PEREGRINE FALCON MONITORING ON THE CALIFORNIA CHANNEL ISLANDS, CALIFORNIA, 2022

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INTRODUCTION

American peregrine falcons (*Falco peregrinus anatum*; hereafter peregrines) were common residents on all the California Channel Islands (Willett 1912, Howell 1917, Kiff 1980), although the highest number of reported nests in a single year was 15 (Kiff 1980, 2000). Because peregrines and their nests are less conspicuous to casual observers than are other raptors historically found on the Channel Islands, such as bald eagles (*Haliaeetus leucocephalus*) and osprey (*Pandion haliaetus*), historical estimates of the number of peregrines on the islands were almost certainly too low (Kiff 1980) and could have been 30 or more pairs (Hunt 1994).

Peregrine numbers plummeted across much of the northern hemisphere starting in the late 1940s (Hickey and Anderson 1969). Peregrines were at their lowest numbers in the 1960s and early 1970s, at which time they were extirpated from the eastern United States and across the Midwest and reduced to a few hundred pairs in the western United States and Mexico (U.S. Fish and Wildlife Service 2003). Approximately 100 peregrine eyries in California were producing young each year until at least the mid-1940s, with more than a third of the verified or suspected peregrine nest sites occurring within 10 miles of the ocean, including the Channel Islands (Herman et al. 1970). By 1970, the number of breeding peregrines had dropped by at least 95% in California (Herman et al. 1970, Herman 1971). It appears that nests along the southern coast suffered the earliest reductions and the peregrine population on the Channel Islands was drastically reduced or extirpated by 1955 (Herman et al. 1970), with the last reported sighting of a probable Channel Islands breeding adult occurring on Anacapa Island in 1949 (Kiff 1980).

Overwhelming evidence indicated that declines in peregrines and other bird species feeding higher on the food chain were a result of the effects of DDE, a metabolite of DDT, on egg hatchability (Kiff 1980, Mesta 1999, Kiff 2000). The apparent source of the DDT pollution in the Southern California Bight (SCB) was traced to the Montrose Chemical Corporation's manufacturing plant in Torrance, California. Between 1947 and 1961, an estimated 37 to 53 million liters of DDT-contaminated acid sludge, containing 348-696 metric tons of DDT, was disposed at an ocean dump site 16 km northwest of Catalina Island (Chartrand et al. 1985). In addition, an estimated 1800 metric tons of DDT was discharged from the Joint Water Pollution Control Plant outfall, 3.3 km offshore of Palos Verdes Peninsula (Chartrand et al. 1985).

Peregrines were listed as endangered in 1970 under the Endangered Species Conservation Act of 1969, and later under the Endangered Species Act of 1973 (Mesta 1999). Populations

rebounded following restrictions on the use of organochlorine pesticides in Canada and the United States (banned in 1970 and 1972, respectively) and successful management activities, including the reintroduction of captive-bred and relocated peregrines (Mesta 1999). Between 1983 and 1998, the Santa Cruz Predatory Bird Research Group (SCPBRG) released 34 peregrines on the Channel Islands (10 on San Miguel, 17 on Catalina, 4 on Santa Rosa, and 3 on Santa Cruz; Montrose Settlements Restoration Program 2005, Bird Banding Lab unpublished data). The first pairs with young were seen on Anacapa and Santa Cruz islands in 1989 and 1990, respectively (Hunt 1994). During a 1992 survey, Hunt (1994) located 9 active eyries on 4 of the Channel Islands. Peregrines were removed from the Endangered Species list in 1999, at which time breeding targets for the Channel Islands (5 pairs) and the Pacific Coast (185 pairs) had been greatly exceeded (Mesta 1999). Ten years later, peregrines were removed from the State of California's list of Endangered and Threatened Animals (California Department of Fish and Wildlife 2022).

After a successful lawsuit against Montrose Chemical et al. for damage caused by the release of DDTs and PCBs into the Southern California Bight, the Montrose Settlements Restoration Program (MSRP) was created to implement restoration projects aimed at restoring natural resources that were directly or indirectly harmed by DDT and PCB contamination. The Montrose Settlements Trustee Council (MSTC) was created to oversee the settlement monies and is composed of representatives of Federal and State agencies that have interests in the Southern California Bight: National Oceanic and Atmospheric Administration (NOAA), U.S. Fish and Wildlife Service (FWS), National Park Service (NPS), California Department of Fish and Wildlife (CDFW), California State Lands Commission, and the California Department of Parks and Recreation.

Since the conclusion of peregrine survey efforts in the early 1990s, there were limited surveys conducted on the Channel Islands and the distribution and extent of breeding pairs was not known. Under Phase 1 of MSRP's Restoration Plan, the MSTC contracted with the SCPBRG to conduct a peregrine falcon survey and monitoring project in 2007. The goal of that monitoring effort was to assess the status of peregrines on the Channel Islands and determine whether their recovery was still affected by on-going contamination in the local food web (Montrose Settlements Restoration Program 2005). SCPBRG located 27 occupied territories on 5 of the 8

islands in 2007, but also found that DDE contamination still appeared to be reducing peregrine falcon reproductive success (Latta 2012).

Under Phase 2 of the MSRP Restoration Plan, peregrine surveys were to be conducted at 5-year intervals (Montrose Settlements Restoration Program 2012), although the survey scheduled for 2012 was delayed until 2013. After the Institute for Wildlife Studies (IWS) conducted surveys on all 8 Channel Islands in 2013, the MSTC agreed to our proposal to conduct annual surveys through 2017 to gain more information on population demography and important population parameters, such as survival, immigration, and emigration. IWS located 45-51 occupied territories on the Channel Islands annually from 2013 through 2017 (Sharpe 2014, 2015, 2016, 2017, 2018), with at least 2 territories on each island. We conducted additional limited surveys in 2018 and 2019 and located 38 and 45 occupied territories, respectively (Sharpe and Melling 2018, Sharpe and Melling 2019). We conducted no regular surveys in 2020 and 2021 primarily due to Covid-19 restrictions but received funding for a 2022 survey through the Department of Interior/Park Service and U. S. Navy (USN, San Nicolas Island surveys). This report summarizes the results of our 2022 survey efforts.

STUDY AREA

The California Channel Islands are composed of eight islands located off the coast of southern California (Fig. 1). All the Channel Islands are subject to a Mediterranean climate regime characterized by cool, wet winters and warm, dry summers (Coonan and Schwemm 2009). The northern Channel Islands, which are composed of San Miguel Island, Santa Rosa Island, Santa Cruz Island, and Anacapa Island are located approximately 20 to 44 km off the coast of Ventura and Santa Barbara counties (Junak et al. 1995) and are a tightly clustered group with no more than 9.6 km separating adjacent islands (Moody 2000; Fig. 1). The southern Channel Islands, which are composed of San Nicolas Island, Santa Barbara Island, Santa Catalina Island, and San Clemente Island, are located 32-79 km from the mainland (Junak et al. 1995) and are more remote and scattered than the northern islands, with the closest islands (Santa Catalina and San Clemente Islands) separated by 34 km (Moody 2000; Fig. 1). We did not survey San Miguel Island this season and have only limited information for Anacapa and Santa Barbara Islands.

Anacapa Island (hereafter Anacapa), which is composed of 3 islets (East, Middle, and West Anacapa; Fig. 1) is owned by the NPS. The island encompasses approximately 2.8 km^2, spanning about 8 km from end to end and reaching a maximum elevation of 283 m (Junak et al. 1995).

Figure 1. California Channel Islands located off the coast of southern California, USA.

Santa Cruz Island (hereafter Santa Cruz) is the largest of the 8 Channel Islands and is owned by the NPS (eastern 24% of the island) and The Nature Conservancy (TNC; western 76% of the island). The island measures about 38 km long by 12 km wide at its widest point (Fig. 1), encompassing approximately 249 km^2 with a maximum elevation of 753 m (Junak et al. 1995).

Santa Rosa Island (hereafter Santa Rosa) is the second largest of the Channel Islands and is owned by the NPS (Fig. 1). The island is approximately 24 x 16 km and encompasses about 217 km^2 with a central mountain range reaching an elevation of approximately 475 m (Junak et al. 1995, Rick 2009). The central highland is dissected by drainages; a relatively gentle marine terrace occurs north of the highland, whereas steep, deeply incised drainages comprise much of the south portion of the island (Coonan and Schwemm 2009).

Santa Barbara Island (hereafter Santa Barbara), owned by the NPS, is located 62 km from the nearest point on the mainland and 38 km east of its nearest neighboring island, Santa Catalina

Island (Fig. 1). With an area of only 2.6 km^2 it is the smallest of the Channel Islands. It has a series of low terraces, with small peaks at the north and south ends of the island (high point at 193 m) and is bound by sheer cliffs on much of the north, west, and part of the south sides of the island (Drost and Junak 2009).

San Nicolas Island (hereafter San Nicolas), owned by the USN, is the most remote of the Channel Islands. It is located 98 km from the mainland (Junak et al. 1995) and 45 km from its nearest neighbor, Santa Barbara (Moody 2000; Fig. 1). It is approximately 13 x 5 km in size and has an area of about 58 km^2 and a maximum elevation of 277 m (Junak et al. 1995).

Santa Catalina Island (hereafter Catalina), located 34 km south of Long Beach, California, is owned primarily by the Santa Catalina Island Conservancy (~90%). The island is 34 km long, 0.8 to 13.0 km wide, and has an area of 194 km^2, 80 km of coastline, and maximum elevation of 648 m (Junak et al. 1995; Fig. 1).

San Clemente Island (hereafter San Clemente), owned by the USN, is the southernmost of the Channel Islands, located approximately 92 km off the coast of California (Fig. 1). The island is 143 km^2, about 34 km long, and has a high point of 610 m (Willey 1997). It is characterized by a series of marine terraces on the west side and a steep escarpment on the east side (Kaiser et al. 2009).

METHODS

Permitting

Our research activities were covered by multiple state and federal permits. IWS has a Memorandum of Understanding with the CDFW to conduct peregrine research on the Channel Islands, a permit (#21564) from the United States Geological Survey's Bird Banding Laboratory (BBL) allowing us to band peregrines with both federal and auxiliary leg bands and draw blood, and a research permit from the Catalina Island Conservancy. Our Migratory Bird Treaty Act permit (#MB95076A-0) allowed us to collect feathers, failed eggs, and eggshells at nests.

Survey Method

We used a survey method like that used by the National Park Units in the Northern Colorado Plateau Network (NCPN), as described by Daw et al. (2006). We monitored potential

nesting areas for up to 4 hours, normally the maximum time between eyrie visits/exchanges at the ledge (Daw et al. 2006), with a minimum of 3 visits to each known territory between February and June. The NCPN protocol allows for the use of recorded vocalizations to elicit vocal or behavioral responses from territorial birds, which has been found to increase the likelihood of detection and decrease the amount of time required to detect many bird species (Johnson et al. 1981, Anderson 2007, Barnes et al. 2012). Although call-broadcast surveys typically have been used for forest-dwelling raptors (Kimmel and Yahner 1990, Watson et al. 1999), they have also been used for non-forest raptors (Balding and Dibble 1984).

The call-broadcast technique we incorporated into our survey protocol was developed by Barnes et al. (2012) to survey for peregrines in the Lake Mead National Recreation Area, Nevada. The 10-minute survey protocol begins with a 3-min passive observation period, followed by a 30-sec broadcast period, a 1-min passive observation period, a second 30-sec broadcast period, and a final 5-min passive observation period. We uploaded recorded peregrine vocalizations (Stokes Field Guide to Bird Songs: Western Region; Time Warner Trade Publishing, New York, NY) to a FOXPRO NX4 game caller (FOXPRO Inc., Lewiston, PA). The vocalizations consisted of 5 sec of the 'cack' alarm call and 10 sec of the 'eechup' call from an adult female peregrine (described in Linthicum 1996), which were looped to produce 30 sec of continuous calling. During the call-broadcast we rotated up to 360° (depending on terrain, habitat, and broadcast location) to evenly project the sound around the broadcast point. We discontinued the broadcast immediately when we detected a responding peregrine.

We used the 4-hr passive observation and/or the 10-min call-broadcast protocol, depending on where and when we were conducting the survey, as described below. We did not conduct surveys or monitoring during periods of heavy rain, heavy fog, or severe cold. Ideally, we did not conduct surveys or monitoring during periods of sustained high winds greater than 25 km/h. However, the Channel Islands can have long periods of high winds, which would have made it impossible to conduct any surveys for a week or more. Therefore, when there were high winds, we conducted most surveys/monitoring on leeward sides of the islands.

Surveying Historical Territories

We began surveying historical territories for activity in February 2022. All territory locations that we confirmed during our 2013-2019 surveys (Sharpe 2014, 2015, 2016, 2017, 2018; Sharpe and Melling 2018, Sharpe and Melling 2019) were uploaded to Garmin eTrex 20 GPS units (Garmin International Inc., Olathe, KS) to assist in locating the known territories on each island. We added satellite imagery (BirdsEye Satellite Imagery™, available through Garmin Basecamp™) onto each GPS unit for ease of orienting in relation to geographic features.

Initial surveys at each historical territory generally included a 10-min call-broadcast survey, followed by up to 4 hours of passive observations if no peregrines were detected. If any peregrines were detected, we returned at approximately 10–14-day intervals for further monitoring (see Monitoring Active Territories below). If no pair was detected, we usually returned at least 2 more times at approximately 1-month intervals to verify that the territory was inactive.

Surveying for New/Previously Unknown Territories

We used the 10-min call-broadcast method to conduct ground-based surveys for new or previously unknown peregrine territories on the islands. Although peregrine habitat typically contains tall cliffs (50+ m) to serve as perching and nesting sites (Johnsgard 1990), we did not assume that those were the only places that peregrine would nest on the islands. In other studies, peregrines have been found nesting on the ground (Hickey and Anderson 1969, Pagel et al. 2010) and in tree nests of other raptors and in tree cavities (Campbell et al. 1977). Because peregrine nests have historically been found far inland in canyons on Santa Rosa (Pemberton 1928), we surveyed for peregrines both along the coastal bluffs and cliffs and in interior portions of the islands. Call-broadcast locations during a single day were generally ~1 km apart, although they could be more closely spaced if required for adequate coverage in areas of high topographic relief that may have minimized the distance at which the broadcast could be heard by peregrines (e.g., opposite sides of a steep ridge, along a coastline with many harbors or prominent points) or where ocean noise impacted our ability to hear responding peregrines. We recorded our daily survey routes, call-broadcast locations, and sightings of peregrines on GPS units. We often revisited areas with potential peregrine habitat to determine whether birds had gone undetected or had occupied an area after a previous survey.

Monitoring Active Territories

A primary goal of our monitoring was to determine breeding chronology and outcome, including egg-laying and incubation periods, reproductive success/failure, recycling attempts, and number of young produced and fledged. We attempted to visit occupied territories at 10–14-day intervals to estimate the breeding chronology. We refined estimates of lay and hatch dates by aging chicks using photos and descriptions in Clum et al. (1996) and Moritsch (1983) and a 33-day incubation period (Linthicum 1996). We only used the 10-min call-broadcast about one time per month at active territories, if needed, to minimize the chance that the birds would become acclimatized to the recorded vocalizations. We observed peregrines and potential or known nest sites from 150-1500 m using binoculars and 20-60x spotting scopes. We estimated distances to peregrines or nest sites using a distance measuring function on our GPS units.

On each visit to an active territory, we recorded data on weather conditions, time, observer location, peregrines observed, and behavior of any adult or chick. To standardize behavioral observations made during these visits, we used the definitions and descriptions in Linthicum (1996). For most territories with chicks, we made our last visits when chicks were ≥28 days of age to determine success (see Terminology below).

Nest Entry and Banding

We entered a subset of active nests when the chicks were approximately 21-28 days of age. The recommended age range for banding is 21-35 days (Heinrich 1996), but we lowered the upper age limit to minimize the likelihood of chicks jumping from the eyrie. We evaluated each eyrie prior to entry to determine the safest anchoring technique(s) and route of entry. In some cases, we did not band the chicks when a nest entry was not safe for the birds and/or the biologists. For eyries that were only visible from a distant location, a biologist remained at the observation point and directed the climber to the eyrie via radio. Once at the eyrie we placed chicks in a Deluxe Pet Carrier Backpack (PetAmi, City of Industry, CA; Fig. 2) and carried them to the top of the nest cliff for processing.

Peregrines exhibit reverse size dimorphism (females larger than males) and we determined the sex of each chick based on weight, overall size, and the breadth of the tarsi (Burnham et al. 2003, J. Barnes, personal communication). We attempted to band chicks when they were at least 21 days old, at which time they had developed sufficiently so that differences

in the size of the tarsus was evident (Craig and Enderson 2004). Males were fit with a U. S. Geological Survey (USGS) lock-on #6 band on the left leg and a black anodized aluminum band with silver alphanumerical characters (Acraft Sign & Nameplate Co., Edmonton, Alberta, Canada) on the right leg. Females were banded with a USGS lock-on #7A band on the right leg and an Acraft band on the left leg. If there was any question as to the sex of the birds, then we used the female bands (Heinrich 1996, Gustafson et al. 1997).

Figure 2. Peregrine chicks in a backpack pet carrier for transport to/from the eyrie for banding.

Prey Remains

During nest entries we collected prey remains and sent them to Paul Collins at the Santa Barbara Museum of Natural History for identification. He keyed out prey items using a reference collection and determined the minimum number of individuals (MNI) based upon duplicate feathers or body parts (e.g., 2 left feet of a species would indicate a minimum of 2 individuals).

Eggshell Measurements

We collected eggshells and addled eggs during nest entries and delivered them to the Western Foundation of Vertebrate Zoology (WFVZ) in Camarillo, California for eggshell thickness analyses. René Corado measured the thickness of eggshells using a measuring device consisting of a thin gauge wire mounted to a digital gauge (Starrett Gauge; 0.00005 mm resolution) fixed to a mounting bracket with a moveable bottom plate (the RC Method in previous reports). For whole eggs, he took 10 shell measurements around the equator of each egg

(not at the poles because more calcium is deposited at the ends) where there was no visible debris, both with and without the membrane, as applicable. If a membrane was no longer attached to the shell at the equator, then measurements were taken without membrane, but added an average membrane thickness if membranes were present elsewhere. Otherwise, an average membrane thickness of 0.063 mm (Linthicum et al. 1994) was added. For samples that contain only eggshell fragments, usually only 1-2 measurements were taken on each fragment. To ensure that the egg fragments belonged to the species in question, only those fragments that could be clearly identified as peregrine eggshells were measured.

We calculated the clutch mean as the mean thickness of all the eggshell measurements from samples representing each individual clutch of eggs (Latta 2012). We calculated percent eggshell thinning by comparing the mean eggshell thickness with the standard pre-DDT peregrine eggshell thickness in California of 0.364 mm (Kiff 1994) using the equation N% = [1 - (thickness/0.364)] x 100 (Latta 2012).

Terminology

There are a variety of definitions used to describe peregrine occupancy and nesting success, but we followed the guidelines in the 2003 Monitoring Plan for the American Peregrine falcon (U.S. Fish and Wildlife Service 2003), as defined below.

Occupied Territory: A territory where either a pair of peregrines is present (2 adults or an adult/subadult mixed pair), or there is evidence of reproduction (e.g., incubation, brooding, eggs or young, food delivery to an eyrie).

Nest Success: The proportion of occupied territories in which we observed one or more young $\geq$ 28 days old.

Productivity: The number of young observed at $\geq$ 28 days old per occupied territory, averaged across all occupied territories.

We further categorized occupied territories based upon the following breeding stages (see Linthicum 1996 for further descriptions).

Courtship: Behavior indicative of pair bonding, such as cooperative hunting, adult prey exchanges, copulation, or ledge courtship displays.

Incubation: Adult observed in incubation posture (low horizontal position) or inferred to be incubating based upon behavior (for eyries that were not visible). The female does most of the

incubation, but the male will bring her food several times per day and relieve her at incubation. During incubation, there is generally an adult present at the eyrie, except when disturbed or for short periods on warm days.

Nestling: Chick(s) present. May be able to see chicks, hear begging, or see adults apparently feeding chicks. Generally, only females brood and feed nestlings. An adult brooding young nestlings (< 7 days old) can look a lot like incubation, so we waited for a prey delivery to the eyrie to confirm that chicks were present.

Fledgling: When young reach ≥ 28 days old.

We classified the breeding activity of occupied territories as either successful, unsuccessful, unknown, or none as described below.

Successful: A pair produced one or more nestlings that survived until at least 28 days of age.

Unsuccessful: A pair that engaged in prolonged courtship or copulating that either did not produce eggs or failed during the incubation or nestling stage (chicks < 28 days old).

Unknown: There was insufficient survey data to determine nesting outcome.

None: Pair present, but no (or minimal) signs of courtship observed.

Data Management

We entered survey data into island-specific Excel files that were shared via the cloud-based file storage program Dropbox. We combined the data into a master database and the field notebooks were kept on each island as backup records.

RESULTS

Surveying and Nest Monitoring

We visited 48 historical peregrine territories on the Channel Islands at least once in 2022 and located 3 new or previously unknown territories (Table 1). We confirmed a total of 34 occupied territories. Survey summaries for each island and territory are provided below.

Anacapa Island

We did not conduct surveys of Anacapa this season, but we were able to monitor the Cathedral Cove territory via a live web cam.

MC54 Cathedral Cove: The Cathedral Cove pair (Fig. 3) used their historical nest with a live web camera this season. They laid eggs on 12, 15, and 20 March, 2 chicks hatched on 19 April, and the third chick hatched on 23 April. The last chick hatched died on 25 April, probably from starvation because it couldn't compete with the 2 older chicks. We entered the eyrie on 19 May to band the 2 chicks (Fig. 4, Table 2) and collect eggshell fragments and prey remains for analyses (Appendix I). The chicks fledged successfully but took their first flights from a location out of view of the camera.

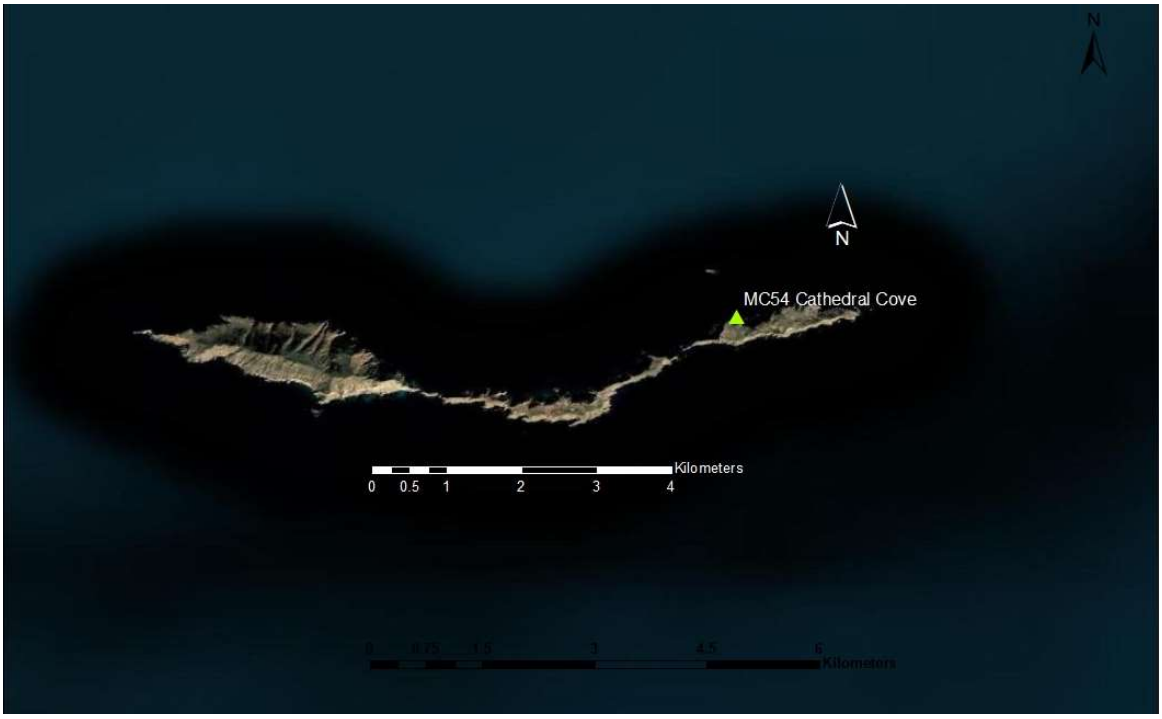

Figure 3. Location of the Cathedral Cove peregrine eyrie on Anacapa Island, CA.

Table 1. Status and breeding activity observed at peregrine falcon territories surveyed on the California Channel Islands in 2022.

Island/ Territory Name	State Code[b]	Territory Type	Occupancy Status	Breeding Activity	# Chicks Hatched[c]	# of Fledglings[c]	Notes (see report text for more details)
Anacapa							
West Anacapa[a]	MC21	Historical	Occupied	Successful	3	2	Monitored via live cam
Santa Cruz							
Gherini Knife Edge	MC18	Historical	Occupied	Unknown	.	.	Could not confirm nesting
Laguna	MC19	Historical	Unknown	Unknown	.	.	Single adult seen on 2 surveys
West End[a]	MC20	Historical	Occupied	Successful	2	1	One chick disappeared 5/26-5/28
Sea Lion	MC30	Historical	Occupied	Unknown	.	.	Courtship observed
Black Point	MC38	Historical	Unknown	Unknown	.	.	Single adult seen on 2 surveys
Arch Rock[a]	MC45	Historical	Occupied	Successful	1	1	Assumed to have fledged
Valley Anchorage	MC46	Historical	Occupied	Unknown	.	.	Courtship observed
Cavern Point	MC52	Historical	Occupied	Unknown	.	.	Pair present
Bowen Point	MC53	Historical	Occupied	Unknown	1	.	Nestling(s) based upon vocalizations
Pelican Bay[a]	MC60	Historical	Occupied	Unsuccessful	2	0	Failed after 5/29
Punta Diablo	MC61	Historical	Unknown	Unknown	.	.	Single adult seen on 3 surveys
Punta Gorda[a]	MC62	Historical	Occupied	Successful	2	2	Fledglings observed 6/23
San Pedro West[a]	MC63	Historical	Occupied	Unsuccessful	.	.	3 eggs. Failed during incubation
West Point South	MC64	Historical	Occupied	Unknown	.	.	Courtship observed
East Smuggler's[a]	MC77	Historical	Occupied	Successful	1	1	Fledgling observed 6/12
Del Norte	MC81	Historical	Occupied	Successful	2	2	Fledglings observed 6/26
Pozo	MC90	Historical	Unknown	Unknown	.	.	Only one survey completed
Platt's Harbor	MC94	Historical	Occupied	Unknown	.	.	Pair observed 5/25
Sierra Blanca	MC95	New	Occupied	Unsuccessful	.	.	Failed during incubation
Coches Prietos	MC96	New	Occupied	Successful	3	3	Discovered by N. Todd on 4/29
Santa Rosa							
Carrington Point	MC16	Historical	Occupied	Successful	3	3	Fledglings observed 6/25
Lime Point[a]	MC27	Historical	Occupied	Successful	2	2	Fledglings observed 6/25
Water Canyon	MC31	Historical	Occupied	Unknown	.	.	Pair first observed 5/13
Bee Rock Canyon[a]	MC34	Historical	Occupied	Successful	2	2	Chicks about 34 days old on 6/26

Table 1. Continued

Island/ Territory Name	State Code[b]	Territory Type	Occupancy Status	Breeding Activity	# Chicks Hatched[c]	# of Fledglings[c]	Notes (see report text for more details)
Orr's Camp	MC35	Historical	Unknown	Unknown	.	.	Single adult seen on 3 surveys
Trancion[a]	MC50	Historical	Occupied	Unsuccessful	.	.	Courtship observed
Krumholtz	MC51	Historical	Unknown	Unknown	.	.	Single adult seen 4/15
Soledad	MC55	Historical	Unknown	Unknown	.	.	Single adult seen 4/18
Bonn Point	MC65	Historical	Unknown	Unknown	.	.	Single adult seen 5/26
Chickasaw Canyon	MC66	Historical	Unknown	Unknown	.	.	No birds observed
Sandy Point[a]	MC67	Historical	Occupied	Unsuccessful	.	.	Failed during incubation
Gnoma	MC76	Historical	Unknown	Unknown	.	.	Single bird observed 4/19
San Nicolas							
Harrington	MC73	Historical	Occupied	Unknown	.	.	Still incubating at last survey
Cattail Canyon	MC74	Historical	Occupied	Unknown	3	.	Chicks 3-4 weeks old at last survey
Midway	MC82	Historical	Unknown	Unknown	.	.	Single adult seen on 2 surveys
Army Springs	MC97	Historical	Unknown	Unknown	.	.	Single adult seen on 2 surveys
Grand Canyon	MC98	New	Occupied	Unknown	2	.	Chicks ~2 weeks old at last survey
Santa Barbara							
North Signal Peak	MC72	Historical	Occupied	Successful	3	3	3 fledglings seen by B. Anderson
Rookery	MC93	Historical	Occupied	Unknown	.	.	Pair reported by B. Anderson
Santa Catalina							
Bullethead	MC49	Historical	Unknown	Unknown	.	.	No birds seen during 2 surveys
Silver Peak[a]	MC75	Historical	Occupied	Successful	2	1	One chick disappeared after banding
Lone Tree	MC78	Historical	Occupied	Unknown	.	.	Did not determine if nesting
Seal Point	MC88	Historical	Unknown	Unknown	.	.	No birds seen during single survey
San Clemente							
Cave Canyon	MC59	Historical	Occupied	Unsuccessful	.	.	Eggs did not hatch
Seal Cove[a]	MC79	Historical	Occupied	Unsuccessful	.	.	No chicks observed after incubation
Wilson Cove[a]	MC89	Historical	Occupied	Successful	2	2	Fledglings observed 6/15
Pyramid[a]	MC92	Historical	Occupied	Successful	3	3	Fledglings observed 6/2

[a]Territory included in calculations of productivity
[b] Designated by the California Department of Fish and Wildlife (CDFW)
[c]Minimum number

Figure 4. The Cathedral Cove nestlings at banding, Anacapa Island, CA, 2022.

Table 2. Summary of peregrine falcon banding on the California Channel Islands, CA in 2022.

Island/Territory Name	Sex	Age (days)	USGS Band #	Color Band	Wt. (g)
Anacapa					
MC54 Cathedral Cove	Female	30	1947-21697	97/AE	1185
MC54 Cathedral Cove	Male	30	1156-16883	19/AE	765
Santa Cruz					
MC96 Coches Prietos	Male	17-19	1156-16884	18/AN	455
MC96 Coches Prietos	Male	17-19	1156-16885	38/AE	390
MC20 West End	Female	25-27	1947-21698	98/AE	625
Santa Catalina					
MC75 Silver Peak	Female	25-27	1947-21699	50/AN	690
MC75 Silver Peak	Male	25-27	1156-16893	06/AE	450

Santa Cruz Island

Surveys on Santa Cruz ran from 20 February to 26 June. We surveyed 18 historical territories and located 2 new or previously unknown territories (Table 1). We confirmed occupancy in 16 territories (80%) and at least one adult was present in 3 additional territories.

MC18 Gherini Knife Edge: We confirmed a pair in the historical Gherini Knife Edge territory (Fig. 5) on 4 March. We believe the birds were incubating at the 2018 eyrie by 27 April, but we could not confirm the outcome of any nesting attempts through our last survey on 22 June.

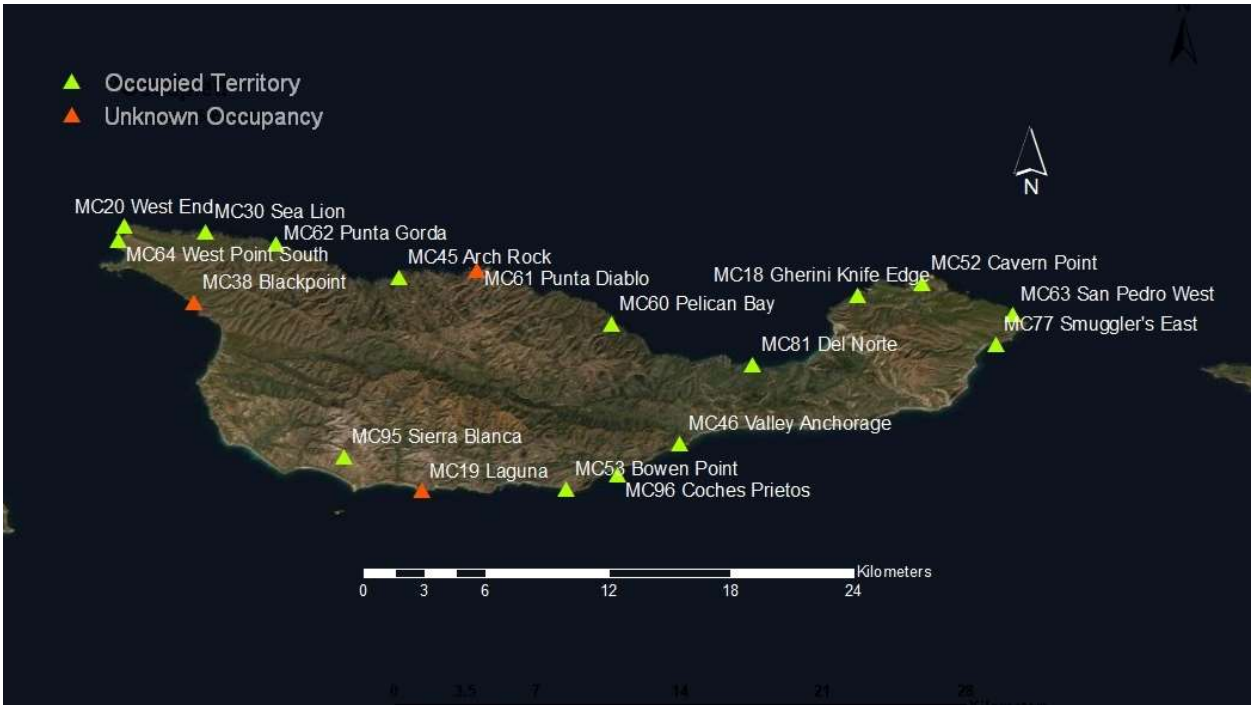

Figure 5. Status of surveyed peregrine falcon territories on Santa Cruz Island, CA in 2022.

MC19 Laguna: We were unable to confirm occupancy in the historical Laguna territory (Fig. 5). We observed a single adult during 4-hr surveys on 20 March and 13 May, but we saw no peregrines during surveys on 7 April and 12 June.

MC20 West End: We confirmed a pair in the historical West End territory (Fig. 5) on 14 April, at which time they were incubating 3 eggs. We observed at least 1 nestling on 14 May and confirmed 2 nestlings on 26 May. When we entered the eyrie on 28 May there was only 1 chick

present (Fig. 6). We banded the chick (Table 2) and collected prey samples and an addled egg (Appendix I). We located the fledgling away from the eyrie on 9 June.

Figure 6. Peregrine falcon chick at the West End eyrie, Santa Cruz Island, CA at banding.

MC30 Sea Lion: We confirmed a pair in the historical Sea Lion territory (Fig. 5) on 4 April. We observed at least one adult on each of 7 other surveys through 23 June but did not confirm any nesting.

MC38 Black Point: We observed a single adult in the historical Black Point territory (Fig. 5) on 5 March and 16 May, but saw no peregrines during surveys on 1, 15, and 17 April. We could not confirm occupancy in this territory.

MC45 Arch Rock: We confirmed a pair exhibiting courtship behavior in the historical Arch Rock territory (Fig. 5) during our first survey on 18 March. The birds were incubating by 16

April, and we observed a single 3-4-week-old chick on 10 June. We did not observe any birds on our final survey on 24 June but fog obscured visibility throughout much of the 3-hr survey. We believe the chick fledged.

MC46 Valley Anchorage: We confirmed a pair in the historical Valley Anchorage territory (Fig. 5) on 4 April. We saw the pair during surveys on 19 and 28 April and 3 and 16 May, but we saw no peregrines on 12 and 27 May or 12 June. We could not confirm nesting this season.

MC52 Cavern Point: We confirmed a pair in the historical Cavern Point territory (Fig. 5) on 18 March. We did not see any peregrines during the 4-hr survey on 14 April and only a single adult on 15 May. We do not know if there was any nesting attempt made this season.

MC53 Bowen Point: We confirmed a pair exhibiting courtship behavior in the historical Bowen Point territory (Fig. 5) during our second survey on 5 April. We believe the birds were incubating on 16 April, but because the eyrie entrance is blocked from view by vegetation, we did not confirm the presence of nestlings (based upon vocalizations) until 22 June, at which time they should have been close to fledging age.

MC60 Pelican Bay: We confirmed a pair in the historical Pelican Bay territory (Fig. 5) on 5 April. The birds were incubating by 19 April. During our 14 May survey there appeared to be either young chicks or hatching in progress based upon the adults' behavior. We entered the eyrie on 29 May to band the chicks and collect prey and eggshell samples (Appendix I). Unfortunately, the chicks were only about 1 week old (Fig. 7), so we did not band them. Although both adults were still present during our 8 June survey, we could not confirm that the chicks were present. We saw no peregrines on our 26 June survey and believe that the nesting attempt failed. These were the first known chicks to hatch in this territory since our surveys began in 2013.

MC61 Punta Diablo: We conducted 5 surveys in the historical Punta Diablo territory (Fig. 5) between 1 March and 25 May and saw a single adult during 3 of the surveys. We could not confirm that the territory was occupied this season.

Figure 7. The Pelican Bay peregrine chicks on Santa Cruz Island, CA.

MC62 Punta Gorda: We confirmed a pair in the historical Punta Gorda territory (Fig. 5) on 19 March. The pair was incubating by 1 April and nestlings were present by 13 May. We confirmed there were 2 approximately 2-week-old chicks on 26 May. We observed both fledglings flying during our last visit on 23 June.

MC63 San Pedro West: We confirmed a pair exhibiting courtship behavior in the historical San Pedro West territory (Fig. 5) on 16 March. The pair was incubating by 18 April, and we confirmed there were 3 eggs on 30 April. They were still incubating on 11 May, but the eyrie was empty and we saw no peregrines on 25 May. This nesting attempt failed during incubation or early chick-rearing.

MC64 West Point South: We confirmed a pair exhibiting courtship behavior in the historical West Point South territory (Fig. 5) on 5 March. We conducted 7 more surveys through 9 June and saw peregrines during 4 of the surveys but could not confirm any nesting attempts.

MC77 East Smuggler's: We confirmed a pair in the historical East Smuggler's territory (Fig. 5) on 14 April, at which time they were incubating. There was at least 1 nestling on 11 May, and we confirmed 1 fledgling on 12 June.

MC81 Del Norte: We confirmed a pair in the historical Del Norte territory (Fig. 5) on 15 April, at which time we believe they were incubating. We could not confirm the presence of nestlings until 26 June, at which time we observed 2 chicks approximately 30 days old.

MC90 Pozo: We made only one survey of the historical Pozo territory (Fig. 5) on 19 March and did not see any peregrines.

MC94 Platt's Harbor: We observed a pair in the Platt's Harbor area (Fig. 5) on 25 May during bald eagle surveys. We do not know their breeding status.

MC95 Sierra Blanca: We located a pair in a new territory that we named Sierra Blanca (Fig. 5) on 29 April, at which time they were incubating. They were still incubating on 12 May, but we could not determine their status on 30 May and determined that the nesting attempt had failed by our last survey on 8 June.

MC96 Coches Prietos: Nick Todd informed us of a potential pair at a new territory at Coches Prietos on 29 April. We confirmed there was a pair incubating on 2 May and there were nestlings present on 15 May. We entered the eyrie on 27 May and found 3 chicks ranging from about 13-17 days old. We banded the 2 older chicks (Table 2) and collected prey remains and eggshells for analyses (Appendix I).

Santa Rosa Island

Surveys began on Santa Rosa on 2 February and continued every other week through 27 June. We surveyed 12 historical territories and confirmed occupancy in 6 (50%) of them (Fig. 8). We did not locate any new territories.

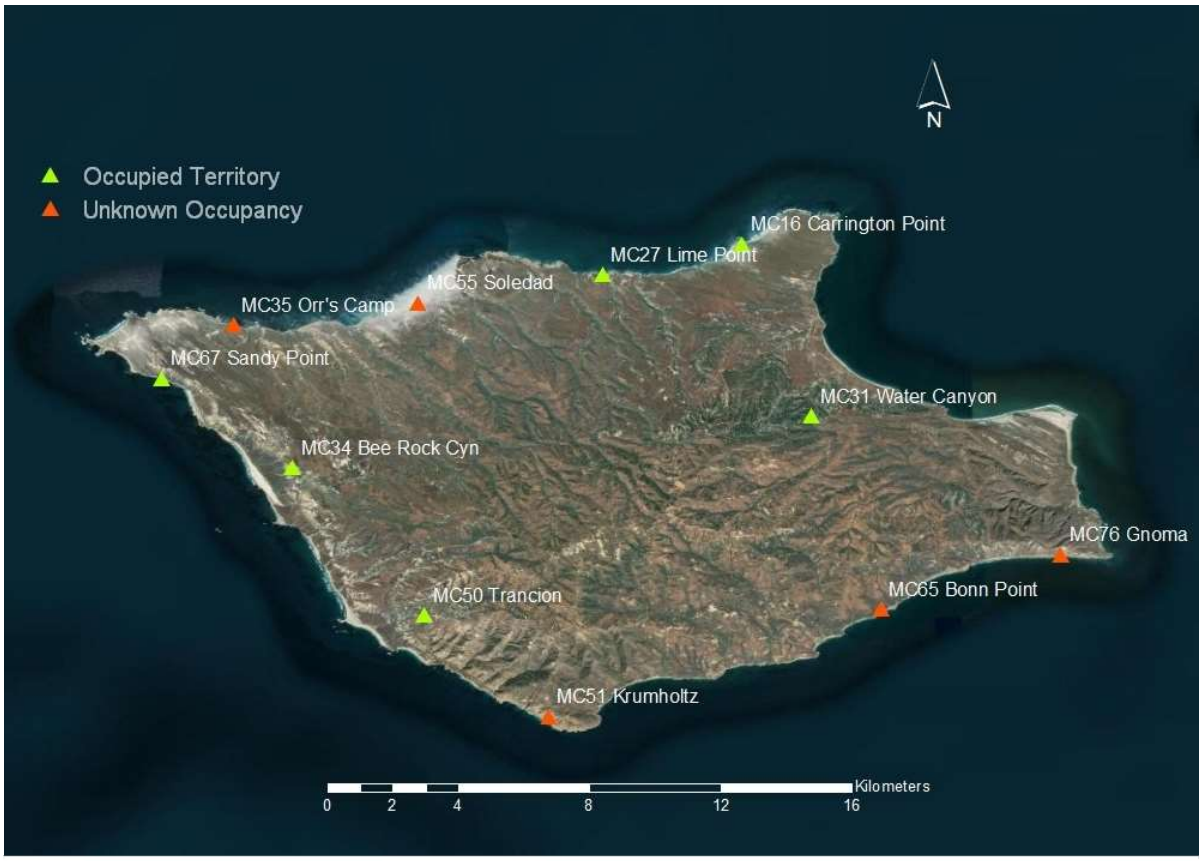

Figure 8. Status of surveyed peregrine falcon territories on Santa Rosa Island, CA in 2022.

MC16 Carrington Point: We confirmed a pair in the historical Carrington Point territory (Fig. 8) on 19 February. We did not confirm nesting until 27 May (our 11th survey), at which time we believe they had nestlings >7-10 days old. We observed 3 fledglings during our last visit on 25 June.

MC27 Lime Point: We confirmed a pair in the historical Lime Point territory (Fig. 8) on 4 February. The birds were incubating at a previous eyrie in Lobo Canyon on 14 April and they had 2 nestlings on 17 May. There were 2 fledglings present on our last visit on 25 June.

MC31 Water Canyon: We did not confirm a pair in the historical Water Canyon territory (Fig. 8) until our fifth survey on 13 May, at which time they were exhibiting courtship behavior. We conducted 4 more surveys through 27 June but could not confirm any nesting attempt.

MC34 Bee Rock Canyon: We confirmed a pair in the historical Bee Rock Canyon territory (Fig. 8) on 18 March, at which time they were exhibiting courtship behavior. The birds were incubating on 14 April and there were 2 nestlings about 1-2 weeks old on 8 June. Both fledglings were in the nest on our last visit on 26 June.

MC35 Orr's Camp: We surveyed the historical Orr's Camp territory (Fig. 8) 8 times between 17 February and 11 June and a single peregrine was seen during 4 visits. We did not confirm that this territory was occupied this season.

MC50 Trancion: We confirmed a pair in the historical Trancion territory (Fig. 8) during our fifth survey on 16 April. The pair exhibited courtship behavior through our last survey on 9 June, but there was no indication that they nested this season.

MC51 Krumholtz: We surveyed the historical Krumholtz territory (Fig. 8) 9 times between 20 February and 11 June. We observed a single peregrine flying, perching, and feeding on a bird during our 15 April survey, otherwise there were no other peregrine sightings. We do not believe this territory was occupied.

MC55 Soledad: We conducted 9 surveys of the historical Soledad territory (Fig. 8) between 20 February and 12 June. The only peregrine seen during our surveys was a single bird during the 18 April survey. We could not confirm occupancy in this territory.

MC65 Bonn Point: Road closures make it difficult to survey the historical Bonn Point territory (Fig. 8) due to the hiking time required to reach the territory. We conducted a 10-min survey on 19 February, a 4-hr survey on 4 April, a 3.5-hr survey on 26 May, and a 70-min survey on 12 June. A single adult was seen perching on the cliffs and then flying towards the interior of the island near the end of the survey period on 26 May. We could not confirm occupancy in this territory.

MC66 Chickasaw Canyon: We surveyed the historical Chickasaw Canyon territory (Fig. 8) for 10 min to 2 hr on 20 February, 6 March, 20 March, and 15 April. We did not observe any peregrines and have never observed nesting in this territory.

MC67 Sandy Point: We confirmed a pair in the historical Sandy Point territory (Fig. 8) on 2 March and the birds were incubating on 14 April. The nesting attempt failed by 15 May and we observed no further nesting attempts.

MC76 Gnoma: We conducted 6 surveys in the historical Gnoma territory (Fig. 8) between 7 February and 16 May. The only peregrine sighting was of a single adult on 19 April. We have not detected any breeding within this territory since 2017.

San Nicolas Island

We conducted surveys on San Nicolas on 5-8 April and 3-7 June (Fig. 9) and located pairs in 2 historical territories (Harrington and Cattail Canyon) and in 1 new territory (Grand Canyon; Fig. 9).

Figure 9. Status of surveyed peregrine falcon territories on San Nicolas Island, CA in 2022.

MC73 Harrington: We did not confirm a pair in the historical Harrington territory (Fig. 9) until 3 June, at which time they were incubating in their 2019 eyrie. During our first visit on 5 April, we observed an adult digging in the scrape at the 2019 eyrie but did not see a second bird. We did not observe any birds in the area during a 15-min survey on 8 April. We were unable to see the eggs during the 3 June survey but confirmed 3 eggs in the scrape during the last visit on 7 June. We were unable to return to the island to determine the outcome of the nesting attempt.

MC74 Cattail Canyon: We confirmed a pair in the historical Cattail Canyon territory (Fig. 9) on 6 April, at which time an adult appeared to be digging in a scrape at a new eyrie location. There were 3 chicks approximately 3-4 weeks old present on 4 June. We were unable to return to the island to determine whether the chicks fledged.

MC82 Midway: We observed a single peregrine perched on the South Range Marker in the historical Midway territory (Fig. 9) on 7 April. We did not observe any peregrines during a 1-hr survey on 8 April. We observed a single peregrine hunting and perching in the area during a 4-hr survey on 6 June. We were unable to confirm occupancy in this territory and have never confirmed nesting in this territory.

MC97 Army Springs: We surveyed the area of the historical Army Springs territory (Fig. 9), erroneously referred to as Arlington Springs in previous reports, on 6 and 7 April and 4 June. There was a pair of barn owls (*Tyto alba*) in the 2019 eyrie on 6 April, but they were no longer present on 4 June. On 6 and 7 April we observed a single peregrine perched and/or flying to the southeast of the 2019 eyrie. We could not confirm occupancy in this territory.

MC98 Grand Canyon: We located a pair in the newly discovered Grand Canyon territory (Fig. 9) on 7 April, at which time they were exhibiting courtship behavior. On 4 June we located an eyrie with 2 approximately 2-week-old chicks present. We were not able to return to the island to determine whether the chicks fledged.

Santa Barbara Island

We did not conduct surveys on Santa Barbara this season but did get 2 sighting reports from Ben Anderson with the California Institute of Environmental Studies.

MC72 North Signal Peak: B. Anderson reported 3 fledglings and an adult in the historical North Peak territory (Fig. 10) during the week ending 25 May.

MC93 Rookery: B. Anderson reported 2 adults in the historical Rookery territory (Fig. 10) during the week ending 25 May.

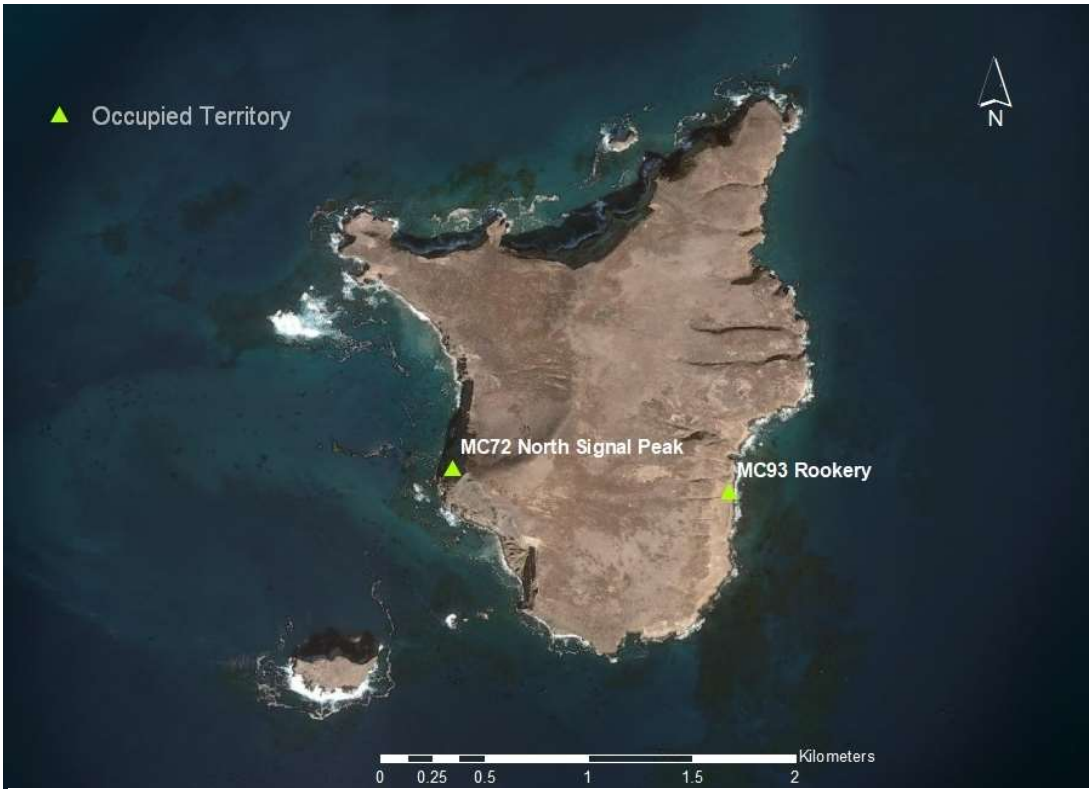

Figure 10. Status of surveyed peregrine falcon territories on Santa Barbara Island, CA in 2022.

Santa Catalina Island

We surveyed 4 historical territories on Catalina (Fig. 11) and did not locate any new territories.

Figure 11. Status of surveyed peregrine falcon territories on Santa Catalina Island, CA in 2022.

MC49 Bullethead: We conducted 4-hr surveys in the historical Bullethead territory (Fig. 11) on 15 March and 21 April and did not observe any peregrines.

MC75 Silver Peak: We confirmed a pair in the historical Silver Peak territory (Fig. 11) on 7 March. They were incubating on 21 April and 2 nestlings were present on 11 May. We entered the eyrie on 1 June to band the chicks (Table 2) and collect prey and eggshell fragments for analyses (Appendix I). Only the female nestling was present on 17 June, and she was flying by 1 July.

MC78 Lone Tree: We confirmed a pair in the historical Lone Tree territory (Fig. 11) on 14 March. It is difficult or impossible to view much of the potential nesting habitat in this territory from land and we were unable to determine their nesting status.

MC88 Seal Point: We made a single survey of the historical Seal Point territory (Fig. 11) on 8 March and did not observe any peregrines.

San Clemente Island

We surveyed 4 historical territories on San Clemente (Fig. 12) and found that all territories were occupied. We did not locate any new territories.

Figure 12. Status of surveyed peregrine falcon territories on San Clemente Island, CA in 2022.

MC59 Cave Canyon: We confirmed a pair in the historical Cave Canyon territory (Fig. 12) on 3 April, at which time they were incubating. On 21 May they were incubating 2 eggs in a second eyrie, so apparently the first nesting attempt failed. There was no activity at the eyrie on 15 June, so we classified the nesting attempt as unsuccessful.

MC79 Seal Cove: We confirmed a pair in the historical Seal Cove territory (Fig. 12) on 18 March. They were incubating on 10 April, but there was no activity at the nest on 22 or 23 May, although the adults were in the vicinity. We considered this a failed nesting attempt.

MC89 Wilson Cove: We confirmed a pair in the historical Wilson Cove territory (Fig. 12) on 16 March. The pair was incubating on 1 April and there were 2 nestlings present on 10 May. The fledglings were perched on the nest cliff on 15 June.

MC92 Pyramid: We confirmed a pair in the historical Pyramid territory (Fig. 12) on 19 March, at which time they were incubating. The female of the pair (Band #1947-21681) fledged from the Cathedral Cove territory on Anacapa Island in 2016. There were 3 nestlings present on 6 May and all 3 were flying around the nest area on 2 June.

Resightings

In 2022, we received sighting reports from the mainland for 3 peregrines that we had banded as nestlings on the islands.

A male banded in 2014 at the Carrington Point territory on Santa Rosa (Band #1156-16821) was the breeding male at Point Arguello in Santa Barbara County, California.

A male banded in 2014 at the Laguna territory on Santa Cruz (Band #1156-16831) was seen in Torrey Pines State Reserve, San Diego County, California on 9 May.

A female banded in 2017 at the Krumholtz territory on Santa Rosa (Band #1156-16872) successfully raised 4 chicks in Laguna Beach, California. She was found with a leg injury on 6 June and taken to the Serrano Animal Clinic for evaluation and rehabilitation and she was still recovering there as of 31 October.

PREY REMAINS

We collected prey remains from 4 territories on 3 islands in 2022 (Appendix I) from which 62 individual prey items were identified. Forty-two prey items (68%) were identified to the species level, representing 24 different species. Four additional prey items could be identified only to the family level, and 16 prey items were identified as Order Passeriformes (Table 3). The

most common species identified were red-necked phalaropes (*n*=7), red phalaropes (*n*=6), and western gulls (*n*=5).

Table 3. The Minimum Number of Individuals (MNI) identified from prey remains collected from peregrine falcon eyries on 3 of the California Channel Islands in 2022. The %MNI is the total of each category divided by the total MNI for all categories (*n* = 62).

	Island[a]				
Category	SCZ	ANA	SCI	Total	%MNI
Lesser nighthawk, *Chordeiles acutipennis*			1	1	1.6
Common poorwill, *Phalaenoptilus nuttallii*			1	1	1.6
Sanderling, *Calidris alba*	1		1	2	3.2
Western sandpiper, *Calidris mauri*	1		1	2	3.2
Least sandpiper, *Calidris minutilla*		1		1	1.6
Unidentified sandpiper, Scolopacidae spp.		4		4	6.5
Red-necked phalarope, *Phalaropus lobatus*	2	5		7	11.3
Red phalarope, *Phalaropus fulicarius*	2	3	1	6	9.7
Pigeon guillemot, *Cepphus columba*	1			1	1.6
Cassin's auklet, *Ptychoramphus aleuticus*		1		1	1.6
Western gull, *Larus occidentalis*		3	2	5	8.1
California gull, *Larus californicus*	1		1	2	3.2
Sabine's gull, *Xema sabini*	1			1	1.6
Black tern, *Chlidonias niger*	1			1	1.6
Forster's tern, *Sterna forsteri*	1			1	1.6
Royal tern, *Thalasseus maximus*			1	1	1.6
Acorn woodpecker, *Melanerpes formicivorus*			1	1	1.6
Ash-throated flycatcher, *Myiarchus cinerascens*		1		1	1.6
Hermit thrush, *Catharus guttatus*		1		1	1.6
Western bluebird, *Sialia Mexicana*	1			1	1.6
Northern mockingbird *Mimus polyglottos*			1	1	1.6
Western meadowlark, *Sturnella neglecta*	1			1	1.6
Hooded oriole, *Icterus cucullatus*			1	1	1.6
Orange-crowned warbler, *Leiothlypis celata*		1		1	1.6
Black-headed grosbeak, *Pheucticus melanocephalus*		1		1	1.6
Unidentified passerine, Passeriformes spp.	5	4	7	16	25.8

[a]SCZ=Santa Cruz Island, ANA=Anacapa Island, SCI=Santa Catalina Island

EGGSHELL MEASUREMENTS

We collected eggshell fragments and/or an addled egg (1 total) from 5 territories on 3 islands in 2022 (Appendix I). Percent eggshell thinning, compared to peregrine eggs from pre-1947 in California, ranged from 7.2% to 19.3% (Table 4), with a mean thinning of 13.4% across all samples. The addled egg will be processed and analyzed in late 2022 or early 2023.

Table 3. Measurements of peregrine falcon eggshell fragments collected from nests on the California Channel Islands in 2022.

	Clutch Means		
Island/Territory	Eggshell Thickness (mm)	% Thinning	Notes
Santa Cruz Island			
MC60 Pelican Bay	0.338	7.2	10 measurements from 2 large fragments with membranes
MC96 Coches Prietos	0.307	15.7	Measured from 10 small fragments with membrane thickness (0.076 mm) added
Anacapa Island			
MC54 Cathedral Cove	0.323	11.2	10 measurements from 6 fragments with membrane thickness added when needed
Catalina Island			
MC75 Silver Peak	0.294	19.3	10 measurements from 8 fragments with membranes

PRODUCTIVITY

At least 39 chicks hatched on the Channel Islands in 2022, of which a minimum of 27 (69%) survived to ≥28 days of age. We calculated productivity based upon 15 pairs (see Table 1) that we monitored from early in the breeding season (i.e., courtship, early incubation) and for which we know the outcome of the breeding season. Fourteen pairs (93%) laid eggs, 11 pairs (73%) hatched at least 1 chick, and 10 pairs (67%) successfully produced at least 1 chick ≥28 days of age. Minimum productivity was 1.13 fledglings per occupied territory and 1.7 fledglings per successful nesting attempt.

DISCUSSION

We have not conducted intensive surveys for peregrine falcons on the California Channel Islands since 2017, but we were able to survey 5 of the 8 Channel Islands this season thanks to funding through the U. S. Department of the Interior's Office of Restoration and Damage Assessment and the U. S. Navy (San Nicolas Island surveys). The number of occupied peregrine territories was similar between 2017 and 2022 on the 5 islands we surveyed (difference of ±1 territory/island), except for Santa Rosa where we could only confirm occupancy in 6 territories, compared to 10 in 2017. We were unable to conduct surveys on San Miguel, Anacapa, or Santa Barbara islands primarily due to transportation costs, but there were an additional 15 territories on those islands during our 2017 surveys.

As in previous seasons, the northern Channel Islands continue to be the stronghold for Channel Island peregrines. In other peregrine populations, density of peregrine territories is positively correlated with availability of food resources, with higher densities generally occurring in association with large seabird or shorebird colonies (Ratcliffe 1980). As compared to the southern Channel Islands, the northern Channel Islands have higher seabird diversity (Carter et al. 1992, Takekawa et al. 2004), as well as more cliffs with ledges and potholes for peregrine nesting (Hunt 1994; P. Sharpe, personal observations).

The nesting success of 67% in occupied territories with known outcomes was the same as in 2017 (Sharpe 2018), but productivity of 1.13 fledglings/occupied territory and 1.7 fledglings/successful territory was among the lowest we have recorded. Although 2018 had lower productivity of 0.94 fledglings/occupied territory, there were 1.9 fledglings/successful territory that year (Sharpe and Melling 2018). Nest success and productivity can vary between years, but productivity per successful nest has been decreasing on the Channel Islands since our first survey in 2013 ($r = -0.74$, $df = 6$, $P = 0.04$), dropping from a high of 2.6 fledglings/successful nest in 2013 (Sharpe 2014) to a low of 1.7 fledglings/successful nest this season. Continued monitoring will allow us to determine whether the downward trend in productivity continues to a point where it could negatively impact the peregrine population on the Channel Islands.

The potential impact of DDE on the productivity of peregrines and other species on the Channel Islands continues to be of concern decades after the cessation of DDT discharges to the

SCB due to widespread DDT contamination. Kivenson et al. (2019) conducted an initial study of one of the deep-water dump sites (Dump Site 2, ~900 m bsl, Fig. 13) in 2011 and 2013 using autonomous and remotely operated underwater vehicles. They located approximately 60 barrels

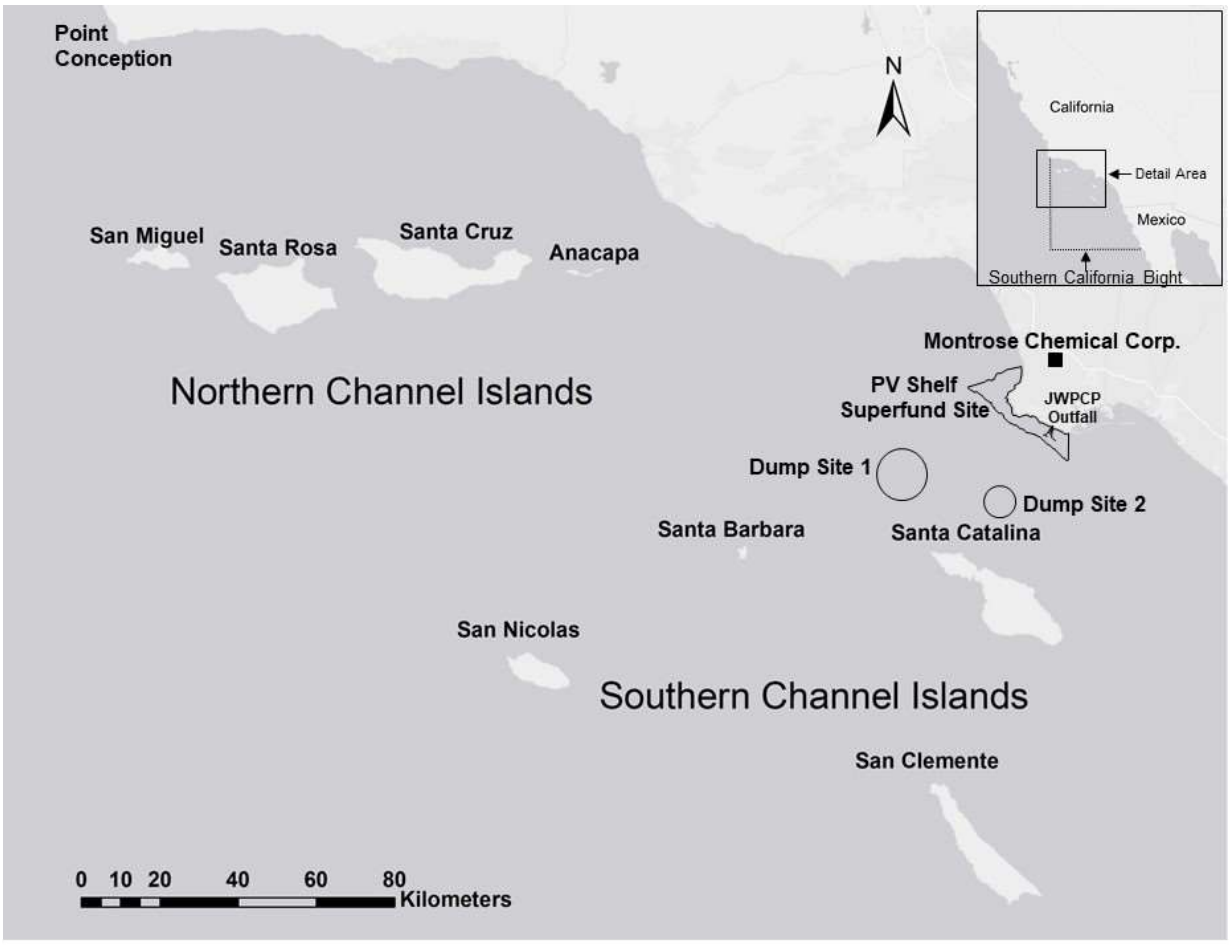

Figure 13. California Channel Islands and sites related to DDT contamination of the Southern California Bight.

of waste and found concentrations of DDTs in the sediments that peaked at levels approximately 40 times greater than the highest contamination recorded in surface sediments at the nearby Superfund site off the Palos Verdes Peninsula (Fig. 13). The same dump site gained national attention in 2021 after a research team surveyed 146 km^2 around the area and identified 27,000 barrels potentially containing DDTs and other industrial wastes (Weisberger 2021). Maruya and Schiff (2009) found that 71% of sediment samples collected in the SCB had elevated levels of total DDTs, whereas 95% of samples collected in 2018 had DDTs (Du et al. 2020).

Our examination of prey remains only describes the breadth of prey use, but it can show the potential pathways through which peregrines could accumulate DDE. We would expect peregrine prey feeding largely on marine resources would have higher DDE body burdens than prey species feeding on terrestrial food sources. Enderson et al. (1982) reported that peregrines feeding on prey with 1.0 ppm DDE during the breeding season could be expected to lay eggs with 16% eggshell thinning. Alcids and gulls, which made up 19% of the prey items identified this season, have had DDE body burdens of 2 ppm or higher around the Channel Islands (Garcelon et al. 1989; Hunt 1994), so these species could be major sources of DDE to peregrines.

Historically, peregrine populations with eggshell thinning exceeding 17% were either declining or extirpated (Peakall and Kiff 1988), but populations with average thinning below 14.5% appeared normal (Fyfe et al. 1988). Eighteen clutches collected on the Channel Islands from 1988-1993 had 19.8% thinning (Kiff 1994) and mean eggshell thinning was 18.3% in 2007 (Latta 2012), 16.1% in 2013 (Sharpe 2014), 22.1% in 2014 (Sharpe 2015), 17.3% in 2015 (Sharpe 2016), 23.8% in 2016 (Sharpe 2017), 28.9% in 2017 (Sharpe 2018), and 22.7% in 2018 (Sharpe and Melling 2018). Mean clutch eggshell thinning from the 4 eyries we entered in 2022 was 13.4%, which is the lowest we have recorded during our studies. The unhatched peregrine eggs that we have analyzed for DTTs since 2013 contained an average of 4.6 ppm DDE in the egg contents. We collected a single addled egg this season, but it has yet to be processed and shipped for analysis. It will be interesting to see if its contamination with DDTs is lower in correlation with the increased thickness of the eggshells observed this season. Continued collection and analyses of unhatched peregrine eggs and eggshells is a simple, unobtrusive way to monitor the potential contamination of the food chain.

We continue to locate new breeding territories on both the northern and southern Channel Islands and believe that the peregrine population will continue to expand into currently unoccupied breeding habitat. Although nesting density is high on the northern Channel Islands and the levels of productivity appear sufficient to maintain the population, factors such as juvenile/adult survival and emigration/immigration rates play an important role in population persistence. Annual population monitoring and banding of young could help us gain an understanding of these population parameters for the Channel Island peregrines and help determine whether contaminants or other issues are negatively impacting the population.

During the 2023 season, we will attempt to monitor a subset of peregrine territories on Anacapa, Santa Rosa, Santa Cruz, Catalina, and San Clemente islands in conjunction with bald eagle surveys. We will have only 2-3 personnel for the 2023 season, but we should be able to make monthly checks of 2-5 territories per island. We also will conduct surveys on San Nicolas if the USN has funding for another season of surveys.

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Appendix I. Samples collected in 2022.

Sample ID	Island[a]	Territory	Sample Type	Collection Date	Notes
22-MC54-SF-1	Anacapa	Cathedral Cove	Shell Fragments	5/19/2022	Collected from eyrie
22-MC54-PR-1	Anacapa	Cathedral Cove	Prey Remains	5/19/2022	Collected from eyrie
22-CP-SF-1	Santa Cruz	Coches Prietos	Shell Fragments	5/27/2022	Collected from eyrie
22-CP-PR-1	Santa Cruz	Coches Prietos	Prey Remains	5/27/2022	Collected from eyrie
22-MC20-AE-1	Santa Cruz	West End	Addled Egg	5/28/2022	Collected from eyrie
22-MC20-PR-1	Santa Cruz	West End	Prey Remains	5/28/2022	Collected from eyrie
22-MC60-SF-1	Santa Cruz	Pelican Bay	Shell Fragments	5/29/2022	Collected from eyrie
22-MC75-SF-1	Santa Catalina	Silver Peak	Shell Fragments	6/1/2022	Collected from eyrie
22-MC75-PR-1	Santa Catalina	Silver Peak	Prey Remains	6/1/2022	Collected from eyrie