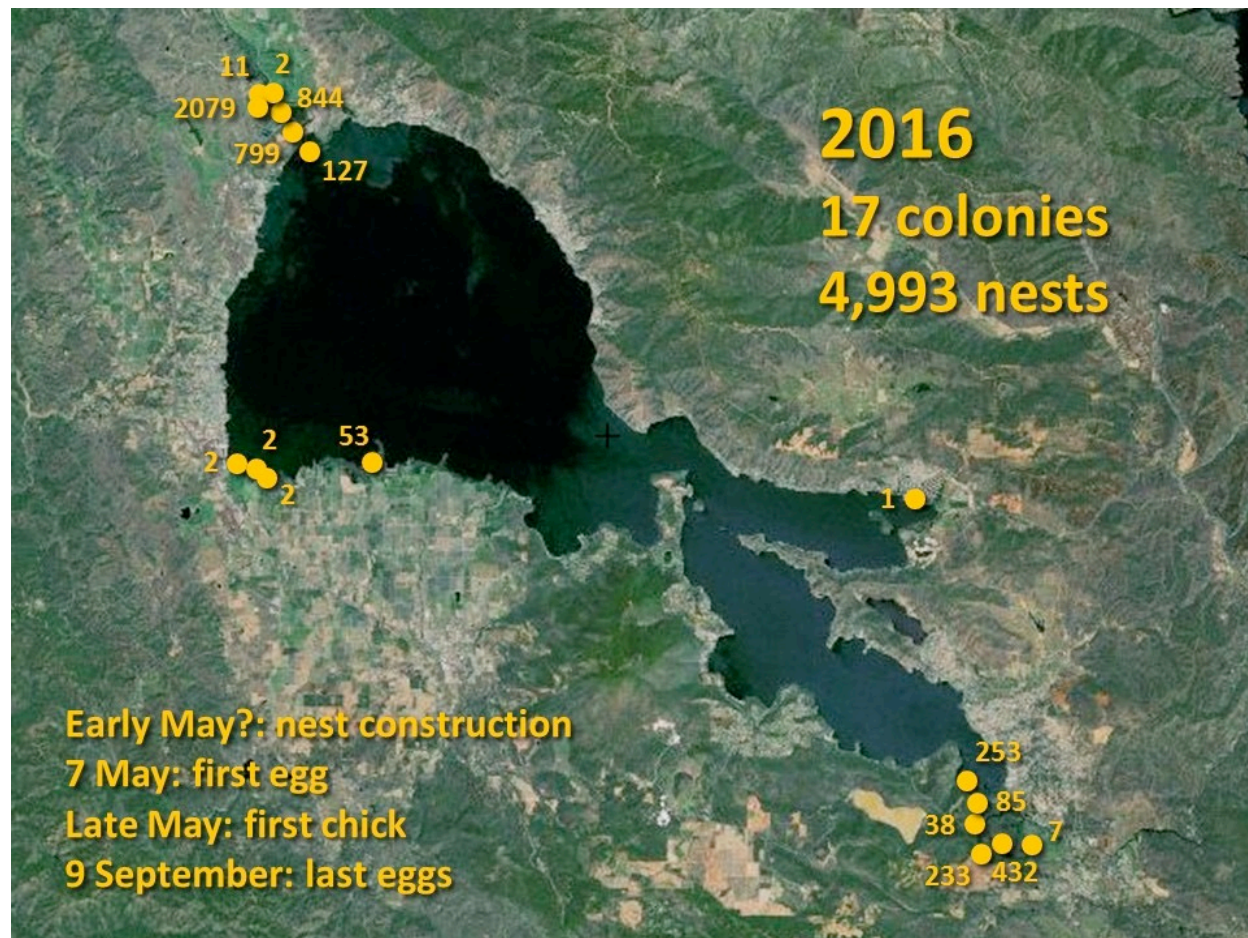
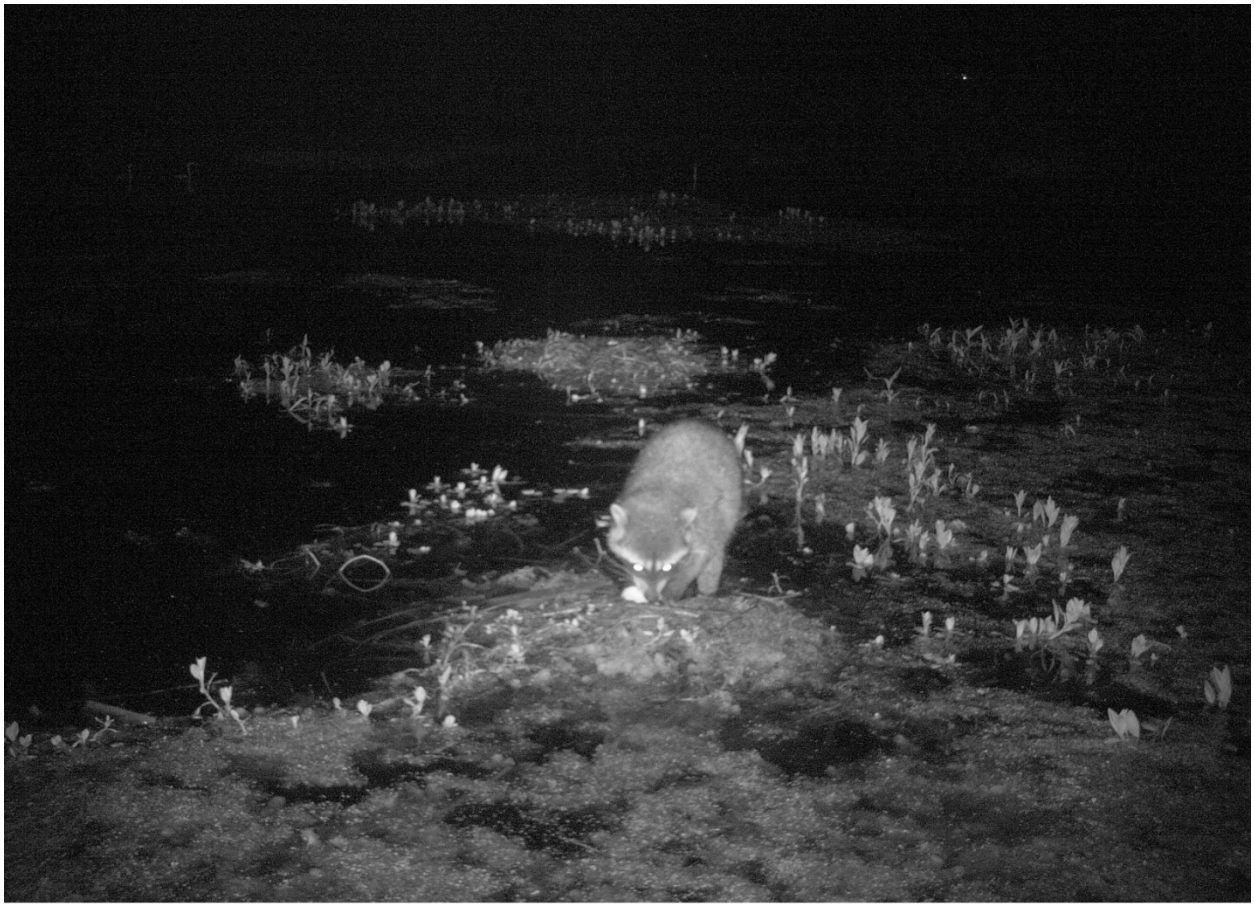


Fig. 2. Raccoon predation on eggs of a grebe nest at Rodman Slough: South on 3 August.



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Fig. 3. American Crow predation on an egg from a grebe nest at Rodman Slough: South on 28 July.

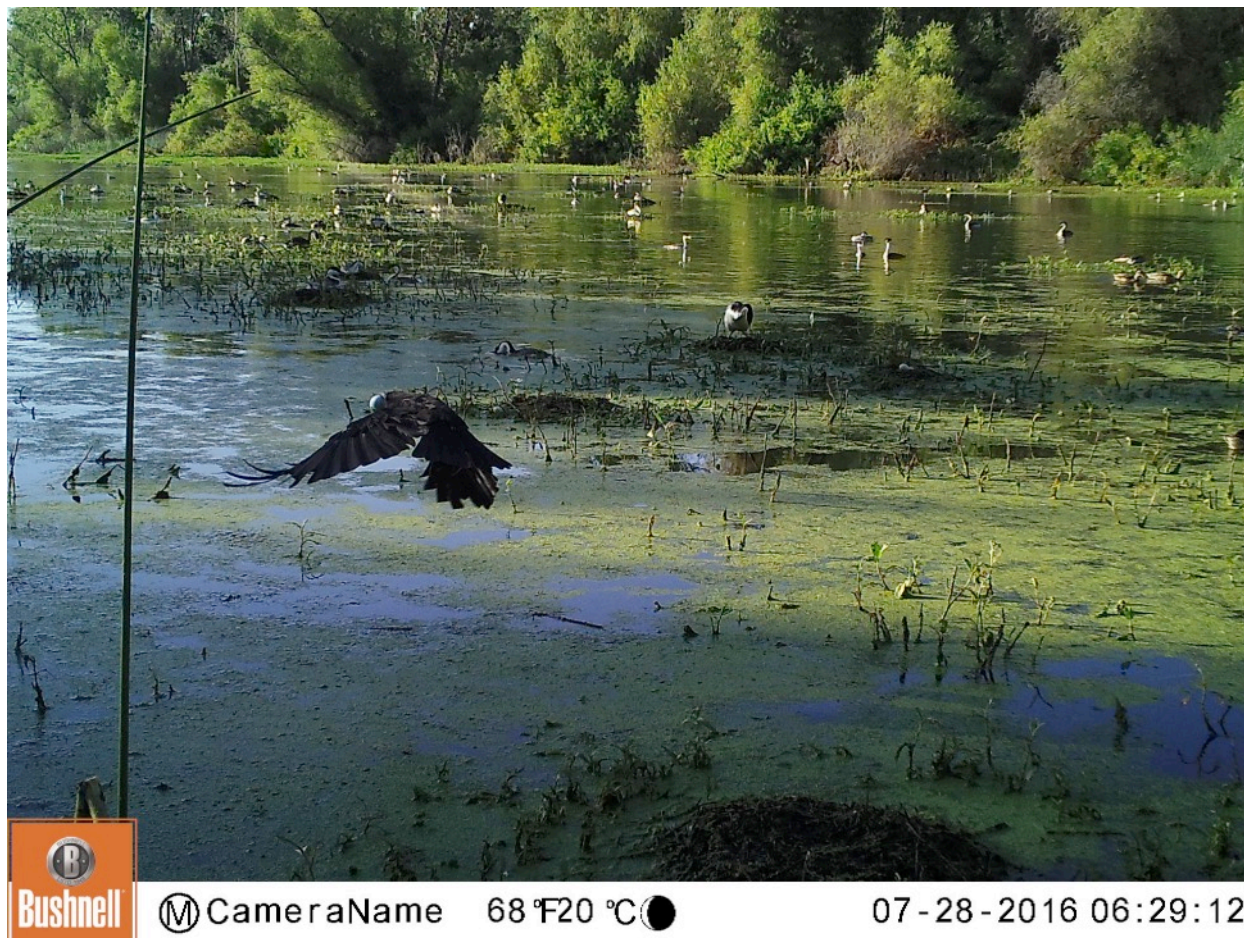


Fig. 4. Two Western Grebe eggs smashed by a basking Western Pond Turtle (left) and a Red-eared Slider (right) at Rodman Slough: South on 30 July.



Fig. 5. First instance of apparent ovicide by Western Grebes at Rodman Slough: South on 5 July.



Fig. 6. Second instance of apparent ovicide by Western Grebes at Rodman Slough: South on 5 July.

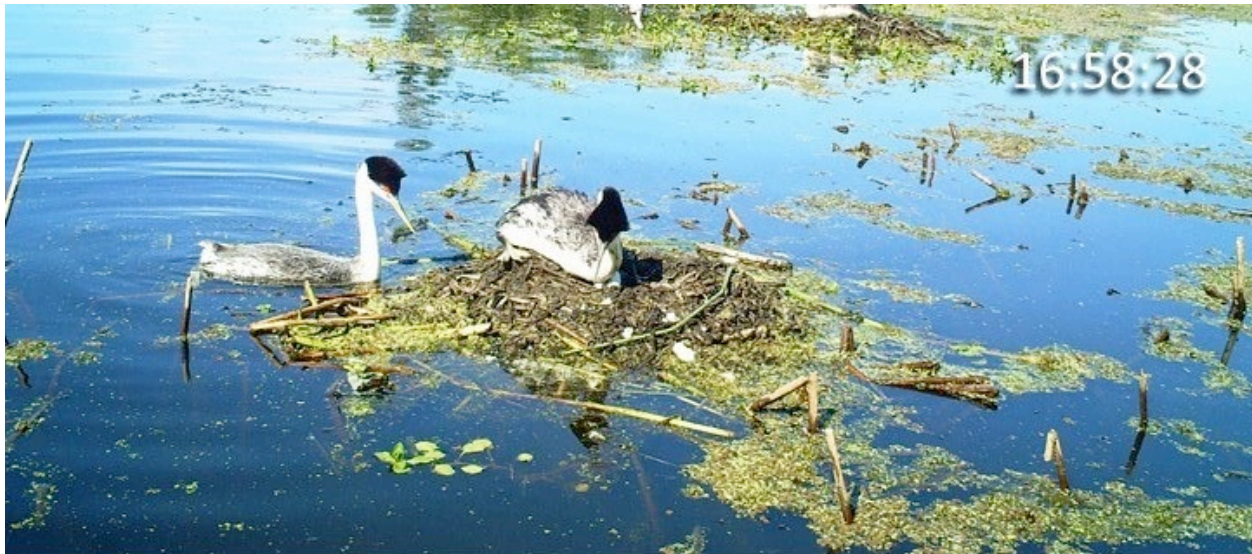


Fig. 7. Apparent ovicide by a Clark Grebe at Rodman Slough: South on 5 August.

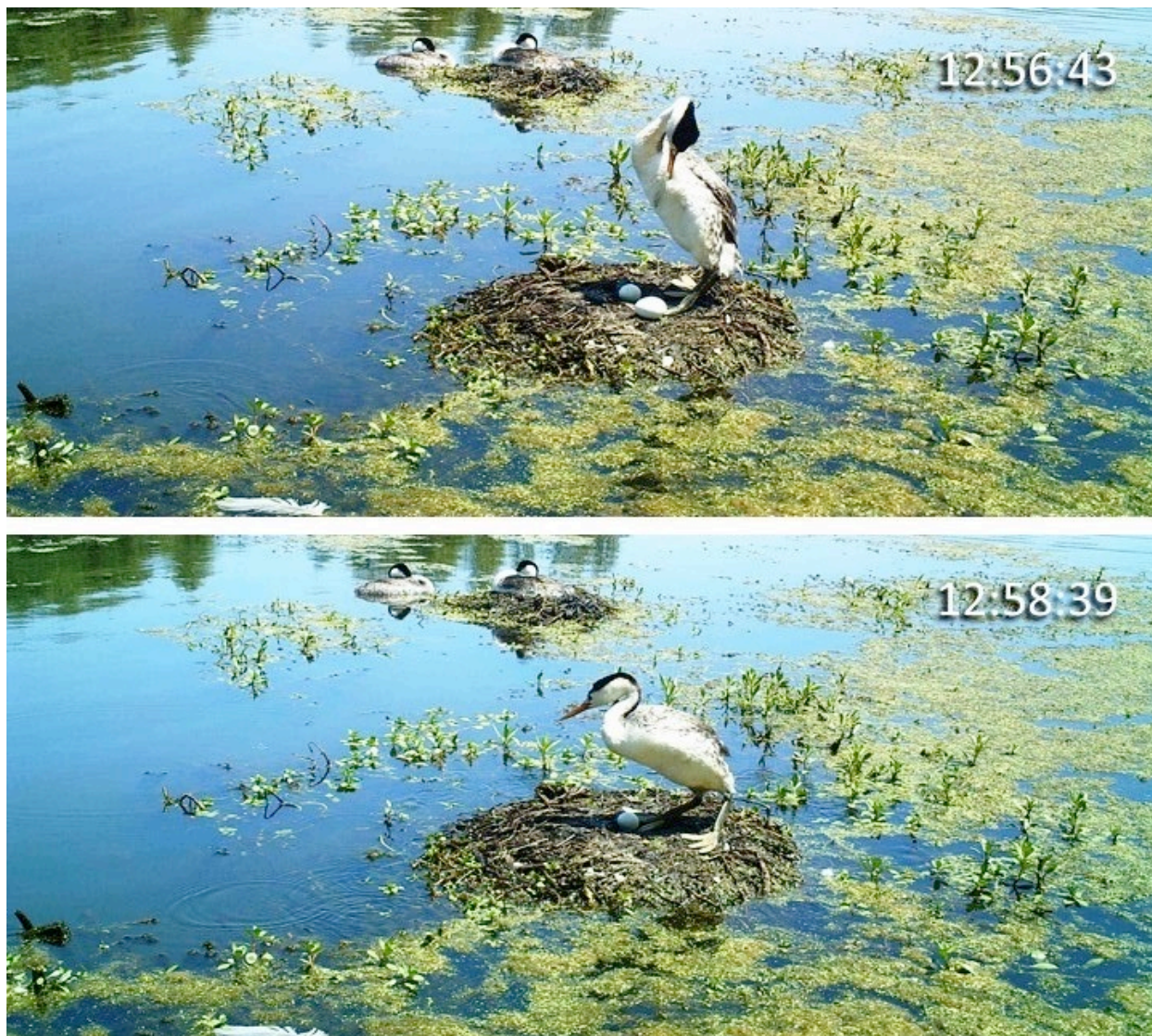


Table 1. Summary of pertinent breeding data for *Aechmophorus* grebe colonies on Clear Lake during 2016. Distance (m) from shore refers to the distance from emergent vegetation.

Colony	Type of colony	Distance (m) from shore	Egg dates	Peak activity	Number of nests	Western Grebe (%)

Rodman Slough: NW Channel	shore	0	5-9 to 9-9	8-2	2079 shore	227 (77.5)
Rodman Slough: Far North Marsh	shore	0	6-23 to 7-8	6-23	11 shore	1 (100)
Rodman Slough: Far North	shore	0	8-2 to 8-2	8-2	2 shore	1 (100)
Rodman Slough: North	shore open	0-2	6-23 to 8-24	8-2	843 shore 1 open	41 (65.1)
Rodman Slough: South	shore open	0-30	6-10 to 8-24	7-3	787 shore 12 open	81 (60.9)
Northwest End of Clear Lake	open	3-230	6-23	6-23	127 open	2 (66.7)
Lakeport: Manning Creek	shore open	0-6	7-28	7-28	1 shore 1 open	?
Point between Manning Creek and Rumsey Slough	shore	0	7-28	7-28	2 shore	?
Rumsey Slough: West	open	105-110	7-3	7-3	2 open	?
Long Tule Point	shore open	0-25	6-30 to 7-3	7-3	37 shore 36 open	?
Sunrise Shores	shore	0	6-28 to 7-8	6-28	253 shore	51 (61.7)
Southwest End of Clear Lake	shore	0	6-28 to 7-8	6-28	85 shore	36 (60.0)
Anderson Marsh: North	shore	0	6-15 to 7-15	7-8	38 shore	2 (66.7)
Anderson Marsh: Southwest	shore	0	6-10 to 7-3	7-3	233 shore	?
Anderson Marsh: Southeast	shore	0	6-10 to 6-15	6-10	432 shore	?
Cache Creek	shore	0	6-10 to 6-15	6-10	7 shore	2 (50)
Clearlake Oaks	shore	0	8-7	8-7	1 shore	1 (100)

Table 2. Chronological summary of new nests of *Aechmophorus* grebes discovered during field work on Clear Lake during 2016.

Date	New Nests	Cumulative Total
10 June	634	634
15 June	144	778
23 June	1,519	2,297
28 June	744	3,041
30 June	24	3,065
03 July	330	3,395
08 July	696	4,091
15 July	6	4,095
28 July	8	4,103
02 August	889	4,992
07 August	1	4,993
16 August	0	4,993
24 August	0	4,993
09 September	0	4,993
13 September	0	4,993

Table 3. Disturbances and potential disturbances of *Aechmophorus* grebes within a grebe colony with eggs during 33.25 hours of 13 days of observation on Clear Lake during 2016.

Type of disturbance	< 25 m	Entries	Disturbances	Disturbances / hr	Predation	Predation / entry	Predation / hr
Kayak or canoe	3	2	2	0.06	–	–	–
Motor watercraft	3	–	–	–	–	–	–
California Gull	2	1	–	–	–	–	–

American Crow	16	7	5	0.15	1	0.20	0.03
River Otter	3	-	-	-	-	-	-