Aechmophorus Grebe (Western and Clark's) Monitoring on Cascade Reservoir, Idaho, 2003–2021

Photo by Ron Dudley

IDAHO DEPARTMENT OF FISH AND GAME

Ed Schriever, Director

600 South Walnut Street
Boise, Idaho 83712

Prepared By
Diane Evans Mack, Regional Wildlife Biologist, McCall Subregion
Betsy Wagner, Senior Wildlife Technician, McCall Subregion

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Introduction

Western grebes (*Aechmophorus occidentalis*) are colonial waterbirds that nest on freshwater lakes or marshes with extensive open water, where they feed primarily on fish. Western and Clark's grebe (*A. clarkii*) occur together at breeding sites in Idaho, although western grebes far outnumber Clark's grebes on Cascade Reservoir. The 2 species are similar in appearance, and perform the same rituals during courtship. They were not distinguished in our study and hereafter are referred to as *Aechmophorus* grebe or "grebe". Both species are Tier 2 Idaho Species of Greatest Conservation Need, based on downward population trends and sensitivity to a number of threats, from fluctuating water levels to direct mortality at solar arrays (Idaho Department of Fish and Game 2017). Breeding Bird Survey data for 1993–2019 show a 2.8% annual decline in Idaho for this 27-year period, while the U.S. and Canada as a whole are stable or slightly increasing (Sauer et al. 2020).

Aechmophorus grebes arrive at Idaho nesting areas in late April to early May. They do not begin nesting right away, and likely use water level as a cue of suitable conditions to begin nesting. Grebes construct a floating platform nest in emergent vegetation found in shallow back channels and coves that offer shelter from wind and waves (LaPorte et al. 2020). Nests are in colonies, where the earliest nests establish the core and subsequent nests radiate outward. Once eggs are laid, these nests are extremely vulnerable to abrupt rises or falls in water levels, whether from natural high wind and wave events or water-level management. Unlike ducks or geese, grebes have difficulty walking on dry land, so rapidly receding water is as much a concern as flooding. Young leave the nest on their parents' backs as soon as they hatch and are raised on the open water. Grebes depart Idaho nesting sites from September through October.

Cascade Reservoir supports the largest *Aechmophorus* grebe breeding population in Idaho. The reservoir was created in 1948 with the completion of the dam, and it reached full capacity for the first time in 1957 (U.S. Department of the Interior 2002). Despite its expanse, the reservoir is relatively shallow, especially around the perimeter. While other grebe breeding locations had been documented in Idaho as early as 1903 (summarized in Trost 1985), Cascade Reservoir was first documented as a breeding colony in 1983, with a reported 150–200 nests (Trost 1985). Trost's surveys in 1984 and 1994 documented Cascade Reservoir as the largest breeding colony in Idaho in those years, and that remains true today, supporting more than half of the state's population. Grebes on Cascade Reservoir likely have benefited from IDFG's efforts to recover the yellow perch (*Perca flavescens*) fishery in these waters in recent years (Janssen et al. 2011).

IDFG conducted annual surveys of the grebe colony between 2003 and 2021. The methods used evolved during that time period. This report summarizes efforts to monitor the grebe population on Cascade Reservoir since 2003.

Land-based Surveys

For the first 3 years (2003-2005), monitoring efforts were loosely focused on becoming familiar with where grebe activity occurred on the reservoir. We counted grebes from shore, used congregations of grebes and their behavior to identify the location of nesting colonies, entered colonies to examine nests after grebes had returned to open water, and documented the presence of chicks on the water. We established 52 land-based vantage points around the reservoir and visited these points over the course of a 2-month period (mid June to mid August) each year. Not all observation points were visited on each survey day, and 2004 was the most comprehensive effort.

Pre- and Post-Nesting Boat Surveys

In 2004, in addition to land-based counts, we also conducted a boat survey, circumnavigating the reservoir to count adult grebes. The following year we aimed for 2 surveys---a pre-nesting survey of adults and a post-nesting survey of adults and chicks to document productivity. In 2006, we dropped land-based observations and focused our efforts on the pre-and post-nesting boat surveys.

The pre-nesting boat survey occurred after spring migration and prior to nesting to obtain a baseline estimate of resident adults for the breeding season. The survey generally occurred mid-June. We used a 6-m long motor boat that put the observers 2 to 3 m above the water's surface. Using binoculars, each of 2 observers counted from separate sides of the boat, 1 viewing toward shore and the other looking outward. A third person operated the boat, maintained a speed of 19–25 km/hr (12–16 mph), and monitored GPS waypoints to stay on course. We conducted surveys when there was no precipitation and mild winds (Beaufort sea state 3 or lower).

The established route included a circumnavigation of the reservoir and its arms to Tamarack Falls Bridge, the bridge across Lake Fork Arm, the mouth of Boulder Creek in Boulder Arm, and the powerline behind the breakwater in Gold Fork Arm (Figure 1). The transect ran parallel to, and 300-500 m off, the shoreline. In 2011, we added additional forays away from shore toward the middle of the reservoir in the widest section to encounter birds not visible from our shoreline transect. In 2013, we formalized these additional transects into a zig-zag configuration in the middle of the reservoir.

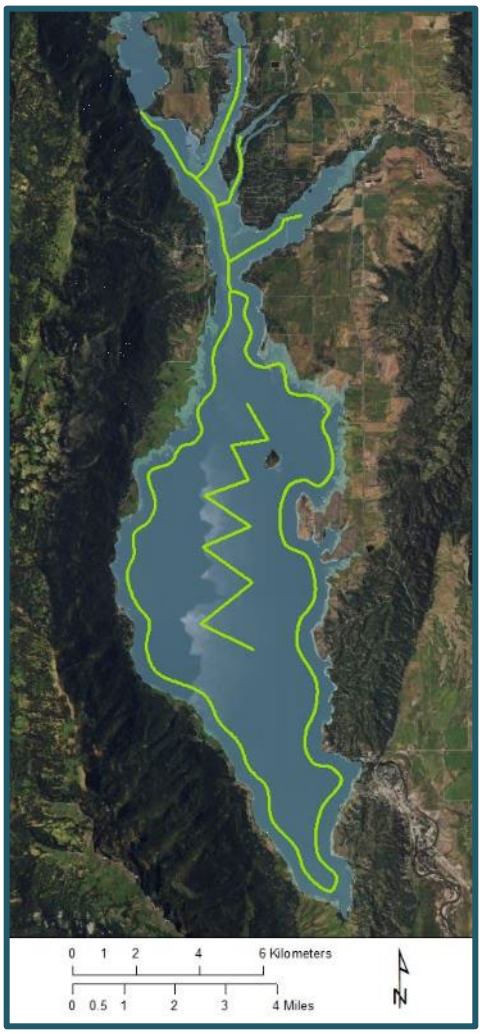

Figure 1. Grebe survey transect on Cascade Reservoir, Idaho.

In 2020, we extended this zig-zag transect to the south, resulting in a total survey length of 79 km (49 mi).

The post-nesting survey was more difficult to schedule because nest initiation was unpredictable and the precise date was usually unknown to us. We aimed to survey during a relatively small window of time roughly 3 weeks after adults had departed the nesting colony with their chicks. Ideal timing was when chicks were large enough to not be hidden on adults' backs and still smaller than adults when viewed in silhouette on the water at a distance. In 2017, when we had solid information of the onset of incubation and hatching (D. Lachman, personal communication), we calculated the optimum timing for the post-nesting boat survey was ~23 days after chicks had left the nests with adults.

Figure 2. Diane Evans Mack (left) and Betsy Wagner (right) conduct post-nesting grebe survey on Cascade Reservoir, Idaho.

Our surveys occurred from mid-July to mid-August. Because of lower water levels at that time of year, we used a smaller boat for the post-nesting survey but otherwise followed the same route and protocol as the pre-nesting survey, with 2 observers scanning opposites of the boat (Figure 2). We often stopped to confirm the presence of chicks, and at times left the survey route to approach grebe concentrations for more accurate counts of both adults and chicks.

We used counts as an index for abundance of adults, broods (an index to successful nests), and total young. Broods were tallied by size (e.g., 1-chick, 2-chick, 3-chick, 4-chick broods). Our counts were an index because not all birds were above water when we passed by, and some birds may have moved during the course of the 6+-hour survey and thus were missed entirely or double-counted. These sources of error were similar year to year, making the imprecise counts generally comparable.

Across the years of our boat surveys, we tallied, on average, ~2,600 adult grebes during the pre-nesting survey. This number varied substantially year to year, ranging from 1,100 to >4,000 (Figure 3, Table 1). Since 2004, we had incomplete surveys in 3 of 18 years due to weather and not covering the middle of the reservoir well. On several other surveys, some grebes were visiting the nesting colony or had started nesting; in these cases, we certainly missed the adults that were not on the open water and not visible in the nesting colony. The average count of adult grebes in the most recent 8 years (2014-2021), in which our survey coverage was the most consistent, was 3,033 adults.

We did not find strong agreement between our count of adults on the pre-nesting survey and the post-nesting count (Table 1). For most of the years with complete surveys, the post-nesting count was higher. As mentioned above, we missed adults in a few years because they were in the nesting colony; thus, we would expect the post-nesting count to be higher. For 1 post-nesting survey (2018), our timing was too late and we suspect that some chicks were included in the adult count because they were too big to distinguish from adults from a distance. For 2 post-nesting surveys (2008 and 2010), we did not complete the survey after encountering 0 chicks in large concentrations of adults close to known nesting colonies.

We documented comparatively strong chick numbers in only 6 of the 17 years for which we had post-nesting boat surveys (Figure 3, Table 1). These were years where we counted >500 chicks, and 2-chick and 3-chick broods were well represented. Observing 2- and 3-chick broods was an indication that adults completed full incubation and nests were not abandoned prematurely. However, even these years were at the low end of ratios reported from a Manitoba study from the 1970s, which found 0.53 chicks/adult in a low-water year and 0.88 chicks/adult in a high-water year (LaPorte 2012). We documented 5 years of essentially zero productivity. In 2010 and 2013, we had evidence that a single, intense wind-wave event caused total nest failure. For the other 3 years (2008, 2015, 2021), water level likely was the primary cause of poor recruitment (see below under Water Levels).

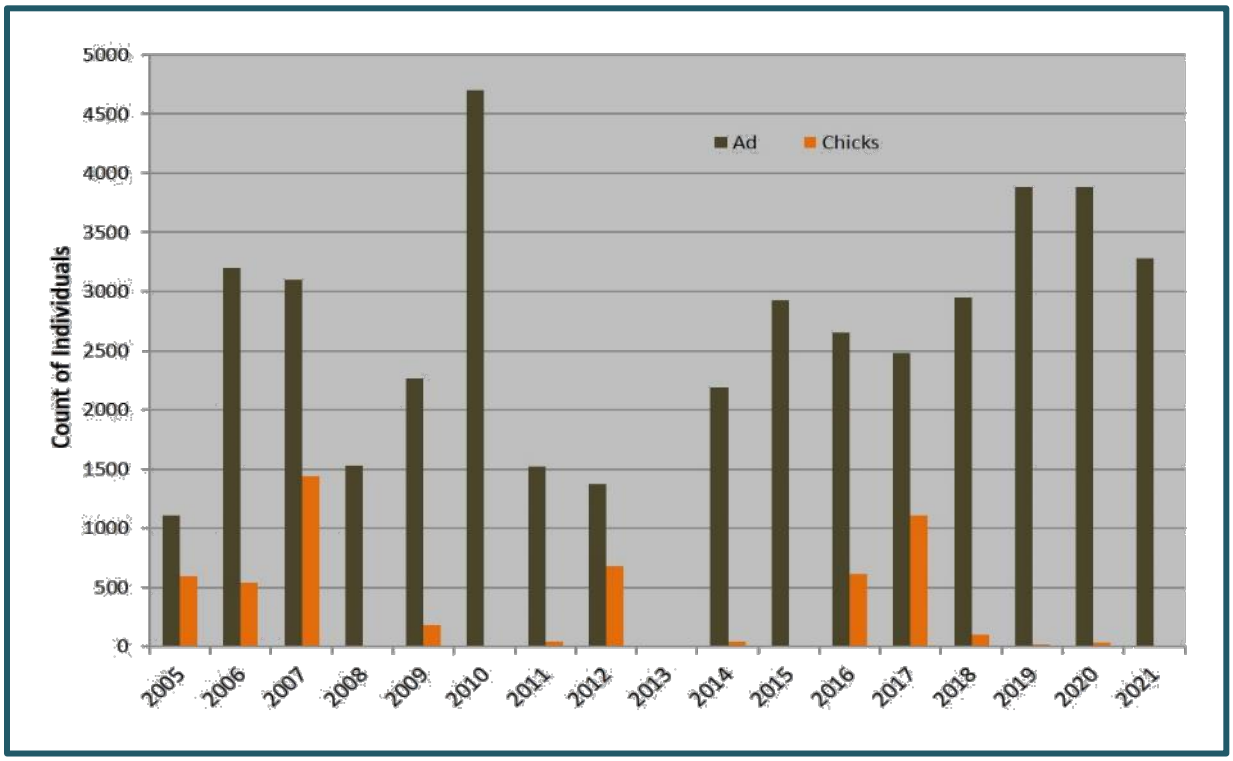

Figure 3. Boat-based counts of *Aechmophorus* grebe adults (pre-nesting survey) and chicks (post-nesting survey) on Cascade Reservoir, Idaho.

Table 1. Annual *Aechmophorus* grebe abundance and productivity from boat-based surveys, Cascade Reservoir, Idaho.

	Pre-Nesting			Post-Nesting				# Broods with:				
Year	Date	Complete Survey?	Adult Count	Date	Complete Survey?	Adult Count	Chick Count	1-Ch	2-Ch	3-Ch	4-Ch	Total Broods
2004	6/24	No	1443									
2005	6/22	Yes	1111	7/20	No	1901	594	162	186	20		368
2006	7/11	Yes	3200+	7/28	No	2516	541	123	120	50	7	300
2007	5/17	No	2891-3491	7/10	Yes	3488	1443					659
2008	6/27	Yes	1533	8/7	No[a]		0					0
2009	6/12	Yes	2262	7/30	Yes	4217	183	81	48	2	0	131
2010	6/25	Yes	4691-4765	8/10	No[a]		0[b]					0
2011	6/29	Yes	1525	8/30	Yes	2265	46	34	6	0	0	40
2012	6/15	Yes	1374[c]	8/14	Yes	2322	678	280	164	22	1	467
2013	6/11	No	1400[c]	7/30	Yes	2049	1[d]	1	0	0	0	1
2014	6/6	Yes	2189	8/4	Yes	3210	46	36	5	0	0	41
2015	6/18	Yes	2929	8/21	Yes	2049	1					1
2016	6/22	Yes	2654	7/28	Yes	4830[e]	616	271	127	25	4	427
2017	6/14	Yes	2483	8/8	Yes	2522	1109	191	219	151	2	563
2018	6/19	Yes	2951	7/31	Yes	4982[f]	97	95	1	0	0	96
2019	5/31	Yes	3887	7/26	Yes	4563	15	11	2	0	0	13
2020	6/10	Yes	3886	7/22	Yes	2933	32	14	6	2	0	22
2021	6/14	Yes	3284	8/2	Yes	4215	0[g]	0	0	0	0	0

[a] Survey stopped after 0 chicks observed off known nesting areas with large groups of adults.

[b] Wind-wave event washed over nesting colony.

[c] Nesting had started; some portion of adults missed.

[d] Wind-wave event on June 19 caused considerable damage around reservoir. Campers at Sugarloaf reported waves of 4-5 ft.

[e] Some portion of adults and chicks possibly double-counted.

[f] Chicks too large to distinguish from adults at a distance; some portion of this adult count likely was chicks.

[g] Drought year, low water levels, several failed nest attempts at different places on the reservoir based on UI drone monitoring (A. Yen, personal communication).

Nesting

Grebe nesting colonies were located in the northern half of the reservoir north of Sugarloaf Island on both the western and eastern shorelines (Figure 4). It appears that the grebe population had several key locations for nesting, which they typically used for 2 or more consecutive years before relocating. Duck Bay, on the western shoreline (area C, Figure 4), was the primary location for many years, even when some portion of the nesting population was nesting elsewhere (e.g., areas A and B). Beginning in 2015, the area west of Hot Springs Creek and Old Hwy 55 (areas F and G, Figure 4) became the epicenter. In 2020, grebes returned to Duck Bay, as well as the area north of Stonebraker Lane (area E, Figure 4). We also documented solitary or small groups of nests constructed in other parts of the reservoir from our land-based observations in 2003–2005 (e.g., near French Creek and Hurd Creek). These nest structures separate from the main colony were not followed to completion, so their status is unclear.

Nesting typically was underway in early June. Boat surveys in 2012, 2013, and 2020 observed adults in nesting areas by the second week of June (10^{th} to 15^{th}). In 2017, the University of Idaho (UI) began a study of grebe nest success using drones to identify the extent of each nesting colony, quantify the number of nests, establish nesting chronology, and follow individual nests through the season to calculate nest success (Lachman 2019, Lachman et al. 2020). The UI study provided more precise information on the timing of nest initiation than we could obtain from boat surveys. For example, UI drone flights documented the earliest onset of the nesting season, 4 June, in 2020 (Yen et al. 2021). Likewise, the UI drone flights obtained more precise information on the number of nests and their outcomes. We compared those data to our boat-based counts of adult grebes and broods to assess the validity of our boat surveys. Similarly, the UI study used our pre-nesting boat survey data to identify where grebes were staging for nesting so they knew where to focus their drone flights.

In several years, we entered the nest colony on foot after grebes had departed (and water had receded due to draw-downs; Figure 5) to map the footprint of the colony, count nests, and look for signs of adult mortality and egg predation. We mapped perimeters of the colonies in 2005, 2006, 2007, 2010, 2013, 2015, and 2016. In 2009 and 2017, we counted every nest in each year's colony (Table 2). We also counted nests in 2004, but obtained a full count (786 nests) at only 2 of the 3 locations used that year. In 2018 and 2019, we obtained nest counts from the UI study (Lachman et al. 2020, Lachman and Yen 2020). All of the full nest counts exceeded 1,000 nests. The number of nests loosely corresponded with our pre-nesting adult counts if we assume each nest was associated with 2 adults. We would expect not all grebes counted during surveys nested in any given year. We did not tally the number of eggs left on nests during ground-based counts, as the interim between grebes leaving and our entry provided ample time for predation. Nevertheless, we observed many nests with at least 1 egg remaining. We occasionally observed remains of dead adults at nests as well. With the onset of the UI study, 2017 was the last year IDFG mapped colony footprints or conducted land-based nest counts.

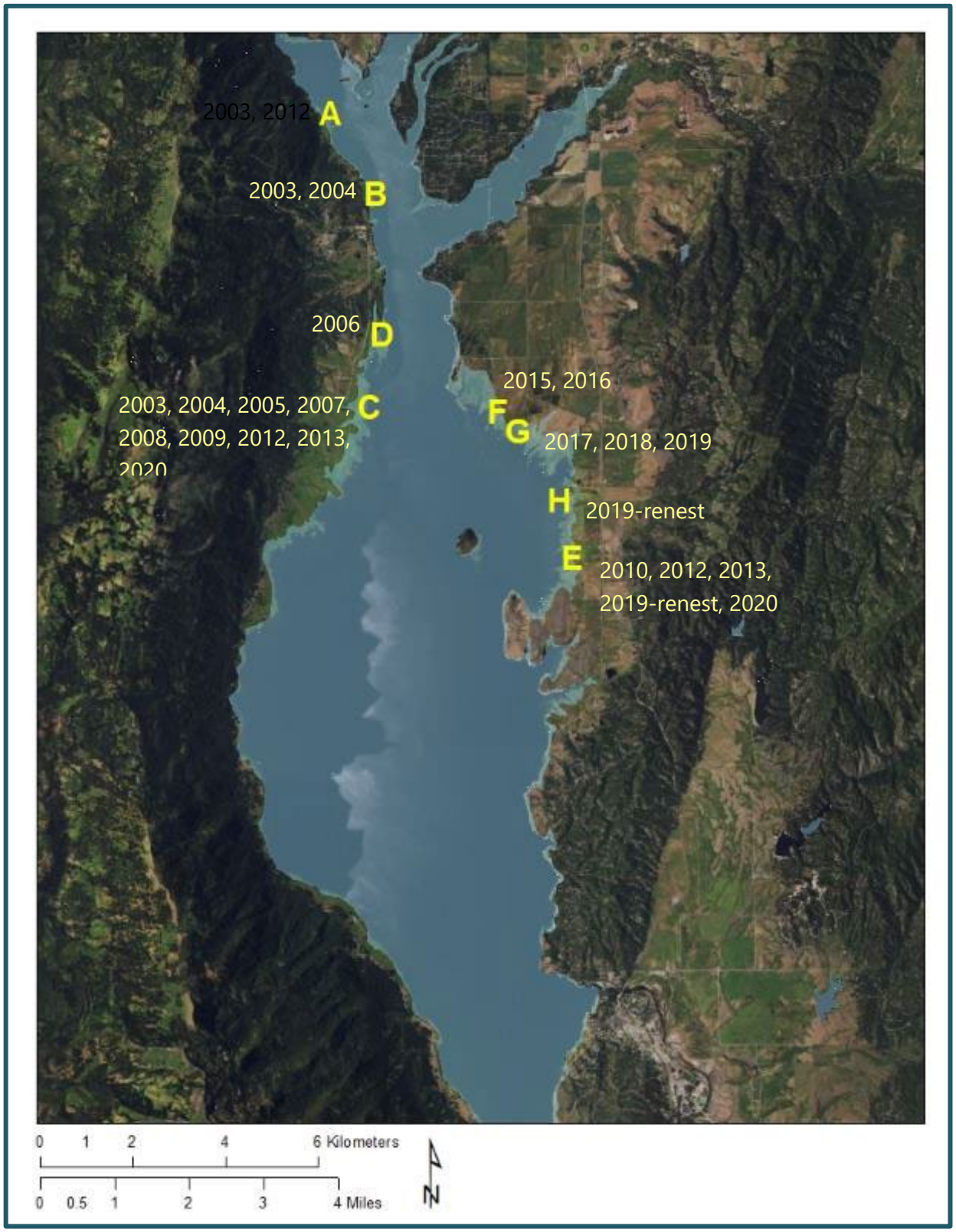

Figure 4. *Aechmophorus* grebe nesting colony locations on Cascade Reservoir, Idaho, 2003–2020. Data for 2018–2020 from D. Lachman and A. Yen, University of Idaho research project.

Figure 5. *Aechmophorus* grebes constructing nests, Cascade Reservoir, Idaho. Inset: Ground-based nest counts were conducted after grebes departed the colony. By early fall, receding water had exposed their nests as large grassy mounds.

Table 2. Comparison of nest counts with boat survey counts of adult *Aechmophorus* grebes, Cascade Reservoir, Idaho.

Year	Location/Map Area, Figure 4	# Nests	Pre-nesting Adult Count	Expected Min # Adults	Source/Method
2009	Duck Bay, area C	1,514	2,262	3,028	IDFG ground search
2017	Old Hwy, area G	1,259	2,483	2,518	IDFG ground search
2018	Old Hwy, area G	1,059	2,951	2,118	UI drone flights
2019	Old Hwy, area G	1,399	3,887	2,798	UI drone flights

Water Level Fluctuations and Depth

Water level fluctuations

To assess the extent to which grebe productivity on Cascade Reservoir was linked to fluctuating water level, we obtained daily surface water level readings for the reservoir from the Bureau of Reclamation hydromet database (Bureau of Reclamation 2021). This database offered a single daily reading from a gauge at the dam on the southern end of the reservoir. We mapped daily change in surface water level during May through July, corresponding to the grebe nesting season. We

looked at the seasonal pattern of change relative to overall breeding success (number of chicks observed on the water; Table 1) for 3 time intervals: 2005–2010, 2011–2015, and 2016–2021.

The general pattern at Cascade Reservoir was a gradual increase in water level in May and early June as the reservoir filled with spring run-off, a leveling off (plateau) at or close to full pool, and then a steady decline as water was drawn for irrigation downstream (Figures 6a, 6b, 6c). Higher grebe productivity appeared to correlate positively with the duration of the plateau. In years with higher chick numbers and multiple-sized broods (e.g., 2007), the plateau lasted 2 to 3 weeks. In contrast, years with poor chick numbers (2008, 2011, 2015) tended to have short plateaus or none at all. The date of the plateau did not seem as influential as its duration. For example, in 2007 the reservoir began to plateau ~22 May (Figure 6a), whereas in 2017 the plateau occurred ~3 weeks later (9 June; Figure 6c). One exception to this pattern was 2013; the hydromet graph indicated that this should have been a good chick year. However, this was a year when a strong wind-wave event washed over the nesting colony, likely causing almost total nest failure.

Water depth

Adult grebes need to swim to and from their nests, so it stands to reason that water depth also influences nest success. Water depth >40 cm in a nesting colony was considered optimal by LaPorte (2012); most nests in a Manitoba study were located in >25 cm of water. More locally, the UI study found that grebes on Cascade Reservoir preferred to nest in 40–80 cm of water (Lachman 2020). In 2015 and 2016, we installed a single camera paired with a measuring stick (stadia rod) at a representative nest location within a nesting colony (Figure 7). Our intent was to correlate our readings with the hydromet gauge so that we could establish how water levels at the dam generally changed water depth at a nesting colony. We installed the camera sets prior to nest initiation to avoid entering an active nest colony. In 2015, we selected a location at area E (Figure 4) from the colony footprint we mapped post-nesting in 2013. We anticipated that grebes would return to this nesting area in 2015, but they did not; they nested in area F (Figure 4). In 2016, we selected a location in area F based on nest sites we mapped post-nesting in 2015.

Our stadia rod measurements on the outer edge of the 2016 nesting location (area F, Figure 4) showed that 40 cm of water depth corresponded to 4826.43 ft on the gauge, and 25 cm at the colony corresponded to 4825.96 ft on the gauge. These depth-to-gauge relationships differ for each nesting location around Cascade Reservoir, but the calculation illustrates how a difference of 0.50 ft on the gauge could mean the difference between suitable and unsuitable water depth in a nest colony. Across the years of our monitoring, the water level plateaus occurred above a gauge measurement of 4827 ft (Figures 6a, 6b, 6c). In 2008 and 2011, years of poor chick counts, this level wasn't reached until relatively late in the nesting season. In 2021, a year of dismal nesting and renesting, the reservoir never reached full pool, peaked at a gauge measurement of 4826.46 on 13 June, and started to fall the next day.

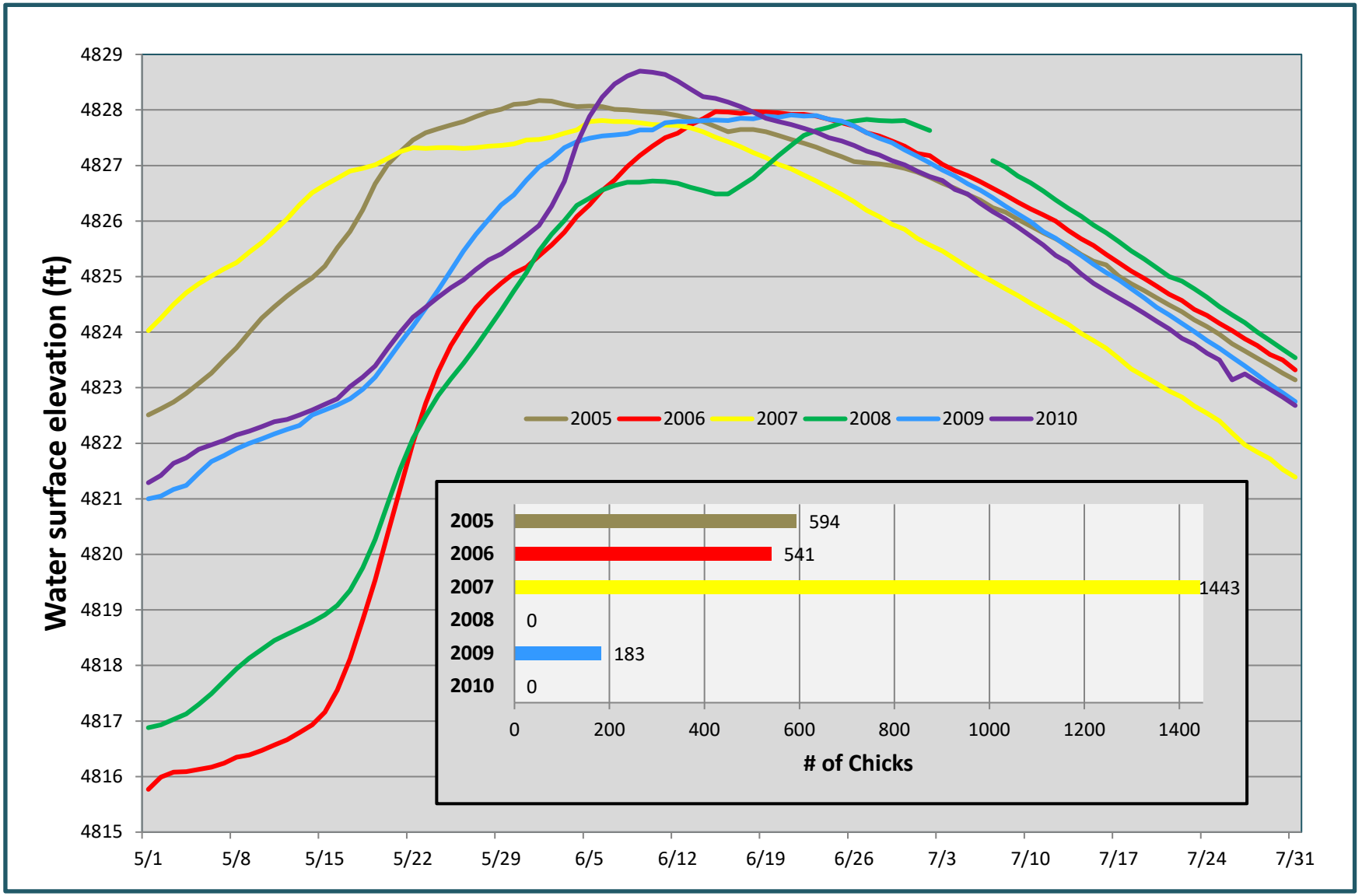

Figure 6a. Seasonal change in surface water level at Cascade Reservoir, Idaho, 2005–2010, compared with the number of grebe chicks detected on the water post-nesting.

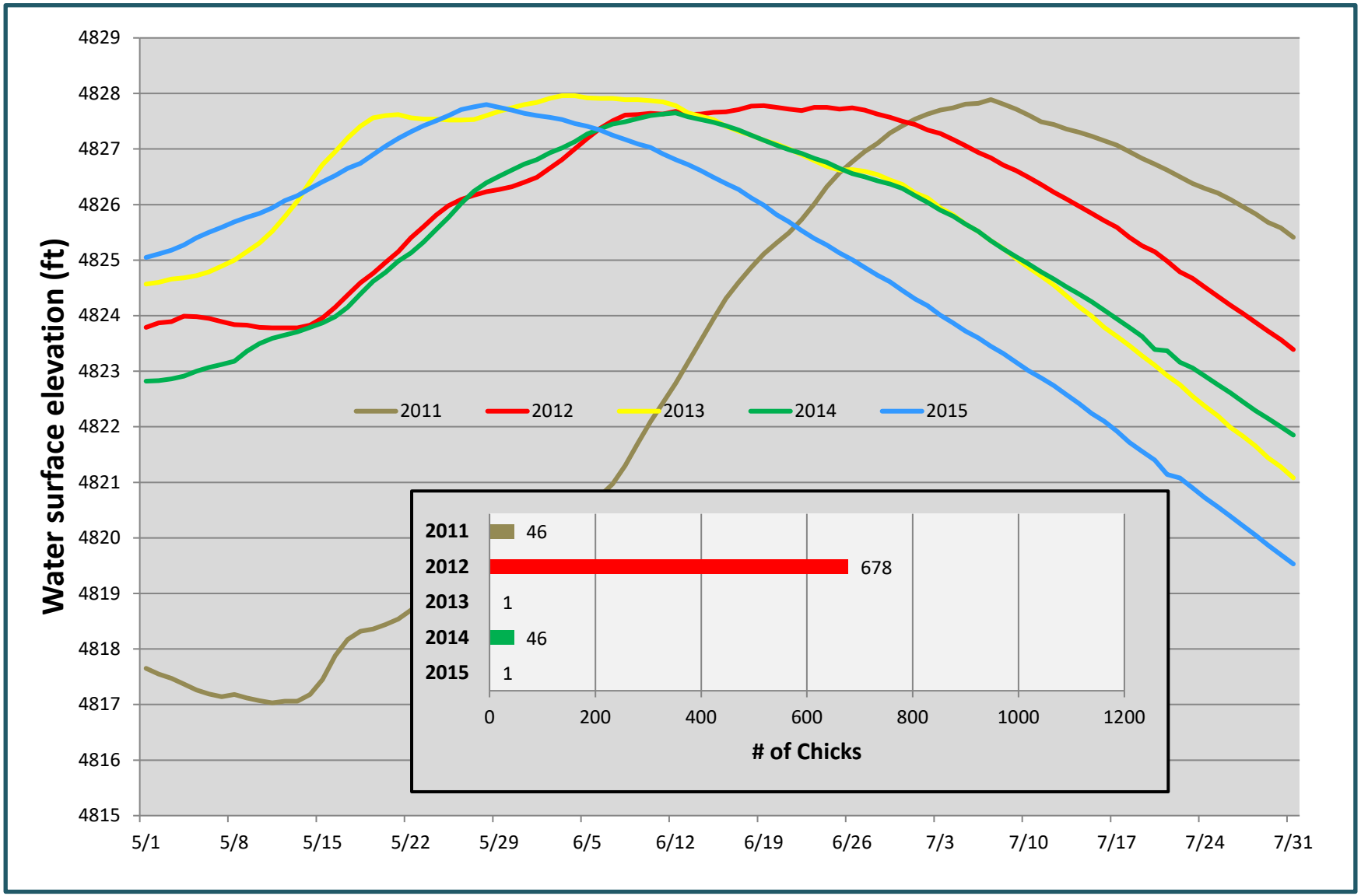

Figure 6b. Seasonal change in surface water level at Cascade Reservoir, Idaho, 2011–2015, compared with the number of grebe chicks detected on the water post-nesting.

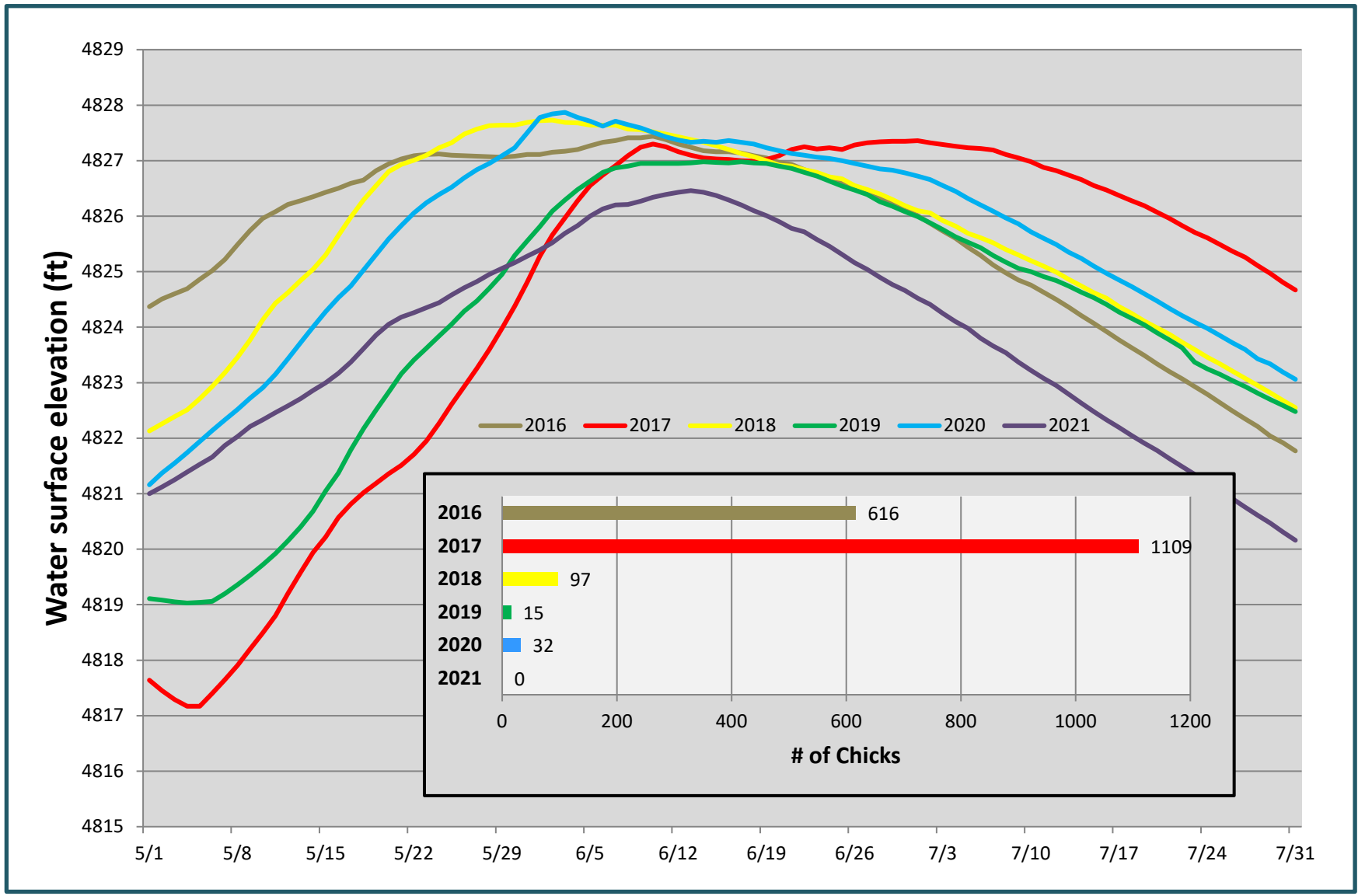

Figure 6c. Seasonal change in surface water level at Cascade Reservoir, Idaho, 2016–2021, compared with the number of grebe chicks detected on the water post-nesting.

Figure 7. Camera paired with water level measuring stick, Cascade Reservoir, Idaho, 2016. Left: Near nesting area F (Figure 4) in May prior to water level increase. Right: Camera image at peak water level in June with grebe in background.

Discussion/Recommendations

Boat surveys were a reasonably effective way to monitor the abundance of *Aechmophorus* grebes on Cascade Reservoir during the breeding season, especially with the same observers conducting most of the surveys. We recognize that counts could be more reliable with slightly different approaches, and for that reason have not attempted any rigorous analyses of the boat survey results. Other methods could include increasing the number of surveys per season, using a distance-based transect survey and a stratified random sample of transects to estimate abundance, and conducting the pre-nesting season survey in late May to avoid any chance of some portion of adults on nests.

It appears that the likely nesting areas on Cascade Reservoir are well documented. Over the past 18 years, we never observed a nesting colony on the south end of the reservoir. Research on western grebes elsewhere found that locations of breeding colonies tend to be traditional but vary widely with water conditions (LaPorte et al. 2020). Our observations suggest that the nesting colony shifted location after 1–2 years of nest failures. It also wasn't uncommon to have large concentrations of grebes nesting in 2 or more locations simultaneously.

It is clear that maintaining consistent water levels for an approximately 3-week period (the length of incubation) is an important management strategy for *Aechmophorus* grebe breeding success and recruitment on Cascade Reservoir. We found that we could identify which years had good chick counts simply by looking at the pattern of water level change during May through July. The

ongoing UI research using drones to map and follow nests has provided more detail that confirms the importance of sustained water depth during the time period that adults are accessing nests. Their work also corroborated that the main issue at Cascade Reservoir is not the loss of nests to flooding, but rather a lack of access to nests partway through incubation due to declining water levels in some years. Riensche et al. (2009) designed a floating nest platform that was used with some success on a reservoir in California that also had seasonal drawdowns. After witnessing grebes attempting to renest, after initial nest failure, in exposed open water on Cascade Reservoir, artificial nests placed in suitable, sheltered locations could be a potential management tool in some situations.

We recognize that balancing needs for water is complicated. Managing water to address other concerns at Cascade Reservoir, such as water quality, recreation, and fish health, could benefit *Aechmophorus* grebes as well. We encourage multi-resource discussions that consider how and where these interests intersect.

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Approved by:

IDAHO DEPARTMENT OF FISH AND GAME

Tricia Hebdon, Asst. Chief
Bureau of Wildlife

Jon Rachael, Chief
Bureau of Wildlife