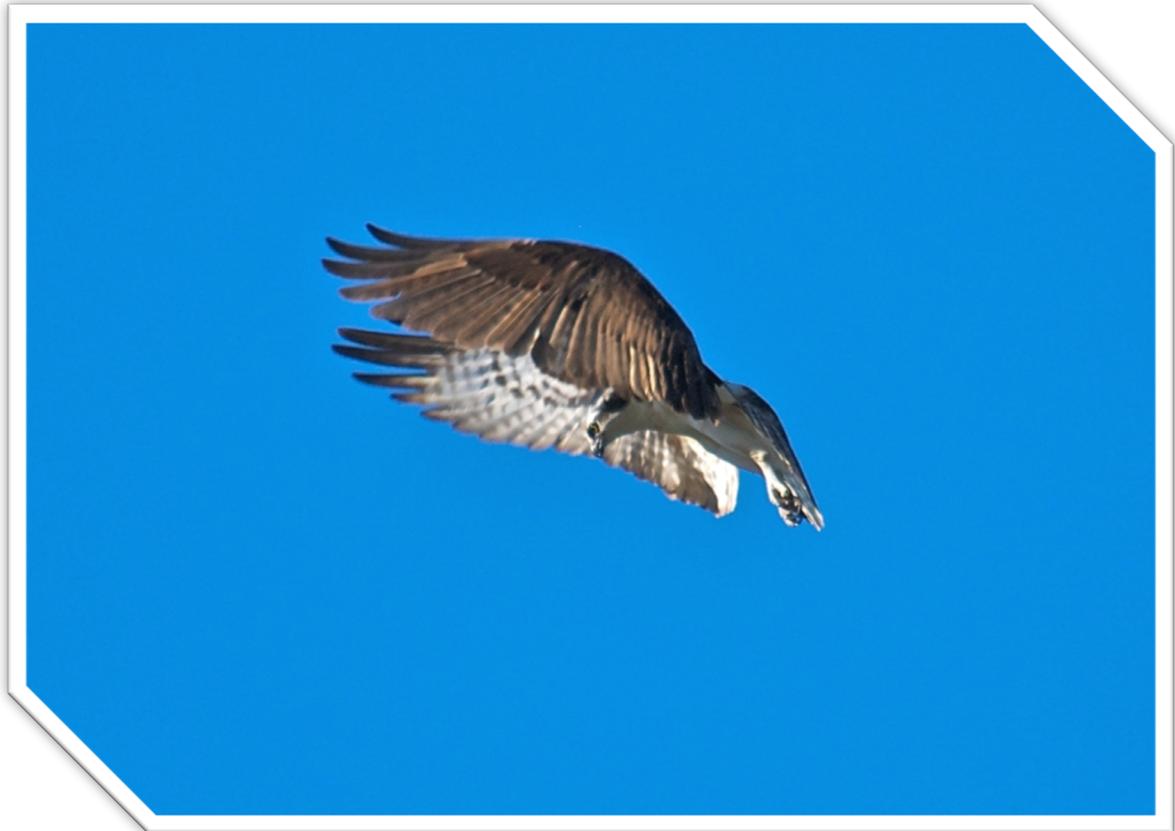


**Osprey (*Pandion haliaetus*): the 2019 Nesting Season
Kent Lake Reservoir, Marin Municipal Water District,
Marin County, California.**



Final report to:

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1.0 Background

The Kent Lake Osprey colony was founded in the mid-1960s, with the first nest reported from the Big Carson arm in 1967 (C. May, T. Haggerty, pers. comms.). Beginning in 1981, Marin Municipal Water District (MMWD) initiated a monitoring effort to determine the species and location of nesting trees, the number of active nests, and the reproductive success of the colony. This monitoring effort (“Phase I”) continued each year from 1981-2000, except for 1990. The average growth rate of the colony over that 20-year monitoring period was approximately 10 percent/year (Evens 2001). The colony’s growth peaked in 1994 when 52 nests were “occupied” (attended by a pair early in the nesting season), 46 were “active” (supported an adult pair into the incubation period), and 30 were “productive” (fledged young). During that peak year, we estimated that the colony produced more than 50 chicks. Over those first two decades of monitoring reproductive success of the colony averaged 1.4 (± 0.37) chicks/nest (Evens 2001), thereby surpassing the 0.8-1.3 chicks per nest/year considered the threshold for a viable population (Henny and Wight 1969, Spitzer and Poole 1980).

The colony was not monitored during the 2001 and 2002 nesting seasons. In 2003, Avocet Research Associates (ARA) entered into a revised agreement with MMWD to identify the nest sites around Kent Lake and to provide GPS coordinates for each site. Estimates of the colony’s reproductive success were not within the scope of “Phase II” of monitoring. The methods employed in the 2003 study have been repeated each subsequent year through 2019. The results of the 2003-2019 monitoring efforts are provided to MMWD as data files (shapefiles) containing GPS coordinates and an electronic topographic map with the nest sites plotted. Tom Gaman of East-West Forestry Associates archives the data files and provides the expertise for the mapping. Jules Evens of ARA oversees the fieldwork and with the help of Mr. Gaman and a MMWD ranger locates, identifies, and classifies nesting sites. The results of the 2019 monitoring season are summarized in this report, incorporated into the existing dataset, and evaluated with respect to earlier results.

2.0. Nest site monitoring: 2019

During the 2019 monitoring effort, Evens and Gaman repeated the methods used each year since 2003. Field observations were collected on 29 April and 31 May in an attempt to coincide with peak nesting activity. Other observers included MMWD Rangers Phil Johnson (4/29) and Darrell Nickerson (5/31) and ARA Associate Ron Mallory (4/29). In an effort to assess the status of nests not easily viewed from the lake proper, supplementary observations were made by Mallory from the fire-road linking Alpine Dam and Kent Lake (6 June). The primary goal of these site visits was to locate and describe functional nesting trees. The results of our observations are summarized in Tables 1-4 and Figures 1-4 below. These results are supported by electronic metadata, provided separately.

2.1 Nest sites

Trees supporting nests were identified to species [Douglas-fir, *Pseudotsuga menziesii*, or coast redwood, *Sequoia sempervirens*] and classified by vitality [live or dead]. A summary of tree species and vitality classes of trees that supported occupied nests in 2019 is provided in Tables 1 and 2.

Since the inception of the study, live trees have been used more frequently than dead trees (Evens 2001, ARA 2014). However, from 2017 through 2019 numbers of live and dead trees supporting functional nest structures were nearly equivalent. As in previous years, coast redwoods provided the commonest nest substrate (Table 1).

As mentioned in earlier reports, there has been a shift in distribution of occupied nests from the northern reach of the lake, including the “Big Carson” arm, to the southern reaches (Figures 1 & 2). This shift coincided with the establishment of the Bald Eagle nest in the middle reach of the lake in 2008. Whether eagle presence was the primary cause of this distributional shift is moot, however eagles are known predators of osprey chicks as well as being kleptoparasites (Bierregaard *et al.* 2016), so avoidance of marauding eagles seems a likely reproductive strategy for ospreys.

Table 1. Trees with functional nests in 2019: species and class.
(Percentages of total in parentheses)

Class/Species	Douglas fir	Redwood	Total
Live	4 (16.7)	9 (37.5)	13 (54.2)
Dead	1 (4.2)	10 (41.7)	11 (45.8)
Total	5 (20.8)	19 (79.2)	24 (100.0)

2.2 Reproductive effort

The reproductive effort of osprey colonies is most often evaluated using three criteria: number of occupied nests, number of active nests, and number of productive nests.

Occupied: nest maintained and attended by adults until egg-laying;

Active: nest at which adults persist into the incubation period (i.e. on 2 visits).

Productive: nest that successfully fledges at least one young.

In 2019 we identified 24 potentially functional nest sites distributed within the Kent Lake watershed (Figures 1 & 2, Tables 1 & 2). Of those sites, 20 (79.2%) were attended by at least one adult on at least one site visit and therefore classified as “occupied.” Adults were present at 12 nest sites (50.0%) on both visits and were therefore classified as “active.” Six nests (25.0%) that were present in 2018 were not found in 2019 and were classified as “gone.” Locations [UTM coordinates], species, and classes of nesting trees are described in *shapefiles* provided to MMWD and archived with East-West Forestry Associates.

In summary, during the 2019 monitoring effort, of 24 apparently functional nest sites, 19 were “occupied” of which 12 persisted to be classified as “active.” As in the previous eleven years, one nest site (#61) was occupied by a pair of Bald Eagles (*Haliaeetus leucocephalus*); that eagle nest was excluded from the analysis of active nests.

Status (occupied/active/empty) as well as classification of individual nest sites, and year established is given in Table 2.

Two nests at Bon Tempe Lake were occupied on a single visit 30 April (JE pers. obs.). Two nests near Cataract Gulch that were present in 2018 were not found and apparently gone on 6 June 2019 (R. Mallory, pers. obs.).

Determination of the number of productive nests was beyond the scope of this study. Our estimate of the minimum number of occupied and active nests is an index of annual reproductive effort, however earlier observations estimated that 65-75 percent of active nests were not ultimately productive. Indeed, in 2019 a preliminary evaluation of 47 active nests around San Francisco Bay, estimated that 13 ultimately failed, for a productivity rate of 72.3 percent (T. Brake, pers. comm.).

In 2019, the number of *occupied* and *active* nests continued an apparent downward trend that has been evident during Phase II of the monitoring effort (Fig. 4). The number of *occupied* nests ($n=19$) and *active* nests ($n=12$) fell well below the respective 16-year means (Table 3, Fig. 3 & 4). The 2019 results, although still relatively low in each category, suggest that the colony at Kent Lake is still viable, although in diminished capacity. Ancillary field observations suggest that numbers of active nests along Inverness Ridge were also reduced in 2019 (J. Evens, T. Gaman, R. Mallory, pers. obs.).

3.0 Discussion

To recapitulated the history of the colony: As stated in several past reports (2011-2018), following its founding in the mid-1960s, the colony increased fairly steadily during the 1st decade of monitoring, leveled-off or “plateaued” during the 2nd decade of monitoring, and has declined somewhat during the 3rd decade of monitoring (Figure 3). There are several possible explanations for these observed patterns.

- 1) Numbers of active osprey nests have increased around San Francisco Bay over the past decade, indicating a shift in regional distribution (Brake *et al.* 2014).
- 2) Numbers of nests along Inverness Ridge, west of Kent Lake ($15\pm$ in 2018), are not systematically surveyed, however it appears that those nests had relatively low success rates in 2018 and 2019, mirroring Kent

- Lake's pattern (J. Evens, pers. obs.; T. Gaman and R. Mallory, pers. comms.).
- 3) The colony has had only modest reproductive success since the Bald Eagle pair arrived in 2008 (see discussions in earlier reports). Incidentally, Bald Eagles were found nesting on Inverness Ridge in 2013 and by 2019, three (or four?) Bald Eagle nests have been identified in West Marin.
 - 4) Changing ecological conditions may be affecting fisheries and foraging success. (It is important to note that foraging within Kent Lake is rather limited. Birds apparently commute to other reservoirs, coastal estuaries, or San Pablo Bay to forage.)
 - 5) The Kent Lake colony was founded about 50-years ago and may be approaching senescence or changing patterns of recruitment (Gaston and Descampes 2011).
 - 6) Heavy precipitation in May 2019 may have thwarted reproductive success in West Marin and San Francisco Bay. Both sites had a relatively high degree of nest failures this year (T. Brake, pers. comm.). Inclement weather during incubation and chick rearing could limit foraging success and nestling survival.

Including Kent Lake, the San Francisco Bay area Osprey population supported approximately 84 occupied nests in 2019: San Francisco Bay (50 occupied, 47 active—T. Brake pers. comm.); Inverness Ridge ~15 (J. Evens pers. obs.); Kent Lake 19 (this report).

Considering the histories and proximity of these nesting clusters, it is apparent that Kent Lake was the founding population, that it grew through the mid-1990s, and that it served as a source population for Inverness Ridge (established in the mid-1970s) and probably San Francisco Bay (established in the late 1990s, Brake *et al.* 2014).

Caveat:

Determining the number active nests is a survey technique commonly used to assess the colony health of Ospreys. An underlying assumption is that if adults persist through the incubation period of the nesting cycle, they are likely to be

successful. This assumption was challenged this year by subsequent visits to some nests that were classified as both “occupied” and “active,” but found subsequently to be empty (R. Mallory, pers. comm.). An estimated 30± percent of active nests apparently failed in 2019, perhaps due to exceptionally inclement weather—high wind and rainfall— in mid-May 2019 [7.33 inches, May 15-20, marinwater.org].

Table 2. Status of nest sites at Kent Lake, 2019.

Status: Occupied = birds on or attending 1st visit; Active = birds on or attending 2nd visit (Active* indicates present on 5/31 but apparently empty on 6/6); Empty = no activity at nest site; unknown = nest not found. Tree spp.: RDW = coast redwood; FIR = Douglas fir. Nest condition: 1 = rudimentary structure; 2 = partially built but not functional; 3 = nest complete, usually lined with lichen. Year established (Year est). **Red indicates Bald Eagle nest site.**

Osprey Nest #	4/29/19 Status	5/31/19 Status	Tree species	Tree class	Nest cond.	Year Est
1	Gone	Gone	RDW	DEAD	0	1981
8	Occupied	Active	RDW	DEAD	3	1981
42	Gone	Gone	FIR	LIVE	0	1987
61	Occupied	Active	FIR	LIVE	3	1993
91	Occupied	Empty	RDW	DEAD	3	1996
92	Occupied	Empty	RDW	DEAD	3	1997
95	Occupied	Active	RDW	DEAD	3	1998
112	Gone	Gone	RDW	LIVE	0	2000
122	Empty	Empty	RDW	LIVE	2	2003
126	Gone	Gone	RDW	LIVE	0	2004
128	Empty	Empty	FIR	LIVE	2	2004
132	Gone	Gone	RDW	LIVE	0	2012
135	Occupied	Active	FIR	DEAD	0	2004
161	Occupied	Active	RDW	DEAD	2	2007
171	Occupied	Active*	RDW	DEAD	3	2010
174	Occupied	Active	RDW	LIVE	3	2010
175	Empty	Gone	FIR	DEAD	0	2011
179	Occupied	Gone	RDW	LIVE	3	2011
180	Occupied	Active	RDW	LIVE	3	2012
181	Occupied	Active	RDW	DEAD	3	2013
182	Empty	Empty	FIR	LIVE	1	2014
183	Occupied	Active*	RDW	DEAD	0	2014
185	Occupied	Empty	RDW	LIVE	3	2014
189	Occupied	Active	RDW	LIVE	3	2017
190	Occupied	Active	RDW	DEAD	3	2017
191	Gone	Gone	RDW	LIVE	0	2017
192	Occupied	Active	RDW	LIVE	3	2018
193	Empty	Empty	RDW	LIVE	2	2018
194	Occupied	Empty	RDW	LIVE	3	2018
195	Occupied	Empty	RDW	DEAD	3	2019
30 sites	19 occupied	12 active				

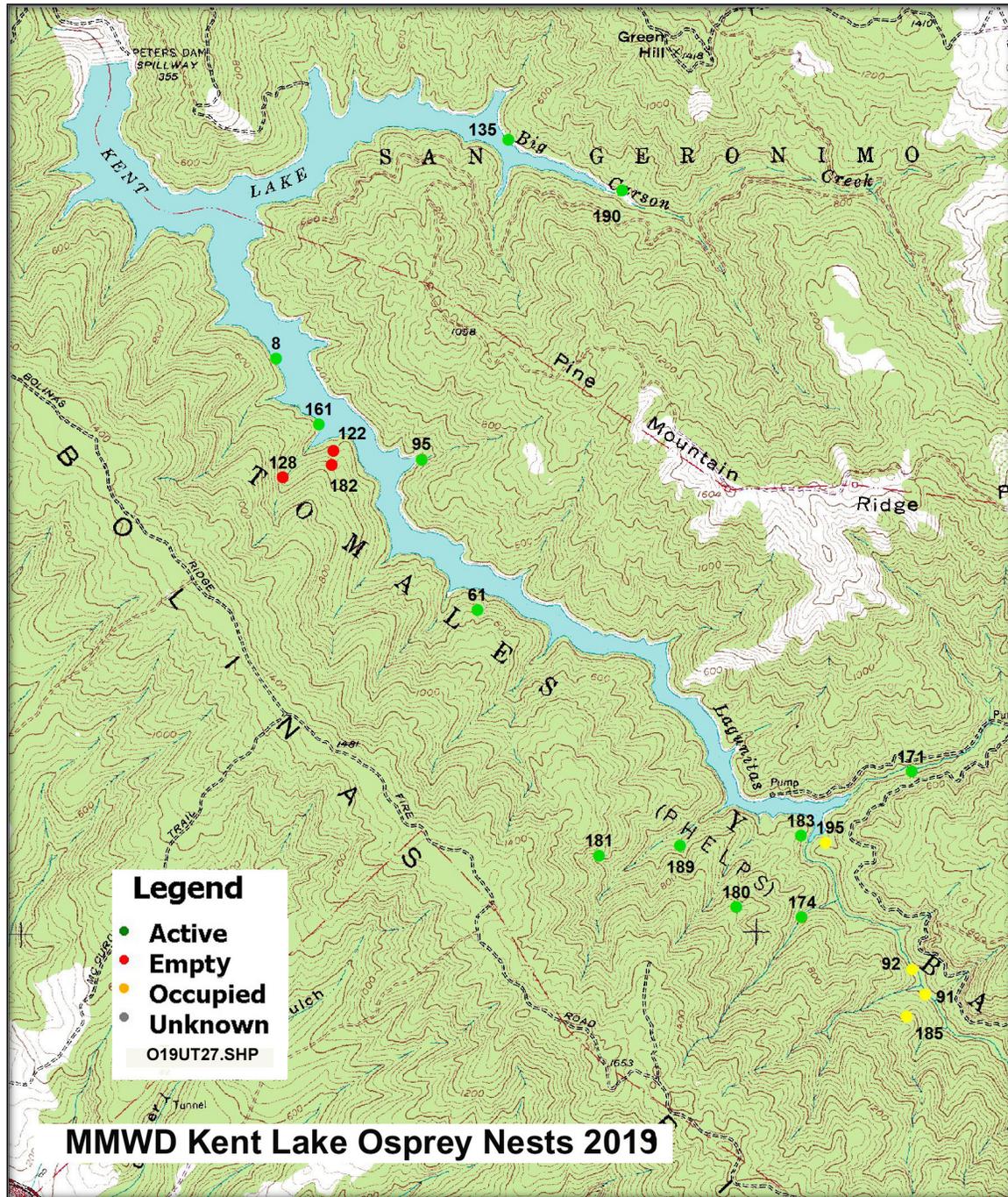
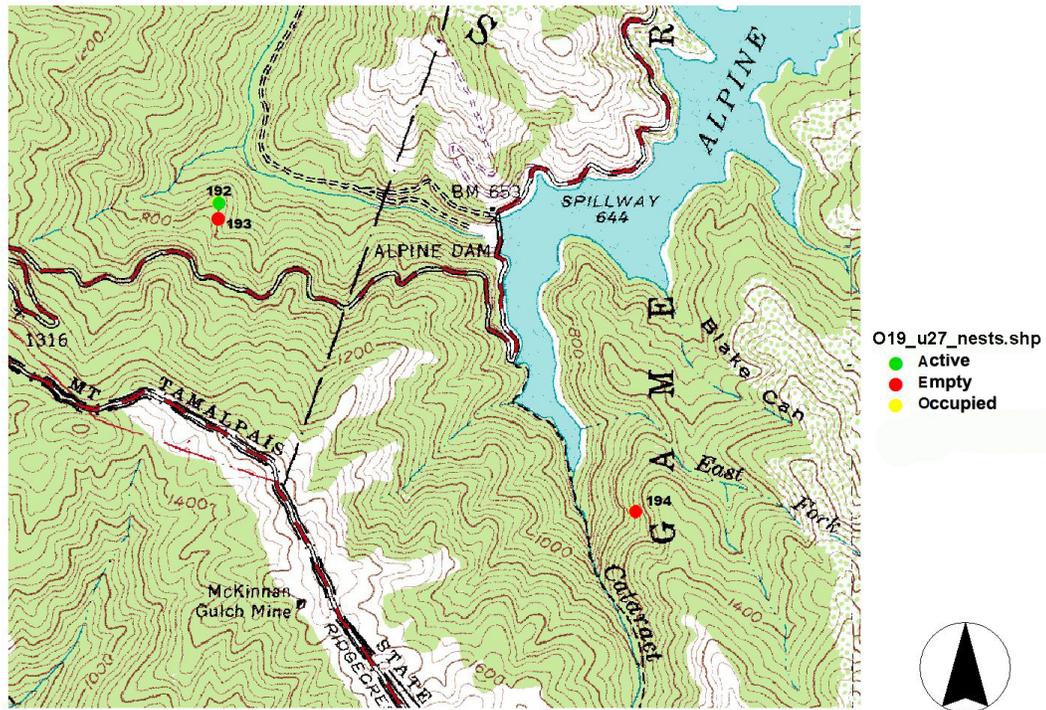


Figure 1. Distribution and status of osprey nest sites at Kent Lake, 2017. (Nest #61 was used by a pair of Bald Eagles.)

MMWD Alpine Lake Vicinity Osprey Nests 2019



Note: These are approximate locations.

Figure 2. Distribution and status of Osprey nests in the vicinity of Alpine Dam, 2019.

Table 3. Numbers of nests sites and their status: 2003-2019.

(In the “occupied” column, values in parentheses for each year indicate the percentage of use relative to available sites. In the “active” column, values in parentheses represent the ratio of active to occupied nests. In the last row, averages are followed by standard deviation in parentheses.

Year	Total nest sites	# Occupied	# Active (A:O)
2003	49	42 (0.86)	Unknown
2004	53	45 (0.85)	18 (0.40)
2005	59	50 (0.85)	44 (0.88)
2006	54	44 (0.82)	37 (0.84)
2007	52	42 (0.81)	29 (0.69)
2008	50	42 (0.84)	21 (0.50)
2009	49	43 (0.88)	27 (0.63)
2010	42	31 (0.74)	27 (0.87)
2011	46	34 (0.74)	28 (0.82)
2012	40	32 (0.80)	27 (0.84)
2013	40	28 (0.70)	19 (0.68)
2014	36	25 (0.69)	14-25 (0.56-1.00)
2015	33	28 (0.85)	21 (0.75)
2016	31	19 (0.61)	16 (0.84)
2017	38	26 (0.68)	20 (0.77)
2018	29	19 (0.66)	13 (0.68)
2019	24	19 (0.79)	12 (0.63)
17-year avg (sd)	42.7 (9.94)	33.5 (10.16)	23.7 (8.48)

Table 4. Number of active nests for each year of monitoring with means (se) for each monitoring phase.

Year	Active nests: Phase I	Year	Active nests: Phase II
1981	11	2003	ND
1982	15	2004	18
1983	14	2005	44
1984	14	2006	40
1985	20	2007	29
1986	22	2008	21
1987	27	2009	28
1988	26	2010	27
1989	28	2011	28
1990	25	2012	27
1992	24	2013	18
1993	33	2014	19.5
1994	46	2015	21
1995	24	2016	16
1996	35	2017	20
1997	24	2018	13
1998	30	2019	12
1999	33	Mean (se)	23.7(9.1)
2000	35		
Mean (se)	25.6 (2.0)		

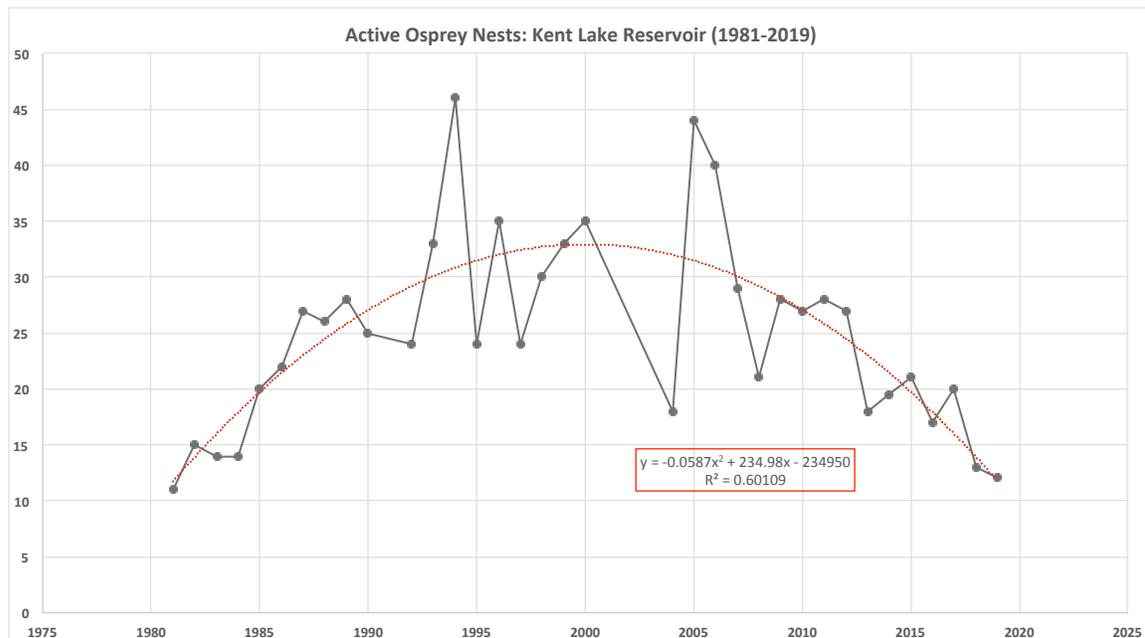


FIGURE 3. Number of active nests at Kent Lake reservoir over the course of the monitoring effort (1981-2019) fixed with a moving average and a polynomial regression line. (The years 2001-2003 are excluded due to lack of data.)

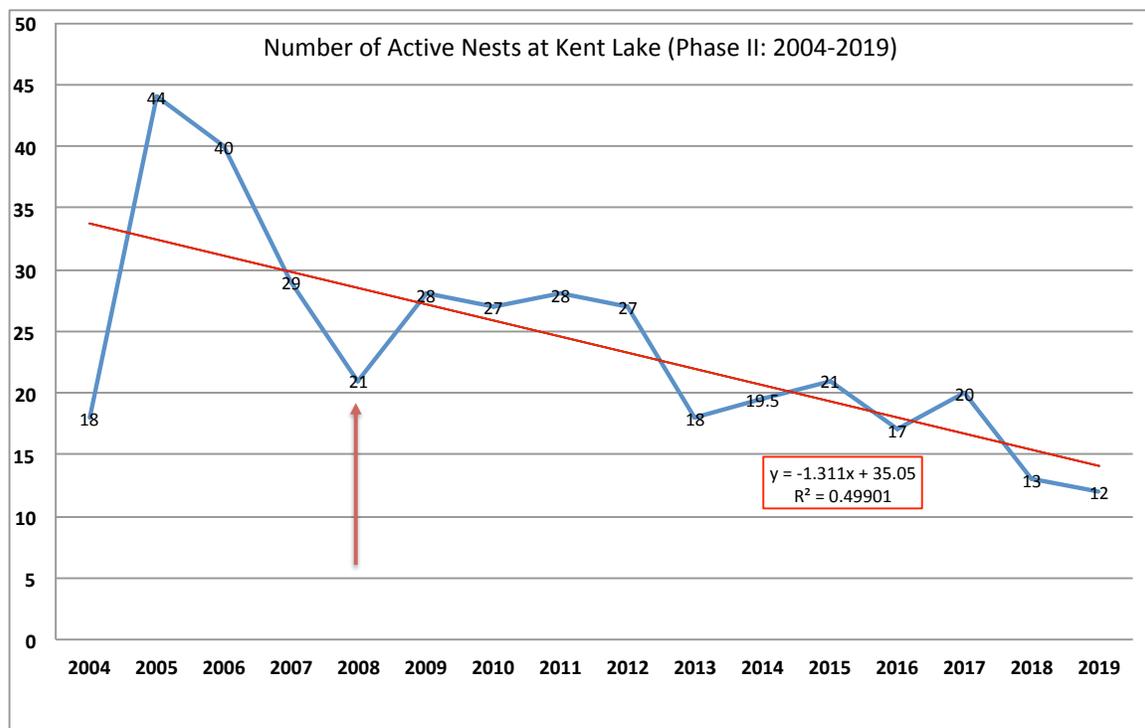


Figure 4. Number of active nest sites at Kent Lake over Phase II of monitoring (2004-2019) fit with a linear regression line. Red arrow indicates the first year of nesting by Bald Eagles.

4.0 Other species of interest.

A complete list of avian species detected during the course of the 2010-19 field seasons is attached (Appendix A.)

Purple Martin (*Progne subis*) is a *Bird Species of Special Concern* in California (Shuford and Gardali 2008) because of a non-cyclical decline of the population.¹ Cavity nesting sites appropriate for the species—and competition for those sites with other species, especially the non-native European Starling (*Sternus vulgaris*)—is a limiting factor for the colonial nesting martin in California. Kent Lake has hosted from one to four martin nest sites nearly every year of our studies. The years 2013-19 were relatively good years for martins, with a minimum of three nesting snags occupied each year. One pair was apparently using a Wood duck nest box in 2019. Martins are uncommon to rare in Marin County with Kent Lake providing one of the few reliable nesting sites. Preservation of natural martin nest sites is considered critical to the continued survival of martins in the west (WPMWG 2010).

A pair of Wood Ducks (male and female) (*Aix sponsa*) was present on both visits in 2019 suggesting possible nesting. Common Mergansers (*Mergus merganser*) continue to increase in abundance.

5.0 Summary

The 2019 monitoring effort was the 35th year that the Kent Lake Osprey population has been evaluated since the project began in 1981. In 2019, as in recent previous years, nests were more commonly located in coast redwood (89%) than in Douglas-fir (11%). In contrast to the last several years, dead trees supported slightly more nest sites than live trees (55.6% vs 44.4%).

During the 2019 season, we plotted locations of 24 nest sites, identified the species and vitality class of all nesting trees found, and classified the status of each nest as either empty, occupied, active, or unknown. Of all nests identified in 2019, (n=24) ,19 (79.2%) were occupied and 12 (50.0%) were classified as active. Overall numbers were

¹ <http://www.prbo.org/calpif/pdfs/puma.pdf>

below the decadal mean. The apparent downward trend in the number of occupied nests reported in the several earlier monitoring reports (2009-2018) was again apparent in 2019.

Bald Eagles occupied a nest site in the middle reach of the lake (#61) which held two eagle nestlings on May 31. (2019 was the twelfth consecutive season of eagle nesting at this site.) We speculate that the eagle's presence, may be one factor contributing to the apparent decline in the Kent Lake osprey population, but other factors may also be contributing. R Like Kent Lake, the Inverness Ridge population apparently had a poor reproductive year in 2019 (pers. obs.). Regionally, the San Francisco Bay population, which nests almost exclusively on man-made structures, is apparently strong and growing (Brake *et al.* 2014; Brake 2017; Brake 2019, pers. comm.).

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7.0 Acknowledgements

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U.S. Fish and Wildlife Endangered Species Permit: TE 786728-5
California Department of Fish and Game Collecting Permit # 801092-04



Appendix A.

Avian species (n=76) detected at Kent Lake during the course of osprey surveys: 2010-2019. "I" = introduced species. Special status species are designated as such: California Bird Species of Special Concern (BSSC) and/or Audubon Watch List (AWL). Asterisks indicate species that nest in the watershed. Species detected in prior years (†).

Canada Goose *	Western Scrub-Jay *
Wood Duck *	American Crow
Mallard *	Common Raven *
Common Merganser *	Purple Martin (BSSC) *
California Quail *	Tree Swallow *
Double-crested Cormorant	Violet-green Swallow *
Great Egret	Barn Swallow *
Turkey Vulture *	Chestnut-backed Chickadee *
Osprey *	Bushtit *
Bald Eagle *	Red-breasted Nuthatch *
Cooper's Hawk (BSSC)	Pygmy Nuthatch *
Sharp-shinned Hawk (BSSC)	Brown Creeper *
Red-shouldered Hawk	Pacific Wren *
Red-tailed Hawk *	Bewick's Wren *
Spotted Sandpiper	Golden-crowned Kinglet *
Eurasian Collared-Dove-I *	Wrentit (AWL) *
Band-tailed Pigeon (AWL) *	Swainson's Thrush *
Mourning Dove *	Hermit Thrush *
Anna's Hummingbird *	American Robin *
Allen's Hummingbird (BSSC, AWL) *	European Starling-I *
Belted Kingfisher *	Cedar Waxwing
Acorn Woodpecker *	Orange-crowned Warbler *
Downy Woodpecker *	Black-throated Gray Warbler *
Hairy Woodpecker *	Hermit Warbler (AWL) *
Red-breasted Sapsucker	Wilson's Warbler *
Northern Flicker *	Spotted Towhee *
Pileated Woodpecker *	California Towhee *
American Kestrel (new in 2016)*	Song Sparrow *
Merlin (new in 2015)	Dark-eyed Junco *
Olive-sided Flycatcher (BSSC, AWL) *	Western Tanager *
Western Wood-Pewee *	Black-headed Grosbeak *
Pacific-slope Flycatcher *	Brown-headed Cowbird *
Black Phoebe *	Purple Finch *
Cassin's Vireo *	House Finch *
Hutton's Vireo *	Pine Siskin *
Warbling Vireo *	Lesser Goldfinch *
Steller's Jay *	American Goldfinch *

† Additional species detected in prior years or non-survey visits: Northern Spotted Owl, Northern Pygmy-Owl, Common Poorwill, Vaux's Swift, Yellow-rumped Warbler.