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Natural Resource Stewardship and Science

Prairie and Peregrine Falcon Occupancy and Productivity Monitoring at Pinnacles National Park

2023 Annual Report

Natural Resource Report NPS/SFAN/NRR—2024/2625

ON THE COVER
Prairie falcon fledglings, Discovery Wall, Pinnacles National Park, California.
NPS / GAVIN EMMONS

Prairie and Peregrine Falcon Occupancy and Productivity Monitoring at Pinnacles National Park

2023 Annual Report

Natural Resource Report NPS/SFAN/NRR—2024/2625

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Executive Summary

Pinnacles National Park ("Pinnacles") provides diverse habitats for numerous cliff-nesting raptors, including prairie falcons (*Falco mexicanus*) and peregrine falcons (*F. peregrinus*), as well as a spectacular array of summits and cliff-wall routes for rock-climbers. This monitoring program was established to determine long-term trends in the number of occupied territories and productivity of nesting prairie and peregrine falcons. The monitoring program grew out of a need to reduce potential disturbance that climbers and off-trail hikers may have on cliff-nesting raptors. The falcon monitoring program began with a pilot effort in 1984, and after two years of no monitoring efforts in 1985 and 1986, monitoring data have been collected annually from 1987 to the present. This report summarizes the results from the 2023 breeding season and represents the 38th year of monitoring at the park, consistent with the standardized methods and procedures detailed in the Prairie Falcon Monitoring Protocol for Pinnacles National Monument (Emmons et al. 2011).

To monitor falcons, field technicians surveyed all potential nest sites three times per breeding season, with visits spaced 21 to 28 days apart. We revisited those nests determined to be active to confirm rearing of nestlings and fledging of young. In 2023, we conducted monitoring from 1 January 2023 until 9 July 2023, with a total of over 150 possible and active nest sites monitored during 870 observation hours.

For prairie and peregrine falcons combined, we documented 14 territorial pairs this year, with 12 pairs actively nesting. Six nests successfully fledged 17 young; six nests failed. For prairie falcons specifically, we documented ten territorial pairs, with three nests successfully fledging 10 young. For peregrine falcons, we documented four territorial pairs, with three nests successfully fledging 7 young. Falcon fecundity for the 2023 season was notably lower compared to the 37-year average. The data from 38 years of falcon monitoring at Pinnacles suggest an apparent cyclic population pattern in annual prairie falcon productivity, supplemented by increased peregrine falcon breeding efforts in recent years (Appendix C).

Acknowledgments

P. Johnson provided oversight and support for the 2023 falcon monitoring efforts, and J. R. Hickey—as the program manager of the San Francisco Bay Area Network (SFAN) Inventory and Monitoring (I&M) Program—was critical in keeping the Pinnacles raptor monitoring program funded annually and on a permanent basis. E. Edson also provided valuable assistance in her role as the SFAN I&M Program data manager confirming QA/QC checks and validations of data for the raptor monitoring database. J. R. Hickey, L. Grace, Kirk Sherrill, and P. Johnson also provided recommendations, reviewer suggestions, and formatting revisions for the 2023 annual report, contributing to a concise and efficient document consistent with I&M standards.

The following volunteers, interns, and staff provided invaluable raptor monitoring observations and survey efforts throughout the 2023 season: M. Baird, J. Belli, M. Gnekow, K. Lopez, I. Sein, L. Regan, K. Bright, E. Lehnert, and A. Welch.

Introduction

Pinnacles National Park ("Pinnacles") is a National Park Service (NPS) unit and was legislatively converted from a national monument to a national park in January 2013. Pinnacles provides diverse habitats for cliff-nesting raptor species, including sensitive species such as prairie falcons (*Falco mexicanus*), peregrine falcons (*F. peregrinus*), and golden eagles (*Aquila chrysaetos*). The dramatic landscapes, extensive trails, arrays of summits, and cliff-wall routes at Pinnacles are also used intensively for recreation by rock-climbers and hikers. All raptors provide an important ecosystem function as predators of smaller species. However, activities of climbers and off-trail hikers can disturb the reproductive success of cliff-nesting raptors, and prairie falcons nest in the Pinnacles cliffs at sufficiently high density to track trends in reproduction over time. Therefore, the prairie falcon is the central focus of the monitoring program (Emmons et al. 2011). Additionally, peregrine falcons also nested at Pinnacles historically, are sensitive to human disturbance, are obligate cliff-nesters, and have identical nest phenology patterns as prairie falcons. Because they directly compete with prairie falcons for nesting habitat and prey, we also documented peregrine falcon monitoring in this report. For the purposes of this report, "falcons" refers to prairie and peregrine falcons and excludes American kestrels (*Falco sparverius*) because kestrels are abundant and are not obligate cliff nesting raptors. Other raptor species in the park either nest in forested habitats or do not nest in sufficient densities within the park to warrant a similar level of monitoring effort.

Many scientific studies have documented the negative impacts of human disturbance on raptor nest and roost sites, and the resulting nest failures and territory abandonment associated with these disturbances. Nesting raptor species at Pinnacles that are sensitive to human disturbance include prairie falcons (Fyfe and Olendorff 1976; Ogden and Hornocker 1977; Harmata et al. 1978; Sitter 1983; Steenhof 1998), peregrine falcons (particularly in remote locations: see Hickey 1942, 1969; Bond 1946; Steenhof 1998), golden eagles (Newton 1979, 1990; Scott 1985; Steidl et al. 1993; Watson 1997; Steenhof et al. 1997; Kochert et al. 1999), sharp-shinned hawks (*Accipiter striatus*; Delannoy and Cruz 1988), and long-eared owls (*Asio otus*; Marks 1986; Marti and Marks 1989; Bloom 1994).

Studies of prairie and peregrine falcon nest occupancy and productivity have also shown these species to be especially sensitive to human disturbance from mining (Becker and Ball 1981; Bednarz 1984), recreation (Boyce 1982), agriculture (USDI 1979), habitat destruction and nest-site limitation (Becker and Ball 1981; Steenhof et al. 1997), and proximity to major roadways (Platt 1974; Boyce 1982).

The main sources of human disturbance of cliff-nesting falcons at Pinnacles are visitors who are rock-climbing and hiking on- and off-trail in the park. Scientific studies have consistently demonstrated that these recreational activities can be balanced against raptor nesting by establishing closures or advisory areas that act as buffers between human activity and raptor nesting during the breeding season (Fyfe and Olendorff 1976; Olsen and Olsen 1978; Becker and Ball 1981; Suter and Joness 1981; Porter et al. 1987; Holthuijzen et al. 1990; Cade et al. 1996; White et al. 2020).

Falcon monitoring data have been collected at Pinnacles for 38 years beginning with a pilot effort in 1984, and consecutively from 1987 to present. (No monitoring was conducted during 1985 and 1986 due to lack of funding.) Annual raptor monitoring data collected at Pinnacles support the establishment of climbing/hiking advisories in core areas each breeding season to help protect cliff-nesting raptor species from human disturbance. Core areas are locations at Pinnacles suitable for prairie and peregrine falcon cliff-nesting where climbing impacts could occur, based on the presence of historical climbing routes accessible to visitors. Non-core areas refer to all other areas within Pinnacles suitable for cliff-nesting. The core versus non-core sampling design is detailed further in the Methods section.

The Prairie Falcon Monitoring Protocol for Pinnacles National Monument (Emmons et al. 2011) provides standardized methods and procedures for prairie and peregrine falcon monitoring at Pinnacles and further details the program specifics. The program established two long-term monitoring objectives to:

- Track changes in the total numbers of territorial falcon pairs in core areas and non-core areas.
- Track changes in average annual productivity (hatchlings/pair, fledglings/pair) in core areas and non-core areas.

Study Area and Field Methods

Pinnacles is located in the Gabilan Mountains of the central Coast Range of California. The national park encompasses 10,694 hectares (26,425 acres) with elevation ranging from 244 to 1,007 meters (800 to 3,304 feet). The climate is Mediterranean with hot, dry summers and cool, damp winters. Temperatures range from a seasonal mean of 5.2˚C in winter to 25.2˚C in summer (41.4˚ to 77.4˚F). The average yearly rainfall is 42.3 cm (16.6 inches), with the majority of precipitation occurring from November to April (WRCC 2013).

Pinnacles provides a diverse range of habitat types for birds and other species. These habitats include volcanic rock formations and outcroppings, California mixed chaparral, pine-oak woodlands, grasslands, and riparian creek corridors.

Sample Design

Sampling of prairie and peregrine falcons is focused on both core areas and non-core areas. Each core and non-core area is a potential nesting territory, and in this context the terms “area” and “territory” can be used interchangeably. Within a given year, prairie or peregrine falcons may actively defend one or more of these areas or territories. Core areas (Figure 1) are locations in Pinnacles that can support falcon cliff nesting, and where impacts to raptors due to rock climbing activities can occur as determined from historical rock-climbing use and access patterns. Core area monitoring is conducted through a census, because the area is sufficiently small to allow for complete coverage.

Non-core areas refer to all other areas within the park that can support prairie and peregrine falcon cliff nesting. The Prairie Falcon Monitoring Protocol for Pinnacles National Monument (Emmons et al. 2011) calls for sampling non-core areas on a rotating basis. For 2003 to 2023, non-core area monitoring was conducted through a census along with core area censuses. This Park-wide censusing of core and non-core areas was possible because of comprehensive historical data on prairie and peregrine falcon nest sites gathered over the past 38 years, extensive monitoring experience of the raptor biologist, and supplemental raptor monitoring efforts by interns, volunteers, and other Pinnacles employees. In addition, GIS modeling completed in 2008 (by Stephen Skartvedt with the San Francisco Bay Area Network, unpublished) confirmed that all potential prairie and peregrine falcon nesting areas in the park have been surveyed annually during the past 20 years.

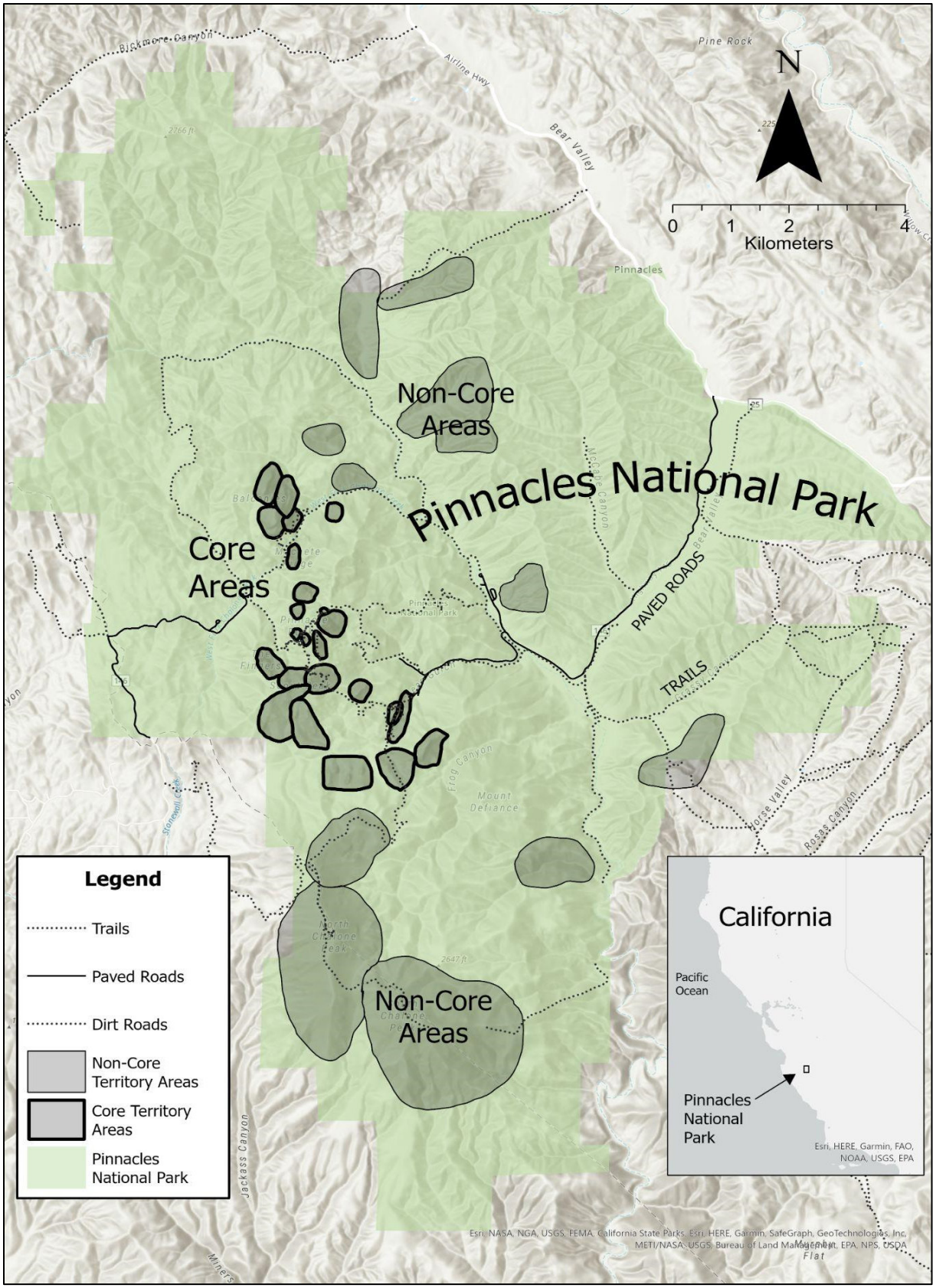

Figure 1. Core and non-core areas within and overlapping the Pinnacles National Park boundary.

Field Methods

Survey methods followed the standard operating procedures detailed in the Prairie Falcon Monitoring Protocol for Pinnacles National Monument (Emmons et al. 2011).

We surveyed potential and established prairie and peregrine falcon territories in core and non-core areas using Swarovski HD STS-80 and ATS-65 20–60x spotting scopes and Zeiss Victory FL 10×32 binoculars. We made observations from the locations that provided the best view of a given eyrie (cliff nest) or territory and adjusted those watch spots depending on where the pairs ultimately nested. We used Magellan Triton 500 and DeLorme Earthmate PN-60 GPS units to plot every observation point. We recorded field data on standardized datasheets and field notebooks, and later we entered the data into a Microsoft Access database (Appendix D).

Many researchers have recommended three- to five-hour observation periods to document territorial occupancy of peregrine falcons and prairie falcons (USFWS 1984; Cade et al. 1996; Smith and Hutchins 2006). Steenhof et al. (1999) employed two-hour observation periods during point surveys to document territory occupancy of prairie and peregrine falcons in the Snake River region of Idaho. For a potential falcon territory to be classified as unoccupied at Pinnacles, we adopted a conservative standard of visiting potential nest sites on at least three separate occasions per breeding season, with survey occasions spaced 21–28 days apart, to confirm territorial occupancy, courtship, and incubation of eggs within a breeding season (Fuller and Mosher 1981; Fraser et al. 1983; Steenhof 1998). Survey duration was ultimately dependent upon visibility, but at least three 4-hour surveys (12 hours total) were required to conclude that that no breeding falcons were present. We revisited nests determined to be active to confirm rearing of nestlings and fledging of young. We monitored nests in core areas more frequently than non-core areas and during weekend days when climbers were more likely to be present.

While other monitoring programs infer fledging success at 90% fledge age (Steenhof and Kochert 1982; Anderson and Squires 1997; Steenhof 1998), our protocol continues surveys until all young falcons are confirmed as fledged.

During the falcon breeding season, status was defined as follows:

Territories: Territorial behavior included focused, defensive, and repeated perching and flying at specific locations with cliff nesting potential or historical use, territorial disputes and defense, stooping and scold calling, and consistent and repeated sleep-roosting at specific locations with cliff nesting potential or historical use.

Courtship: Courtship behavior included copulation, food drops and swapping, and potential nest-site inspections and preparation.

Incubation: We determined incubation status by observing prairie falcons flying into a cliff cavity or hole and not re-emerging for extended periods of time. During this time, we conducted egg counts whenever possible (e.g., when lighting conditions allowed and when incubating falcons temporarily left the nest during food drops and/or nest switches). Soft incubation—the onset of incubation—was determined by a small number of eggs laid and the female incubating for short durations (15 to 75

minutes of incubation and 20 minutes or more not incubating the eggs). Hard incubation was characterized by the adult falcons—primarily the females—incubating a full clutch of eggs for hours in duration.

Nestlings: We aged hatched young prairie and peregrine falcons by physical features, based on an aging guide (Moritsch 1983). We determined hatch dates by counting backwards from at least two (preferably three or more) independent aging estimates.

Fledging: We confirmed fledging by seeing young perched and/or in flight away from the nest site. We estimated fledging dates by the coordination and strength of flight, the size of perches that falcon young of year landed on, and the amount of vocalization during flight.

Monitoring Schedule

The prairie and peregrine falcon monitoring season started on 1 January and continued through the end of the nesting season, ending on 10 July (Table 1).

Table 1. Timing of nesting behavior of prairie falcons at Pinnacles National Park. "X" indicates behavior was observed (also shown in gray).

Behavior	January	February	March	April	May	June	July
Territorial Falcons	X	–	–	–	–	–	–
Courtship Behavior	X	X	X	–	–	–	–
Nesting	–	–	–	X	X	–	–
Fledging	–	–	–	–	–	X	X

Weather was always an important factor. During temperature extremes, heavy fog, or rain, most birds of prey were generally inactive and therefore monitoring was not done during these periods.

Data Management

We entered the data into a Microsoft (MS) Access database designed by the network data manager for the San Francisco Bay Area Network Inventory and Monitoring Program and we implemented quality assurance and control procedures as described in the Data Management standard operating procedures (SOP) of the Pinnacles Falcon Monitoring Protocol (Emmons et al. 2011). We archived original data sheets with Pinnacles Resource Management, and as backup, we archived a static copy of the Access database on the Golden Gate National Recreation server and the NPS Data Store (see reference https://irma.nps.gov/DataStore/Reference/Profile/2302033). To share data more broadly, we submitted nest data to the California Department of Fish and Wildlife (previously California Department of Fish and Game) California Natural Diversity Database.

We derived the tabular data in the Results section of this report from queries to the Breeding Raptors and Raptor Observations tables in the MS Access database.

Climbing Advisories

Climbing advisories went into effect by mid-January. Park staff installed informational signs near territories that had been occupied by prairie and peregrine falcons at least once during the preceding three years. Park staff advised visitors to avoid these areas and that compliance was voluntary. Advisory areas with posted signs (Figure 2) included the Balconies, Hawkins, Scout Peak, and Little Pinnacles territories.

Figure 2. Setting up advisory sign (NPS/GAVIN EMMONS, 2014).

Results

During the 2023 field season, Pinnacles staff spent 450 hours in the field surveying for prairie and peregrine falcons, and volunteers contributed 420 hours of time. We detail results specifically for prairie falcon monitoring below, whereas Appendixes A and B detail the results for peregrine falcon monitoring and tabular data for combined prairie and peregrine falcon productivity. Our 37-year means refer to annual monitoring efforts in 1984 and in 1987–2022, with 1985 and 1986 excluded due to lack of any monitoring efforts during those two years.

Prairie Falcons

Eight prairie falcon pairs nested this year, and three nesting pairs successfully produced 17 nestlings and 10 fledglings, compared to our 37-year means (SD) of 9.6 (2.2) nesting pairs, 27.9 (9.4) total nestlings, 7.4 (2.4) successful nests, and 25.9 (9.0) fledglings (Table 2).

Table 2. 2016 to 2023 Pinnacles prairie falcon nesting productivity—core and non-core areas combined.

Year	Territorial Pairs	Nesting Pairs	Successful Nests	# Total Nestlings	# Total Fledglings	# Fledglings / Nest Mean (SD)
2016	11	6	5	19	19	3.8 (0.8)
2017	10	9	4	27	15	3.8 (0.5)
2018	10	10	6	26	22	3.7 (1.0)
2019	11	7	5	15	15	3.0 (1.2)
2020	9	7	4	18	14	3.5 (0.6)
2021	9	9	8	31	31	3.9 (1.0)
2022	9	9	9	32	32	3.6 (1.2)
2023	10	8	3	17	10	3.3 (1.5)
Mean (SD) Total (1984 to 2022)*	11.5 (0.7)	9.6 (2.2)	7.4 (2.4)	27.9 (9.4)	25.9 (9.0)	3.4 (0.8)

* Mean total for 1984 to 2022 excludes the two years, 1985 and 1986, where monitoring was not conducted.

Occupied Territories

Through the 2023 season, we confirmed ten territorial pairs of prairie falcons over the course of the breeding season. While this number is lower than our mean (SD) territorial occupancy of 11.5 (0.7) pairs (1984 to 2022; Table 2), statistical analyses have yet to be completed to determine if the difference is significant. Of the ten territorial pairs, eight (80%) nested this year.

Core Areas: In 2023, there were six territorial prairie falcon pairs within the core areas, which is lower than our mean (SD) of 7.0 (1.5) territorial falcon pairs in the core areas over the previous 37 years.

Non-Core Areas: In 2023, we confirmed four territorial prairie falcon pairs within the non-core areas, which is comparable to our mean (SD) of 4.5 (1.5) territorial falcon pairs in the non-core areas over the last 37 years.

Prairie falcon fledgling at South Balconies (NPS/GAVIN EMMONS, 2009).

Annual Productivity

Eight prairie falcon pairs nested during the 2023 season. Three nesting pairs successfully fledged a total of 10 young (Tables 2, 3). Five nests failed during egg incubation or nestling development. The total number of nesting falcon pairs, successful nests, and total fledgling production within core and non-core areas this season were lower than their 37-year averages (Table 2, Figure 3). Statistical analyses have yet to be completed to determine if these differences are significant.

Table 3. 2023 Pinnacles prairie falcon breeding summary.

Territory	Nest Used/ Last Year Used	# Eggs Laid	# Young Hatched	# Young Fledged
Crowley Towers*	CT-4/ 2020	5	5	5/5
Crowley Towers*	CT-10/ NEW	3	0	0/0
Teapot Dome*	TD-3/ 2016	5	4	0/0
South Chalone	SC-14/ 2021	3	0	0/0
North Chalone	NC-1/ 2021	2	2	2/2
Prescribed Burn Cliffs*	PB-3/ 2021	3	3	3/3
Resurrection Wall*	RW-2/ 2021	Unk	0	0/0
Willow Spring Slide	WSS-2/ 2022	4	0	0/0

* Nests within the core areas.

Note: Unk = Unknown, could not get accurate egg count before nest failed.

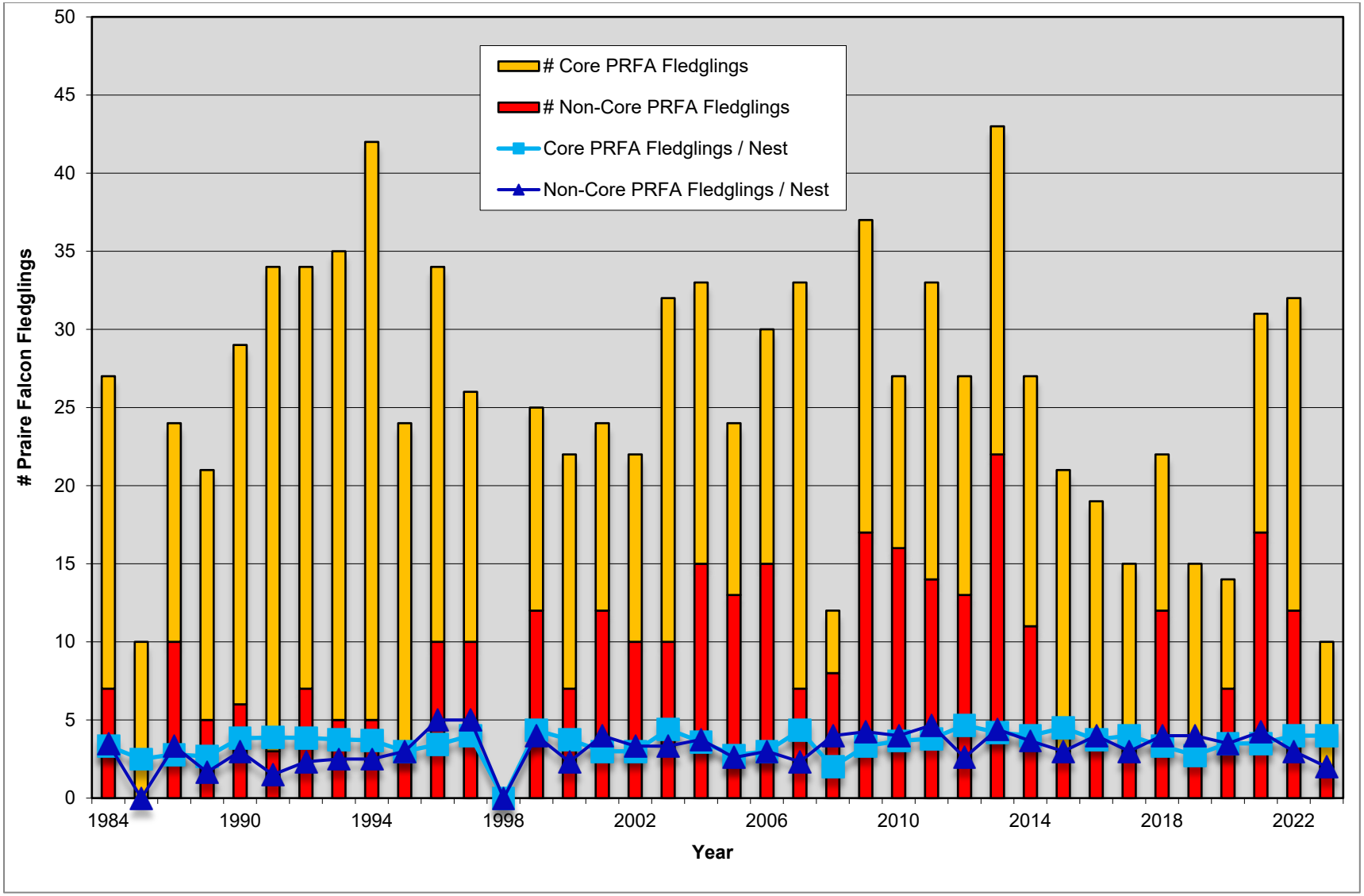

Figure 3. Core vs. non-core prairie falcon (PRFA) fledgling productivity at Pinnacles from 1984 to 2023. Data for 1998 reflects total nest failure and no successful fledging of young due to extreme flooding throughout Park. No monitoring conducted in 1985 and 1986.

Core Areas: Of the six territorial prairie falcon pairs in the core areas in 2023, five attempted nesting and two nested successfully, producing 8 total fledglings and a mean (SD) of 4.0 (1.4) fledglings per nest (Table 4). Productivity was lower than the 37-year (1984 to 2022) mean (SD) of 4.7 (1.9) successful nests per season and 16.8 (7.5) total fledglings, although it is important to note that statistical analyses have yet to be completed to determine if these results are significant. See Appendix A for additional historical data.

Table 4. 2016 to 2023 Pinnacles prairie falcon nesting productivity—core areas only—and historical average.

Year	Territorial Pairs	Nesting Pairs	Successful Nests	# Total Nestlings	# Total Fledglings	# Fledglings / Nest Mean (SD)
2016	7	4	4	15	15	3.8 (1.0)
2017	6	6	3	22	12	4.0 (0)
2018	7	7	3	14	10	3.3 (1.2)
2019	7	5	4	11	11	2.8 (1.3)
2020	6	4	2	11	7	3.5 (0.7)
2021	5	5	4	14	14	3.5 (1.3)
2022	5	5	5	20	20	4.0 (0.7)
2023	6	5	2	8	8	4.0 (1.4)
Mean (SD) Total (1984 to 2022)*	7.0 (1.5)	6.0 (1.6)	4.7 (1.9)	18.0 (7.8)	16.8 (7.5)	3.5 (0.8)

* Mean total for 1984 to 2022 excludes the two years, 1985 and 1986, where monitoring was not conducted.

Non-Core Areas: Of the four territorial prairie falcon pairs in the non-core areas in 2023, three attempted nesting and one nested successfully, producing two total fledglings and a mean (SD) of 2.0 (0) fledglings per nest (Table 5). While these numbers were lower than our 1984 to 2022 means (SD) of 3.6 (1.5) nesting pairs, 2.7 (1.3) successful nests per season, and 9.1 (5.1) total fledglings, and 3.2 (1.1) fledglings per nest, statistical analyses have yet to be completed to determine if these differences are significant. See Appendix A for additional historical data.

Table 5. 2016 to 2023 Pinnacles prairie falcon nesting productivity—non-core areas only—and historical average.

Year	Territorial Pairs	Nesting Pairs	Successful Nests	# Total Nestlings	# Total Fledglings	# Fledglings / Nest Mean (SD)
2016	4	2	1	4	4	4.0 (0)
2017	4	3	1	5	3	3.0 (0)
2018	3	3	3	12	12	4.0 (1.0)
2019	4	2	1	4	4	4.0 (0)
2020	3	3	2	7	7	3.5 (0.7)
2021	4	4	4	17	17	4.3 (0.5)
2022	4	4	4	12	12	3.0 (1.6)
2023	4	3	1	2	2	2.0 (0)
Mean (SD) Total (1984 to 2022)*	4.5 (1.5)	3.6 (1.5)	2.7 (1.3)	9.8 (5.3)	9.1 (5.1)	3.2 (1.1)

* Mean total for 1984 to 2022 excludes the two years, 1985 and 1986, where monitoring was not conducted.

Phenology

We observed the first prairie falcon pair at Teapot Dome / Egg on 1 January 2023 (Appendix B). Incubation was first observed at Resurrection Wall on 30 March. The first hatching occurred between 28 April and 2 May at North Chalone Peak, and the first fledging occurred between 10 June and 11 June at North Chalone Peak. The last fledging occurred at Crowley Towers between 12 June and 15 June.

Other Notes

Of the eight eyries chosen in 2023, prairie falcons had previously used seven. Two prairie falcon pairs nested at the Crowley Towers formation – on the east face (at the CT-4 nest) and on the south face (at the CT-10 nest). The CT-10 nest was previously undocumented; however, all prairie falcon eyries were within historically documented territories. Five nesting attempts failed this year during egg incubation (three nests) and during rearing of nestlings (two nests).

Discussion

Prairie falcon productivity rates for the 2023 season were markedly lower than the 37-year averages of the Pinnacles raptor monitoring program. However, these differences must be statistically analyzed to determine if they are significant, particularly given an apparent cyclic pattern in falcon productivity in prior years (Figure 3). In 2023, we documented eight prairie falcon pairs attempting to nest and three nests successfully produced 10 fledglings. For comparison, our 37-year means (SD) were 9.6 (2.2) nesting pairs, 7.4 (2.4) successful nests, and 25.9 (9.0) fledglings per year (Table 2). Reproductive rates for core-area counts of total successful nests, nestlings, and fledglings in 2023 were lower than the 37-year averages (Table 4). Similarly, counts in non-core areas of total successful nests, nestlings, and fledglings were also lower in 2023 than their historical averages (Table 5). When combined, counts of total successful prairie and peregrine falcon nests, nestlings, and fledglings were still lower than long-term averages (Appendix C).

Setting aside total nesting failure in 1998 (due to parkwide flooding in the middle of the nesting season), prairie falcon productivity was lower in 2023 than in any year since 1987. Multiple factors may have contributed to low prairie falcon productivity in 2023. For example, we suspect that the timing of precipitation events in the past winter—with heavy rain and flood events in December 2022—contributed to heavy growth of grassy cover in 2023. The increased grass and associated ground cover may have provided more shelter to primary prey species like California ground squirrels (*Otospermophilus beecheyi*), thereby making them more difficult to capture. If timing of precipitation increased grassy cover in this manner, falcon pairs may have hunted less efficiently throughout the nesting season resulting in the observed low productivity. Conversely, we documented low precipitation timing and events in December 2020 and late rain events in March 2021, and similar precipitation timing and events in December 2021 and March 2022. We documented higher falcon productivity in 2021 and 2022 than in any previous year since 2013 (Emmons 2022 and Emmons 2023), possibly related to reduced vegetation growth and cover (and more exposed conditions for prey species) resulting in more hunting efficiency and success for prairie falcons during the breeding seasons.

Statistical analyses will be completed to determine if occupancy trends and annual differences in productivity rates are significant and those results will be presented in future documents.

Conclusions, Management Implications and Recommendations

Prairie Falcons: Climbing / Hiking Advisories

In January, we instituted advisories directed at park visitors to avoid rock-climbing and other activities in active falcon territories with historical climber usage. We posted signs detailing climbing / hiking advisories for Little Pinnacles, Balconies, Hawkins, Scout Peak, Crowley Towers, and Goat Rock / Resurrection Wall territories. In March and April, park staff updated advisories and lifted them in territories that were confirmed as unoccupied by prairie and peregrine falcon pairs.

We instituted a partial advisory at Balconies after confirming a prairie falcon nest site at South Balconies and a peregrine falcon nest site at General Balconies. The park opened North Balconies to climber use after the Balconies falcon pairs shifted nesting efforts to the General and South Balconies nest sites.

To prevent theft, park staff affixed all regular advisory signs to metal brackets and cement foundations. For historic perspective of sign tampering, the General Balconies advisory sign was vandalized and replaced in 2014 but was not visibly altered from 2015 to 2023. However, the Little Pinnacles advisory sign showed minor signs of vandalism in 2016 and 2017. No additional signs were disturbed or stolen.

In 2023, we documented two incidents of climbers in advisory areas, although the falcon biologists did not observe territorial defense behavior by prairie or peregrine falcons during those incidents.

Human-Falcon Interactions and Nest Failures

Falcon adults in the Hawkins Peak, General Balconies, Crowley Towers, Egg, North Chalone Peak, South Chalone Peak, Drywall, and Willow Spring Slide territories responded to the presence of on-trail hikers and raptor biologists with agitated behavior by circling and wailing above their respective territories.

Educational Opportunities

Throughout the year, the raptor biologist and park staff participated in public-outreach opportunities to inform visitors about raptor conservation. Educational opportunities included two scheduled presentations for staff at the East Side Search and Rescue Cache, as well as informal events (e.g., visitor contacts in high-use areas such as High Peaks, Balconies Cliff Trail, and Bear Gulch Reservoir). Refer to Appendix E for further information on public interest highlights for the 2023 season.

Management Recommendations

- Continue to establish climbing/hiking advisories in core areas (high visitor-use areas) each breeding season to help reduce human disturbance of cliff-nesting raptor species.
- Increase opportunities for visitor-use assistants and park rangers to educate park visitors about climbing / hiking advisories. Prior to 2004, park rangers and interpreters spoke with climbers and hikers at trailheads and regularly roved on trails to provide interpretation and

protection of resources. In 2016 interpretation rangers renewed "climber coffee" outreach efforts at east side park trailheads and the East Side Nature Center, but these efforts have been sporadic in subsequent years due to staff turnover, loss of staff capacity, and greater prioritization on parking cars as opposed to visitor outreach and communication. More on-trail roving opportunities should be explored. Renewing this strategy of interfacing with visitors on trails may help to increase compliance with climbing advisories, as annual visitation increases at the park.

- Enforce advisories with law enforcement rangers. Although advisories are voluntary, disturbing wildlife is a citable offense as noted in text on advisory signs, on the official park website, and on park interpretive displays and trailhead bulletin boards. Law enforcement rangers should continue to enforce this regulation to discourage visitors from willfully threatening nesting efforts of breeding raptors at Pinnacles.
- Continue use of staff and visitors to observe raptor activity in the field. Such raptor surveillance can be achieved through regular communication with NPS staff and visitors, continued use of monthly monitoring updates on raptor status at the park, and reminders about filling out wildlife-observation cards.
- Install remote video-surveillance equipment to monitor falcon nest sites on a continuous basis to help determine causes of nest failures.

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Appendix A. 1984 to 2023 Nest Productivity for Prairie Falcons

Table APP A.1. 1984 to 2023 Pinnacles prairie falcon nesting productivity—core and non-core areas combined.

Year	Territorial Pairs	Nesting Pairs	Successful Nests	# Total Nestlings	# Total Fledglings	# Fledglings / Nest Mean (SD)
1984	10	9	8	30	27	3.4 (0.9)
1987	6	4	4	13	10	2.5 (1.7)
1988	12	9	8	24	24	3.0 (1.2)
1989	12	11	9	24	21	2.3 (1.1)
1990	14	10	8	31	29	3.6 (0.9)
1991	14	11	10	34	34	3.4 (1.3)
1992	13	11	10	38	34	3.4 (1.5)
1993	13	12	10	39	35	3.5 (1.1)
1994	13	13	12	45	42	3.5 (1.1)
1995	13	11	8	24	24	3.0 (0.5)
1996	12	10	9	35	34	3.8 (1.0)
1997	12	8	6	26	26	4.3 (0.8)
1998	10	7	0	0	0	0 (0)
1999	10	8	6	25	25	4.2 (0.8)
2000	8	8	7	22	22	3.1 (1.2)
2001	10	10	7	24	24	3.4 (1.1)
2002	11	9	7	26	22	3.1 (1.1)
2003	12	9	8	33	32	4.0 (1.1)
2004	12	11	9	36	33	3.7 (1.4)
2005	13	10	9	29	24	2.7 (1.1)
2006	15	14	10	35	30	3.0 (0.8)
2007	14	12	9	35	33	3.7 (1.3)
2008	12	5	4	12	12	3.0 (1.2)
2009	12	11	10	41	37	3.7 (1.4)
2010	13	11	7	27	27	3.9 (0.7)

* Mean total for 1984 to 2022 excludes the two years, 1985 and 1986, where monitoring was not conducted.

Table APP A.1 (continued). 1984 to 2023 Pinnacles prairie falcon nesting productivity—core and non-core areas combined.

Year	Territorial Pairs	Nesting Pairs	Successful Nests	# Total Nestlings	# Total Fledglings	# Fledglings / Nest Mean (SD)
2011	13	12	8	33	33	4.1 (0.6)
2012	12	11	8	28	27	3.4 (1.2)
2013	12	11	10	47	43	4.3 (0.8)
2014	12	10	7	30	27	3.9 (1.2)
2015	11	8	5	21	21	4.2 (0.8)
2016	11	6	5	19	19	3.8 (0.8)
2017	10	9	4	27	15	3.8 (0.5)
2018	10	10	6	26	22	3.7 (1.0)
2019	11	7	5	15	15	3.0 (1.2)
2020	9	7	4	18	14	3.5 (0.6)
2021	9	9	8	31	31	3.9 (1.0)
2022	9	9	9	32	32	3.6 (1.2)
2023	10	8	3	17	10	3.3 (1.5)
Mean (SD) Total (1984 to 2022)*	11.5 (0.7)	9.6 (2.2)	7.4 (2.4)	27.9 (9.4)	25.9 (9.0)	3.4 (0.8)

* Mean total for 1984 to 2022 excludes the two years, 1985 and 1986, where monitoring was not conducted.

Table APP A.2. 1984 to 2023 Pinnacles prairie falcon nesting productivity—core areas only.

Year	Territorial Pairs	Nesting Pairs	Successful Nests	# Total Nestlings	# Total Fledglings	# Fledglings / Nest Mean (SD)
1984	7	6	6	22	20	3.3 (1.0)
1987	5	4	4	13	10	2.5 (1.7)
1988	8	6	5	14	14	2.8 (1.3)
1989	8	8	6	16	16	2.7 (1.2)
1990	9	7	6	23	23	3.8 (1.0)
1991	9	8	8	31	31	3.9 (0.8)
1992	9	7	7	29	27	3.9 (1.3)
1993	10	9	8	34	30	3.8 (0.7)
1994	10	10	10	38	37	3.7 (1.0)
1995	10	9	7	21	21	3.0 (0.6)
1996	9	8	7	28	24	3.4 (0.7)
1997	8	6	4	16	16	4.0 (0.8)
1998	7	5	0	0	0	0 (0)
1999	6	5	3	13	13	4.3 (0.6)
2000	5	5	4	15	15	3.8 (1.0)
2001	7	6	4	12	12	3.0 (1.2)
2002	5	5	4	12	12	3.0 (1.2)
2003	5	5	5	22	22	4.4 (0.9)
2004	7	7	5	21	18	3.6 (1.9)
2005	6	5	4	12	11	2.8 (1.3)
2006	7	6	5	17	15	3.0 (0.7)
2007	6	6	6	26	26	4.3 (0.5)
2008	7	3	2	4	4	2.0 (0)
2009	7	7	6	24	20	3.3 (1.6)
2010	8	6	3	11	11	3.7 (0.6)
2011	8	7	5	19	19	3.8 (0.4)
2012	7	6	3	14	14	4.7 (0.6)
2013	6	6	5	25	21	4.2 (0.8)
2014	6	4	4	16	16	4.0 (1.4)

* Mean total for 1984 to 2022 excludes the two years, 1985 and 1986, where monitoring was not conducted.

Table APP A.2 (continued). 1984 to 2023 Pinnacles prairie falcon nesting productivity—core areas only.

Year	Territorial Pairs	Nesting Pairs	Successful Nests	# Total Nestlings	# Total Fledglings	# Fledglings / Nest Mean (SD)
2015	6	4	4	18	18	4.5 (0.6)
2016	7	4	4	15	15	3.8 (1.0)
2017	6	6	3	22	12	4.0 (0)
2018	7	7	3	14	10	3.3 (1.2)
2019	7	5	4	11	11	2.8 (1.3)
2020	6	4	2	11	7	3.5 (0.7)
2021	5	5	4	14	14	3.5 (1.3)
2022	5	5	5	20	20	4.0 (0.7)
2023	6	5	2	8	8	4.0 (1.4)
Mean (SD) Total (1984 to 2022)*	7.0 (1.5)	6.0 (1.6)	4.7 (1.9)	18.0 (7.8)	16.8 (7.5)	3.5 (0.8)

* Mean total for 1984 to 2022 excludes the two years, 1985 and 1986, where monitoring was not conducted.

Table APP A.3. 1984 to 2023 Pinnacles prairie falcon nesting productivity—non-core areas only.

Year	Territorial Pairs	Nesting Pairs	Successful Nests	# Total Nestlings	# Total Fledglings	# Fledglings / Nest Mean (SD)
1984	3	3	2	8	7	3.5 (0.7)
1987	1	0	0	0	0	0 (0)
1988	4	3	3	10	10	3.3 (1.2)
1989	4	3	3	8	5	1.7 (0.6)
1990	5	3	2	8	6	3.0 (0)
1991	5	3	2	3	3	1.5 (0.7)
1992	4	4	3	9	7	2.3 (1.5)
1993	3	3	2	5	5	2.5 (2.1)
1994	3	3	2	7	5	2.5 (2.1)
1995	3	2	1	3	3	3.0 (0)
1996	3	2	2	7	10	5.0 (2.1)
1997	4	2	2	10	10	5.0 (0)
1998	3	2	0	0	0	0 (0)
1999	4	3	3	12	12	4.0 (1.0)
2000	3	3	3	7	7	2.3 (1.2)
2001	3	4	3	12	12	4.0 (1.0)
2002	6	4	3	14	10	3.3 (1.2)
2003	7	4	3	11	10	3.3 (1.2)
2004	5	4	4	15	15	3.8 (0.5)
2005	7	5	5	17	13	2.6 (1.1)
2006	8	8	5	18	15	3.0 (1.0)
2007	8	6	3	9	7	2.3 (1.5)
2008	5	2	2	8	8	4.0 (0)
2009	5	4	4	17	17	4.3 (1.0)
2010	5	5	4	16	16	4.0 (0.8)
2011	5	5	3	14	14	4.7 (0.6)
2012	5	5	5	14	13	2.6 (0.8)
2013	6	5	5	22	22	4.4 (0.9)
2014	6	6	3	14	11	3.7 (0.7)

* Mean total for 1984 to 2022 excludes the two years, 1985 and 1986, where monitoring was not conducted.

Table APP A.3 (continued). 1984 to 2023 Pinnacles prairie falcon nesting productivity—non-core areas only.

Year	Territorial Pairs	Nesting Pairs	Successful Nests	# Total Nestlings	# Total Fledglings	# Fledglings / Nest Mean (SD)
2015	5	4	1	3	3	3.0 (0)
2016	4	2	1	4	4	4.0 (0)
2017	4	3	1	5	3	3.0 (0)
2018	3	3	3	12	12	4.0 (1.0)
2019	4	2	1	4	4	4.0 (0)
2020	3	3	2	7	7	3.5 (0.7)
2021	4	4	4	17	17	4.3 (0.5)
2022	4	4	4	12	12	3.0 (1.6)
2023	4	3	1	2	2	2.0 (0)
Mean (SD) Total (1984 to 2022)*	4.5 (1.5)	3.6 (1.5)	2.7 (1.3)	9.8 (5.3)	9.1 (5.1)	3.2 (1.1)

* Mean total for 1984 to 2022 excludes the two years, 1985 and 1986, where monitoring was not conducted.

Appendix B. 2023 Nest Phenology and Success for Prairie and Peregrine Falcons

Table APP B.1. 2023 Pinnacles nest phenology and success for prairie falcons (PRFA) and peregrine falcons (PEFA).

Nest Species	Territory Occupied	Nest Code	Arrival Date	Begin Incub	Hatch Date	Fledge Date	Abandon Date	Failed Date	# of Eggs	# of Nestlings	Known Fledglings	Possible Fledglings	Occup. Status
PRFA	Ball Pinnacle	*TD-3	<1/1	–	–	–	–	–	–	–	–	–	Occupied
PRFA	Cyn N of Willow Spgs	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	Central High Peaks	*TD-3	<1/1	–	–	–	–	–	–	–	–	–	Occupied
PRFA	Citadel	–	<1/12	–	–	–	–	–	–	–	–	–	Occupied
PRFA	Crowley Towers	CT-4	<1/12	<4/13	5/1–3	6/12–15	–	–	–	5	5	5	5
PRFA	Crowley Towers	CT-10	<1/6	<5/26	5/26–28	–	–	<6/12	–	3	0	0	Failed
PRFA	D. Soto Canyon	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	Deserted Valley	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	Discovery Wall	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	Drywall	–	<1/23	–	–	–	–	–	–	–	–	–	Occupied
PRFA	Egg	*TD-3	<1/1	–	–	–	–	–	–	–	–	–	Occupied
PRFA	Frog Canyon	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	Frog / Hand	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	General Balconies	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	Goat Rock	*RW-2	<1/30	–	–	–	–	–	–	–	–	–	Occupied
PRFA	Guard Rock	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	Hanging Valley	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	Hawkins	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	High Pks W of CPA	–	–	–	–	–	–	–	–	–	–	–	Not Occ.

Note: for the “Occup. Status” column, numbers refer to possible fledglings, “Occupied” = territorial occupation, “Not Occ.” = no occupation, “Failed” = failed nest. For the “Nest Code” column, * refers to territorial links for raptor pairs occupying more than 1 territory.

Table APP B.1 (continued). 2023 Pinnacles nest phenology and success for prairie falcons (PRFA) and peregrine falcons (PEFA).

Nest Species	Territory Occupied	Nest Code	Arrival Date	Begin Incub	Hatch Date	Fledge Date	Abandon Date	Failed Date	# of Eggs	# of Nestlings	Known Fledglings	Possible Fledglings	Occup. Status
PRFA	Little Pinnacles	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	Machete	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	Marion Canyon	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	Mating Rocks	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	Narrows	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	NE Sec 15	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	Neglected Valley	*PB-3	<1/25	–	–	–	–	–	–	–	–	–	Occupied
PRFA	North Balconies	*CT-4	<1/12	–	–	–	–	–	–	–	–	–	Occupied
PRFA	North Chalone	NC-1	<1/19	<4/6	4/28–5/2	6/10–11	–	–	3	2	2	2	2
PRFA	North Wilderness Rock	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	Pig Canyon	–	1/6	–	–	–	–	–	–	–	–	–	Occupied
PRFA	Pipsqueak Pinnacles	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	Prescribed Burn Cliffs	PB-3	<1/25	<3/31	4/30–5/2	6/11–13	–	–	–	3	3	3	3
PRFA	Resurrection Wall	RW-2	<1/30	<3/30	–	–	–	<5/9	–	–	–	–	Failed
PRFA	Scout Peak	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	South Balconies	*CT-10	<1/6	–	–	–	–	–	–	–	–	–	Occupied
PRFA	South Chalone	SC-14	<2/16	<4/12	–	–	–	<5/21	–	–	–	–	Failed
PRFA	S. Wilderness Rock	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	Teapot Dome	TD-3	<1/1	<4/10	4/30–5/4	–	–	<5/25	5	4	0	0	Failed
PRFA	Tugboat	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	Tunnel	–	–	–	–	–	–	–	–	–	–	–	Not Occ.

Note: for the “Occup. Status” column, numbers refer to possible fledglings, “Occupied” = territorial occupation, “Not Occ.” = no occupation, “Failed” = failed nest. For the “Nest Code” column, * refers to territorial links for raptor pairs occupying more than 1 territory.

Table APP B.1 (continued). 2023 Pinnacles nest phenology and success for prairie falcons (PRFA) and peregrine falcons (PEFA).

Nest Species	Territory Occupied	Nest Code	Arrival Date	Begin Incub	Hatch Date	Fledge Date	Abandon Date	Failed Date	# of Eggs	# of Nestlings	Known Fledglings	Possible Fledglings	Occup. Status
PRFA	Upper Bear Gulch	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	Upper Condor Gulch	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	Western Front	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PRFA	Willow Spring Slide	WSS-2	<1/12	<5/10	–	–	–	<5/10	4	0	0	0	Failed
PEFA	Hawkins Peak	HP-1	<1/12	<3/23	4/24–26	6/5–7	–	–	3	3	3	3	3
PEFA	Pig Canyon	–	–	–	–	–	–	–	–	–	–	–	Not Occ.
PEFA	Upper Condor Gulch	*HP-1	<1/12	–	–	–	–	–	–	–	–	–	Occupied
PEFA	Lower Condor Gulch	*HP-1	<1/12	–	–	–	–	–	–	–	–	–	Occupied
PEFA	Central High Peaks	*HP-1	<1/12	–	–	–	–	–	–	–	–	–	Occupied
PEFA	Goat Rock	*HP-1	<1/12	–	–	–	–	–	–	–	–	–	Occupied
PEFA	Resurrection Wall	*HP-1	<1/12	–	–	–	–	–	–	–	–	–	Occupied
PEFA	General Balconies	SGB-6	<1/6	<4/10	–	–	–	<5/11	–	–	–	–	Failed
PEFA	Machete	*SGB-6	<1/6	–	–	–	–	–	–	–	–	–	Occupied
PEFA	South Balconies	*SGB-6	<1/6	–	–	–	–	–	–	–	–	–	Occupied
PEFA	North Chalone	–	<5/30	–	–	–	–	–	–	–	–	–	Occupied
PEFA	South Chalone	SC-11	<2/16	<4/12	4/18–20	5/20–21	–	–	–	1	1	1	1
PEFA	Frog / Hand	*LP-1	<1/3	–	–	–	–	–	–	–	–	–	Occupied
PEFA	Little Pinnacles	LP-1	<1/3	<4/1	5/6–9	6/15–18	–	–	–	3	3	3	3
PEFA	Hanging Valley	*LP-1	<1/3	–	–	–	–	–	–	–	–	–	Occupied
PEFA	Willow Spring Slide	–	–	–	–	–	–	–	–	–	–	–	Not Occ.

Note: for the “Occup. Status” column, numbers refer to possible fledglings, “Occupied” = territorial occupation, “Not Occ.” = no occupation, “Failed” = failed nest. For the “Nest Code” column, * refers to territorial links for raptor pairs occupying more than 1 territory.

Appendix C. 2023 Results and Discussion for Peregrine Falcon Occupancy and Productivity

Results: Peregrine Falcons

Four peregrine falcon pairs occupied territories and nested at Pinnacles in 2023—at Little Pinnacles, Hawkins Peak, South Balconies, and South Chalone Peak (Table APP C.1). This marked the 19th consecutive year that at least one peregrine falcon pair has nested at Pinnacles. Prior to 2004, peregrine falcon occupancy or nesting had not been confirmed at Pinnacles for 49 years. Three of the nesting pairs successfully hatched and fledged a combined seven young (Figure APP C.1), compared to our 18-year (since 2005) means (SD) of 1.9 (1.2) nesting pairs, 1.7 (1.1) successful nests, 4.7 (3.4) nestlings, and 4.6 (3.4) fledglings (Table APP C.2). The fourth nesting pair failed in their nesting attempt during the egg incubation period.

Table APP C.1. 2023 Pinnacles peregrine falcon breeding summary.

Territory	Nest Used/ Last Year Used	# Eggs Laid	# Young Hatched	# Young Fledged
Hawkins Peak *	HP-1/ 2022	3	3	3/3
Little Pinnacles *	LP-1/ NEW	3	3	3/3
South Balconies *	SGB-6/ 2021	–	0	0/0
South Chalone Peak	SC-11/ 2022	1	1	1/1

* Nests within the core areas.

Figure APP C.1. Peregrine falcon fledgling at Hawkins Peak (NPS/GAVIN EMMONS, 2012).

Table APP C.2. 1984 to 2023 Pinnacles peregrine falcon nesting productivity—core and non-core areas combined.

Year	Territorial Pairs	Nesting Pairs	Successful Nests	# Total Nestlings	# Total Fledglings	# Fledglings / Nest Mean (SD)
1984	0	0	0	0	0	0 (0)
1987	0	0	0	0	0	0 (0)
1988	0	0	0	0	0	0 (0)
1989	0	0	0	0	0	0 (0)
1990	0	0	0	0	0	0 (0)
1991	0	0	0	0	0	0 (0)
1992	0	0	0	0	0	0 (0)
1993	0	0	0	0	0	0 (0)
1994	0	0	0	0	0	0 (0)
1995	0	0	0	0	0	0 (0)
1996	0	0	0	0	0	0 (0)
1997	0	0	0	0	0	0 (0)
1998	0	0	0	0	0	0 (0)
1999	0	0	0	0	0	0 (0)
2000	0	0	0	0	0	0 (0)
2001	0	0	0	0	0	0 (0)
2002	0	0	0	0	0	0 (0)
2003	0	0	0	0	0	0 (0)
2004	1	0	0	0	0	0 (0)
2005	1	1	1	3	3	3.0 (0)
2006	1	1	1	3	3	3.0 (0)
2007	1	1	1	3	3	3.0 (0)
2008	1	1	1	3	3	3.0 (0)
2009	1	1	1	3	3	3.0 (0)
2010	1	1	1	1	1	1.0 (0)
2011	1	1	0	0	0	0 (0)
2012	1	1	1	4	4	4.0 (0)
2013	2	1	1	4	3	3.0 (0)

* Mean total for 1984 to 2022 excludes the two years, 1985 and 1986, where monitoring was not conducted.

Table APP C.2 (continued). 1984 to 2023 Pinnacles peregrine falcon nesting productivity—core and non-core areas combined.

Year	Territorial Pairs	Nesting Pairs	Successful Nests	# Total Nestlings	# Total Fledglings	# Fledglings / Nest Mean (SD)
2014	2	2	2	3	3	1.5 (0.7)
2015	2	2	2	6	6	3.0 (1.4)
2016	2	2	1	3	3	3.0 (0)
2017	2	2	2	7	7	3.5 (0.7)
2018	2	2	2	4	4	2.0 (1.4)
2019	4	3	2	7	6	3.0 (0)
2020	4	4	3	8	8	2.7 (1.2)
2021	4	4	4	9	9	2.3 (1.0)
2022	4	4	4	14	14	3.5 (0.6)
2023	4	4	3	7	7	2.3 (1.2)
Mean (SD) Total (2004 to 2022)*	2.1 (1.2)	1.9 (1.2)	1.7 (1.1)	4.7 (3.4)	4.6 (3.4)	2.6 (1.1)

* Mean total for 1984 to 2022 excludes the two years, 1985 and 1986, where monitoring was not conducted.

Occupied Territories

Core Areas: In 2023, there were three territorial peregrine falcon pairs within the core areas.

Non-Core Areas: In 2023, there was one peregrine falcon pair within the non-core areas.

Phenology and Productivity

We first observed the peregrine falcon pair at Little Pinnacles on 3 January 2023 (Appendix B), and we first observed incubation by the Hawkins peregrine falcon pair on 23 March. We first observed hatching of young at the South Chalone nest between 18 and 20 April. We confirmed fledging of young at the South Chalone nest between 20 and 21 May, at the Hawkins Peak nest between 5 and 7 June, and at the Little Pinnacles nest between 15 and 18 June. The General Balconies nest failed during egg incubation.

Discussion: Combined Prairie and Peregrine Falcon Occupancy and Productivity

Given the small sample size that peregrine falcon pairs have occupied and produced young at breeding territories at Pinnacles, we cannot currently ascertain any statistical relevance or trends specifically to peregrine falcon breeding results at the park. However, we combined prairie and peregrine falcon results over the 38 years of monitoring efforts (Table APP C.3 and Figure APP C.2) to represent overall falcon occupancy and productivity numbers at Pinnacles. Combined falcon occupancy and productivity rates across both species in core and non-core areas this year were lower than the 37-year running averages. Twelve falcon pairs attempted to nest this year and six nests

successfully produced 17 fledglings, compared to our 37-year means (SD) of 10.4 (2.2) nesting pairs, 8.2 (2.5) successful nests, and 28.2 (9.2) fledglings (Table APP C.3). Setting aside total nesting failure in 1998 (due to parkwide flooding in the middle of the nesting season), combined peregrine falcon and prairie falcon productivity in 2023 was the third lowest on record for the 38 years of falcon monitoring at Pinnacles, as opposed to productivity for just prairie falcons documented as the lowest on record (tied with 1987 results) over the total years of monitoring effort at the park.

Table APP C.3. 1984 to 2023 Pinnacles prairie and peregrine falcon nesting productivity—core and non-core areas combined.

Year	Territorial Pairs	Nesting Pairs	Successful Nests	# Total Nestlings	# Total Fledglings	# Fledglings / Nest Mean (SD)
1984	10	9	8	30	27	3.4 (0.9)
1987	6	4	4	13	10	2.5 (1.7)
1988	12	9	8	24	24	3.0 (1.2)
1989	12	12	9	24	21	2.3 (1.1)
1990	14	10	8	31	29	3.6 (0.9)
1991	14	11	10	34	34	3.4 (1.3)
1992	13	11	10	38	34	3.4 (1.5)
1993	13	12	10	39	35	3.5 (1.1)
1994	13	13	12	45	42	3.5 (0.9)
1995	13	11	8	24	24	3.0 (0.5)
1996	12	10	9	35	34	3.8 (1.0)
1997	12	8	6	26	26	4.3 (0.8)
1998	10	7	0	0	0	0 (0)
1999	10	8	6	25	25	4.2 (0.8)
2000	8	8	7	22	22	3.1 (1.2)
2001	10	10	7	24	24	3.4 (1.1)
2002	11	9	7	26	22	3.1 (1.1)
2003	12	9	8	33	32	4.0 (1.1)
2004	13	11	9	36	33	3.7 (1.4)
2005	14	11	10	32	27	2.7 (1.1)
2006	16	15	11	38	33	3.0 (0.8)
2007	15	13	10	38	36	3.6 (1.3)
2008	13	6	5	15	15	3.0 (1.0)

* Mean total for 1984 to 2022 excludes the two years, 1985 and 1986, where monitoring was not conducted.

Table APP C.3 (continued). 1984 to 2023 Pinnacles prairie and peregrine falcon nesting productivity—core and non-core areas combined.

Year	Territorial Pairs	Nesting Pairs	Successful Nests	# Total Nestlings	# Total Fledglings	# Fledglings / Nest Mean (SD)
2009	13	12	11	44	40	3.6 (1.4)
2010	14	12	8	28	28	3.5 (1.2)
2011	14	13	8	33	33	4.1 (0.6)
2012	13	12	9	32	31	3.4 (1.1)
2013	14	12	11	51	46	4.2 (0.8)
2014	14	12	9	33	30	3.3 (1.5)
2015	14	10	7	27	27	3.9 (1.1)
2016	13	8	6	22	22	3.7 (0.8)
2017	12	11	6	34	22	3.7 (0.5)
2018	12	12	8	30	26	3.3 (1.3)
2019	15	10	7	22	21	3.0 (1.0)
2020	13	11	7	26	22	3.1 (0.9)
2021	13	13	12	40	40	3.3 (1.2)
2022	13	13	13	46	46	3.5 (1.1)
2023	14	12	6	24	17	2.8 (1.3)
Mean (SD) Total (1984 to 2022)*	12.5 (2.1)	10.4 (2.2)	8.2 (2.5)	30.3 (9.8)	28.2 (9.2)	3.3 (0.7)

* Mean total for 1984 to 2022 excludes the two years, 1985 and 1986, where monitoring was not conducted.

In comparing prairie falcon results (Table APP A.1 and Figure 3) with combined prairie and peregrine falcon results (Table APP C.3 and Figure APP C.2), peregrine falcon breeding efforts appear to be supplementing overall large falcon productivity. Overall falcon fecundity has remained generally consistent with the 37-year averages, but prairie falcon fecundity generally appears to be cyclic while peregrine falcon fecundity is increasing. At Hawkins Peak, since 1984, a prairie falcon pair consistently nested in the territory until a peregrine pair began occupying the territory 18 years ago; since 2004 no prairie falcons have nested at Hawkins Peak. In 2020 to 2023, a peregrine falcon pair occupied territories at Little Pinnacles and Frog/Hand, ultimately nesting and fledging young successfully at Frog/Hand in 2020 and 2022, and at Little Pinnacles in 2021 and 2023, for the first time since the Pinnacles falcon monitoring program began. These territories were also used consistently in previous years by prairie falcon pairs, but not during the 2020 to 2023 breeding seasons. These observations suggest that—in certain instances—prairie and peregrine falcons may compete for territorial occupancy of limited cliff-nest habitat at Pinnacles. Agonistic interactions between the two species—leading to peregrine falcon pairs evicting prairie falcons from territories

and to lower prairie falcon nesting productivity in the presence of peregrine falcons—have been documented in other locations where the ranges of these falcon species overlap (Porter and White 1973; Walton 1973; Dekker and Corrigan 2006).

From 2014 to 2023 we have documented mixed observations of prairie falcons apparently abandoning certain historic territories due to peregrine falcon presence—as detailed above—but tolerating peregrine falcon nesting pairs in other territories. We observed both prairie and peregrine falcon pairs in relatively close proximity—at South and General Balconies—nesting and fledging young. In 2021 and 2022 the prairie and peregrine falcon pairs at Balconies defended the cliff areas, and we observed few confrontations between the falcon pairs. Similarly, at South Chalone Peak in 2020 to 2023, prairie and peregrine falcon pairs both nested, selecting cliff nest locations within close proximity that were separated from each other by visual barriers of cliff walls. During the 2021 and 2022 seasons, the South Chalone Peak prairie and peregrine falcon nests both successfully fledged young. During the 2023 season, the South Chalone prairie falcon nest failed during egg incubation and the peregrine falcon nest successfully fledged one young. General literature references are lacking regarding prairie and peregrine falcon pairs tolerating and successfully nesting in close proximity. At present, due to limited peregrine nesting efforts at Pinnacles, data specific to the park remain scarce and therefore are inconclusive regarding competition for cliff-nest habitat between the two species.

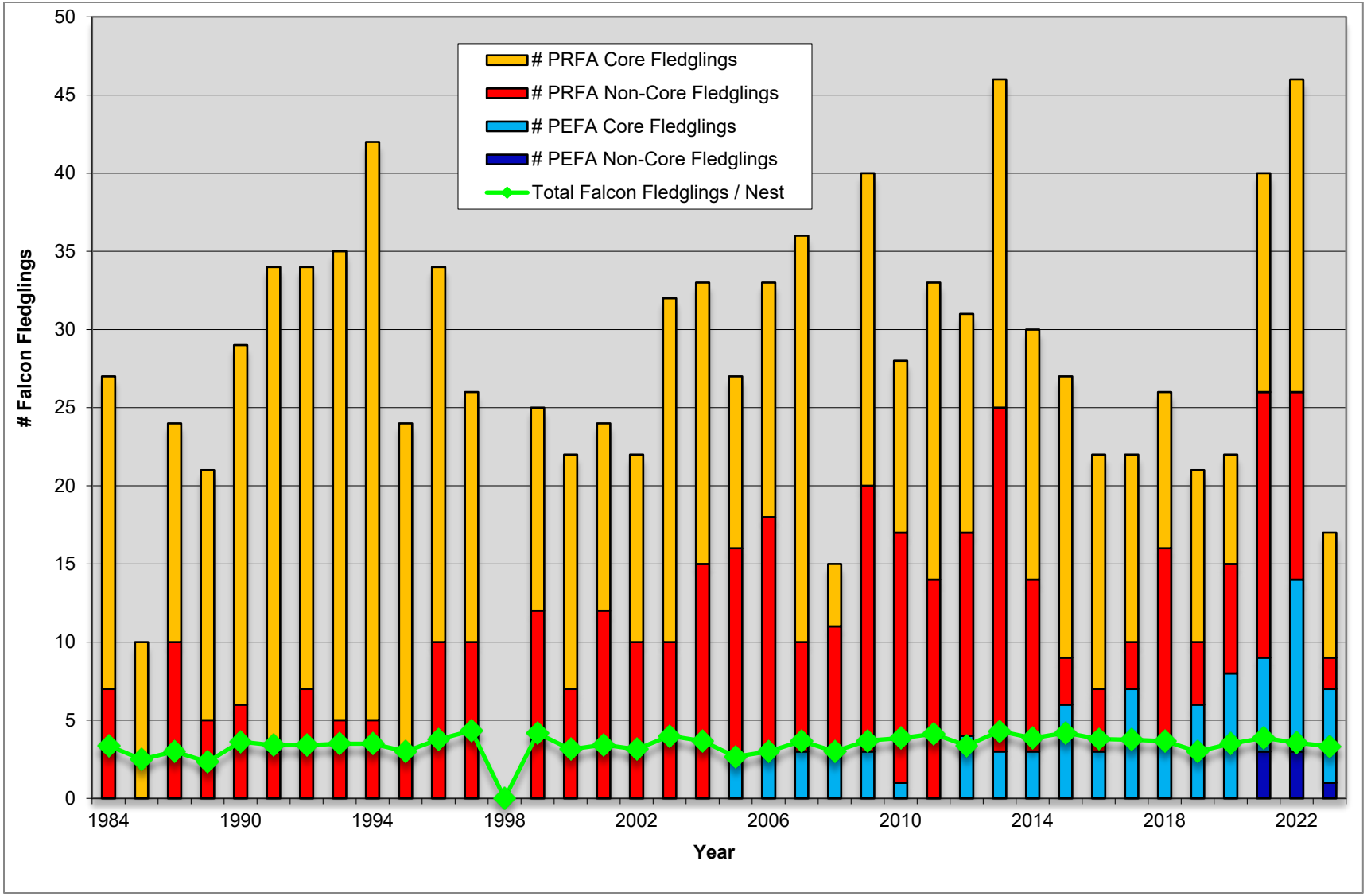

Figure APP C.2. Combined core and non-core Pinnacles prairie falcon (PRFA) and peregrine falcon (PERA) fledgling productivity, 1984–2023. Data for 1998 reflects total nest failure and no successful fledging of young due to extreme flooding throughout Park. No monitoring conducted in 1985 and 1986.

Appendix D. Documentation of Changes in Data Collection Methods

No changes were made to data collection methods for the Pinnacles raptor monitoring program through the course of the 2021–2023 seasons.

In October 2020, contractors in the Central I&M Office completed updates to the Pinnacles Raptor Monitoring database with guidance from S. Wakamiya and G. Emmons. The updated database incorporated a refactored schema to implement Inventory and Monitoring Division standards and allow for *ad hoc* data while maintaining data integrity, as well as a new user interface. The updated database allows for tracking of data-processing levels, protected records, protocol configuration, and taxon reference authority identification, as well as ensuring data quality. The updates also streamline and improve efficiencies in creating annual breeding status records. G. Emmons tested functionality by entering and validating data in the new system while S. Wakamiya tested functionality during the data-certification phase.

Following the end of the 2017 to 2019 field seasons, the Raptor Monitoring Access database was reviewed by G. Emmons, S. Wakamiya, and regional Inventory & Monitoring database managers. The database review was part of a greater effort to confirm consistency of I&M databases according to national standards. G. Emmons reviewed quality assurance / quality control (QA / QC) tools and offered recommendations on building more efficiencies into database design, and S. Wakamiya worked with the regional database managers to address inconsistencies in circular references, table relationships, and foreign key lengths.

Following the end of the 2016 field season, the front end of the Raptor Monitoring Access database was updated with an improved Data Entry Form interface and several redundant fields were removed. The back end of the database was updated with additional Data Summary Tools including improved QA queries for duplicate and missing records, and for checking errors in survey locations and falcon-occupancy determinations. The Breeding Raptors table was also updated for improved and more consistent terminology in occupancy status fields.

Following the end of the 2015 field season, legacy data were revised to account for negative data (i.e., no birds observed) for all prairie and peregrine falcon observations for the years of 2003 to 2015. Legacy data were also revised to account for missing data in records including observer location, weather, and falcon territories observed.

Following the end of the 2014 field season, the Raptor Monitoring Access database was updated from .mdb to .accdb format. Terminology and data entry fields in the Data Entry Form were updated to more clearly reflect raptor observations pertaining to the I&M Protocol versus observations of other raptor species in the park, to distinguish more efficiently between occupancy and fecundity results, and to provide easier access to territory tables. Data summary tools were also added as queries to allow for more comprehensive review and revision of breeding-summary and raptor-observation information in spreadsheet format.

Appendix E. Public Interest Highlights

The 2023 breeding season was the 38th year of raptor monitoring at Pinnacles. Field observations began 1 January 2023 and ended 9 July 2023, with a total of greater than 150 possible and active nest sites monitored during 870 observation hours. Climbing advisories were put into effect in January to reduce nest disturbance by visitors, updated to reflect unoccupied territories in March, and lifted in July at the end of the raptor breeding season.

- During the 2023 season, Pinnacles staff conducted prairie falcon nest entries to collect data on genetics and rodenticide exposure at two nest sites—the North Chalone Peak (NC-1) and Crowley Towers (CT-4) nests. Blood samples were taken from seven falcon nestlings. Blood serum samples from 2021 to 2023 (totaling 32 samples) were tested for rodenticide exposure at California Animal Health & Food Safety Lab System (CAHFS), and all samples returned with negative exposure results. Test results from 20 prairie falcon nest entries conducted in 2014 to 2019 indicated positive exposure for nestlings from two nest entries and negative exposure for all nestlings from the other 18 nest entries. During the 2014 season, all four falcon nestlings at the South Balconies nest tested positive for trace amounts of Diphacinone. During the 2017 season, one of the two nestlings at the Egg nest tested positive for measurable amounts of Diphacinone, and the other nestling tested negative for rodenticide exposure. These results represented the first confirmation of rodenticide exposure in the Pinnacles prairie falcon population. Additionally, banding and blood sample information collected in 2009 to 2023 will be used in regional efforts to ascertain genetic insularity and pair fidelity in the Pinnacles prairie falcon population.
- During the 2023 season, three territorial pairs of peregrine falcons successfully fledged a total of seven young, representing the 19th consecutive year that a pair of peregrine falcons has successfully nested at the park during the history of the raptor monitoring program. Prior to 2004, the last previously confirmed peregrine falcon territorial occupancy or nest effort at Pinnacles was documented at the Drywall territory in 1957.
- As noted in Appendix C, falcon productivity was notably lower in 2023 than in recent years, especially after very high productivity documented in 2021 and 2022. The data suggest an apparent cyclic population pattern for prairie falcons, with peregrine falcon breeding efforts appearing to supplement overall falcon productivity to yield fecundity rates that are generally consistent with Pinnacles' 37-year average.
- Incoming Pinnacles interpretive staff and volunteers received two presentations described above that focused on raptor monitoring and falcon nesting, and we circulated monthly raptor-monitoring updates and associated photos to NPS staff and associating organizations throughout the 2023 breeding season via email.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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